

THE DEVELOPMENT AND IMPLEMENTATION OF E-
HEALTH SERVICES FOR THE LIBYAN NHS: CASE
STUDIES OF HOSPITALS AND CLINICS IN BOTH URBAN
AND RURAL AREAS

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Abstract

This thesis provides an assessment of the readiness levels within both urban and rural hospitals and clinics in Libya for the implementation of E-health systems. This then enabled the construction of a framework for E-health implementation in the Libyan National Health Service (LNHS).

The E-health readiness study assessed how medications were prescribed, how patients were referred, how information communication technology (ICT) was utilised in recording patient records, how healthcare staff were trained to use ICT, and how the ways in which consultations were carried out by healthcare staff. The research was done in five rural clinics and five urban medical centres and focused on the E-health readiness levels of the technology, social attitudes, engagement levels and any other needs that were apparent. Collection of the data was carried out using a mixed methods approach with qualitative interviews and quantitative questionnaires. The study indicated that any IT equipment present was not being utilised for clinical purposes and there was no evidence of any E-health technologies being employed. This implies that the maturity level of the healthcare institutions studied was at level zero in the E-health maturity model used in this thesis.

In order for the LNHS to raise its maturity levels for the implementation of E-health systems, it needs to persuade LNHS staff and patients to adopt E-health systems. This can be carried out at a local level throughout the LNHS, though this will need to be coordinated at a national level through training, education and programmes to encourage compliance and providing incentives.

In order to move E-health technology usage in the participating Libyan healthcare institutions from Level 0 to Level 2 in the E-health Maturity Model levels, an E-health framework was created that is based on the findings of this research study. The primary aim of the LNHS E-Health Framework is the integration of E-health services for improving the delivery of healthcare within the LNHS.

To construct the framework and ensure that it was creditable and applicable, work on it was informed directly by the findings from document analysis, literature review, and expert feedback, in conjunction with the primary research findings presented in Chapter Five.

When the LNHS E-Health Framework was compiled there were several things taken into consideration, such as: the abilities of healthcare staff, the needs of healthcare institutions and the existing ICT infrastructure that had been recorded in the E-readiness assessment which was carried out in the healthcare institutions (Chapter 5).

The framework also provides proposals for E-health systems based on the infrastructure network that will be developed. The processes addressed are electronic health records, E-consultations, E-prescriptions, E-referrals and E-training.

The researcher has received very positive, even enthusiastic, feedback from the LNHS and other officials, and that expect the framework to be further developed and implemented by the LNHS in the near future.

Structure of the Thesis:

- Chapter One: Background to the Study.
- Chapters Two and Three: Literature Review.
 - Chapter Two: E-health Literature Review.
 - Chapter Three: Models and Frameworks for Assessing for E-health Systems Readiness.
- Chapter Four: Research Methodology.
- Chapter Five: Results and Analysis.
- Chapter Six: Design and Development of an E-health Framework for the Libyan National Health Service.
- Chapter Seven: Reflection, Evaluation and Further Work.

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If there has been anyone left out in these acknowledgements, the researcher expresses his humblest apologies and thanks you from the bottom of his heart.

Declaration

I declare that the research contained in this thesis, unless otherwise formally included within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

Signed:

Dated: 15 / 12 / 2016

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List of Acronyms

| | |
|----------------|---|
| AIU-EPR | Actual individual usage of electronic patient record |
| ASTM | American Society for Testing and Materials |
| AUR | Actual User Readiness |
| BMC | Benghazi Medical Centre |
| CVD | Cardiovascular diseases |
| CEO | Chief Executive Officer |
| EM | Extrinsic Motivation |
| E-health | Electronic health |
| E-prescribing | Electronic prescribing |
| E-consultation | Electronic consultation |
| E-referral | Electronic referral |
| E-training | Electronic training |
| EPR | Electronic patient record |
| EMR | Electronic Medical Records |
| EMRS | Electronic Medical Records systems |
| EPIC | Electronic Privacy Information Centre |
| ER | Engagement Readiness |
| GPCHE | General People's Committee for Health and Environment |
| HIPAA | Health Insurance Portability and Accountability Act |
| HICT | Health information and communication technology |
| HTA | Health Technology Assessment |
| HIS | Health Information System |
| HI | Health information |
| HER | Electronic health record |

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| HL7 | Health Level 7 |
| HoN | Health on the Net |
| Hi-Ethics | Health internet Ethics |
| IN | Identity Number |
| ISMS | Information Security Management Systems |
| ISO | International Standards Organisation |
| ICT | Information and Communication Technology |
| IT | Information Technology |
| IMPE | Ideal Medical Products Engineering |
| IM | Intrinsic Motivation |
| IHE | Integrating the Health Enterprise |
| LIS | Laboratory information system |
| LNHS | Libyan National Health Service |
| NHIST | National Health Information System of Turkey |
| NHS-IT | National Health Service-Information technology |
| NCR | Need-Change Readiness |
| OMG | Object Management Group |
| OPD | Outpatient Department |
| OTA | Office of Technology Assessment |
| PDA | Personal Digital Assistant |
| PHRs | Personal Health Record systems |
| PR | Public Relation |
| RIS | Radiology information system |
| ReHRA | Rural e-Healthcare Readiness Assessment Model |
| SR | Structure Readiness |
| TAM | Technology Acceptance Model |

| | |
|-----|---------------------------------|
| TAU | Technology Acceptance and Use |
| TRA | Technology readiness assessment |
| TRI | Technology Readiness Index |
| WHO | World Health Organisation |

List of Participation

| Year | Event | Type of participation |
|------|--|---|
| 2016 | <p>The paper title: "What Changes Need to be Made within the LNHS for Ehealth Systems to be Successfully Implemented?"</p> <p>The 2th International Conference on Information and Communication Technologies for Ageing Well and e-Health – ICT4AWE 2016 Venue: Rome, Italy Event date: 21 - 22 April, 2016</p> <p>Available online at: http://www.scitepress.org/DigitalLibrary/</p> <p>Mansour, A. and Lyn, P. (2016) What Changes Need to be Made within the LNHS for Ehealth Systems to be Successfully Implemented? In Proceedings of the International Conference on Information and Communication Technologies for Ageing Well and e-Health, 71-79, 2016, Rome, Italy. ISBN: 978-989-758-180-9.</p> | <p>Publish Paper</p> <p>The researcher has won the ICT4AWE 2016 Best Student Paper Award.</p> |
| 2016 | <p>The paper title: “Assessing Ehealth readiness within the Libyan national Health Service by carrying out research case studies of hospitals and clinics in both urban and rural areas of Libya”</p> <p>has been selected to be included in a book of selected papers of the CCIS Series published by Springer.</p> | <p>The paper was published by Springer in their book CCIS Series. Paper</p> |
| 2015 | <p>SFT-15: Successes and Failures in Telehealth</p> <p>6th Annual Meeting of the Australasian Telehealth Society</p> <p>12-13 November 2015 Brisbane, Australia</p> | <p>Poster and it has been published</p> |
| 2015 | <p>BSMS Health Education Conference Innovating Clinical Practice. 3 December, 2015.</p> | <p>Poster</p> |

| | | |
|------|--|-----------|
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| 2015 | <p>Postgraduate Research Student Conference Life, Health and Physical Sciences 20th – 21st July 2015 Huxley Building</p> | Attending |
| 2014 | <p>Libyan Higher Education Forum A Vision for the Future Libya Higher Education and Development Forum 5th-6th June 2014, London.</p> | Poster |
| 2014 | <p>Doctoral College - Life and Physical Sciences Research Student Conference The Faculty of Science and Engineering Doctoral College Research Student Conference, University of Brighton 2014 22nd – 23rd July 2014 “Pathways to Innovation”</p> | Poster |
| 2014 | <p>Conference theme: Growing Together: Impact, Innovate, and Inspire 21 May 2014 (9-4 pm) Sallis Benney Theatre, Grand Parade, Brighton</p> | Attending |
| 2014 | <p>Recent developments in digital health Telemedicine and eHealth Section 27 February 2014, Royal Society of Medicine,</p> | Attending |

| | | |
|------|--|--------|
| | London | |
| 2014 | <p>Research Poster Competition and Celebration of Research Event 2014 4.00 - 6.30pm, 17 February 2014 at Grand Parade, Brighton</p> | Poster |
| 2013 | <p>The 2nd Faculty of Science and Engineering Postgraduate Research Student Conference “Making Science Accessible” The Faculty of Science and Engineering Doctoral College Research Student Conference, 8th – 9th July 2013 Huxley Building, The University of Brighton</p> | Poster |
| 2012 | <p>The 1st Faculty of Science and Engineering Post- Graduate Research Student Conference 25th – 26th June 2012 the Doctoral College Science and Engineering Research Student conference, that is taking place on the 25th and 26th June 2012 in Huxley 307 lecture theatre Huxley Lecture Theatre</p> | Poster |

Confirmation All Training Needs Have Been Met:

The researcher has attended the following research training and support programmes:

| Module Code | Module Title | Attending Dates |
|--------------------|---|---|
| RMM05 | Conceptualising and Designing Research Projects | 06 th - 20 th of June 2012 |
| SWM43 | Research in Computing | September 2012 to January 2013 |
| RMM17 | An Overview of Research Methodologies | 22 nd - 30 th of October 2012 |
| Unit 4 | Preparing for Thesis Submission and Viva | 23 rd of June 2016 |

Chapter One
Background to the Study

1.1 Introduction

1.1.1 E-health

E-health can be defined as the provision of healthcare electronically. The primary areas that E-health covers are: (1) the delivery of healthcare information to healthcare workers and patients online and through ICT, and (2) the use of ICT for the improvement of public healthcare delivery, for instance the use of online resources to train healthcare staff (Afaq et al., 2014 and Jeffrey, 2006).

Wilkins (2016) defined health information systems. He cites the World Health Organisation (2004) gives a definition of health information systems as systems for integrating the collection of data, making reports, carrying out processes and using information that is needed for the improvement of healthcare provision and improving healthcare management on every level (Alfred et al., 2010). E-health involves IT and communicating electronically; this assists in providing and supporting clinical healthcare at distances (WHO, 2010). Bashshur and Shannon (2009) go on to state that E-health involves using information communication technology for supporting and promoting the administration of healthcare, clinical healthcare over long distances, public health and educating professionals and patients about issues related to healthcare. E-health can provide new methods for utilising healthcare resources; for instance, healthcare records for up-to-date information about patients that is easily accessible. The objectives of E-health technology are more efficient healthcare, encouragement of more use of evidence-based medicine, improving patient healthcare staff relationships and patient empowerment (Monaco, 2015; Yalcin and Can, 2016). Globally, E-health can be utilised for disseminating healthcare information that is up to date and accurate (Gray et al., 2016; Kwankam, 2009). The areas most likely to find the greatest benefits from E-health are those that are sparsely populated and rural as they can employ telemedicine and gain better access to specialist healthcare data (Kallio, 2015 and Kwankam, 2009). Andrews et al. (2007), found that in rural areas of Canada, there are high rates of usage of E-health, with as many as 95% of participants in their study having been online before, often using online video communications and owning digital cameras. The obstacles of distance and time become less of an issue when E-health systems are employed for distributing healthcare information, as collected knowledge can be disseminated globally (Robison, 2015 and Kwankam, 2009).

From the view-point of creating healthcare strategies, investing more in E-health technologies can create reductions in healthcare costs and improve the provision of healthcare to patients regionally and nationally. As populations become increasingly older, E-health technologies can provide healthcare services more efficiently and cost effectively. It is essential to examine successful E-health implementations to see how their impacts can be improved financially, and how they can be integrated with existing healthcare structures at a local level (Nguyen et al., 2016; Christophorou et al., 2016; Nungu, Pehrson and Sansa-Otim, 2014).

There are increasing numbers of developed countries and a few developing countries, which have installed E-health services (Hodge, 2011; ECFHCR, 2010), though each began from a different place, uses different approaches, moves at its own speed, and follows its individual path in the deployment of E-health services. The EU have set up goals for all member states to implement successful E-health programmes in their Digital Agenda (Ricciardi et al., 2013; Nelson, Staggers, 2014). In the context of the present research study E-health is defined as: "the use of ICT in health products, services and processes combined with organisational change in healthcare systems and new skills, in order to improve health of citizens, efficiency and productivity in healthcare delivery, and the economic and social value of health" (Jeffrey, 2006).

The USA administration has earmarked huge amounts of public funding to assist healthcare organisations in implementing E-health systems. Unfortunately, the USA healthcare organisations have experienced failure rates of about 50% while implementing new IT systems (Rahimi et al., 2008). Vretveit et al. (2007) argue that the main reason for these high failure rates is that broader organisational risks of clinical innovation have not been assessed enough. Her research has suggested that important ways of identifying risks in innovating new clinical systems are assessing a healthcare institutions readiness for the introduction of new IT systems (Vretveit et al., 2007). In spite of change agents and champions contributing in a positive way to people's readiness being shaped, the idea of readiness has been given a limited amount of attention in literature regarding general organisational change (Suchan, 2008; Pare et al., 2011). Because evidence is emerging about new E-health systems failing, it is very important for organisations to be able to gauge their readiness for the implementation of new IT systems.

E-health readiness assessments for healthcare institutions can be used to identify problems that could potentially cause failures to occur, thus allowing healthcare institutions to innovate and are categorised as organisational readiness (Turner et al., 2009; Kristensen et al., 2009).

Li (2010) states that performing an E-health readiness assessment before the implementation is necessary for assessing how successful it is likely to be, as well as its likely value and merit. Furthermore, Lorenzi (2009) points out that performing a pre-implementation evaluation aims to provide direction when carrying out decision making regarding subsequent developments or implementing tasks. In recent times there have been tools created for assessing E-readiness that focus upon healthcare in rural communities (Wickramasinghe, 2005; Jennett et al, 2003, 2005; Ojo et al, 2008).

Additionally, some researchers are looking at telehealth readiness assessments as being of importance before implementations are carried out (Jennett, Gagnon and Brandstadt, 2005). E-health readiness assessment frameworks currently being used are predominantly developed for use in developed nations. This means that because the developing world differs so much, it is always possible that an E-health readiness assessment tool might not be appropriate for the country in which it is being used. Additionally, the tools and models are generally designed for adopting telehealth technology so they have limitations when being used for making assessments for adopting E-health systems. Therefore, it is necessary that developing nations are assessed by frameworks specifically designed to suit their needs to see if they are ready for E-health implementation.

Health technology assessments are an expanding field which evaluate the safety, efficiency, effectiveness, cost, legality, ethics, and implications for an organisation, if a specific health technology is applied; such technology is generally a medical device, a clinical or surgical procedure or a drug (Nguyen et al., 2016; Zucchella et al., 2016; Taylor et al, 2009).

It is critically important that the correct criteria be used for evaluating the readiness as so much hangs upon the results of the evaluation being correct, for instance the incorrect equipment might be purchased or the whole endeavour might simply be

doomed to failure before it begins and this money, time and effort might have been expended far more effectively in another area of need.

1.1.2 Libya

Libya is a country in Northern Africa and covers an area of 1,665,000km². It has a coastline of 1,900km and shares borders with Egypt, Sudan, Chad, Niger, Algeria and Tunisia. The estimated population of Libya in 2008 was 5,527,000, giving it a 3.3 persons per km² population density. The north of Libya is the most densely populated with 10% of the land being populated by 85% of the population. The largest seven cities of Libya are: Tripoli, Benghazi, Misrata, Zawia, Sabha, Sirt and Derna (WHO, 2011). Figure 1.1 shows a map of Libya.

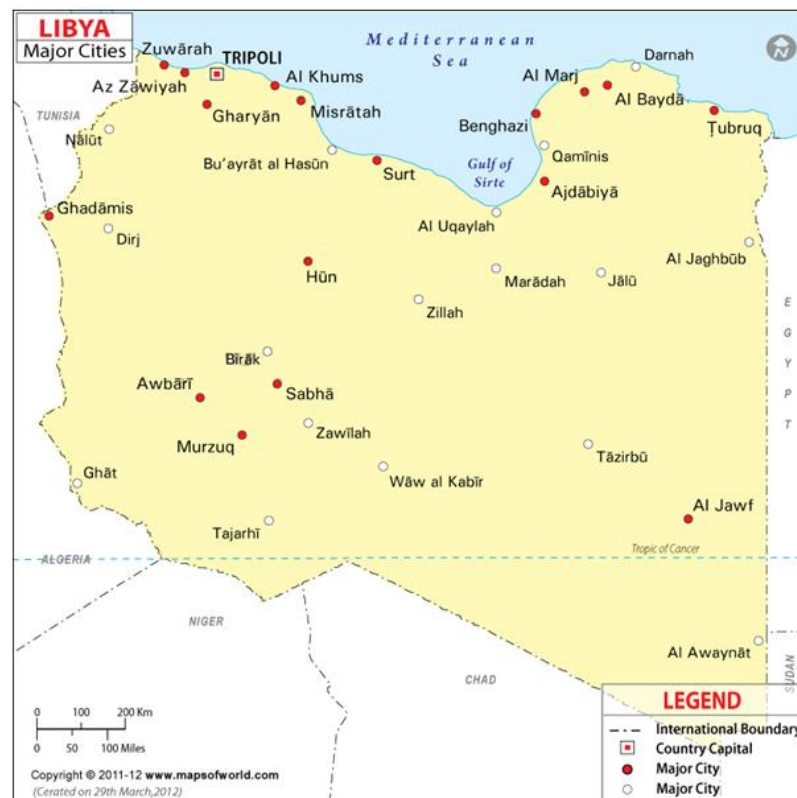


Figure 1.1: Map of Libya showing the location of participating sites (WHO, 2011).

The National Health Policy which was declared by the General People's Committee (GPC) in 1973 provided a framework for the National Health Strategy in accordance with which the health programmes are designed and implemented to deliver healthcare to all citizens. The Public Health Law No. 106 of 1973, states that: “health is a lawful right of all people and is to be guaranteed to them by the state.” (Kumar and Arteimi, 2009).

Libya has been reasonably successful in raising healthcare standards since 1973. For example, in the 1960s the average life span of individuals was only 46 years, whereas now the average life expectancy is 73. The mortality rate for children aged under five years fell from 16% in the 1970s to 2% in 2000. In 1999, immunization records showed that 92% of children aged under one year were vaccinated against measles and 97% against tuberculosis. However, the Libyan National Health Service is facing major problems since the civil unrest in February 2011. Kumar and Arteimi (2009) state that “some of the reasons identified behind these major problems are challenges like lack of Human Resource Planning, Production and Management, Absence of a National Health Information System, inadequate use of Information and Communication Technology for Healthcare, lack of Management and Accountability, Poor Coordination in National Institutions” (Kumar and Arteimi, 2009).

The research study reported in this thesis was carried out in five different areas of Libya, two healthcare institutions from each area, meaning that a total of 10 healthcare institutions were selected for the research. Table 1.1 shows the healthcare institutions which participated in this study in rural and urban areas of Libya, and Figure 1.1 shows a map of Libya and the locations of participating sites.

| City | Healthcare institution |
|-------------|-------------------------------|
| Tripoli | Tripoli Medical Centre |
| | Al-Razi Clinic |
| Benghazi | Benghazi Medical Centre |
| | Al-Quiche Clinic |
| Sabha | Sabha Medical Centre |
| | Al-Manshia Clinic |
| Sirt | Ibn Sina Medical Centre |
| | Al-Hyat Clinic |
| Zawia | Zawia Medical Centre |
| | Al-Bassatein Clinic |

Table 1.1: Healthcare institutions that participated in the study.

In the case of Libya, Information Communication Technology is seen as more and more necessary for supporting healthcare services. June 2010 saw the first terabit

international fibre optic cable arriving in Libya and the government has also announced it will invest ten billion American Dollars in ICT infrastructure until 2020. The infrastructure is rapidly developing also to allow the implementation of E-health systems in rural medical centres, as well as urban medical centres (Bakeer and Wynn, 2014).

One of the biggest hospitals in Libya is the Benghazi Medical Centre (BMC), which has a capacity of over 1,200 beds. Through a selection process involving international companies, in November 2010, the German company Nexus was given the contract for implementing a Health Information System at the Benghazi Medical Centre. BMC is focusing upon developing Electronic Health Records for their patients to improve medical treatments provided (NEXUS, 2010). In some of the healthcare institutions in rural areas, information communication technologies are not very coordinated and quite isolated and the programs of implementation there are lacking in communication between one another (WHO, 2011a).

Libya is the main subject of the present research study which conducts an exploration of the readiness of rural and urban healthcare institutions for the implementation of E-health services and other healthcare factor that need to be taken into account when a healthcare Information System is planned.

1.1.3 E-health for Libya

E-health utilisation can impact positively on healthcare provision in the Libyan National Health Service (LNHS) by making healthcare data more available, improving the continuity of healthcare for patients, reduce the time patients need to wait and cut down on medical mistakes.

The introduction of ICT in the LNHS would have to be accompanied by huge changes to the structure of the organisation's procedures, roles and responsibilities of individual professionals and their work processes. Developed countries have carried out comprehensive research about information and communication technology, which explains it in detail and sets out comprehensive guidelines. The same cannot, however, be said of developing nations' studies of ICT. Some research though has recently been published on the usage and implementation of information and communication technology in developing countries (IRMA, 2010; Akpan-Obong, 2007), though they do

not appear to be comprehensive enough to provide a complete research profile of ICT in developing countries, especially inside the LNHS.

The Libyan Ministry of Health sees E-health technologies as crucial to developing the LNHS for managing its healthcare operations (NEXUS, 2010). Because healthcare ICT is becoming so important to the provision of healthcare, it is very important to gain a comprehensive understanding as this could be very useful on a pragmatic level.

The research reported in this thesis explores ways of assessing the readiness of healthcare institutions for implementing E-health systems in rural and urban areas of Libya. This will be carried out by studying E-health implementations in other countries and by carrying out interviews and surveys amongst healthcare staff in the LNHS.

For the purpose of achieving this, several different models for assessing E-health readiness were taken into consideration and the Chan framework was chosen specifically for measuring the E-health readiness in Libya. The mixed method that was formulated for this research used the Chan framework for its formulation. The reasons for choosing Chan framework are explained in more detail in Chapter 3.

1.1.4 Section Summary

This section has shown how E-health technologies can potentially lead to the delivery of healthcare provisions more cost effectively and with improved quality. There are though several examples of E-health implementations that are less than successful. To improve understanding of what needs doing to successfully implement E-health technologies in the LNHS, the research in this study will concern itself with the issues that are related to the development of an E-health framework, issues that are made evident through assessing the readiness of healthcare institutions in Libya for E-health implementation. The following section will highlight the benefits of employing E-health technologies.

1.2 How E-health Systems can be Beneficial

A lot of research (Alvarez, 2002; Ruotsalainen et al., 2003; Iliakovidis, Wison and Healy, 2004) has indicated that E-health will allow ICT developments to develop healthcare service infrastructure in many countries. The expectation is that healthcare assistance will be easier to access and will be attainable anywhere all the time, no matter the location is in which it resides or was created.

It is the expectation of healthcare experts that the implementation of E-health systems would impact the practice of healthcare significantly (Eng, 2001; Grimson et al., 2000; Ruotsalainen et al., 2003; Wilson et al., 2004); that data could be retrieved reliably and accurately, when and where required; patient medical histories could be reviewed so that medical tests do not need to be repeated; healthcare staff could communicate independently of where they are located so that patients could be diagnosed faster and more effectively. Moreover, healthcare staff could be updated with new medical knowledge as soon as it is published online through E-training and could ask for advice from other healthcare staff from anywhere in the world if they were unable to deal with a case themselves (Ruotsalainen et al., 2003). The populace would benefit by being able to access improved information about healthcare and they would also be able to access improved healthcare services (Beogo et al., 2016; Goeuriot et al., 2015; Ruotsalainen et al., 2003; Silber, 2003; Wilson et al., 2004). It would be possible for patients to be treated or monitored at home so that they do not need to travel while sick or be hospitalised (Imai, 2016). Figure 1.2 shows the core E-health application domains.

There is an expectation that the implementation of E-health systems will mean that healthcare structures will become harmonised, allowing healthcare services to be provided seamlessly and continuously (Goeuriot et al., 2015; Grimson et al., 2000; Ruotsalainen et al., 2003; Wilson et al., 2004). When different healthcare organisations cooperate with each other, then healthcare data can be shared if it needs to be shared (Robison, 2015). There is also an expectation that it will mean better services can be provided with money being used more efficiently and effectively. Because of improved documentation of healthcare practices, it would be possible evaluate their effectiveness, thus allowing decisions on future healthcare policies to be more effective.

A downside to E-health implementation is that those who do not know how to use computers or do not have online access will be passed by in the benefits available from E-health systems. Though E-health services can provide enormous healthcare assistance, they not utilised on a wide scale in healthcare services worldwide (Bush et al., 2016 and E-health, 2004). There are many E-health systems currently available internationally (Iliakovidis et al. 2004), though much of their potential has not yet been realised (Ruotsalainen et al., 2003). Some of the largest obstacles to realising this potential are healthcare organisations not being committed enough to their

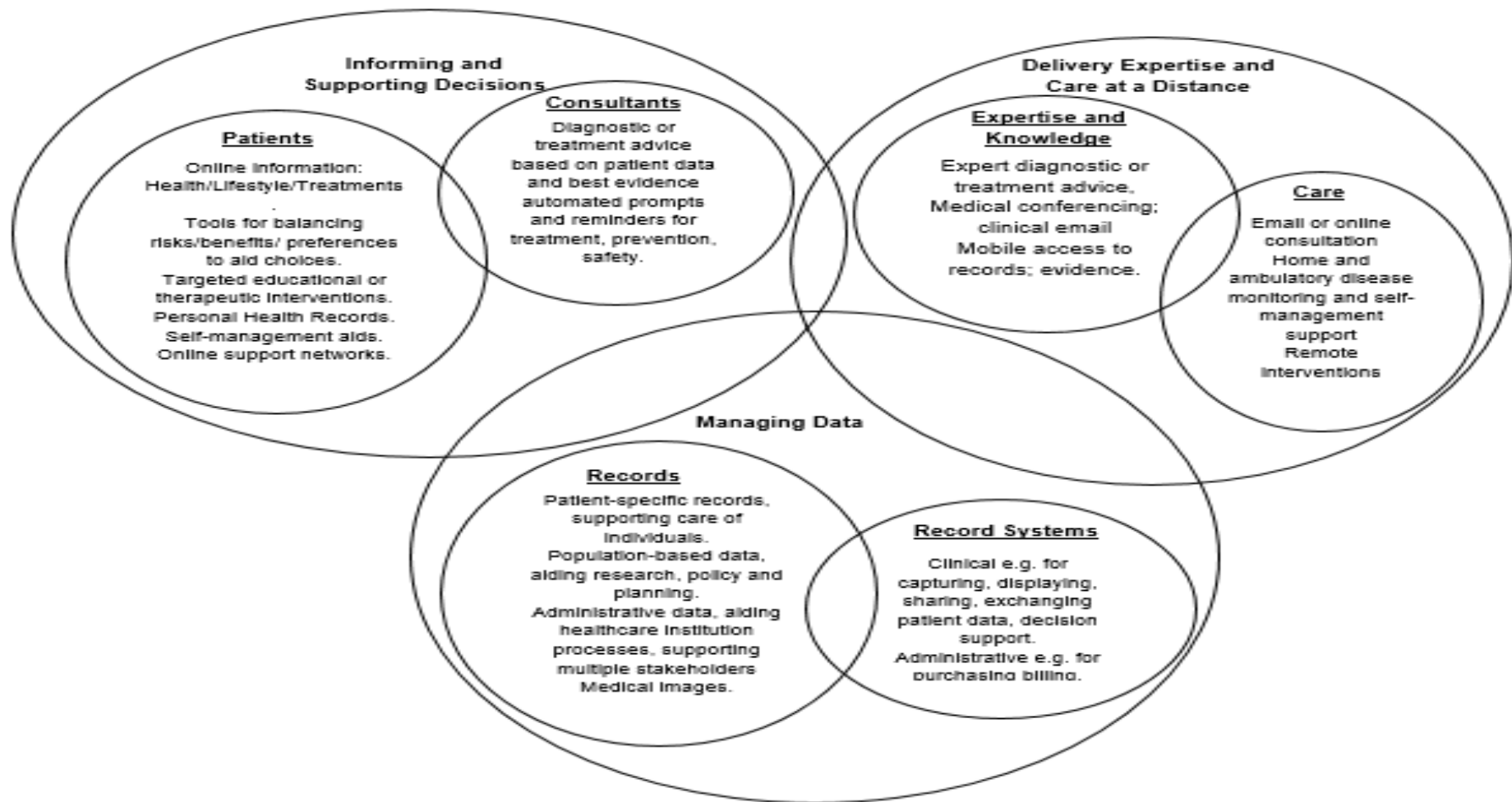


Figure 1.2: Core E-health application domains.

implementation and development, healthcare systems not being interoperable, lack of a shared vocabulary and ontology (E-health, 2004). In addition to this, E-health systems have tended to be more technologically aligned, making them difficult to operate, costly and with vulnerabilities to changing environments. Perhaps the greatest reason for their failure is a lack of study of the socio-technical side of E-health technology. In order to develop E-health technology effectively it is necessary to thoroughly understand the healthcare activities where the installation will take place. The development should be begin by considering what the staff operating the system will need and in what context the system will be used (Ciampi et al., 2016; Berg, 1999; Nykanen and Karimaa, 2004).

1.3 Electronic Patient Records in Developed Countries

Electronic Patient Record (EPR) medical applications were first used in the 1950s in the United States. They were seen as tools for research that would help improve therapeutic and diagnostic processes once applied to the enormous quantity of medical information available in patient medical records (Carnicero and Fernandez, 2012).

The developed world has since the 1970s seen a steep increase in health costs due to an increase in third party payment schemes and a rise in utilisation. This has led to a demand for cost containment as a common policy in a majority of the developed countries of the world (Erixon and der Marel, 2011; Ausubel et al., 1995).

In 2003 CISCO IT carried out an operating upgrade study, in 117 countries, on more than 34,000 EPR systems. On the basis of their findings they concluded that having a planned organisational change management group is essential in order to bring about an untroubled implementation of the upgrade process. This would also contribute to the payoff from the IT investment, measured by cost containment, client satisfaction and time (Nguyen et al., 2016; Zucchella et al., 2016; Timbrell, 2006; Kraabel, 2005).

In October 2004 during the Annual Symposium of the American Medical Informatics Association, Dr. Gregory Cooper put forward an important conclusion regarding some clinical informatics in the United States. He said that the 35 years of usage of such systems thus far shows that the future could be viewed optimistically, though caution ought to be used in and around resisting the usage or implementation of systems that might change healthcare delivery in a fundamental manner (Cooper, 2004). For example, the UK government paid £7,000,000,000 for an NHS-IT database upgrade in

2004 (BBC News, 2005). The health needs of the UK have been assessed for many years by the NHS-IT, a modern, sophisticated computational system. Health needs can be seen as not only primary, secondary, tertiary medical care needs, but can also include literacy, language, socioeconomic, and political matters etc. Those needs need to be assessed in order to construct further innovations in the NHS-IT in the long term. It has been difficult to achieve the coordination of this aspect of the NHS-IT health information and communication system.

1.4 EPR in Developing Countries: Barriers to Introducing E-health

EPR health systems have been discussed extensively by the WHO, Medinfo, and other agencies over the past decade. The focus of these discussions has been at an international, regional, national and individual level. Even though very little has been published on the “Actual Individual Usage of Electronic Patient Record” (AIU-EPR) in developing countries, there are similarities in the problems experienced in the usage of comparable ICT in other sectors.

Several problems that inhibit AIU-EPR in developing countries are described below (Zhang et al., 2016; Rajapakse and Peter, 2012; Fraser et al., 2005; Dobrev et al., 2008; Freudenheim, 2012; Omary et al., 2010; Ncube, 2010):

Fundamental Problems:

- National standards are lacking;
- With technology transfer, cultural differences are not recognised;
- A shortage of trained staff and a lack of demand and user awareness;
- Maintenance deficiency;
- Required basic facilities are inadequate;
- Problems with healthcare systems;
- Health Information Infrastructure is inadequate for the utilisation of Health Information Communication Technology.

Reliability Problems:

- Limited access to basic services;
- Electrical supply is not reliable and constant enough;
- Insufficient backup programmes;
- Insufficiently reliable and available communication systems.

Political Problems:

This set of issues arises due to a scarcity of resources, and suspicious and questionable technology developed in foreign countries, due to the need to import almost all the equipment required. This generates a situation where developing countries are dependent upon developed countries for their technology, though the alternative does exist for them to develop their own EPR industry.

The majority of EPR that occurs in developing countries is confined to major metropolitan teaching healthcare organisations, or university departments concerned with healthcare and EPR research, and cannot yet be commonly found in government healthcare organisations. The following points explain some issues that could affect the implementation of EPR in the specific context of developing countries (Blaya et al., 2010; Tierney et al., 2010; Drury, 2005; Ncube, 2010):

- A lack of foreign capital;
- Worries about employment stability;
- Not enough qualified workers;
- Investments are not going to show short-term returns, but are longer-term investments;
- Doctors are overworked;
- To make changes new resources need to be found or reallocated from elsewhere;
- EPR implementation is a narrow margin business and this creates fear of limited results;
- Financial incentive to change is not apparent;
- Lack of capital creates financial barriers.

Chan et al. (2010) write more specifically about problems with AIU-EPR. He describes in particular the idiosyncrasies and characteristics of healthcare delivery systems, focussing upon deficiencies in several areas, including: human factors, healthcare complexities, technology and design.

1.5 Different Sorts of E-health Systems

Normally, E-health systems are categorised into three types: (1) delivery of healthcare services to patients by healthcare staff, (2) educating and disseminating information about healthcare practices, and (3) buying and selling healthcare products (Ruotsalainen et al., 2003).

The first type looks at structures for *delivery of healthcare services to patients by healthcare staff*, and includes functions ranging from the delivery of healthcare services to administration.

- **Healthcare institution systems:** this includes systems for radiology, sending messages from one healthcare institution to another and laboratories.
- **Primary care systems:** E-health systems that provide services for the pharmacy, the GPs and prescribing electronically.
- **Homecare systems:** E-health systems that use telemedicine to deliver care services remotely, to patients at home or other healthcare institutions, and provide a good treatment so that it is not necessary to visit the healthcare institution.

The second type looks at *disseminating information about healthcare practices*, and includes virtual healthcare institutions, websites about specific healthcare topics and online consultation businesses. These systems could be used for:

- **Medical consultations,** searching for second opinions and healthcare treatments.
- **Healthcare education and disseminating** information for public healthcare, healthcare publications and material for preventive medicine.

Where such systems are used for disseminating information, the population can inform and empower themselves by accessing these sites online. It is however necessary to question various online sources as the information they provide may not be valid or of the highest quality (Wilson, 2002). There are specific sites that are more credible than others, so it would be advisable for healthcare institutions to advise patients on which ones to use.

The third type looks at *buying and selling healthcare products*. E-trading or E-commerce for purchasing healthcare products enables people to buy good quality healthcare products easily and cheaply online.

The classification of E-health systems can also be done according to their functionality. These groups are (Ruotsalainen et al., 2003):

- **Networks for regional healthcare information:** these set up leading edge healthcare services by networking and implementing them through the use of a

variety of technologies. It is common for these systems to integrate legacy systems already in use, as well as systems for administration and imaging, into a single network, and to develop new applications and fresh interfaces for providing broader services in the region.

- **Systems for hospitals:** including systems for recording/recalling patients' medical records and managing healthcare information.
- **Telemedicine:** these systems are utilised for accessing expert or second opinions while still at home or in another healthcare institution.
- **Healthcare insurance validation:** these systems utilise cards that show that the patient has valid healthcare insurance.
- **Healthcare information systems:** give information on healthcare issues for healthcare staff and patients and allow consultations to take place or the purchase of healthcare products.
- **Monitoring systems for homecare services:** these systems can be utilised with patients who are very ill and are living at home and use wireless technology.

It can be seen from these categorisations that the facilitators for a lot of E-health technologies use the internet and electronic patient healthcare records which enable the sharing of healthcare data between one healthcare provider and another, and allow E-prescribing to take place (Ruotsalainen et al., 2003). The downside of electronic patient healthcare records is that the data recorded is done so differently to other healthcare institutions generally, which does not allow information to be shared as freely as it might be (Safran and Goldberg, 2000).

1.6 Research Process

There were two stages to the present research: the first, consisting of five steps, begins with the literature study and ends with the collection of data. The second stage consists of three steps: (1) data analysis, (2) selection of components of existing frameworks for E-health readiness assessment as a basis for a framework tailored for the present study, and (3) development of a novel E-health readiness assessment framework on the basis of the first stage, and extending significantly the components from the second stage. An illustration of this can be seen in the diagram shown in Figure 1.3.

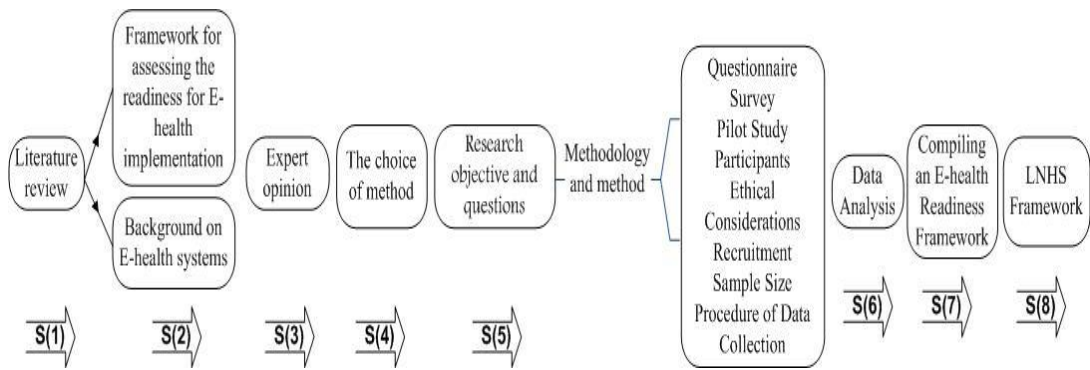


Figure 1.3: The research process.

1.7 The Significance of the Present Research

The World Health Organisation (2010) gives a definition of health information systems as systems for integrating the collection of data, making reports, carrying out processes and using information that is needed for the improvement of healthcare provision and improving healthcare management on every level (Alfred et al. 2010). Health information systems by nature comprise an assortment of sub-systems that collect and report data.

Anderson (2007) points out that patients are in effect consumers; the advent of E-health presents them with the chance to improve the access they have to insurers and healthcare providers. Improved communication could result from provider messaging, electronic medical records being accessed, and accessing knowledge about different ways of treating patients (Anderson, 2007). Whereas patient treatment times are usually limited due to general practitioners not having much time, E-health provides the opportunity to go online and become more informed about a vast array health issues (Menachemi and Collum,2011). While a doctor may take a long time to return a phone call and making an appointment to visit one may take even longer, E-health can make things easier (Menachemi and Collum, 2011). The ability of E-health to aid in the education of patients and to help them manage themselves more effectively has been well documented (Carriazo, 2015 and E-health initiative, 2012).

Among the biggest challenges to developing countries in developing economically and socially are: diversifying economically, lack of employment, high levels of disease, using natural resources unsustainably, and poverty (Nugent, 2008). Huang et al. (2009) state that by providing improved healthcare services to a population, an important step is taken in the movement toward poverty alleviation.

The LNHS does not provide adequate access to the basics needed for a healthcare service for the majority of the population, and accessing healthcare in rural parts of the country can be challenging (WHO, 2011; Giaedi, 2008; Khalil and Al-Bousify, 2008). Most Libyans use as their primary healthcare provider the LNHS, which faces many challenges in providing a high level of healthcare, especially since the civil unrest there and the lack of funding provided by the previous dictatorship. The problems with the LNHS include clinical treatments that are outdated, a lack of healthcare workers, specialised skills, education about health and health information that is accurate, thus resulting in an increase in the loss of patient records, errors being made medically, delaying patients in being referred, and long waiting times for those attending clinics or hospitals (Giaedi, 2008; Khalil and Al-Bousify, 2008).

The research in this study concerns itself with the issues that are related to the development of an E-health framework, issues that are made evident through assessing the readiness of healthcare institutions in Libya for E-health implementation. For the purpose of achieving this, several different models for assessing E-health readiness were taken into consideration and the Chan framework was chosen specifically for measuring the E-health readiness in Libya, the reasons for choosing Chan framework is discussed in more details in Chapter Three. The questionnaire that was formulated for this research used the Chan framework for its formulation.

The focus of this study is the investigation of the readiness of the LNHS for the implementation of E-health systems. Libya has undergone rapid economic development in the last decade. The population has grown extremely fast due to a rising birth rate, declining mortality, naturalisation and large numbers of migrant professionals. This has necessitated a need for services to be upgraded and increased due to increasing demands (The Libya Report, 2006). However, since February of 2011 funds that could be used for this expansion have been diverted into emergency services for war, and this study takes the changes resulting from the post-2011 period into account.

E-health can potentially be helpful in overcoming a great deal of the challenging issues facing hospitals and clinics in rural locations (Ouma and Herselman, 2008; Yellowlees et al., 2008). However, when introducing E-health solutions, each case needs to be properly assessed using existing literature, along with what is currently going on in the hospitals and clinics in the rural areas.

The use of electronic patient records has been considered an essential requirement for the LNHS to manage its healthcare delivery system (Khalil and Al-Bousify, 2008). Because HICT is going to be so pivotal to managing healthcare services, a better understanding of the issue that could affect electronic patient records is required, as it has important pragmatic implications. This research study focused on providing a deeper understanding of EPRs in healthcare systems in countries with a similar level of development to Libya. It has investigated the potential of the LNHS to integrate EPR technology that has been developed over a much longer period in more developed nations. The result of this study should provide developing countries with information that could aid them in implementing EPR more efficiently and effectively. Additionally, this study will lay the groundwork for future investigations of the implementation of EPR in other less developed countries.

Though empirical research already exists about adopting E-health systems in the Libyan National Health Service, it remains limited.

The data that has been collected in this research study can be utilised in order to better understand the issue involved in the implementation of E-health technology and improving their usage in the future.

The outcome of this study can hopefully be utilised by healthcare professionals, information system operators and hospital managers as a starting point when adopting E-health systems in hospitals, whether in Libya or other developing countries. For those wishing to study or research health informatics, this study can provide assistance in future research on E-health systems.

1.8 Research Questions

The primary research question which this study addresses is:

How could an E-health framework that has been designed to enhance the delivery of healthcare services in Libya be composed?

The primary research question was divided into two subsidiary research questions as illustrated in Figure 1.4, and various measuring instruments were utilised for collecting the data more effectively. There were several different instruments utilised for measuring in this research in order that a deeper understanding of the analysis of the

investigation might be achieved. Moline and Cameron (2010) state that the use of several different methods for making measurements allows more detail to be obtained about the subject being investigated.

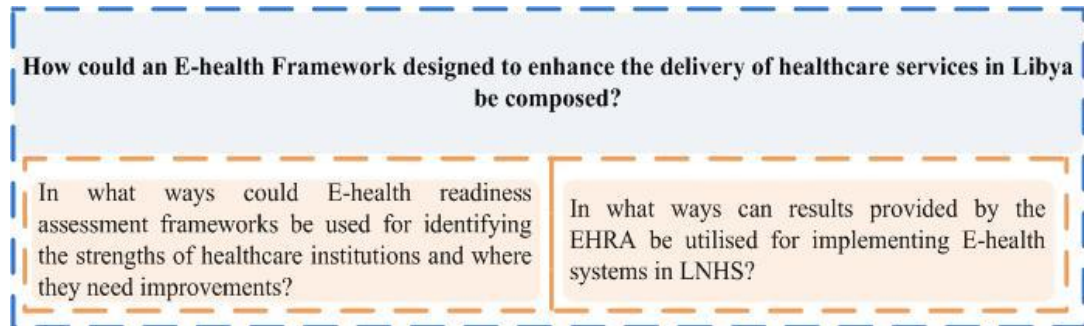


Figure 1.4: Subsidiary research questions.

1.9 Aims of the Research

This study's aim is to examine the factors entailed in developing healthcare Information Systems in developing nations and propose frameworks for facilitating design and development of healthcare IS in developing nations in the future.

This research has used the LNHS as a test case for investigating what technical, political, healthcare and social factors need to be examined when healthcare information systems are planned in developing countries. The grounding for this will be in the following:

- What has previously been developed in the West and the Middle East, in developing and developed nations.
- A course of questionnaires, observations and group interviews with healthcare staff in Libya.

1.10 Problem Statement

Khalil and Al-Bousify (2008) state that the implementation of E-health technology in Libyan healthcare institutions would naturally occur in a health service providing improving services for its patients. They also add though that before the healthcare service reaches this point of progression it needs to implement a whole plethora of essential services more proficiently such as: early interventions, easy accessibility, efficiency, effectiveness, educational competency, ethical practice, and dealing with emergencies. When this paper was published in 2008, when A El Taguri et al. (2008) also criticised the LNHS as performing below the levels that might be expected. Since

that time the relative balance that existed under the Gaddafi regime has long since dissipated into a drawn-out battle for control among tribes in which no single faction is strong enough to exert total control and bring about political and economic balance once more. There were high hopes among the Libyan population with the deposal of Gaddafi and it is this researcher's deepest wish that the country will unite and rebuild the economy with the large amount of oil revenue that flows into Libya; then the needs stated by Khalil and Al-Bousify (2008) could be fulfilled and a natural progression to the implementation of E-health systems could take place.

This researcher's intention for this research study is to illustrate the ways in which the implementation of E-health systems in a healthcare system such as the LNHS could lead to the provision of better healthcare services and save money. The LNHS needs a lot more staff to run effectively and efficiently (A El Taguri et al., 2008). This is due in part to the underpayment of healthcare staff, which has led to many seeking employment in other countries, meaning healthcare institutions have had to resort to employing staff from other countries where the training may not be as thorough and has led Libyans to seek medical treatment abroad (A El Taguri et al., 2008). There is a strong need in Libya to train more staff and the use of E-learning technology could provide this more cost-effectively than paying teachers and building schools (A El Taguri et al., 2008).

1.11 Structure of the Thesis

Chapter One: Background to the Study

This chapter provides an introduction to the research study and highlights the benefits of employing E-health technologies and the issues that might affect its implementation. It also outlines some of the challenges of implementing different types of E-health systems in developing nations and in rural communities. It also gives a description of the study's research questions and aims. It gives a description of the approaches and methods used for completing the research, and of the ways in which this study will contribute to this field of research. Lastly, research questions and problem statement.

Chapters Two and Three: Literature Review

The literature review is divided into two chapters: Chapter Two deals with literature on E-health and Chapter Three looks at frameworks for assessing the readiness for E-health implementation. The first chapter focuses on definitions of E-health and its advantages, how health information systems evolve, conditions required for E-health initiatives,

keeping sensitive healthcare data private and secure, how E-health might benefit users and likewise obstacles to its effective usage, electronic patient records, the benefits of electronic prescription systems, care services using tele-health and tele-medicine systems, a brief description of some characteristic traits of urban and rural areas of Libya, and E-health architectures that could be implemented. Chapter Three looks at the assessment for readiness for E-health implementation in Libya, how healthcare technology assessments and their definitions have evolved, the quality and productivity of healthcare systems, conceptual frameworks for models used in assessments, defining the assessment of E-health readiness, different sorts of models used for assessing E-health readiness in healthcare systems, identifying the elements required for assessing E-health readiness, existing E-health readiness assessment frameworks currently used in developing nations, getting communities involved in assessments for E-health implementation readiness assessments, and applying overall E-health readiness assessments constructs.

Chapter Four: Research Methodology

This chapter gives a description of the theoretical approach, and explains what methods were employed in the study. It examines some of the philosophical assumptions that have been made about the validity of research.

It also presents the research objectives and questions, and discusses the methods and methodology followed in this study. Furthermore, it describes the way in which the data for this research was collected, and also presents the pilot study, ethical considerations, questionnaire survey, participants, response rate, sample size and how the data was collected. This chapter also describes the process of analysing the data collected, and summarises the content of all the previous chapters and evaluates the research methodology as a whole.

This study was carried out employing both quantitative and qualitative research designs, using multiple case studies. The methods for collecting data included interviews, questionnaires, observation and existing reports.

Chapter Five: Results and Analysis

This chapter analysis and interpret the data which was collected using quantitative and qualitative research approach used for this study. It includes a presentation of the

survey's results and a descriptive analysis of the results about healthcare professionals in Libya.

This chapter analyses the results of the study using the template from Creswell (2009) which is utilised for a collective or multiple case study. Techniques for analysing semi-structured interviews qualitatively were investigated, and came to the conclusion to employ an optimum system, a combination of deductive/inductive approach. This chapter presents a description of what this approach entails.

It includes a full description of how available and accessible ICT technology and E-health systems are in the healthcare institutions in urban and rural areas in Libya, and their infrastructure is described. Lastly, it includes a summary and conclusion of the study findings.

Chapter Six: Design and Development of an E-health Framework for the Libyan National Health Service

This chapter includes a discussion on the study's findings. It focuses on the ways in which the outcomes that have been identified and the recommendations can be utilised for compilation of an E-health framework that can be utilised in the Libyan National Health System.

Chapter Seven: Reflection, Evaluation and Further Work

This chapter summarises and discusses the whole study and points out the most pertinent findings. It also provides an outline of some suggested topics for researching in the future and acknowledges the ways in which the study is limited. The end of this chapter includes some recommendations and contributes some important pieces of knowledge.

1.12 Chapter Summary

This chapter summarised what areas have been studied for this study, by giving an overview of the background, the issues, the goals and aims, the design of the research, and the limitations, pertinence and processes of the research. Lastly, this chapter has shown how the research will provide valuable contributions in the fields of E-health and healthcare delivery within the Libyan National Health Service, in particular providing a solution for balancing the inequalities in the service provided to rural and urban populations in healthcare delivery. Chapters Two and Three will provide the literature

review for this thesis and focus on literature about E-health and frameworks and models for assessing E-health readiness and how they can be used for measuring readiness to embrace new healthcare technologies.

Chapter Two
E-health Literature Review

2.1 Introduction

Chapter 1 introduced this research study by detailing the question around which the research will be based, as well as stating why the study is important and what its objectives are. This and the next chapter shall be focussing upon reviewing the literature. The literature review within a research project is defined by Nordquist (2009) as assessing bodies of research that address research questions. This implies taking each research question and telling us what areas of research are needed as background for it.

Therefore, both Chapters Two and Three are a literature review, where Chapter Two will focus on the definitions of E-health and its advantages and drawbacks, how E-health systems evolve, conditions required for E-health initiatives, and how to keep sensitive healthcare data private and secure. Whereas Chapter 3 will focus on the theories that have been used for applying E-health readiness assessment models which being used currently in developing countries. Furthermore, this chapter will focus on how Health Technology Assessment (HTA) has evolved and how it is defined and it will examine conceptual frameworks of assessment models.

2.2 Definitions of E-health

A more thorough way of defining E-health needs to include points of view from business, technological and healthcare perspectives. E-health encompasses more than just business or technological breakthroughs, it is a paradigm shift and is committed to creating a network globally of minds working to bring about better healthcare across the planet by using ICT (Carter-Templeton, 2016; Turner et al., 2004). The most important sectors for applying E-health (Kwankam, 2009) include:

- Electronic medical records; this includes clinical administration systems, electronic X-ray images, patient records, electronic booking systems and electronic prescribing systems.
- Healthcare information networks and E-health services.
- Tools for supporting decisions.
- Services and technologies that are accessible via the internet.

From business perspective a contrasting way of defining E-health was that given by Sharma and Wickramasinghe (2005) who stated that it was efforts channelled by

healthcare chiefs and hi-tech firms so that they could fully enjoy benefits that can be had from combining the internet and with healthcare provision.

In the technological perspective, Sharma and Wickramasinghe (2005) assert that E-health ought to include the delivery of healthcare services and data via the internet and other similar E-commerce technology. Rodrigues (2008) makes the point that although E-health is often associated with using the internet, it does actually mean the use of any electronic exchange to share information that is connected to a health issue or the use of electronic means to analyse health-related data in order to deliver healthcare more efficiently and effectively. Because of this, the term E-health is applied to almost every situation where medicine and computers are found together (Klasnja and Pratt, 2012; Quinn et al., 2009; Franc et al., 2011).

Oh, Rizo, Enkin, and Jadad in 2005 defined E-health by stating that it acted as leverage for ICT for connecting government, healthcare providers and the patients, and for educating and informing healthcare workers, patients and healthcare managers and stimulating innovations in the delivery of healthcare services, managing healthcare systems and improving healthcare systems.

E-health can be used to describe a vast array of electronic ICT that is used in the healthcare industry (Robison, 2015; Kreps and Neuhauser, 2010). The term E-health also encompasses multimedia, health portals, robotics, electronic images, surgery carried out with the assistance of computers and monitoring systems that are portable or wearable (Quesada-Arencibia et al., 2016; Gray et al., 2016; Vavoulas et al., 2016).

The term E-health is used when describing ICT, when applied to a vast array of functions which have an effect upon the way healthcare is administered to a general population (Swedish Society of Nursing, 2013). Another definition of E-health (Reinhold, 2006) is that it refers to many activities which involve the use of internet technology for enabling the practice of healthcare.

Another definition of E-health is using the latest ICT in order to fulfil the requirements of patients, healthcare workers, healthcare providers and those making policy decisions (Bellika and Johansen, 2008). An alternative definition is that E-health is an area of medical informatics that is emerging and delivers information and health services through use of the internet and technology related to the internet (Evers, 2006).

Almunawar and Anshari, (2012) give a description of E-health as being when the internet and ICT is used for informing, educating and empowering patients, managers, healthcare workers, policy makers and the general population; and for creating improvements in how the delivery of data and healthcare is managed and healthcare systems are managed.

E-health has addressed the challenges it has faced within the healthcare sector; where Sharma and Wickramasinghe (2005) say that for the facilitation of providing healthcare delivery more effectively, the many fresh possibilities fall mostly into these categories:

- The rise in patients demand for the ability to request specific services online from healthcare institutions.
- The ability to enhance the possibilities of institutions to transmit to one another.
- The ability of healthcare providers to connect with patients online.
- The evolving technologies that allow healthcare users to communicate with one another directly.

In this thesis the definition of E-health that shall be used is the following:

E-health is ICT that is used for delivering healthcare services efficiently and effectively.

As well as defining E-health, it is also very important to look at the goals that E-health needs to fulfil which is the aim of the following section.

2.3 General Potential Benefits and Drawbacks of E-health Systems

2.3.1 Benefits

Anderson (2007) pointed out that the advent of E-health presents patients with the chance to modify the connection they have with healthcare providers. The improvement in communication could entail provider messaging, electronic medical records being accessed and accessing knowledge about different ways of treating patients (Goeuriot et al., 2015; Anderson, 2007; Kallio, 2015; Aiken et al., 2016; Beogo et al., 2016). Though patient treatment times are usually limited due to general practitioners not having much time, E-health provides the opportunity to go online and become more informed about a vast array of health issues (Caffery et al., 2016; Menachemi and Collum, 2011). Though

a doctor may take a long time to return a phone call and making an appointment to visit one may take even longer, E-health can make things easier (Menachemi and Collum, 2011). The ability of E-health to aid in the education of patients and to help them manage themselves more effectively has been well documented (Carriazo, 2015; Robison, 2015 and E-health initiative, 2012).

According to Fitzgerald et al. (2008) there is an expectation that E-health will enhance how accessible healthcare is, as well as making it more efficient and raising the standards of quality by:

- Allowing healthcare to be practiced more effectively by making treatment factors such as location or disability less of a barrier;
- Making healthcare procedures more transparent and accountable and allowing healthcare to be carried out between healthcare providers;
- Making systems more cost-effective by making processes more streamlined and lowering waste levels and the time patients must wait;
- Encouraging practice based on evidence and reducing errors;
- Providing more accurate diagnoses and more appropriate treatments;
- Enhancing the treatment of patients by tailoring their healthcare to them specifically; this is where ICT allows better decisions to be taken by using personal information about specific patients;
- Making patients more empowered to decide what courses of action are best for their own healthcare provision.

Siadat et al. (2012) look specifically at the economic advantages of E-health. He cites Bloom and Cannings (2005) as stating that a population that enjoys a well developed E-health system is more likely to have higher levels of productivity because of increased physical energy and mental clarity.

The main goals of E-health are: increasing the efficiency and quality of healthcare; providing more accurate diagnoses and more appropriate treatments; providing more healthcare that uses medicine based on evidence; empowering patients and users; developing improved relations between healthcare workers and their patients; making systems more cost-effective by making processes more streamlined; lowering waste levels; and reducing the time patients must wait (Robison, 2015; Sharma and

Wickramasinghe, 2005; Kallio, 2015). An explanation of these goals can be found below:

Increasing Patient Empowerment

Noordegraaf, et al. (2012) point out that if personal medical data is made available to those to whom it may concern online, then E-health could allow the population to have more awareness concerning how they care for their own health; this would make patients more empowered to decide what courses of action are best for their own healthcare provision.

Implementing Evidence-based Healthcare

An intervention using an E-health system should be evidence-based. This is because the system needs to have been proven through being scientifically evaluated and supported with case histories, rather than simply assuming the system to be effective and efficient (Pearson, Wiechula, Court and Lockwood, 2005). Case repositories that are available online allow easy access to such proof, therefore allowing decisions about a case to be diagnosed or treated to be made in an ‘evidence-based’ manner (Brendryen, 2013). Of all the sectors in which E-health is being researched, the evidence-based domain remains one of the busiest, though there remains much more research to carry out. Chaudrey et al. 2006 carried out extensive studies on E-health systems that had been implemented and concluded that multifunctional systems yielded real benefits by increasing the delivery of care (in particular in the area of preventative medicine), enhancing the surveillance and monitoring of activities, reducing errors in the prescription of medication and decreasing the rate of utilisation for care that might potentially be inappropriate or redundant.

Increasing Efficiency

One of the primary objectives of E-health is increasing healthcare efficiency, thus cutting expenditure. One effective way of cutting expenditure is in avoiding duplicating or intervening therapeutically or diagnostically when it is not necessary. This could be done by using the internet to connect different healthcare providers, and through enhanced patient participation (Naseem et al., 2014; Carroll, Edwards and Rodin, 2012).

Providing Doctors and Patients Education

It is possible through the use of E-health systems for medical professionals to be educated in the latest medical knowledge and for the healthcare user to be educated in

their own healthcare (in particular in areas such as preventative measures). This allows doctors and patients to keep up to date with any developments that might be made in healthcare (Carriazo, 2015; Wickramasinghe and Fadlalla, 2005; Aiken et al., 2016). This will then most likely improve the level of healthcare provided, as regards using up-to-date methods of treating and preventing illness.

Improving Relationships between Patients and Healthcare Professionals

E-health creates different types of interactions between healthcare professionals and patients and poses new problems regarding ethics on subjects such as: issues of security, privacy and informed consent (Difelice, 2015; Hesse and Shneiderman, 2007). It is pointed out though, by Wickramasinghe and Fadlalla (2005) that this is not an E-health issue, but that all online business contains this as an intrinsic feature. Thus E-health, as well as online services in government, insurance, banking finance and retailing, must all live with the ethical challenges of online businesses. Because of the extremely personal nature of the healthcare industry, the issues faced by other services could be amplified in this sector.

Trondsen (2014) stated that “E-health services can be or come to be a replacement for face-to-face consultations; supplement existing forms of care; create favourable circumstances for strengthening patients participation; disturb relations; and/or force or demand more intense patient participation”.

Raising Healthcare Quality

Policy makers in many healthcare systems equate a rise in efficiency with a reduction in costs; it should not however be forgotten that a rise in efficiency of healthcare is also synonymous with a rise in quality; this being what the goal of E-health ought to be ultimately (Nguyen et al., 2016; Wright et al., 2006). The National E-health Transition Authority (NEHTA) (2012) states that a better informed patient, because of the way E-health informs, finds it easier when communicating with healthcare professionals; this would mean that they should both understand one another better, thus leading to an improved standard of healthcare.

2.3.2 Drawbacks and Problems

While there are many ways in which E-health may be beneficial, there are, however, according to Coughlan and Davison (2008) several drawbacks associated with E-health:

- It is not clear how patient behaviour and the relations between patient and doctor, will be affected by E-health tools;
- There is little hard proof of how effective and cost-effective E-health systems really are;
- It could potentially create a ‘digital divide’ between those receiving advanced patient care using E-health and those that cannot afford such practices, especially those with disabilities and the elderly; such differences need to be kept to a minimum;
- Studies carried out to evaluate systems need to be multidisciplinary;
- How the use of systems, for making clinical decisions and health information technologies (HIT), may be legally and ethically detrimental to specific cases, is as yet not completely clear;
- Researching and developing E-health systems should address both human and organisational issues that are affected, from the perspective of healthcare workers and patients;
- There needs to be an exploration of the role and influence of E-health media and settings in the workplace.

From the viewpoint of society, the spread of E-health has implications that may affect populations technologically, managerially, ethically and organisationally (Feufel et al., 2011). Olla and Tan (2009) pointed out that it may be those that are the most vulnerable in society that might gain the least amount from E-health, as they might suffer cognitively, socially and culturally compared to those that are better off. Barriers could include issues around literacy, being unable to access technology, being less educated and disadvantages due to language and culture (Olla and Tan, 2009). It is only when these imbalances are properly met, that E-health initiatives can be expected to address the needs of a wider spectrum of society.

According to Australian Health Minister’s Conference (2008) the biggest problem with providing E-health services is that many users have difficulty in finding information that is really reliable and accurate. Bates and Wright (2009) state that the quality of E-health information is indicated primarily by how complete the information is and how credible the source is. Medical specialists have suggested that information regarding healthcare that comes from sources that lack credibility are potentially harmful to

patients (El-shheibia and Talal, 2012). Another point is that if the patient is given incomplete information regarding healthcare, then it is possible that it will lead them into making choices concerning their healthcare that are not right. Completeness of healthcare information can be said to be the most important factor for making the right healthcare decisions. As there are very few ways in which information available on the internet is controlled, steps have been taken to raise the quality of healthcare information available online. Therefore, an initiative has been introduced to impose such controls on healthcare information available online, is the Health on the Net (HON) code (El-shheibia and Talal, 2012). This provides patients with a significant system that shows patients which websites meet the standards and provide quality information. A similar development is the Health Internet Ethics (Hi-Ethics), which created an ethical framework as some people were concerned about how reliable, private and confidential information provided online can be (Amataya, 2004; Hillestad et al., 2005).

2.4 E-health Systems and Telemedicine

A massive wave of change has occurred within the field of IT, bringing about new methods and technologies for treating the healthcare challenges of populations around the world (Jabri, 2000; Strickland et al. 2009). A massive breakthrough in IT occurred when the converting of an analogue signal into a digital signal was mastered (digitalisation) (Strickland et al. 2009). This means that it is now possible to transmit sounds and images at high speed with high standards of quality in standardised formats (Gupta et al., 2016).

At the same time another revolution has occurred where data can be sent using optical fibres instead of traditional copper wire, thus allowing bandwidths to be achieved that could previously only be dreamed of (Strickland et al. 2009; Dwivedi, 2009).

Telemedicine involves IT and communicating electronically assists in providing and supporting clinical healthcare at distances (Aiken et al., 2016; WHO, 2010). Bashshur and Shannon (2009) state that E-health involves using ICT for supporting and promoting the administration of healthcare, clinical healthcare over long distances, public health and educating professionals and patients about issues related to healthcare. Telemedicine is defined by Cartwright et al. (2013) as using IT and electronic communications for providing healthcare services when those participating are located

in different places. Telemedicine is also heavily connected with the term 'E-health'. The term E-health is normally used to describe a broad spectrum of technologies used for educating from distances, patients outreach, and other cases where IT and electronic communications are applied to supporting healthcare services. Transmitting still images, conferencing using video, monitoring vital signs remotely, educating on medical issues, call centres for nursing, and patient portals that include E-health, are all acknowledged to be part of E-health and telemedicine (Li et al., 2016; Imai, 2016; Wyatt and Sullivan, 2005; ITU, 2008).

Providing healthcare remotely can be carried out by delivering the data in a variety of methods. These might include (Gray, 2009; ITU, 2008):

- Direct connections from healthcare provider to home: this involves providing patients with consultations with specialist healthcare professionals, homecare nurses and healthcare institutions via video systems operated over a phone line;
- Networked systems: these create links between centralised healthcare clinics and hospitals and those that are more in suburban or rural areas, via systems, a central hub or a system that integrates the networks. The sites may be linked for telecommunication purposes by internet or specialised high speed lines;
- Private networks connecting point to point: these systems are utilised by healthcare clinics and hospitals that deliver a direct service or contract out specialised services to healthcare providers at ambulatory healthcare locations;
- Internet sites for providing patients with E-health services: these sites are very good at providing a patients outreach service directly;
- Links from patients directly to monitoring centres: these can be used for monitoring foetuses, pacemakers, hearts, lungs and many other services that are related. These can be very effective in providing patients with the possibility for maintaining their lifestyles more independently;

It is often the case within healthcare institutions that telemedicine systems are used initially by a handful of key healthcare professionals. Therefore, the telemedicine services that are available initially will be a reflection of the fields in which these pioneers specialise. Some fields in which this has often occurred might include departments dealing with heart and skin problems, the X-ray department and the pathology department. Telemedicine is not however a medical speciality that is offered

separately, but something that might enhance the medical services already provided. Additionally, the service that telemedicine can offer, is in transforming healthcare by being able to encourage patients to become more involved in making decisions and to provide fresh ways of living healthier lifestyles (Foguem and Kamsu-Foguem, 2014). Telemedicine and E-health are used to deliver healthcare services remotely for an array of different purposes (Vavoulas et al., 2016; Raaber et al., 2016; Gray, 2009; Blaya et al., 2010; Zhang et al., 2016), such as:

- Monitoring patients remotely: this makes use of equipment for remotely collecting and sending data to be interpreted at a monitoring station. Telehealth equipment that is for use at home could be telemetry systems used for capturing specific vital signs, such as a patient's weight, blood pressure, glucose count, or ECG. These services might be used for supplementing nurse visits;
- Services for being referred to a specialist: These are normally where a specialist will assist a GP in diagnosing an illness. This often involves images of the patient being seen via a live video connection, consulting remotely or transmitting images or video plus patient data for diagnosis to a specialist so that they might view them later;
- Caring for patients directly: for instance being able to share medical, audio and video information between patients and healthcare professionals for diagnosing illnesses, prescribing, advising or making a treatment plan. This might be a patient who is at a clinic located in a remote area, at their home or at a doctor's office.
- Patient's healthcare and medical information: Included in this category would be patients going online in order to obtain specific healthcare knowledge, plus visiting online chat rooms to gain support from peers.
- Educating in medical issues and mentoring: this might include various activities, ranging from providing healthcare professionals with further medical education, to seminars that specialise in medical education for specific groups, to interactively advising another healthcare professional carrying out an operation;

Some of the fields of E-health systems and telemedicine will be covered in more detail over the following sub sections.

2.4.1 Electronic Health Records (EHRs)

Using IT effectively is a very important factor in trying to improve levels of healthcare as far as the safety of patients, economic efficiencies, and the quality of the outcomes is concerned (Carter-Templeton, 2016; Hillestad et al., 2005). There are increasing numbers of developed countries, and a few developing countries, that, have installed EHRs (Hodge, 2011; ECFHCR, 2010), though each began from a different place, each uses different approaches, moves at its own speed, and follows its individual path in the deployment of EHRs. EHRs are essentially a way of storing data about the health of patients in a form that a computer can process (Bennett and Doub, 2010). EHRs are an E-health service that captures and provides access to healthcare data about patients in detailed and summarised formats. EHRs constitute the centre point for many E-health services such as E-prescriptions, E-consultations and E-referrals. Although E-consultation in the present study are taken to mean consultations between healthcare workers, the patient is still the subject of the consultation. Thus, EHRs (of patients) constitute the centre of the E-health framework. Another definition, given by Board (2011) is that it is a set of elements that together to form the process in which the records of patients are made, utilised, saved and brought up when needed. They are normally stored in healthcare facilities and include persons, information, regulations, processes, devices for storage and facilities for communicating and supporting. Electronic health systems are defined more comprehensively by Sloane (2008), as follows:

- EHRs provide knowledge and supporting decisions that improve the levels of healthcare received by patients;
- Support healthcare being delivered more efficiently through the usage of better processes;
- Save a lot of time currently spent looking for patient records and paperwork;
- Store data that has been longitudinally collected for and about people;
- Improve filing systems and prevent files getting lost;
- Create time savings in the recording of patient data and the treatment and diagnosis of patients;
- Help with communicating and protecting confidentiality of patient's data;
- Provide information about people that can be accessed immediately, but only by those authorised to do so.

Whenever a patient receives a service from a department, such as radiology or the pharmacy, then a record of this can be made electronically. It is also possible that some departments record other information electronically, such as notes made by healthcare professionals, physiological signals etc. The integration of this data is often not carried out though, as they can become caught in silo systems; guarded from unauthorised users by the need for security clearance. Nonetheless, if a system is planned well then there can be good interconnectedness between stakeholders. A representation of interconnectedness between stakeholders, shown by an HER concept overview, is shown in Figure 2.1.

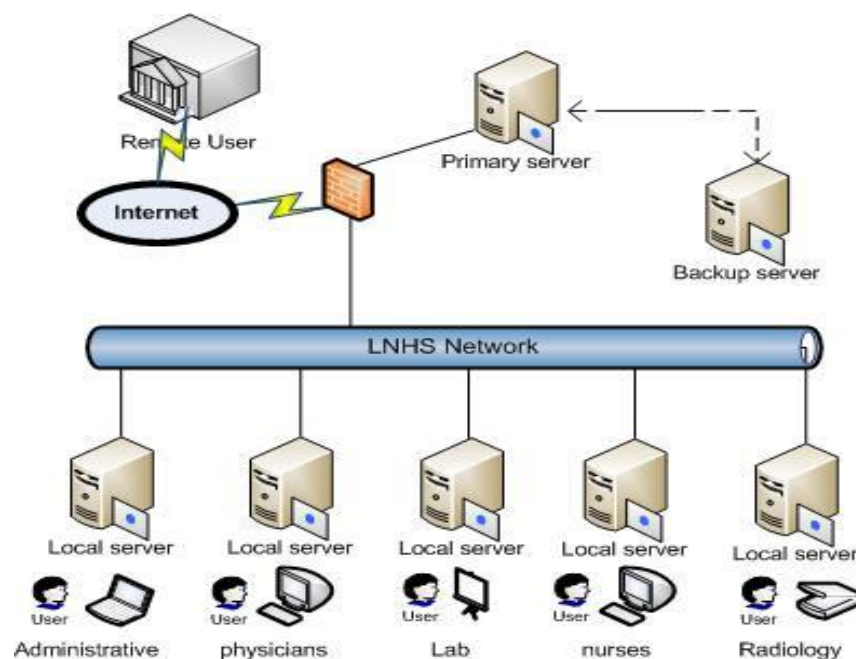


Figure 2.1: Elements of a Typical EHR System (Jean et al., 2013).

Figure 2.2 depicts a basic concept EHR model with a representation of a process of general clinical decision-making, containing four functions that are recorded in four categories: results, goals, interventions and diagnoses (US DoH&HS, 2011). To allow information to flow in an effective manner, EHR systems have the ability to save longitudinal healthcare data and information, help in the management of results, can present results in chronological or other order, support decision making, communicate and connect electronically, give patients support, and aid processes of administration and reporting (Chen, 2011). Consequently, EHRs should cover the essential activities and functions that support the flow of information, other than the data relevant to the patient, to help in the facilitation of an improved healthcare programme.

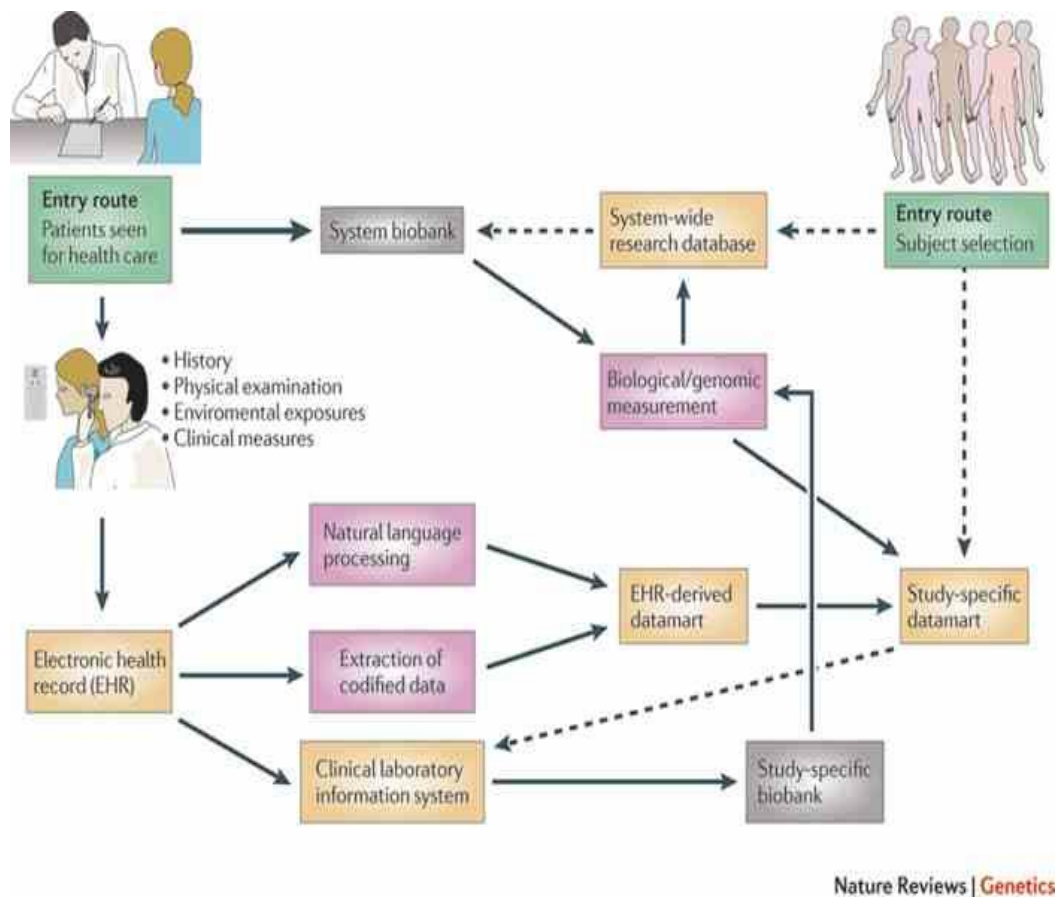


Figure 2.2: A process of general clinical decision (EHR) (Kohane, 2011).

The most important components that have been pointed out above are: functions of EHRs that are direct and supportive and the HER data infrastructure. Below some of their aspects are explained in more detail.

EHR *functions* aid in the provision of healthcare and allow clinical decisions to be made more easily (Linder et al., 2006; Kawamoto et al., 2005). For instance, if a patient should be diagnosed with influenza, then the healthcare worker can record that information on the computer system. Therefore, that patient's records on the computer system might then show any contraindications and illegal prescription alerts regarding the medication prescribed for the patient (Pizziferri et al., 2005; Tierney, 2005; Linder et al., 2004).

Requirements of EHRs that are *supportive* offer assistance with the aspects of healthcare delivery that are linked with administration and finance (HL7, 2004). This is also true when promoting public health, researching medical issues and seeking improvements in the delivery of healthcare (HL7, 2004). For example, registries can be

kept regarding immunisation, so that a child can be checked for registration and hence it can be ascertained whether or not they have already been immunised. Once the child is registered, the EHRs will store the relevant data, which can be provided when needed for reasons of administration or finance (HL7, 2004).

The *infrastructure* of the EHR system gives a structure for operating healthcare functions and supportive EHR requirements, and provides EHR technical abilities that are vital to the stakeholder, while remaining transparent (HL7, 2004). This component of the EHR structure addresses a range of aspects: EHR security (controlling access and protecting privacy); managing records and EHR information; providing access capabilities, managing and verifying accuracy and completeness of EHR information with patients participating and auditing the accessing and usage of EHR information; interoperability in providing processes for automated healthcare delivery; and exchanging vital administrative and clinical data seamlessly with solutions that are standards-based etc. (HL7, 2004; Johnson, 2012; EMC, 2010; Sinha et al., 2012). Even though the overall structure of EHRs that is based on the assumption that there is a fundamental technical environment existing has been delineated (HL7, 2004), how much it has been implemented remains an issue. Laeum, Karlsen and Faxvaag's research (2004) showed that relatively few functions that EHR systems are capable of are actually used in reality, and doctors used relatively few of the functions that systems were capable of carrying out. Of the seven tasks the system they investigated was capable of, only two were utilised, mostly to do with reading information about patients (Laeum, Karlsen and Faxvaag, 2004). By identifying needs that are not met adequately by recording health records on paper, the real needs of patients and healthcare professionals that must be fulfilled by using EHRs can more easily be identified.

It is easy to recognise the advantages offered by EHRs compared to recording health data on paper, by observing the differences between the two. First of all, EHRs are not prone to the restrictions placed upon them by the data being generated in specific healthcare institutions; the information recorded about the medical history of a patient (which might come from multiple locations) can be carried out more coherently and legibly (no illegible doctor's handwriting) (Garets and Davis, 2006; kcatoto, 2012). Secondly, guidelines around accessibility of data need to be laid out explicitly and should be adhered to rigidly (Zandieh et al., 2008; Elnahal et al., 2011; Poon et al., 2004). The third point is that the processes required for healthcare can receive logistical

support (Gans et al., 2005; Sidorov et al., 2006; Ash et al., 2005). On top of this, EHRs can be accessed around the clock day and night, the data can be sorted according to various criteria, there is little danger of records being lost, and an audit trail of documents used can be kept (Williams and Samarth, 2010). These advantages of EHRs improve the functioning of healthcare practices through the provision of multiple processes, for instance healthcare that is evidence-based (Bates et al., 1997; Gans et al., 2005), and medical practices that are becoming more and more efficient (Bates et al., 1997; Williams and Samarth, 2010). E-referrals will be discussed in the following section.

2.4.2 The Use of E-referrals

The definition of a referral given by Kim et al. (2009) is that it is a communication sent with the intention of initiating the transfer of care from those already providing care to those that shall receive the patient. Referral is also defined as directing people to other persons in order to be helped, treated or informed (Reponen et al., 2004; Yih, 2011). Another definition of a referral is given by Shaw (2007) as: communicating in order to initiate a healthcare transfer from those that make the referral to those that receive it. Referring it can be seen then, is essentially intending to and facilitating the transferral of a patient's healthcare, wholly or partly, from one provider of healthcare to another. Wright et al. (2006) define E-referrals as transmitting electronic documents, which can then be seen by those that need to, on their computer. The referrer generates the E-referral on their computer, which is best done by auto-populating it with data straight from the patients' records. The recipient then receives the referral through a direct secured transmission (Shaw et al., 2007). For the sake of this study,

***E-referrals:** will mean to transmit electronic documentation from a doctor to another doctor, from a doctor to a practitioner, or from a doctor to a different department either outside or inside of the same healthcare institution, by use of E-referral management systems.*

The processes involved in E-referrals are shown in Figure 2.3 below.

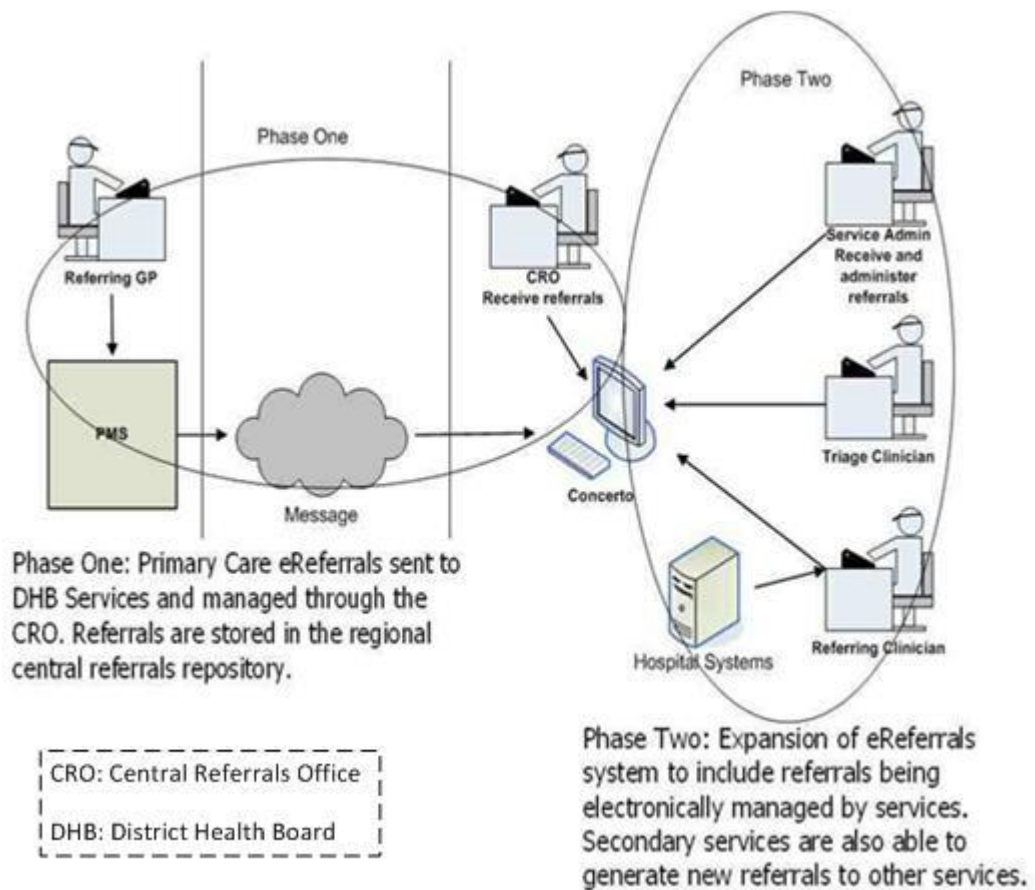


Figure 2.3: E-referral workflow (Jones and Calder, 2012).

In Shaw et al.'s (2007) work, when the term E-referral is used, it refers to the transmission of electronic documents from one doctor to another, a doctor to another healthcare professional or from a doctor to another department inside that healthcare institution or at another, while intending to transfer healthcare to those in need of it.

Compared to other forms of referral, E-referrals can:

- Help a patient's progress to be tracked by staff in the healthcare institution they have been referred from.
- Mean that doctors at the healthcare institution which a patient has been referred to does not need to write out a patient's medical history again as it can be accessed on the system.

The following section looks at prescribing electronically.

2.4.3 The Use of E-prescribing

E-prescribing, is where a prescription is processed electronically. It means electronically filling out, and transmitting a prescription; this is a computer-based process, and

replaces prescriptions that are faxed and filled out on paper (Johnson and Lehmann, 2013). E-prescribing allows the relevant healthcare worker to save a lot of time by transmitting a prescription or renewal electronically to the dispensing pharmacy, be it mail order or a community pharmacy.

The Minnesota Department of Health (2015) defines E-prescribing more formally as: transmitting, by the use of electronic media, prescriptions or information related to a prescription, from the person making the prescription to those that will either dispense or need to approve it. This might occur directly or via an intermediary, and might involve a network for E-prescribing (Teich et al., 2005). It entails a two-way transmission between those dispensing and those at the recipients end; though it is also not limited to this either. This definition covers how prescribing is made safer by accessing information on patient's medical histories, eligibility of pharmacies, how drugs interact with one another, allergies to drugs, information on benefits and specifications on the drug history patients might have received (Zimmer et al., 2008; Johnson et al., 2010; Johnson and Lehmann, 2013).

E-prescribing systems fall into two categories; stand-alone E-prescription systems and EHR systems that have an E-prescription module integrated into them (Dobrev et al., 2008). Stand-alone systems and EHR systems are not linked. Stand-alone systems are not as complex to implement or as expensive, and can be installed more rapidly than an electronic record system that has an E-prescribing module integrated into it. However, the EHR system does allow patient data to be accessed electronically immediately, including: lists of problems, results of laboratory tests and radiology, clinical notes that have been taken and orders. This leads to improved levels of decision-making by doctors regarding the prescribing of medication for each patient. EHR systems allow the offering of a large number of aids to clinical decision-making, such as when screening tests need to be carried out, when immunisations need to be given etc. Healthcare centres with doctors are using EHR systems with E-prescribing capabilities more and more. This is because their functionality is more comprehensive, which allows it to provide a safer and better quality service (Dobrev et al., 2008).

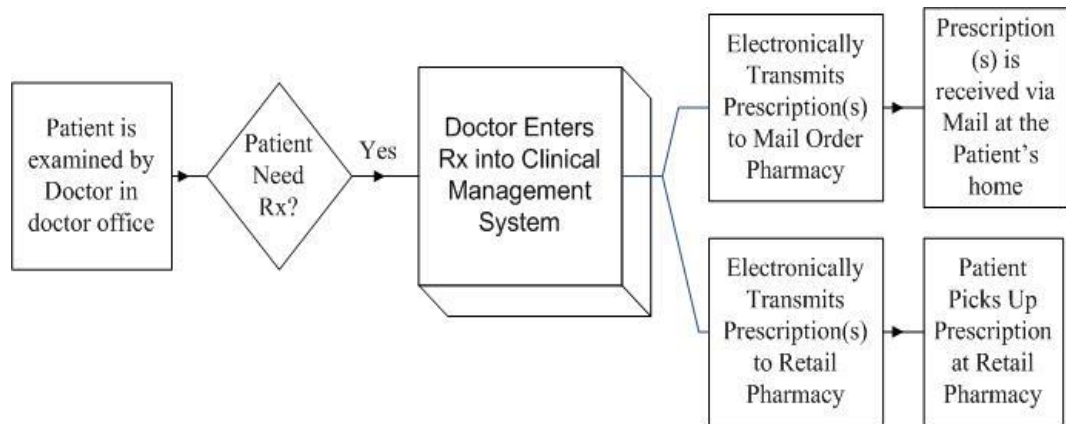


Figure 2.4: Electronic Prescribing, How it works (Ranjan, 2013).

It is not necessary to use any specific type of hardware or software to be able to operate E-prescription technology. Both EHRs and stand-alone systems for prescribing offer clinical decision-support functionalities (Dobrev et al., 2008; Johnson and Lehmann, 2013; Ohlund and Goldkuhl, 2008). The list of hardware that doctors have used for E-prescribing includes: tablet devices, devices held in the hand, desktop PCs, laptops etc. Table 2.1 shows the multi-dimensional advantages of E-prescribing.

| Process Phase | Key Functions of E-health system | Description |
|---------------|--|---|
| Prescription | 1 Identifying the patient | A link is made between the prescription and the patient's personal data, such as date of birth, sex and post code. |
| | 2 Renewing authorisations | The prescriber can be alerted that an authorisation is required to renew a prescription and can generate the renewed prescription. |
| | 3 List of current medications | Those making the prescription can gain access to the patient's medication history from all healthcare, including a pharmacy. |
| | 4 Alerts over safety and supporting decisions-making | This can be when a contraindication, patient's allergies, medical state, body mass or results from a laboratory test are pointed out to a prescriber. |
| | 5 Selecting a medication | Medication can be chosen by selecting from a list; this may be influenced by a |

| | | |
|------------|---|--|
| | | diagnosis and require prescribing accurate dosages. |
| | 6 Formulary alerts | This can allow the prescriber to be aware when a patient's health benefit is jeopardised by a contraindication of the medication prescribed. |
| Transmit | 7 Bidirectional exchange of electronic data | Can allow the communication of information about medication between the dispenser, payer and prescriber. This includes renewal authorisations, requests for changes, information on benefits, history of medications taken, results of counselling, new scripts and so on. |
| Administer | 8 Materials for educating patients | Materials to educate the patient about their medical condition, any therapies they must receive and any possible side effects can be made accessible. |
| | 9 Collaborating in the management of medication | Can aid in connecting the doctor, pharmacist, healthcare plan coordinator, and/or individual care manager, thereby supporting collaboration between them in the managing of medication therapies. |
| | 10 Aids for administrating | These can be useful in providing support in medication administration graphically and visually. |
| Monitor | 11 Links to laboratory testing | This can aid in reminding either the patient or those making a prescription to get laboratory tests that monitor specific medications. |
| | 12 Reminders about refills | Can be used in reminding patients to refill medications. |
| | 13 Alerts about adherence | Medication history can be used for alerting the pharmacist, prescriber or |

| | | |
|--|-----------------------------------|---|
| | | another about the non-adherence of a patient. |
| | 14 Monitoring compliance remotely | Can be useful in alerting the caregiver or those monitoring the care, if a dose has been administered late or missed all together. |
| | 15 Patients feedback | Can be used for asking patients about the experiences that they have had with therapies, for instance; have they experienced any side effects. This can be carried out through E-mail, SMS messaging and Skype. |

Table 2.1: Structure of E-prescription processes.

A big advantage of using E-prescriptions, according to Astrand (2009), is that it is a faster method of dispatching a prescription to whichever pharmacy the patient may choose to use. Before despatching the order, the prescription is checked by the computer for any problems with it; for instance, if it conflicts with any allergies or medications the patient may have which are listed on the system, or any problems that have been recorded; therefore the system performs a check of drug allergies, whether or not any drugs might conflict with each other, and to check for drug interaction to a verity of disease (Astrand, 2009). Additionally, there are controls put in place around drug duplication and whether or not any drugs might be unavailable. The staff would then be alerted about any issues that may potentially affect safety, by alerts popping up describing the issue and how serious it might be (McMullin, 2005). The use of E-prescriptions has been proven to help in reducing mistakes, when compared to preparing prescriptions using paper (Monaco, 2015; Corley, 2003; Lapane et al., 2008).

The main benefits of E-prescriptions can be summarised as follows (McMullin et al., 2005; Corley, 2003; Astrand et al., 2009; Lapane et al., 2008):

- Safer method of dispensing medication: When doctors use electronic prescriptions, the possibility of errors occurring, for reasons such as bad handwriting, are eliminated. A doctor can prescribe more safely when being able

to access a patient's medication history and this helps in preventing the prescribing of drugs that the patient has exhibited allergic reactions to.

- It is more convenient: by using an electronic system, the prescription can be ready for the patient by the time they arrive at the dispensary; far more convenient than arriving at the pharmacy and waiting for the prescription to be made up.
- The cost of medication can be managed better: The doctor can see which insurance plan the patient has and prescribe only medication covered by the insurance plan; thus saving the patient a lot of money potentially.
- The process for renewing prescriptions is made more efficient: the use of E-prescriptions can streamline communication between the doctor and the pharmacy for the renewal of prescriptions. For instance, a pharmacist can send a renewal request electronically to a doctor's computer system should a prescription run out of refills. The doctor's response can be fast and carried out easily, meaning the patient need not wait around for the doctor and pharmacist to talk to one another over the phone.

E-training is discussed in the following section.

2.4.4 The Use of E-training

E-training is where knowledge and skills relating to what is required for work can be acquired by use of a computer or remote guidance (Ettinger, 2004). Ettinger (2004) and Mayo (2001) also say that E-training falls within the organisation's remit, and the purpose is to encourage the individual to behave in a manner that will benefit the organisation. In the present context when E-training is discussed it is with following meaning:

***E-Training:** an application or process which utilises current electronic media for delivering healthcare worker training on the use of E-health applications.*

E-training systems are designed around constructivist ideas. Constructivism is defined by Gaol et al (2014) as knowledge being actively constructed and engaged with those learning. Turnbull (2011) advocates that a learner constructs their learning using the environment they are in and at a rate individual to them. While the learner constructs knowledge, they ought to be supported by those more knowledgeable; for instance an

educator, a mentor or an expert in that specific field (NHS, 2003). Those persons who are more knowledgeable can help by providing extra expertise, a different perspective and a foundation for the construction of knowledge for enhancing the process of learning (Turnbull, 2011; Tsai, 2012). E-training requires the involvement of ICT, which the learner must seamlessly integrate and ground (Olapiriyakul and Scher, 2006). ICT systems for E-learning revolve around multimedia courses that are interactive and online and online tutoring (Tsai, 2012). Figure 2.5 below illustrates an E-training design presented by Tsai (2012).

A framework for E-training can be said to consist of the following parts (Tsai, 2012):

- **Keyword-based search tool:** All the content that is available is held in the database together with any descriptions that might correspond to them. The search tool means that the user can use a keyword to find specific contents.
- **System for managing the learning:** a system for administering and delivering lessons electronically and organising those participating in the training. When it is integrated together with management systems for the learning contents, then it is capable of creating, storing, reusing, managing and delivering digital learning data from a centralised object repository.
- **Environment for learner-system interaction:** This tier presents the user interaction format. It focuses on a user interface that is designed efficiently and is accessible. The user interface generally resides on the computer of the user or online;
- **Tool for Visual Authoring:** this specially created software is used for facilitating in creating lessons efficiently. An author with experience can easily create a lesson with this tool.

E-Consultation is discussed in the following section.

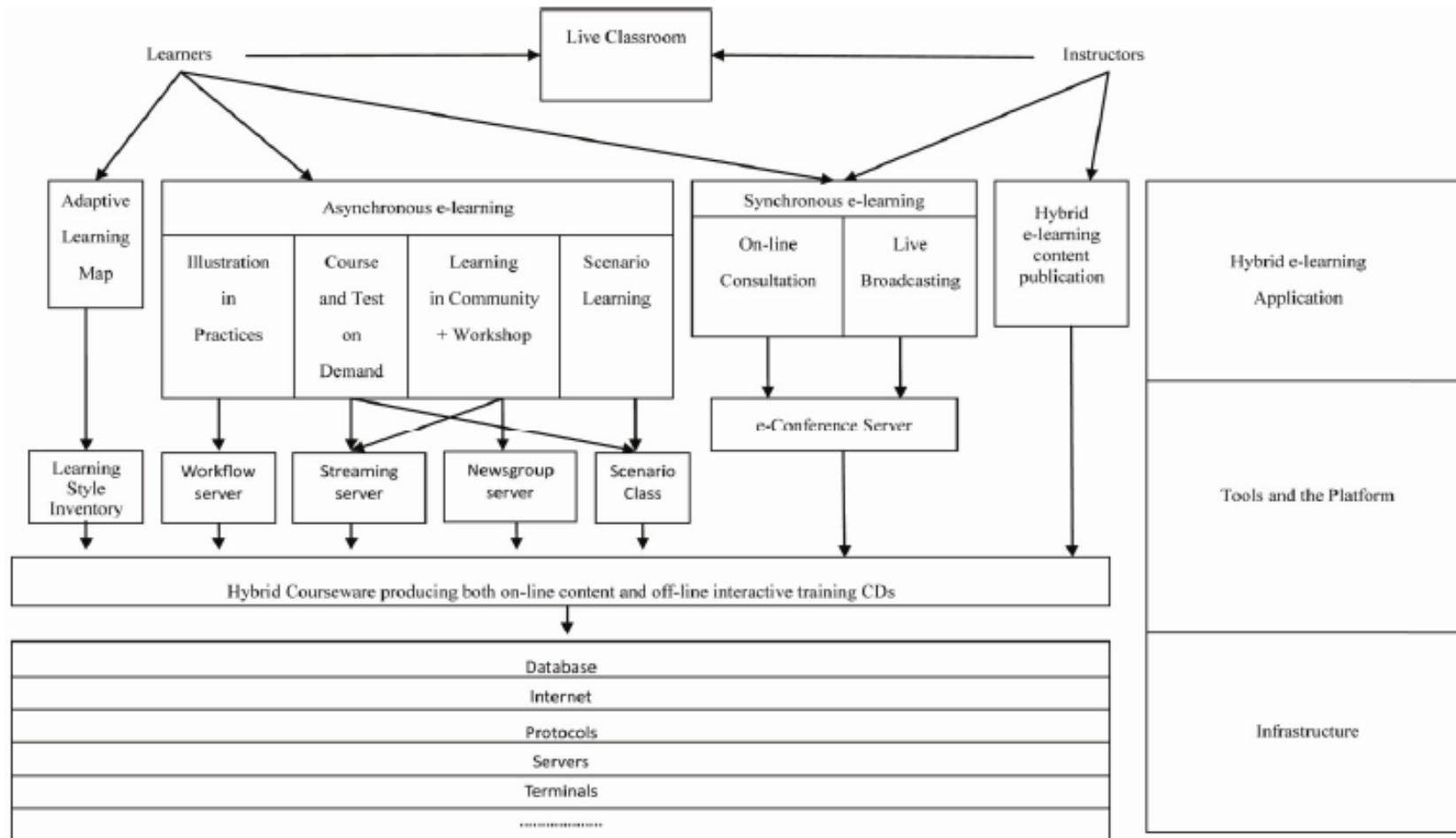


Figure 2.5: IT application for healthcare professional training (Tsai, 2012).

2.4.5 The Use of E-consultations

The term Telemedicine encompasses a great deal of applications, included in which are doctor-to-doctor communication and doctor-to-patient teleclinics (Caffery et al., 2016; Kidholm et al., 2012). Other descriptions of telemedicine include the tele-monitoring of patients, homecare, educating in medical issues and remote consultations between doctors (Imai, 2016; Raaber et al., 2016; Epping et al., 2006; Stachura and Khasanshina, 2008; Vavoulas et al., 2016). A remote consultation between doctors is known as an E-consultation and is typically used in developing areas and where people are limited by an underdeveloped transport infrastructure (Whitten et al., 2005; Gray, 2009). Many rural healthcare institutions are severely economically affected, and are technically severely limited as far the infrastructure of their networks go. Because bandwidths are unreliable and the doctors are overworked due to staff shortages in these regions, E-consultations will be unsupported by media operating in real-time (Cannon et al., 2014; Velasquez et al., 2016).

Remote E-consultations have significantly impacted upon healthcare institutions in rural areas because of dire lack of doctors in those areas (Wood et al., 2016; Kuehn, 2016; Kidholm et al., 2012; Epping et al., 2006; Velasquez et al., 2016). Stachura and Khasanshina (2008) state that specialist consultations that take place remotely, i.e. from doctor to doctor, occur more effectively when using asynchronous computer-mediated communications. There are two different types of systems for asynchronous remote consultations. These are a message-centric system and a discussion or storage-centric service (Stachura and Khasanshina, 2008). The message-centric system provides services that resemble email and allow doctors to ask questions of groups of consulting doctors and then to receive a reply (Whitten et al., 2005). A storage-centric service functions like the internet, allowing basic storing and searching abilities, and a discussion-centric system exhibits the same functions as a bulletin board based on the web.

E-consultations can aid healthcare staff in the sharing of healthcare information. The objectives of E-consultations are the improvement of the healthcare received by patients through the enhancement of skill and knowledge levels of local healthcare staff by specialist teams remotely situated (Deldar et al., 2016; Li et al., 2016). In the present work, the term E-consultation is used with the following meaning:

***E-consultation:** remote consultations between nurses and doctors, specialists and doctors, doctors and doctors or between doctors and any other any other healthcare workers there may be.*

2.5 Policies for E-health

According to American Medical Association (2013) and Meingast et al. (2006) a very important legislative regulation in North America is the Health Insurance Portability and Accountability Act (HIPAA). This act is intended to assist in providing more secure E-health systems. Some of the main points of the HIPAA security requirements are:

- Security configuration maintenance that includes completely documenting the processes and plans for documenting incidents concerning security;
- Each message that will be transmitted on the open network should be encrypted;
- How information is accessed is controlled by policies and processes;
- Establishing trust partnership agreements with stakeholders;
- Official processes put in place in order to access E-health records;
- The network and communicating need controlling; this includes the maintenance of message credibility, privacy and validity;
- When systems are accessed, every individual authorisation must be recorded and kept;
- Making sure system operators are trained to be aware of security issues and that these training techniques are regulated at set intervals;
- Data needs to be authenticated, ensuring that no destruction or alterations take place.

In addition to HIPPA, all the states regulate the handling of healthcare. This regulation is summarised very efficiently in the State of Health Privacy, published by the Health Privacy Project (Pritts, 2013). For example, the Alabama Code contains absolutely no general statute records at all, or even a general statute that restricts the disclosing of confidential data. The California statute though, lets patients see their own healthcare records. The California Code has comprehensively regulated the disclosure and usage of healthcare data. Because of the variations in the codes of different states, there are doubts about who owns certain data, rights to access and disclosing when healthcare information is transferred from one state to another by electronic means. With the HIPAA Privacy Protection being mandated in 2003, a national norm for ensuring the

privacy of healthcare data was set. These are though simply the most basic of rules, with states that practice a more rigorous standard of protection not being affected (Meingast et al., 2006; Medicare Learning Network, 2016).

From the examples given above and because of the sensitivity involved in healthcare issues and the information that comes with it, Governments have an obligation to regulate laws that will aid in the exchanging of information from one stakeholder to another and to protect patient's rights and enable the patients to experience privacy. Examples of countries that set controls on the accessing of such private information, are China and Singapore (Wickramasinghe and Fadlalla, 2005; Huang et al., 2009). It does not matter whether a healthcare system is run privately or by the government, there is clearly a need for regulation by the government, when E-health initiatives are undertaken.

Within E-health there are many players, spread across many geographically distant areas. For an E-health system to work, a very large amount of information needs to move between different locations with ease. In order for this to happen there needs to be some form of standardisation. If a country should decide to implement E-health systems, there needs to be standardisation policies, procedures and protocols put in place right from the start so that the aims of the E-health system might be realised. It is fortunate then that the primary vehicle for E-health is the internet. The internet has a wide range of its own strictly imposed protocols, for instance: transmission control protocol (TCP), Internet protocol (IP) and hypertext transfer protocol (http). Wickramasinghe et al. (2005) have pointed out that the existence of these protocols has led to the internet being commonly adopted for electronic commerce. Wickramasinghe et al. (2005) also assert that, if a country aspires to transform their health system by implementing technologies, then they need to deliberately establish standardisation procedures, policies and protocols; thus reducing a lot the issues that might impede the creation of the structure that they need. Examples of the healthcare security mechanisms are shown below:

Mobile Healthcare Computing Devices (MHCDs)

For recording information healthcare staff need to utilise MHCDs such as tablets, laptops etc. (Istepanian et al., 2006). These can be employed in home visits, emergency treatments and in rural areas. Anyone using this system needs to possess a smart card

that has a digital certificate. Therefore, MHCDs need to have smart card readers, though they could be laptops with PCMCIA-based smart card readers utilised by doctors that carry out visits inside healthcare institutions or at patients' homes. Smart cards are commonly utilised in many developed countries already around the world (Robert et al., 2011). The most commonly utilised of these will be discussed in the following section.

Patient Data Cards (PDCs)

It is not only the use of electronic equipment by healthcare institutions that can increase the efficiency of healthcare received by patients, but the patients themselves that can utilise it. Patients can carry mobile data carriers known as PDCs, which contain healthcare data about the patient such as medical history, allergies, blood type and prescriptions so that if the patient requires medical attention where this information is not readily available, treatment can commence immediately without having to source this information from wherever it may be stored. It also makes the work of healthcare staff more straightforward as they can be more confident in making decisions fast knowing everything they need to know straight away, such as which medication they are taking, so as not to prescribe another drug that might cause a negative reaction. It is recommended for the sake of privacy that the PDCs should be encrypted so that only authorised medical staff can access sensitive information that may be contained on the card (Robert et al., 2011; SCA, 2013).

Health Professional Card (HPC)

In order to maintain confidentiality of patient healthcare records it is imperative that only authorised personnel be allowed access to this data. In order to maintain these security levels authorised staff carry access cards that are programmed individually, called HPCs. It is therefore, in theory at least, impossible for someone with negative intent to tamper with healthcare records. This technology also allows healthcare staff in different departments, or even cities or states, to communicate confidentially with one another. The card alone should not be enough for healthcare staff to access records, rather a PIN should also be required or perhaps an electronic signature or for very sensitive data an iris recognition system would ensure very high security (Robert et al., 2011; British Medical Association, 2014; Parkin, 2016).

From these findings we can point out that when the Libyan National Health Service decide to implement E-health systems, the Libyan Government needs to standardise

policies, procedures and protocols and put them in place right from the start so that the aims of the E-health system might be realised. There needs to be a governing board established for the nationwide implementation of E-health systems in the LNHS.

2.5.1 Health Information Privacy and Security Issues

Since the implementation of the first healthcare system, there has been concern about the security of the information that is recorded, due to the sensitivity of this data. When such data is recorded electronically, many people may become very concerned about how private and secure their personal healthcare data will remain. The installation of any computer system for storing patient healthcare records should be accompanied by rules to ensure that the information remains confidential. It is also very important though for this information to be easily accessible for those authorised, so that patients receive the best treatment possible (Difelice, 2015; Meingast et al., 2006; Anderson, 2012).

The term ‘security’ in this context means being able to protect personal data from being accidentally disclosed to those without authorisation and controlling who has the right to access it. The American Society for Testing and Materials points out various factors that might threaten healthcare data security, because medical records are very personal, and therefore have great potential to be used destructively, there are grave concerns around how private and secure this information remains (Brandt, 2000). Hamidovic and Kabil (2011) refer to the Electronic Privacy Information Centre (EPIC), to indicate that the word ‘privacy’ is hard to interpret accurately, as its use can vary so much from context to context. There are important differences between the terms privacy and security, though they are also related (Perrin, 2011). Hamidovic and Kabil (2011) state that an individual has a right to their privacy; to be able to control information that is personal to themselves. This information should not be used in a way that is not agreeable to them personally.

Hamidovic and Kabil (2011) say that the National Research Council (1997) warns that medical data recorded electronically could potentially be accessed in order to gain from them, either personally or economically. Someone who is authorised to access medical records could do so even when they have no valid reason to do so (e.g. accessing the records of someone they know or are related to or somebody famous). They might even disclose somebody’s confidential information to someone without the consent of the

patient. There is also the possibility that a computer system might be hacked into in order to access or destroy confidential information, or even shut down the system, thus hindering the ability of healthcare workers to treat patients effectively.

To understand how dangerous it could be, it is necessary to examine how this information could be threatened. The ASTM (Amatayakul, 2007) points out a range of things that might threaten the security of healthcare data: threats to the sequence of messages, including replaying and delaying messages; repudiation, where an action takes place, for instance something is modified, and those responsible deny any responsibility; data being modified or destroyed; masquerading, where a person or people pretend to be who they are not, allowing them to launch an attack; disclosure without authorisation, including allowing the contents of a message to be seen, information derived from looking at the flow of messages and data that is viewed by those without authority; denial-of-service attacks, thus preventing the system from functioning.

To oppose such threatening forces, many governments use varying forms of regulations that help to keep their healthcare data available, confidential and maintain its integrity. The next section is discussing healthcare data security.

2.5.2 Healthcare Data Security

In order for patient healthcare data to remain secure when they are looked after using Information System (IS) there is a need for very precise security protocols (Sedlack and Tejay, 2011). This section looks at desirable features of security protocols in detail, using literature about the German health system. Though Germany has a private healthcare system and is a developed nation, it can be used as an example of what has worked and can therefore be utilised where relevant in the LNHS.

Legal Framework

Introducing healthcare telematics, cards for healthcare staff and healthcare E-cards has created many changes in the running of healthcare institutions in Germany. As these changes have had such a massive effect upon the healthcare system, it is essential that specific steps be taken to ensure data privacy (Sunyaev, 2011; Benham-Hutchins, 2008). These steps are not concerned with medicine alone, but include healthcare policies, education, technologies and training, all of which have to follow strict guidelines according to German law.

Privacy

Historically there have been a lot of requirements legally in healthcare data exchange. Companies involved in healthcare ICT need to take such legal requirements very seriously when handling sensitive healthcare data (Difelice, 2015 and Sunyaev, 2011).

German law prioritises the maintenance of privacy within the healthcare system at the highest possible level, with patients having control over the choice of where and when their healthcare data is shared (Sunyaev, 2011).

E-health needs to be used so that patients are in charge of the destiny of their healthcare records. In Germany this is guided by section 9 of the Federal Data Protection Law, which provides healthcare providers with minimum requirements regarding healthcare record data security.

The best mechanism for protecting confidential data is controlling who the material is accessed by (Schreck, 2013). The goal of protecting sensitive information is best carried out through being able to limit what types of access are granted to different healthcare staff. This should allow whoever needs to access information to do so, while the data remains as safe as possible.

Confidentiality

It is one of the basic rights of patients that their medical history remains confidential. Therefore, doctors need to strictly adhere to rules on confidentiality, cultivating an atmosphere of trust between themselves and the healthcare system.

As most healthcare institutions are open to the general public, there is always the possibility of security risks. Therefore, strict and effective forms of data security are required (Santhi and Dheeptha, 2016; Anargyros et al., 2011).

Integrity

Healthcare security requires that all healthcare information, before, during and after healthcare treatments, remain accurate, authentic and complete. Therefore, it is essential that precautions are in effect to stop data being manipulated before and during treatments, but software is required so that any changes to data can be reviewed for authenticity and integrity.

Availability

Though security is essential, because of the often urgent nature of healthcare it is also very important that healthcare staff be able to access vital healthcare information immediately (Sunyaev, 2011; Daim et al., 2016).

Because healthcare records can be needed a long time after they are recorded (even after death) these records need to be stored systematically so as to be retrieved easily, even at a much later date (Sunyaev, 2011, Bos et al., 2008).

Authenticity

It is essential that all healthcare records are authenticated by whoever authored the document recorded and any that fail this need to be deleted (Rivard and Aubert, 2015; Santhi and Dheeptha, 2016). Since the technology is now widely available for signing electronically, it needs to be utilised at all times when healthcare staff amend records.

Liability

While sensitive data is being sent from one source to another, there is always a risk to its security. Therefore, steps need to be taken to ensure that the data will arrive safely, cannot be intercepted and that it can be verified that the sender sent it and the recipient received it (Santhi and Dheeptha, 2016).

Use Regulation

Patients need to be able to choose who has access to their healthcare history (Sunyaev, 2011).

Accuracy

It is essential that all healthcare data about patients be as accurate as possible to avoid doctors carrying out inappropriate medical procedures that could harm a patient (Sunyaev, 2011).

Utility

All healthcare data that is stored needs to be of some use potentially for medical purposes (Santhi and Dheeptha, 2016; Sunyaev, 2011).

Legal Certainty

All healthcare decisions legally require that a person be recorded as being responsible for making a decision, in order that a patient can, if the need arise, take action in order to obtain compensation for poor decisions (Sunyaev, 2011).

Suitability for Daily Use

All systems need to be designed to be user-friendly so that anyone can use it and not only be operable by highly trained staff. Though software may be becoming more and more complicated, those without great computer experience may be required to record data, thus it needs to remain as easy as possible to operate (Penalvo and Francisco, 2008).

2.6 IT for E-health

It is generally recognised at this time that in order to operate a healthcare institution as effectively as possible, all the departments within it (plus any establishments that their work requires them to communicate with externally on a regular basis) require some form of communication linkage. Even though most healthcare institutions will allow for this in their budgets in this day and age, it can only be achieved if the appropriate ICT is employed with appropriate functionality (Menschner, 2015; Schweiger, Leimeister and Krcmar, 2007). Also this has not been the case in many healthcare systems, where coordination has been lacking and because a lack of centralised planning has meant the different departments within healthcare institutions have chosen ICT that matched their needs, but unfortunately are incompatible with ICT chosen by other departments, making communication with one another very difficult (Lucy-Bouler and Morgenstern, 2002). After many years of developing separate IT strategies, the process of connecting up isolated areas or departments can be extremely expensive due to the difficulty of programming such alien IT systems to work with each other.

Integrating different systems can therefore be easier if simplified so that systems remain as autonomous as possible, and overlap only where absolutely necessary. Such changes in the integration of information can make systems more user-friendly, scalable and allow single components to cooperate more smoothly, allowing seamless healthcare that saves money on staff training, costly mistakes and duplication of electronic health records (EHRs), thus optimising processes internally and externally (Monaco, 2015 and Lenz et al., 2005).

The main design employed for most E-health developments is shown in Figure 2.6; this illustrates server-to-client architecture. For these server client architectures to be supported, the ICT infrastructure needs to receive special consideration. The infrastructure for the ICT consists of fibre trunks, underwater cables, phone cables, satellites, earth stations, high-speed services and teleports for business use. Any nation planning to implement E-health systems needs to pay attention to providing an infrastructure that is technically sound. This infrastructure needs to consist of good electrical service, efficient telecommunications and good access to computers and internet connections. The provision of a high bandwidth is essential in providing an adequate multimedia service, therefore providing good E-health levels of quality. ICT requirements are, without a doubt, one of the most important aspects of the infrastructure needed for the implementation of an E-health system.

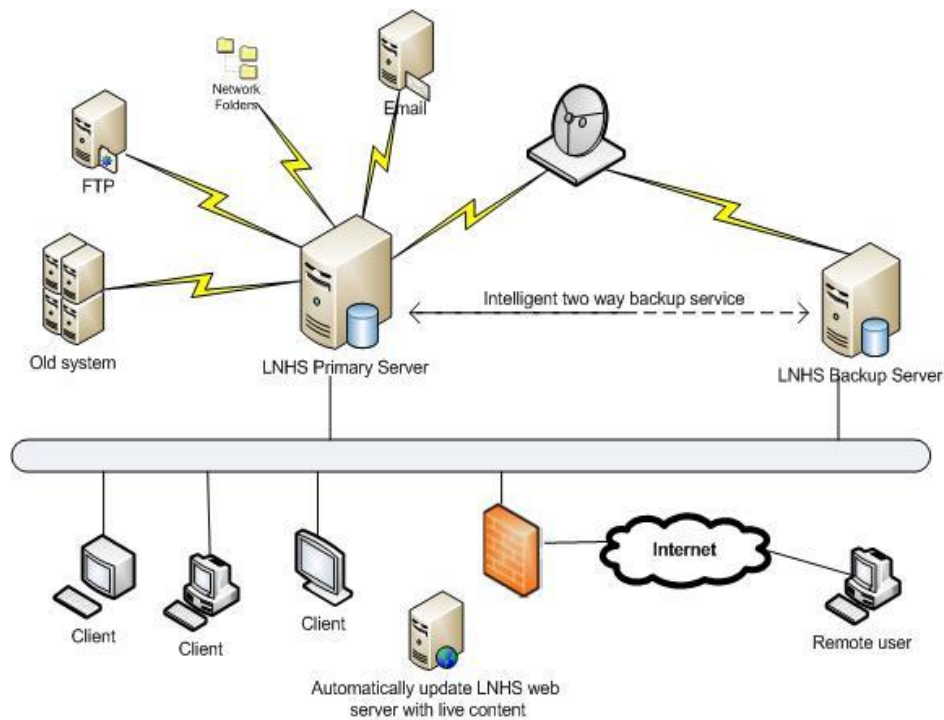


Figure 2.6: The essential ICT architecture for E-health (Wickramasinghe and Fadlalla, 2005).

For large organisations to be able to be competitive on a global scale is important for them to use networks as part of their business strategy. Wickramasinghe et al. (2005) assert that it is of little use to have a hi-tech computer unless it has a broadband connection with a reasonably high download capacity. Since the internet has become so vital to so many types of business and daily life for many, the internet network needs to

work well globally to compete efficiently in business (Manyika and Roxburgh, 2011). Telecommunication infrastructures are absolutely necessary when providing internet access and therefore electronic commerce (Tyler, Hughes and Renfrew, 2011). One of the countries that have been a pioneer of implementing an advanced E-health system is Singapore. In Singapore the authorities have gone to great lengths to install broadband internet connections into virtually every home and workplace (International Telecommunication Union, 2011). A study (International Telecommunication Union, 2011) made of households with internet connectivity would suggest that Singapore lies within the top ten nations globally for levels of online households. Whereas many Asian countries are developing advanced ICT infrastructures, the levels in Sub-Saharan Africa are as yet quite limited in comparison (International Telecommunication Union, 2011).

2.6.1 E-health Architectures

Cooper (2008) gives a definition of a framework as a set of ways for assuming, conceptualising, valuing and practicing that together comprise a way of viewing reality. In the present work, the term framework is used with the following meaning:

***Framework:** is a conceptual or real structure created with the intention to help in supporting the construction of something that will help in expanding the structure into something that will be more useful (Sukys, 2011).*

The development of an E-health framework or model can be informed by various differing types of architecture styles. Architecture styles are defined by Milosevic (2006) as “sets of principles and coarsely grained patterns which could deliver frameworks for a group of systems”. Among these architectures are component-based, layered, object-oriented, client-server-oriented, message-bus architectures, and service-oriented. Each style of architecture serves as a guideline for the development of ICT for a framework for an enterprise such as a healthcare institution. A description of each of these architectures is given in the following paragraph (Yang and Yuen, 2010; Brown, Johnston and Kelly, 2002).

Component-based architectures: This is where application designs are decomposed into components that are either logical or functional and are reusable and are location transparent and are exposing communication interfaces that are well defined.

Layered architectures: Here the concerns of the applications are partitioned into groups that are stacked, also known as layers.

Object-oriented: This style of architecture is about the tasks being divided for systems or applications into individual objects that can be reused and are self sufficient. Each one should contain the data and behaviours that have relevance to that particular object.

Client-server architectures: The system is segregated into applications. This is where the clients are making service requests to the servers.

Message-bus architectures: These are software systems that are used for receiving and sending messages based around a set of formats that are known. This is done so that systems are capable of communicating with each other without the need to know who the recipients are.

In this work SOAs is used. The next section will describe service-oriented architectures (SOAs) in greater detail.

2.6.2 Service-Oriented Architectures (SOAs)

Many researchers have expressed the view that using the SOA approach would be the best way to solve the many problems created by integrating organisations and their data (Petroski, 2004; Buschmann et al., 1996; Gorton, 2006; Hohmann, 2003; Taylor et al., 2009; Taylor, 2009a; Fowler, 2003; Kodali, 2005; Erl, 2005; Brown et al., 2012; Lynch, 2005). For example, Erl (2005) indicates that using the SOA approach offers potential benefits that could develop organisations such as healthcare institutions. The basis of the SOA approach is the idea of service (Afshar, 2007; Murray, 2006). Service is defined by Rubin and Holzworth (2009) as a way in which a consumer has their needs or wants satisfied. This is done through a contract that has been negotiated and has within it service agreements about the services on offer. Demirkan, Spohrer and Krishna (2011) further define a service as representing an accurately defined function that is produced because of a request that has been generated electronically.

Another definition given by United States Government Accountability Office (GAO) (2010) is that SOA guides, and provides the principles for, the transformation of an organisation's assortment of heterogeneous, complex, inflexible and distributed systems into simplified, highly flexible and integrated resources that are capable of changing and being composed for supporting business objectives. Another definition of SOA is that it

is a way of approaching the design of a system that makes allowances for computing that is standards-based, loose coupling, and interoperability (Kodali, 2005). The application of SOA allows clinics and hospitals to be more autonomous and flexible so that they can have more control of the IT they use and it also allows inter-organisational integration of businesses (Rubin and Holzworth, 2009). The SOA approach is deemed very good for developing countries for developing E-health solutions (Gonzalez et al., 2010).

The SOA approach identifies individuals participating in the E-health framework and gives a description of the role they have in the system and their relationship to it. The relationship and roles of the healthcare institutions in the study have implied sets of business services that they provide to the whole system. Each service needs detailed definitions of business rules, data and all the business protocols, though they are not provided within this architecture framework. Once there is a clear definition of the services being provided, it becomes simpler to predict what sorts of applications are needed for each healthcare institution to provide those services (Woods, 2003; Natis, 2008; Fujita and Mejri, 2006).

It can be seen from the discussions above that SOA provides applications with the ability to function and therefore to be used as services. These services use an interface that is standards-based and that is ideal for publishing, and discovering. The service provided by SOA is a data schema and message-based communication with an application. SOA services are also used for providing interfaces that are application-scoped and not interfaces that are object or component-based. Basically SOA services ought not to be seen as architecture that is component-based. The principal advantages of the SOA are:

- **Discoverability:** A service can allow a description to be exposed, thus allowing other services and applications to find them and allow the interface to be determined automatically;
- **Domain alignment:** Common services that have standard interfaces are reused which causes opportunities in technology and business to increase and for costs to be reduced;
- **Abstraction:** A service can be autonomous and gained by use of formal contracts, thus providing abstraction and loose coupling.

In this thesis the E-health framework that will be put together is intended to promote an improved healthcare service for the Libyan National Healthcare Service by utilising information and communication technology (ICT). It is, however, valuable to recognise that ICT is the enabling infrastructure and not the ultimate goal. The ICT infrastructure is the foundation of the network required in order to share information between different areas of Libya and between different healthcare sectors. Included within this are the connectivity of the network and the primary services at the core of the system that hold together a functional E-health system. The use of ICT in the healthcare environment is intended to provide a high performance healthcare service. A high performance healthcare service is one where all those caring for the patients are connected by an environment that is secured and interoperable and where the decentralisation of healthcare data flow has enabled the most comprehensive, timely, safe, efficient, effective and equitable healthcare delivery where and when it is the most required (Marti et al, 2004; Riedl et al., 2008; Ciampi et al., 2016).

Drury (2005) goes on to say that in poorer countries, such as Libya, the development of E-health systems occurs in the context of poverty rather than affluence. Hence, for the purposes of this study the E-health framework that will be compiled, in order to be more beneficial, ought to be contextualized to aid the Libyan National Health Service in healthcare institutions in urban and rural areas.

Given the advantages discussed above, this thesis puts forward the proposal that the architectural style of SOA be used in compiling the provincial E-health frameworks for the Libyan National Health Services.

2.6.3 Internet and Computer Access: Policy and Infrastructure

The development of E-health systems anywhere is highly dependent upon that country's ICT infrastructure (Cabrera and Pardo, 2008; Apulu, 2012; Wootton and Bonnardot, 2015). Within the last decade the technology that enables the use of E-health systems has developed and spread at an unprecedented rate; such that, some thirty years ago people would not have believed the technological advances we now enjoy to be possible, and yet they have almost imperceptibly developed and mushroomed around us (Li et al., 2016). This rapid development has not been universal though; this section looks at different aspects of this rapid development and how it relates to the subject of this thesis.

The economic crisis of 2008 put virtually every form of commerce and industry into recession (Beachy, 2012). One sector which stands out because of its sustained expansion and growth is the internet and telecommunication markets. It is precisely in these areas that growth is needed to accommodate the infrastructure required for implementing E-health systems (Min, 2015; Qureshi, 2013). The more a government can allow and encourage the increase in availability of mobile phone use and internet access among its population, the greater the potential for the implementation of E-health systems (Fatos et al., 2015; Foh, 2012).

The use of landlines for telecommunication has been declining from the mid 2000s, particularly among developed nations. Landline markets were saturated and have been taken over by the mobile phone. In more developed countries the mobile phone market has also maxed out with a paltry 1% growth rate, though developing countries are still expanding in this market, with an impressive 20% growth (also known as the “mobile miracle”) and are showing few signs of this expansion slackening off. The contrast in Libya in this respect is somewhat marked, with 19.3/100 households having fixed-line phone access, compared to 171.52 mobile phones per 100 users; data that supports these figures comes from research carried out by the International Telecommunication Union in 2011, as shown in figure 2.7.

Fixed broadband subscriptions have increased by 100% globally in the past five years. The divide though, between the have and have-not nations of this world, is indeed vast when it comes to fixed-broadband internet access. While developed nations are enjoying an average of 24% of households being served by fixed-broadband services, the situation in developing nations is that a mere 4.2% have access. Not only this, but there are very different levels of access depending upon the nation or area within that nation (ITU, 2011).

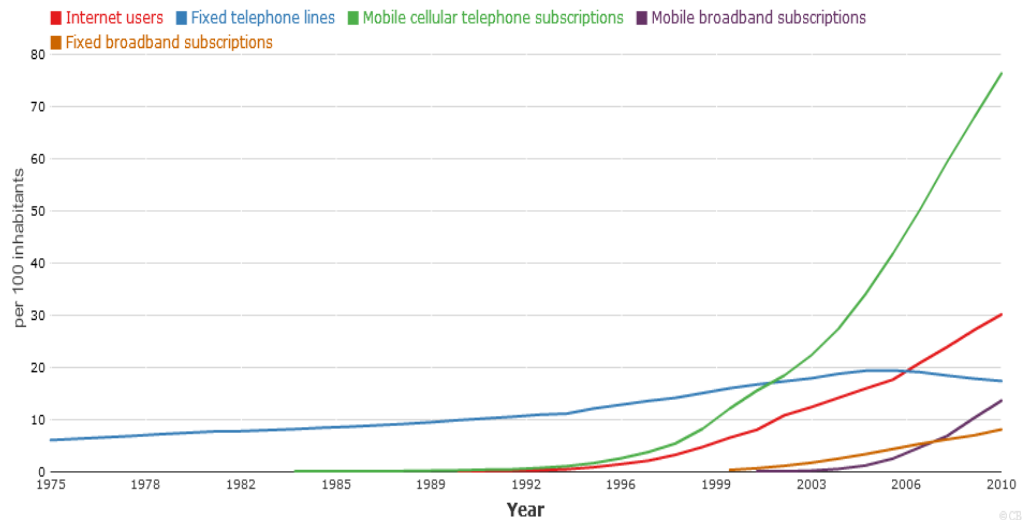


Figure 2.7: Telecommunication per 100 people, between 1975 and 2010 (ITU, 2011).

The fastest growing area in this field is the wireless broadband sector, which has experienced a massive increase in developing nations, in the past couple of years. The trend has been very much moving from the use of fixed-broadband, to accessing it via mobile phones and wireless apparatus (ITU, 2014). This has allowed a great number of people to go online in developing countries and it is now in the hands of those dictating policies within government to ensure this process maintains its momentum, therefore facilitating widespread access in developing countries to E-health facilities online (Ally and Samaka, 2013).

According to ITU (2011), the number of people using the internet increased by 100% between 2005 and 2010, meaning there are now two billion people with online access globally. This means 30% of the global population are internet users, compared to 12% in 2003 and just 6% in 2000. That is an astonishing 500% increase in twelve years, creating somewhat of a mushroom effect in growth. Again such statistics are misleading though, due to the global economic divide. While an average of 66% people had internet access in developed countries in 2010, that figure stands at a mere 16% for developing nations. While many developing nations have provided online access in areas such as government buildings, institutes of science, research establishments, and to a lesser extent schools, libraries, hospitals, archives and museums, the provision of internet access is usually concentrated in larger urban areas and is often much sparser in rural areas and far flung reaches of countries. Even when internet is available in such places,

it is seldom fast enough to be of much use for E-health applications as it is seldom found outside of major cities.

For E-health to prosper in developing countries, the revolution seen in the mobile phone markets needs to happen in the internet market too (Eberhard, 2014; Qianq, 2011). The new generation of mobiles, known as “smart phones”, is certainly bringing the realisation of this closer, but to most people in developing countries these devices are simply too expensive. The need for the realisation of a wider take up of internet access through mobile wireless would require the development of more affordable models.

The effectiveness of a country's ICT infrastructure is more and more dependent upon the bandwidth and capacity of its internet services. There is a global chasm opening between those with access to high speed and large capacity services and those in the less well off countries who have slower speeds and a lower capacity (ITU, 2011). For E-health systems to spread throughout the world and to not remain exclusively for the privileged, policy decisions made in the future need to improve internet access in developing countries, with those of a lower income bracket being targeted (Lewis et al., 2012; Henriqueq et al., 2014; Luna et al., 2014).

The situation in Libya, with regards to the telecommunications industry is a game of two halves. Until 2004 there was only one mobile phone provider in Libya; the government owned company Al-Madar exercised a complete monopoly in Libya, but was not very popular, with Libya having one of the lowest levels of mobiles per person in Africa. In 2004 the government introduced a second mobile operator called Libyana. Because this new state owned company offered cheaper rates, the ownership of mobiles catapulted to become one the highest in Africa within a few years, even becoming the first nation in Africa to have an average of more than one mobile phone per person. The Libyan government has also announced plans to sell off 40% of its shares in its mobile phone providers. In 2010 the Libyan government has invested substantial amounts of money to improve ICT infrastructure, and the national and international network of fibre optic cables and broadband connections (Budde Communication, 2016; Rossotto et al., 2014; Business Wire, 2012).

2.6.4 Development of Health Information Systems (HISs) and Information Technology (IT) Requirements

The World Health Organisation (2006) gives a definition of health information systems as systems for integrating the collection of data, making reports, carrying out processes and using information that is needed for the improvement of healthcare provision and improving healthcare management on every level. Health information systems by their very nature comprise an assortment of sub-systems that collect and report data. Though some sub-systems correspond to healthcare facilities, others are more general (Frankel et al., 2003; Waterson, 2014); corresponding, for instance, to programmes such as the Expanded Programme on Immunization (EPI), or leprosy, malaria and tuberculosis restriction programmes (Sahay et al., 2007). Health information systems are also called Clinical Information Systems (CIS). CIS are information systems that are comprehensive and intended for managing hospitals financially, clinically and administratively.

According to Studnicki et al. (2006), health information systems began in the Eighties, as specific programs that were used on old mainframe or stand-alone computers. The earliest types were mostly used by epidemiologists and other analysts focusing on public health. As PCs harnessed more and more power and Microsoft developed Windows, so the ways in which health information systems were used expanded. Studnicki et al. (2006) go on to say that as technology became better, so public healthcare organisations saw that this was a viable area for investment, in order to gain improvements in healthcare provision. Therefore, these public healthcare organisations started to upgrade, replace and create improved systems for healthcare provision (Vest et al., 2014). The new systems were more robust in nature and more specialised, using up-to-date data storage systems and hardware with more dependable platforms.

The next period of the development of health information systems saw the arrival of integrated systems. This happened because some organisations saw that having only separate systems for specific purposes created some extreme limitations (Studnicki et al., 2006). These organisations then started using internet networks, which led to more health information systems becoming networked. Thus, integrated systems were formed within health information systems.

Lenz and Kuhn (2004) state that there are two sorts of integrated system. Firstly, there are the types that provide links between data and application. Secondly, there are the types that make data accessible from multiple sources via the unified viewpoint of a computer system.

2.7 Healthcare in Urban and Rural Areas

Rural areas have been described in various ways: density of population, how resources are utilised or where areas are located geographically (Eberhardt and Pamuk, 2004; National Geographic, 2011; Pateman, 2010). These differing ways in which the term 'rural' is defined can lead to disagreements about which one should be used (Eberhardt and Pamuk, 2004; Vanderboom and Madigan, 2007). In spite of these conflicting definitions, each country needs to decide upon which interpretation it will use for distributing healthcare resources equally. Hart et al. (2005) state that a majority of the ways in which 'rural' is defined are geographically based. This includes measurements such as population sizes and densities and distances from urban settlements, labour markets and different postal code areas. The 'place' where a person lives, works and plays can greatly influence the level of healthcare facilities that are easily accessible (Lopez and Hynes, 2006; Ompad et al., 2007). Every place has a whole plethora of factors that interact to influence how healthcare services are utilised in that location.

The populations of rural areas in developing countries such as Libya are considered to be vulnerable where access to healthcare services is concerned, because rural populations are less likely to be insured, somewhat older, have an inferior health status, and exhibit a higher rate of chronic disease in comparison to those that live in an urban area (Kjellstrom, 2007). Smith et al. (2008) state that a structural aspect of a rural environment may be that it will have more unemployed and impoverished citizens, be less populated and have different mixtures of occupations in comparison to an urban area. On top of this, a rural population may need to overcome larger and different barriers in accessing healthcare than those that challenge an urban population. For example, a rural resident needs to travel longer distances when accessing healthcare facilities as population densities are much lower, and therefore there are fewer healthcare providers available (Velasquez et al., 2016; Smith et al., 2008). Another factor that might act as a barrier to healthcare access is that of culture; this may mean that self-reliance is emphasised and this, combined with less resources being available,

might lead some of the rural population to not acknowledging or recognising what their healthcare requirements might be (Vanasse et al., 2010).

Data that supports this theory comes from research carried out in the US that showed rural populations there received less preventative healthcare than those residing in urban areas, and that they used healthcare services less overall, whether or not doctors were readily available (Cox et al., 2008; Utz, 2008). The reason behind such inferior healthcare services in rural areas and their lack of use might be down to how well rural residents are educated and their levels of literacy, people's incomes and social status, how they are employed and the conditions in which they work, individual healthcare and abilities for coping with life, living environment and how accessible healthcare facilities are to the rural population (Kulig and Williams, 2011). Deeper explanations of each of these influences are given in the following sections.

2.7.1 Healthcare Issues in Rural Populations

There would appear to be marked differences in health practices between those inhabiting urban and rural parts of Canada. Some of these differences are that rural inhabitants are more exposed to tobacco smoke, smoke more, consume fewer vegetables and fruit, and are more obese (Peer et al., 2013). Other major contributors to there being lower life expectancies in rural parts of Canada found by the same research were: higher levels of suicide, injury and poisoning. Additionally, Strickland et al. (2009) have reported higher levels of violent behaviour in rural areas, such as murder. It is not all bad news for rural inhabitants though, as they claim to be less stressed and feel they belong to a community more than their urban counterparts (Strickland et al., 2009).

2.7.2 Levels of Income and Social Status in Rural Areas

Similar to the effect of lower levels of education, rural populations generally have a lower income status than in urban areas (Yibing, 2005). Singh (2004) reports that in Canada between 1980 and 2000 there was an annual income gap of \$4,821 to \$3,725 in favour of those living in urban areas. Nan Wu (2014) reports that in the US between 1980 and 2012 the gap in annual incomes between urban and rural areas has been worked out to be 23%. In China, growth has been focused along its coastal regions, leading to a very big gap in annual incomes between rural and urban areas. Each region also has widening gaps in the social and healthcare services that are provided. Figures

indicate that in 1993, 50% of Chinese urban inhabitants had medical insurance, compared to only 10% of the rural population (Nan Wu, 2014).

2.7.3 Education and Literacy Levels in Rural Populations

According to Kulig and Williams (2011) and Lawless (2009) rural populations are more likely to achieve lower levels of graduating from secondary schools. This was confirmed in Australia where only 30% of rural students graduated from secondary schools compared to 48% graduated in urban secondary schools. It comes then as no surprise to learn that a lower percentage of younger people in rural areas go on to study in further education (Australian Institute of Health and Welfare, 2005).

2.7.4 Employment Levels and Conditions in the Workplace

Those who live in rural regions are far more likely to be experiencing higher levels of unemployment. There were more unemployed people in rural Canadian areas than urban ones between 1976 to 1989 according to Bollman data (2006) (it fluctuated between 7% and 12% to be precise). Even though many people are employed in farming, fishing, mining, timber and manufacturing industries, the main source of employment in smaller towns and rural areas remains the 'service' industry (Bollman, 2006). Many of these types of work though, might well entail risks to personal safety because they may mean being exposed to noise pollution, extremely cold weather, dangerous machinery and chemicals. These extreme hazards, that appear more commonly in rural areas, explain the greater amount of serious injuries experienced by those working in rural areas (Wright, 2012; UMI, 2006; Gerberich et al., 1998).

2.7.5 Physical Environments

There are other factors affecting health issues, found in the environment, pinpointed for example by the Australian Indigenous HealthInfoNet (2008). These factors were a lowering in the quality of the water supply and that households could be more crowded; these factors were found to affect how disease was controlled in rural areas. Other factors were a lack of adequate facilities to treat waste water, being exposed to chemicals used for agricultural production, and roads being inadequately paved; these were thought to be concerns for the environment of those inhabiting rural areas (Velasquez et al., 2016; Department of Family and Community Services, 2003; World Health Organization, 2009) as shown in figure 2.8.

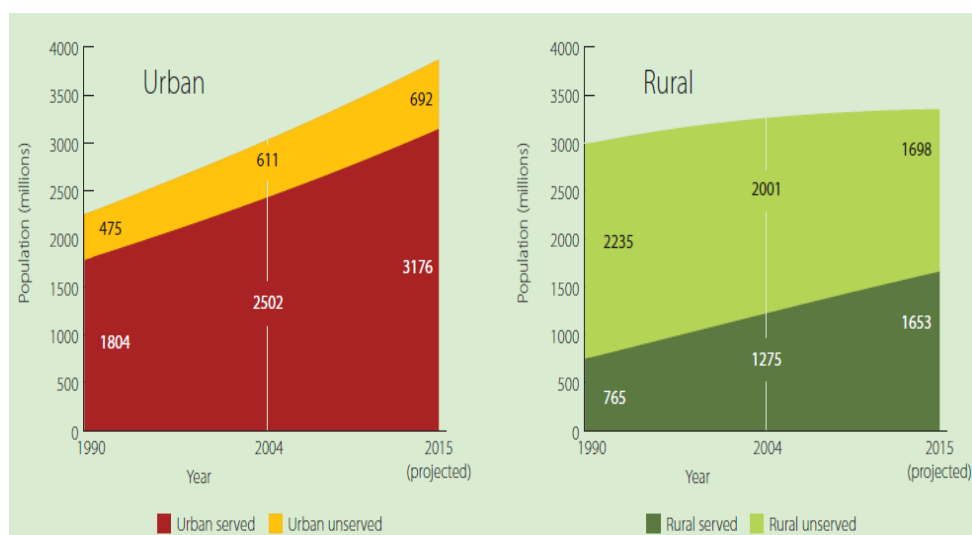


Figure 2.8: Populations living in urban and rural areas that do and do-not have improved sanitary facilities 1990, 2004 and 2015 (World Health Organization WHO, 2006).

2.7.6 Healthcare Provision for Rural Populations

Rural inhabitants experience inferior health status and greater needs for primary healthcare facilities. Despite this they receive a lower level of healthcare services, and have more difficulty in accessing them than urban inhabitants (Llywodrath Cymru Welsh Government, 2011; NHS, 2007; Godden, 2005). In the 1990s the Chinese government spent only 20% of its health budget in rural areas, despite them making up 70% of the population (Claeson, 2004). Rural inhabitants generally live further away from one another, and in smaller groups, than in urban areas. This is a likely factor in the end result of rural areas offering lower standards of healthcare provision than can be found in cities (Wang et al., 2011). For instance, in the US between 1981 and 1989, 237 hospitals in rural areas were shut down (7.8%) (Ricketts and Heaphy, 2000; Herdman et al., 2002). In rural communities in Canada, the inhabitants have access to only half as many doctors as those living in urban areas (only 1 per 1,000) and on top of this they need to travel on average five times as far to see a doctor (10km) (Edward et al., 2005; Tough et al., 2008; Kulig and Williams, 2011).

There has been an increasing number of hospitals closing down in rural areas in developing countries; resulting in reductions in levels of primary healthcare being available and necessitating increasing distances that need to be travelled in order to access that care; these issues though are not the only ones affecting healthcare accessibility in remote and rural areas. Other issues that have evoked concern have been

the specialisation of services, emergency treatments, ambulatory healthcare and the general quality of healthcare on offer (Hundt et al., 2012; Hasna et al., 2010). Each one of these may inadvertently have an impact on the healthcare of those living in rural areas. Haselth and Ryser (2006) studied specialised healthcare services in selected rural areas of Canada between 1998 and 2005, including social workers, dentists and dental surgeons, and found that these services had all suffered reductions. Additionally, only a third of these locations offered services for testing blood and urine, 40% offered ambulatory services and of the 19 institutions studied, only one offered neo-natal services. Though the rural population is aging, owing in great part to migration of the youth to urban areas, elderly care services have gone down to 21.1% in 2005, from 28.7% in 1998 (Haselth and Ryser ,2006).

It is evident in that rural areas, the provision of healthcare services is plagued by a considerable number of obstacles. For the most part the major causes of these problems have been the issues of isolation, long distances and populations that are heavily dispersed (Llywodrath Cymru Welsh Government, 2011; Weller, 2005; World Health Organization, 2010; Kerr et al., 2004). Because of these issues, there have been problems in employing healthcare professionals with the necessary skills and training. In Sub-Saharan Africa, the urban areas are generally more prosperous and thus home to the healthcare professionals with the best skills and training. A good example of this would be Zambia where urban areas possess five times as many nurses and twenty times as many doctors as rural areas. Malawi has 96.6% of its doctors working in healthcare facilities in urban areas, while 86.9% are rural inhabitants. There are 420 thousand people per midwife in Burkina Faso in its poorer areas, compared to one per 8,000 in richer areas. There are many rural areas that have no doctors, nurses or midwives at all to bring healthcare services to the people that are most in need of it (Liese and Dussault, 2004; Kawooya, 2012).

Because of these challenges there have been various innovations in the delivery of healthcare services to those living in rural areas; these include using phone connections for having a medical consultation, grants to help with travel expenses and E-health programmes such as mobile units promoting prevention and treatment of illness (Vo et al., 2011; Kuehn, 2016). In addition to this efforts have been made to bring more healthcare professionals to work in rural healthcare by offering incentives to work there. Examples of this are improved financial packages offered to those working in rural

practices and an increase in the amount of medical students recruited from rural areas (National Rural Health Association, 2012).

2.8 Implications for this Study

In the case of Libya, ICT it is seen as more and more necessary for supporting healthcare services. Currently, there are very substantial amounts of money being invested in improving the national and international network of fibre-optic cables and broadband connections. June 2010 saw the first terabit international fibre-optic cable arrive in Libya and the government has also announced it will invest 10 billion American Dollars in ICT infrastructure until 2020 (This was true at the time of writing in 2012). All of this points toward Libya becoming a nation of people with the capacity to access the internet easily, while already widely communicating via telephone. The infrastructure is rapidly developing to allow the implementation of E-health systems in rural medical centres, as well as urban medical centres (Business Wire, 2012).

One of the biggest hospitals in Libya is the Benghazi Medical Centre (BMC), which has a capacity of 1200 beds. The BMC caters for all medical problems, whether for outpatients or inpatients, and does its best to provide the highest possible levels of healthcare for the inhabitants of Eastern Libya by abiding by international standards that support modern IT. In the last twelve months the BMC serviced over 25,000 patients (NEXUS, 2010). The BMC has collaborated with a management company from France called Denos in order to gain French certification (NEXUS, 2010).

Through a selection process involving international companies, in November 2010, the German company Nexus was given the contract for implementing a Health Information System at the BMC. The reason for selecting Nexus was because its system was functional and user-friendly and because the desired modules had been broadly covered and integrated; ranging from registering to radiology management. The implementation of Nexus's Health Information System will be carried out in two steps and a French company called Ideal Medical Products Engineering (IMPE) will be cooperating and providing up-to-date technology and medical equipment to BMC (NEXUS, 2010).

The Benghazi Medical Centre is now focusing upon developing electronic health records (EHRs) for its patients for enhancing the medical treatments it can offer to its patients (NEXUS, 2010).

In Libya, establishing the Health Information and Documentation Centre (HIDC) for coordinating, collecting and reporting about healthcare data has been a big step in developing a national healthcare Information System (WHO, 2010). The General People's Committee for Health and Environment (GPCHE) deals with healthcare information and its responsibilities include the collection of healthcare data from healthcare institutions, to issue statistical reports on the nation's health, to conduct surveys on health, regular updating and dissemination of health indicators and to train healthcare professionals about how to classify statistics and diseases to an international standard.

The GPCHE serves the wishes of the Libyan government, while collecting, processing and disseminating data about vital statistics and socio-economic/demographic indicators of importance and serves as a centralised information storage point for all areas of development. The HIDC publish a report annually with up-to-date trends and indicators in partnership with the registration offices.

The Libyan Board of Medical Specialisations Library, and medical college libraries also provide information regarding healthcare and medical literature services and get their funding from national institutions. A majority of these libraries allow users to use Medline through use of a CD-ROM.

Libya will be utilised in the present research study in order to conduct an exploration of the readiness of rural and urban healthcare institutions for the implementation of E-health services and other healthcare factors that need to be taken into account when a healthcare IS is planned. The research shall be based upon both the study of healthcare systems that have been developed in developing and developed nations and by interviewing and surveying Libyan doctors, ward assistants, nurses and administrators.

2.9 Chapter Summary

The focus of this chapter was E-health-related aspects of the research study, more specifically, definitions of E-health and goals, the benefits and drawbacks of using E-health, barriers to implementation, security and privacy issues around healthcare information, pre-requisite requirements for initiatives in E-health, the evolution of the requirements for health information systems, EHRs, E-prescription and the advantages it brings, and telehealth and telemedicine healthcare service systems. These sections of the literature review covered different aspects of E-health frameworks and the

advantages offered by them. These were used as a basis for developing the provincial E-health framework introduced in Chapter Six.

Lastly, this chapter gave an overview of some of the typical features of healthcare needs of rural and urban populations, and showed how disadvantaged rural populations are when it comes to access to healthcare services, because of the way their environment is structured and its composition.

The following chapter presents those parts of the literature review that focus upon the Libyan National Health Service, and the theories that have been used to apply the E-health readiness assessment and the most important criteria for implementing an E-health system.

Chapter Three
Models and Frameworks for Assessing for E-health
Systems Readiness

3.1 Introduction

The focus of this chapter is approaches that have been used for applying E-health readiness assessment (Jennett et al., 2005; Chan et al., 2010; Overhage, et al., 2005; Li, 2010; Oliver, et al., 2004). Providing a strong theoretical background for this topic accords with Li (2010), whose contention is that the use of theories for understanding how a society works is a key part of being able to offer a practical solution to any problems that might occur.

For the purpose of this research study, the term “health technologies” refer to: (1) medical equipment such as imaging devices and in vitro diagnostics. etc, and (2) E-health system which refers to the use of ICT in support of healthcare services. Health technologies have the potential to improve lives.

The most important aspects of introducing an E-health system are: (1) technological innovation and (2) implementation. The assessment of the readiness of health systems for E-health introduction is determined almost entirely by these two factors, with the level of innovation required depending upon the needs of those funding it, those that will need to operate it, and those managing it at the planning and operational stages. Innovative solutions are required to ensure that scarce resources are used in the most appropriate ways in order to ensure that the changes needed are met and the new healthcare systems work most efficiently and effectively.

The required level of innovation can be determined by studying implementations that have previously occurred or are occurring in other nations, to see what has been successful and unsuccessful, to learn from this information, and to tailor the implementation to the criteria that presently exist in the system being looked at.

Once a plan of action has been approved at all levels and the funding has been guaranteed then implementation can proceed, though it will need constant assessment to see what is working and what appears to be going wrong. It would of course be beneficial to employ staff who have previous experience of E-health implementations, in order to give guidance about what needs to be done at key points in the transformation.

In consideration of the research objectives for this study, this chapter will examine productivity and service quality in the provision of healthcare. It will focus on how Health Technology Assessment (HTA) has evolved and how it is defined and it will examine conceptual frameworks of assessment models, different sorts of E-health assessment models in use in healthcare services and a definition of E-health readiness assessment. Furthermore, this chapter will look at: identifying E-health readiness assessments; E-health readiness assessment models being used currently in developing countries; and communities involved in E-health readiness assessments. The discussions on these subjects in detail will be in this order:

- Quality Criteria in Healthcare;
- Technology Assessment (TA) in Developing Countries;
- The Evolution of Technology Assessment (TA) and Health Technology Assessment (HTA);
- A conceptual Framework for Assessment Models;
- HTA and E-health Readiness Assessment;
- Review of E-Readiness Assessment Models for Healthcare Services;
- Rural e-Healthcare Readiness Assessment (ReHRA) Model;
- Identifying the components of E-health Readiness Assessment;
- The Involvement of Community in E-health Readiness Assessment;
- The E-health Maturity Model in E-health Readiness Assessment;
- The Interoperability of the Healthcare Systems.

3.2 Quality Criteria in Healthcare

The quality of healthcare is has often been the subject of debates regarding public policy. The challenging thing about having a debate about the quality of hospitals is that every stakeholder will have their own personal definition of what it means. A summary of different viewpoints about hospital quality by Hottum et al. (2011, pp. 1-6) is as follows:

- For a clinician, quality is connected to medical outcomes;
- The head of a hospital might well define quality as: there being no adverse publicity, a bigger share of the market, and a quality assessment programme that is well established;

- To doctors or professional healthcare organisations, quality is something that is assessed in reviews of healthcare providers;
- The view of a reviewer would be that quality equates to conforming to accreditation standards and goals;
- To a marketing person, quality is about satisfied customers;
- For insurers or health plan purchasers, the idea of quality could equate to cost effectiveness and utilising resources that are measured by a standard.

According to Nicholson (2013, pp. 13-14), the three interpretations below express three dimensions of quality that are required for the provision of better service:

- Clinical effectiveness: when the needs of a patient are examined and healthcare provision is based around this evidence;
- Safety: when everything is done that is possible to not harm the patient in any way;
- Patient experience: when a patient is treated as well as possible to aid their recovery and their desires are also taken into consideration, then this is quality care.

Figure 3.1 illustrates the three points that have been explained above, divided into five domains, with three main categories.

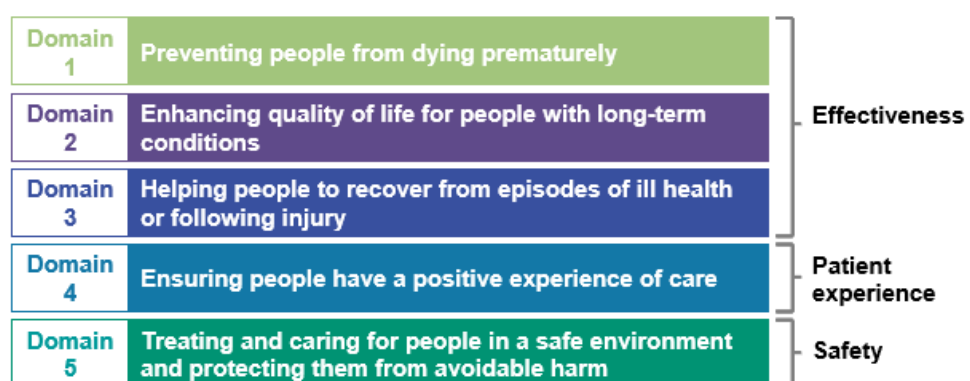


Figure 3.1: The NHS outcomes approach (NHS England, 2015).

Other researchers talk about quality more from a business perspective, using terms such as company output (in the healthcare context the quantity of services produced in a given time period by a healthcare provider), company input (in the healthcare context

the quantity of services provided in a given time period by a healthcare provider), customer output (in the healthcare context the number of patient treated in a given time period by a healthcare provider), and customer input (in the healthcare context the number of patient used the service of a healthcare provider in a given time period). For example, Case (2002) takes a marketing viewpoint about quality, saying service quality is about judgements or attitudes that relate to general service superiority. The two hospital output qualities are process and clinical quality (Hardie et al., 2011; Massey, 2012).

There are several ways in which the perception of the service quality that is accredited to public medical services can be enhanced. For instance, physical facilities can be redesigned and upgraded. Also, patients can be provided with additional information, and the organisational culture could be improved (Manhi, 2011). Burnham (2009) explains that service quality levels can be increased through the provision of more quality consistently over a period of time, and through a reduction in customer input and an increase in company input. There is then an implication that customers and companies co-produce quality healthcare service. Since a healthcare service is co-produced, the companies' and the customers' perspectives on quality ought to be influential in the organisation's output. Johnston and Kong (2011) give as a general definition of customer output: profit, market share, satisfaction, service performance and sales output. Serra et al. (2010) though states that the motivation of profit is not as relevant in the public sector and therefore, it is not possible to use it as a dominant determining factor for the output of the company. Francois's (2000) view is that quality is high if company output frees up scarce resources and the number of patients receiving treatment is high.

In the context of this research, service quality relates to global judgements or attitudes that relate to the superiority of a service.

This section looked at quality of healthcare and the following section will examine Technology Assessment (TA) in developing nations and technology that has been successful and unsuccessful there.

3.3 The need to Assess Technology for Developing Countries

There has been much less TA (for definition see following section) carried out in developing nations than in developed nations, and this has generally been to advise charity or government projects, such as dams or agricultural schemes (Ely et al., 2014).

As an example of what happens if technology assessment is not carried out, in the 1970s aid workers attempted to help African villages by giving them cookers that could use the sun to cook their food, saving them the cost of fuel. They did not though reckon on the preference of the villagers to cook during the evening when the sun had gone down, so the technology did not get used (Daim et al., 2011). This confirms the belief, known for some time, that if technology is introduced without some foreknowledge of a culture, then technological introductions can be doomed to fail. Since such disastrous attempts to introduce technology took place, a new approach has been to meet with villagers to discuss what might be a good idea and what people feel would most likely be a failure, embracing an approach that encourages the participation of recipients (Byrne, 2009; Kusekwa, 2011).

Another example is when mosquito nets were given out in Africa to help control malaria. Unfortunately, the locals equated the nets with the cloth laid over bodies when they are buried in that community, though the problem was solved by simply dyeing the nets (Eisele et al., 2011; Burke and Friedman, 2011). The trend toward TA and encouraging the participation of recipients has resulted in saving much funding for aid projects, instead of wasting inappropriate technology where it is unlikely to succeed. There is though, scope to include recipients even more in the future by investigating what technology can improve their lives.

After reviewing the TA literature, it will be necessary to become more specific and narrow down the parameters of what is required for developing a readiness framework for the LNHS. The following section will focus on how Health Technology Assessment (HTA) originated and the ways in which it has developed until the present.

3.4 The Evolution of TA and HTA

TA is a practice that attempts to predict and analyse what effects technology will have socially, environmentally and economically and strives to give those making decisions some idea of the effects different decisions might have; its purpose is to show what

effect might occur in order to have as few negative consequences as possible (Ely, Zwanenberg and Stirling, 2011).

The expression 'Technology Assessment' (TA) was first used in 1965 by the US Committee on Science and Astronautics in the context of helping policy makers to make more informed decisions (Goodman, 2014; Fox, 2010; Elman, 2014; Goodman, 2004). Goodman (2014) explains though that accurate technical information required by the policy makers was not available in the right form. Policy makers were therefore unable to judge how good a technology program was, or what consequences its utilisation might have. This meant that policy makers took into account what consequences there might be socially, economically and legally, but not technically. Goodman (2004) explains that the US Congress helped develop TA as it would prove of great use to policy makers. Because of these developments the Congressional Office of Technology Assessment (OTA) began its work in 1974 (Elman, 2014).

After the OTA was established, TA helped the US Congress to make decisions more effectively, thus serving the public. Though TA benefitted the decision makers in Congress, there were several private institutions that had other intentions (Goodman, 2014). There were several private companies that utilised TA to aid their organisations in competing in business and with decision making within the organisation. Taylor (2009) stated that TA was required in the private sector for providing information for the process of decision making and technical designs. Longlett et al. (2001, pp. 141-147) said that the following steps can be taken for carrying out analytical assessments:

- Analyse the impact of the technology in accordance with specific sets of dimensions;
- Define the assessment's nature and scope;
- Produce a conclusion and recommendations;
- Collect data.

Longlett et al. (2001) explained that fresh methods were emerging after analytical technology assessments had been introduced, including repeating the processes mentioned above and allowing for alternative processes. Introducing iteration means that processes or activities might need to be repeated for correcting previous outputs and for gaining fresh insights.

Health Technology Assessment (HTA) evolved from TA. Shirley et al. (2001) have emphasised that methods of technology assessment need adaptations for specific domains such as HTA. HTA was introduced around the same time as technology assessment was being developed, prompting a lot of public interest (Goodman, 2004; Elman, 2014). This acted as a catalyst for researchers to make definitions of HTA. Some of these are examined in the following paragraphs.

One definition of HTA is that it is a structured analysis of health technology to provide information for making policy decisions (Garrido et al., 2008; Taylor, 2009). Another definition of HTA is as a research-based practical assessment of appropriate knowledge about what consequences a technology will have (Have et al., 2013; Banta, 2009; Ely, Zwanenberg and Stirling, 2011). Saarni (2008) gives a definition of HTA as systematic evaluations regarding the effect or impact of health technologies. Giovagnoni et al. (2009) explain that HTA is an expanding field that concerns the multidisciplinary evaluation of clinical data, as regards how safe and efficient it is and the economic impact of its purchase. Giovagnoni et al. (2009) further state that the term healthcare technology also encompasses drugs, medical devices and surgeries used for healthcare, as well as support and organisational services in healthcare.

The definition of HTA that will be utilised in the context of this research is as follows:

it is a technique for systematically evaluating supporting systems (healthcare IT systems) within healthcare institutions.

Having covered briefly how HTA evolved and a few definitions of it, from the point of HTA we recognize that a 'one size fits all' approach to implementing E-health systems as national or local systems is not recommended for the LNHS. Therefore, it is necessary to develop a new E-health framework to investigate the technological, political, social, cultural and medical issues that need to be considered when implementing a national E-health system. The following section will review how the healthcare services in Libya will be assessed. The conceptual framework for this assessment was used for guiding the research intentions.

3.5 A Conceptual Framework for Assessment Models

Turner et al. (2009) define evaluation as the measurement or exploration of a system's properties, during project development, planning, implementation or operation, used for informing decision making concerning that specific project in a particular context. Hanney et al. (2007) have pointed out four generic frameworks that they consider to be the most useful for evaluating systems and programs (including HTA). The basis of the framework developed in this thesis is Merrill's (2008) classifications of 22 evaluation approaches. Merrill (2008) has defined program evaluation as being designed and carried out for assisting an audience in assessing the merit or worth of an objective. Preskill and Russ-Eft (2005) have identified the following four different categories:

- **Social agenda or advocacy approach:** the focus of this category of evaluation is to make a difference to society. This evaluation's fundamental objective is ensuring that all parts of society can access education, healthcare and other social services equally. Each stakeholder enjoys equally intense involvement in collecting, designing and interpreting the findings. Unlike the previous definitions, this approach avoids the idea of pinpointing correct answers and uses the postmodernist philosophy, stressing moral relativity, multiple realities and cultural pluralism;
- **Pseudo-evaluation:** this evaluation promotes positive or negative views despite what the real facts and values are; it is a political-oriented approach. It refers to evaluations that have not been completely carried out or have invalid findings; commonly found being used in politics and public relations;
- **Improvement-oriented approach:** this category accentuates how comprehensive a programme's merit and worth is. It examines relevant economic and technical criteria for evaluating a programme's planning and operation. It also examines relevant outcomes;
- **Question and method-oriented approach:** in general this category is used for addressing questions specifically or is based around particular methods, including experimental, accountability and program theory and case study benefit cost-based evaluation.

The meaning of this is that intentions for performing an evaluation in healthcare can differ. HTA can be carried out prospectively or retrospectively. The principles of

carrying out TA that were set out in 1965 founded contemporary HTA approaches. In contemporary healthcare HTA can be performed in technology innovation, either in the pre or post-implementation phases. Both terms are essential in an E-health readiness assessment and shall therefore be explained in more depth.

In contemporary healthcare, post-implementation in terms of technology innovation means assessing an E-health system sometime after it has been implemented (Cruz-Cunha et al., 2013). Post-implementation is carried out to (1) ascertain the success of the E-health system implemented; (2) examine the efficiency and effectiveness of all parts of the implemented E-health system; (3) learn lessons from the implemented E-health system to improve future projects and the current system.

Pre-implementation implies the E-health system has not yet been delivered. Li, (2010) states that performing an E-health readiness assessment before the implementation is necessary for assessing how successful it is likely to be, as well as its likely value and merit. Lorenzi, (2009, pp 1-13) points out that performing a pre-implementation evaluation aims to provide direction when carrying out decision making regarding subsequent developments or implementing tasks. In the planning and pre-implementation stages, evaluating E-health systems ought to cover:

- **Elements that might pose a risk:** assess if there are factors existing externally that the organisation cannot control that might pose a large risk factor for the project;
- **Feasibility:** assess what is required in the organisation for implementing the solution chosen;
- **Relevance:** assess if the solution has sufficient level of ability for solving the problems experienced at present and meeting the organisations' needs;
- **Problematic areas:** seek out and identify weaknesses and areas that may pose a risk within any solutions proposed;
- **Completeness and consistency:** assess whether any proposed solutions are coherent and are not under or oversized.

There are several methods that can be utilised for making evaluations, for instance (1) balanced scorecards (Bisbe and Barrube, 2012; Zelman et al., 2003; Santiago, 1999;

Pink et al., 2001), (2) field studies (Venkatesh et al., 2011; McNair, 2006; Talmon et al., 2009), (3) focus group interviews, (4) organisational readiness assessments (McNair, 2006), and others.

E-health readiness assessments for healthcare institutions can be used to identify problems that could potentially cause failures to occur (thus allowing healthcare institutions to innovate) and are categorised as organisational readiness assessments (Turner et al., 2009; Kristensen et al., 2009). In the next section, definitions of E-health readiness assessments will be explored and the different stages that need to be reached in order to know that a system is ready to embrace E-health implementation.

3.6 Health Technology Assessment and E-health Readiness Assessments

Technology readiness assessment refers to assessing the state of readiness to embrace and use technologies, and (2) the likelihood that the new technologies can be successfully implemented in a way that achieves the organisation's immediate goals and serves its longer-term needs (Li, 2010). Khoja et al. (2007) define E-health readiness as "the extent to which a community is willing to take part in and be successful in, adopting E-health technology". Salleh et al. (2011) state that the idea of 'readiness' for implementing technology is utilised as a shorthand term covering a range of organisational dimensions.

Adapting to an innovation is essentially adapting to change and thus must be looked at with innovation adoption and change management in mind (Khoja et al., 2008). Khoja et al. (2008) have indicated that adopting innovation and changing, when used as precursors for readiness in healthcare institutions, can be seen as ideas, practices or objectives, as viewed by individuals, groups or organisations. Jennett et al. (2005) state that change has often been represented as passing through three different phases; unfreeze, move, and refreeze (see Figure 3.2). The unfreeze phase leads to a reduction in factors that balance, the move phase creates fresh sets of behaviours and outlooks, while the refreeze phase leads to a new culture being reinforced. Mutihac (2010) views the three phases as the current, transition and future states and adds further levels of detail as illustrated in Figure 3.2.

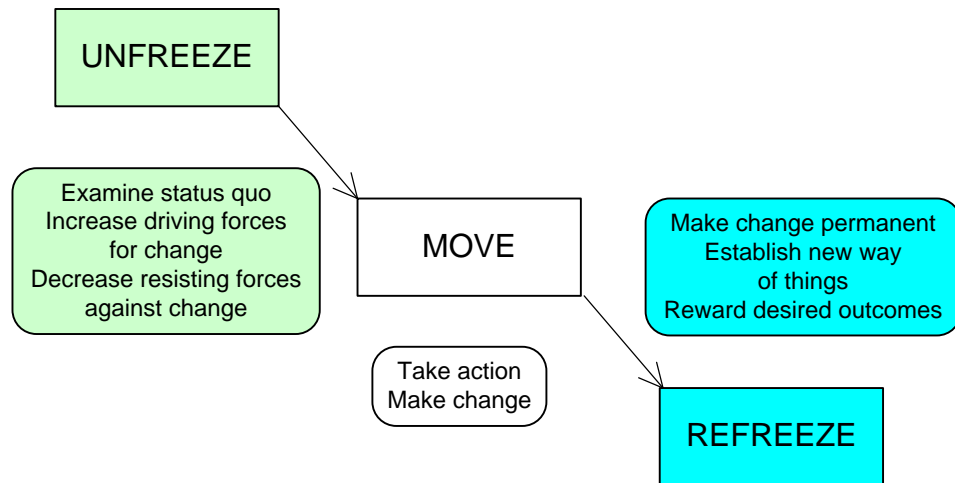


Figure 3.2: Three augmented three-step model (Mutihac, 2010).

Additionally, for Prochaska and Diclemente (2014) change needs an iterative spiral approach and extra dimensions therefore need to be added to the three-step model. They have created two additional phases prior to the unfreeze phase, these being the phases of *contemplation* and *pre-contemplation*. The phase of pre-contemplation is the state in which there are no thoughts of change within a community and there is a lack of awareness that change is a possibility or there are no intentions to change; the contemplation stage is where thoughts regarding change begin to emerge (Perry, 2016). This will lead on to the preparation stage; the beginning of planning for changes.

For Mutihac (2010), readiness is an idea involving the earlier aspects of change, the time between being in a frozen status quo and becoming unfrozen, in other words a community moving from the pre-contemplation to the contemplation and preparing phases (Prochaska and Diclemente, 2014), plus developing a social environment beneficial for diffusing and infusing innovations (Vopava, 2016; Rogers, 1995; Ramdhany, 2012). Kidwell (1996), when researching diffusion of innovation, concluded that when social groups adopted technology, their choices were heavily influenced by how useful the technology was to them and if it was valued. This implies that readiness is a vital and preliminary step in successfully adopting an innovation. For Li et al. (2009) readiness assessment needs to look at recognisable signs of behaviour that indicate either resistance to or support for, change. Models for processing social information have suggested that the readiness of an individual to accept innovation could be influenced by the readiness of other people (Weiner, 2009). This could be why change agents and champions are so important (Jennett et al., 2005; Li et al., 2009;

Salleh et al., 2011). Khoja et al. (2007) stated that “when readiness is created it must include number of attempts to influence beliefs, attitudes, intentions, and behaviours of those participating in change, these attempts are carried out by the change agents”.

In spite of change agents and champions contributing in a positive way to people’s readiness being shaped, the idea of readiness has been given a limited amount of attention in the literature on general organisational change (Suchan, 2008; Pare et al., 2011). Because evidence is emerging about new E-health systems failing, it is very important for organisations to be able to gauge their readiness for the implementation of new IT systems. In the USA healthcare organisations have experienced failure rates of about 50% while implementing new IT systems (Rahimi et al., 2008). Vretveit et al. (2007) argue that the main reason for these high failure rates is the broader organisational risks of clinical innovation that have not been assessed enough. Their research has suggested that important ways of identifying risks in innovating new clinical systems are assessing a healthcare institution’s readiness for the introduction of new IT systems (Vretveit et al., 2007).

The paragraphs above have shown how important it is to carry out readiness assessments of healthcare institutions before implementing new IT systems. The following section will focus on which sorts of electronic readiness assessment models are employed for assessing healthcare institutions. This will aid in assisting the researcher in constructing an E-health readiness assessment.

3.7 Review of E-Readiness Assessment Models for Healthcare Services

Chapter 2 reviewed E-health systems, how they might benefit a population in a developing country and chapter 3 is reviewing how the readiness of that country might be evaluated. There are many factors determining the readiness of a country for the implementation of E-health systems, so it was a rewarding task to investigate the findings of previous research.

The literature review in this research study was carried out using the following online databases: Brighton University resource, Science Direct, Google Scholar, IEEE, PubMed, National Centre for Biotechnology, Interactive Journal of Medical Research, Libyan Journal of Medicine, various resources available from the LNHS, and existing reports available from the investigated hospitals and clinics. Searches were made in

both Arabic and English languages for relevant articles about the implementation of E-health systems in developed and developing countries. The literature search was conducted by using keywords such as “E-health, rural and urban infrastructure, Telemedicine and Telehealth, health information technology, E-health readiness assessment, information and communication technology, E-health in low and middle income countries, challenges of implementing of E-health, success and failure”. The search was restricted to research journal, book chapters, reports, and conference proceedings, excluding duplicate publications. The primary search was carried out between 2011 and early of 2016, and was updated between September and October 2016. Though assessments had already been made of several countries, none had yet been carried out in Libya. This literature review will give some examples of relevant research discovered during the search made. Then the researcher expanded on how these frameworks will be utilised in this assessment to assess the readiness of the LNHS for the implementation of E-health systems. There was though a limited amount of formal articles on this subject about developing countries, so a search was made on many resources to find any recent research carried out on assessing the readiness of developing countries for E-health implementation.

There are several case studies whose goal has been to rate nations using a variety of measures for indicating E-readiness. Depending upon what underlying aims they have, models and tools that are used for assessing can mostly be grouped into three principal categories, these being (Ojo et al., 2007):

1. E-society readiness assessment models;
2. E-systems readiness assessment models;
3. E-economy readiness assessment models.

An E-society readiness assessment model focuses on how able society as a whole is to be benefited by using ICT in the workplace and in people’s personal lives. An E-systems readiness assessment model examines underlying technological structures that are required by E-economy and E-society. E-economy readiness assessment models focus upon simple infrastructures and how prepared countries are to develop ICT for enabling economic activity to enhance their growth economically.

Several researchers have made a critique of these particular models (Justice, 2012; Ojo et al., 2007). There are not very many models and tools presently available for making E-readiness assessments. Each of the tools or models for carrying out assessments defines E-readiness differently, and they all have different goals. The first generation of E-readiness assessment models assumed that the same requirements would apply in all cases, no matter how much a country differed from other countries, what investment was needed, or what a particular application needed. There are a lot of E-readiness models that give little away about the construction of their indices, and how to adjust them for analysing specific E-opportunities. The methodology or any details regarding how assessments are carried out are rarely available to the public and there are generally just single standard values and views provided. Because the methodologies can be ambiguous at times, basing analyses and results on them is challenging. Because there is a prevalent one-size-fits-all attitude, the differences that are required by, say, a policy analyst on the hand and an investor on the other, for reducing uncertainties, or making educated decisions, are obscured. Another pitfall of early E-readiness assessment models was that they are too focused on generalised measures in a country, and pay little attention to the specialised requirements of communities in rural areas. It is the opinion of the present researcher that when attempting to make an assessment of a nation's E-readiness, rural communities need to receive particular attention regarding the unequal distribution of health provision between rural and urban areas. Addressing the digital divide between rural and urban areas must receive a particularly strong emphasis in favour of rural communities in order to address the imbalance.

In recent times there have been tools created for assessing E-readiness that focus upon healthcare in rural communities (Ghazisaeidi et al., 2014; Gholamhosseini and Ayatollahi, 2016; Jennett et al., 2003; Rezai-Rad et al., 2012; Ojo et al., 2006). Additionally, some researchers are looking at E-health readiness assessments as being of importance before implementations of E-health systems are carried out (Jennett, Gagnon and Brandstadt, 2005). As previously mentioned, E-health readiness assessment frameworks currently being used are predominantly developed for use in developed nations. This means that because these parts of the world differ so much from developing countries, it is always possible that an E-health readiness assessment tool might not be appropriate for the country in which it is being used. Additionally, the tools and models are generally designed for adopting telehealth technology so they have

limitations when being used for making assessments for adopting E-health systems. Therefore, it is necessary that developing nations get assessed by frameworks specifically designed to suit their needs to see if they are ready for E-health implementation.

Blaya et al. (2010) systematically reviewed cases where E-health technology had been used and evaluated, in developing nations. They found that if a system improved communications between healthcare institutions, assisted in the management and ordering of medications and helped in monitoring patients that might abandon their care plan, then it was considered promising. They found the systems were effective at evaluating personal electronic assistants and mobile apparatus as they improved the collection of data in regards to quality and time taken.

There are numerous articles available describing the endeavours of researchers to perform such assessments. The ones that seemed most relevant to this research were as follows: firstly Rahimi (2008) found there to be no standard framework available for evaluating what effect implementing an ICT based application had upon healthcare, thus rendering the act of comparing results internationally as yet impossible. Rahimi (2008) states that studies should be made to gauge the effect that implementing ICT-based systems has on healthcare, while evidence-based healthcare informatics can be used to decide if such systems would be beneficial. Despite massive amounts of money being invested in Health Information Systems (HIS), there is as yet no conclusive evidence available as to their benefit. Ludwick (2009) stated that they found it worrying that they could not find any articles that reviewed the ways in which HISs were beneficial or detrimental to the healthcare needs of patients and that this ought to be of concern to those responsible for the adoption of such systems. Black et al. (2011) undertook extensive research, and came to the same conclusion. They found there to be a big difference between the advantages and benefits claimed for E-health systems and the empirical evidence available. They said that there have been very few comprehensive studies carried out on the risks involved in implementing E-health systems, and how cost effective they are remains as yet unclear.

There is a growing number of governments worldwide carrying out massive programmes to implement E-health systems in their healthcare services. However, an array of failings have already occurred that have compromised patient safety, ranging

from badly developed HISs causing errors in prescriptions to cyber criminals accessing EPRs to steal sensitive data (Wermeling, 2015). Wermeling (2015) point out that another way in which E-health can lead to a drop in patient healthcare levels is if it diverts funds from basic healthcare equipment.

Hansen et al. (2016) showed in their studies of a broad range of E-health applications that there was conclusive evidence that ICT was beneficial in basic healthcare environments. They found benefits ranging from reduced costs to improved quality levels and increased accessibility for users to healthcare. The information that they gathered from 10 places around Europe indicated without a doubt that E-health has a positive effect, leading to substantial benefits. Lau et al. (2011) advised not postponing innovation, but to introduce it in carefully planned stages; not to take big leaps into the dark, but to use guidance gleaned from the experience of those that have already implemented E-health systems. The testing of the effectiveness of the E-health systems was carried out by Ehealth IMPACT by developing a generic methodology for economically evaluating E-health applications. It was found that once the developmental and implementation stages were complete, then the benefits rose annually and exceeded the costs, often significantly. The costs remained stable once the system was implemented, while expanding usage caused benefits to get larger annually, proving that E-health can help satisfy the needs of healthcare users (Lau et al., 2011).

Chaudhry et al. (2006) carried out extensive studies on E-health systems that had been implemented and concluded that multifunctional systems yielded real benefits by increasing the delivery of care (in particular in the area of preventative medicine), enhancing the surveillance and monitoring of activities, reducing errors in the prescription of medication and decreasing the rate of utilisation for care that might potentially be inappropriate or redundant. Hossein (2012) looks specifically at the economic advantages of E-health. He cites Bloom et al. (2004) as stating that a population that enjoys a well developed E-health system is more likely to have higher levels of productivity because of increased physical energy and mental clarity (European Commission, 2012).

For a developing country to develop sustainably, it is of primary importance that the healthcare of the population should be effectively tended to. It is not unusual in developing countries to find some health issues, such as infectious or pandemic

diseases, to be in a critical state, and for the healthcare system struggling to cope through insufficient healthcare resources (Watts et al., 2008). As a population suffering from a lack of healthcare is likely to affect the prosperity of businesses, a developing country is unlikely to achieve a great deal of positive development until the healthcare of its population is looked after effectively (Li et al., 2010).

As successful EHRs form the basis for any successful E-health system, the readiness for E-health implementation can be assessed by the level of EHR development and success (Li et al., 2010). This was the conclusion reached by Li et al. (2010) after they had studied many of the frameworks that had been formulated to assess the readiness of developing countries for implementing E-health systems.

A majority of studies carried out to evaluate E-health systems are made once the system has been implemented, as seen in the example of Irani et al. (2008). Fiksdal et al (2014) point out the importance of such studies for evaluating the success of an E-health system, though Ashish (2016) points out the need for evaluations to take place before the implementation of an E-health system in order to allow decisions to have a better sense of direction.

Li et al. (2010) cite four main areas that need to be looked at in order to assess readiness for implementing an E-health system: (1) feasibility, in other words does the organisation possess the necessary resources; (2) the external risks involved, i.e. an assessment needs to be made of what external factors might threaten the project's success; (3) areas where problems may arise, i.e. to identify weaknesses in the solution where risks may occur; and (4) an assessment of how complete and consistent the solution is.

3.7.1 Frameworks for Assessing E-health Readiness

The main difference between framework and model is that a framework gives the overall structure of the research, where the model explores the research's specific methodology. The decision that was taken about which framework would best suit being used in the present research study, meant that this researcher had to review some that had been created previously. This section will give a brief overview of some of the frameworks that were reviewed.

Campbell et al. (2001) have formulated a framework for assessing the suitability of a healthcare system for E-health implementation by using interviews that were semi-structured and then analysing the results. The six themes that resulted from their analysis were as follows: ownership, apprehension, efficacy, turf, practice context and time needed to learn.

The framework created by Jennett et al. (2004) surveyed the views of patients, practitioners, organisations and the public through semi-structured interviews over the phone. They found there to be four factors involved with assessing how ready a system was for the implementation of E-health technology (Jennett et al., 2004):

- Structural readiness which focuses on achieving an acceptable structure for implementing a successful E-health system;
- Engagement which is the active participation of stakeholders in the idea of E-health system implementation;
- Concerns about a lack of readiness which is expressed perceived lack of need or failure to recognise the need for change;
- Core readiness which means the realisation of needs for change and express dissatisfaction with the current circumstances.

Wickramasinghe et al. (2005) propose a framework that concerns itself with preparedness for E-health implementation by concentrating on practitioners, organisations and the public. Their framework allows a healthcare system to be analysed using a synthesis of the four major factors affecting the implementation of E-health, showing their effects on objectives such as efficiency and preventative medicine, as can be seen in the diagram in Figure 3.3.

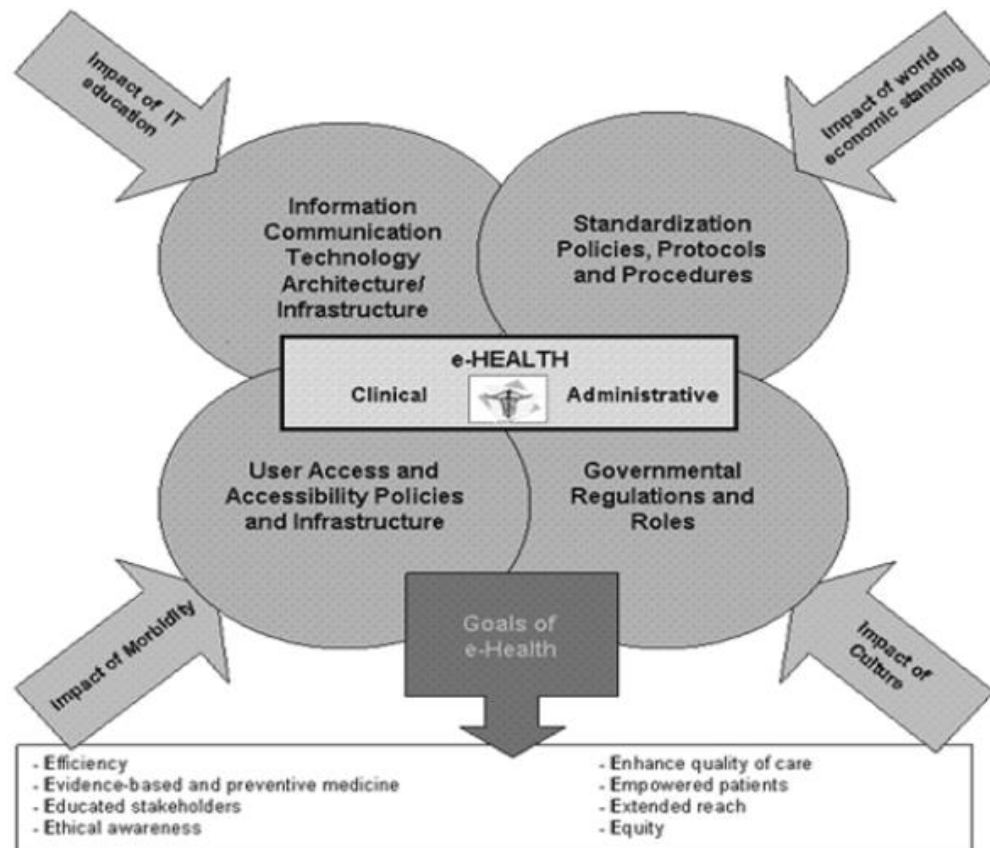


Figure 3.3: E-health Readiness Framework, adapted from Wickramasinghe et al. (2005).

The framework put forward by Overhage et al. (2005) concentrates upon evaluating a system's readiness through the analysis of secondary data from communities applying to fund healthcare initiatives. Seven factors, that were determined to be of most importance, were statistically and subjectively analysed. Li et al. (2010) found this framework to be more suited for issues around the allocation of funds; therefore this system would be quite unsuitable for this thesis.

Khoja et al. (2007) formulated frameworks that can evaluate whether developing countries are ready for E-health systems and they tested these systems in Pakistan. The researchers developed tools by carrying out participatory action research to document the opinions of partners; they reviewed tools that had already been developed and they developed a conceptual framework, basing it on accessible literature about what determines E-health accessibility. Khoja et al. (2007) then formulated different tools for use by healthcare providers and managers for assessing their systems for how ready they were for E-health implementation. This seems like a very efficient and effective system, but the present research will be more extensive, covering a wider range of

participants to create a more holistic assessment. Table 3.1 illustrate the differing perspectives incorporated into different E-health readiness frameworks (Li et al., 2010).

| Publication | System | Patient | Provider | Public | Organisational |
|----------------------------------|---------------|----------------|-----------------|---------------|-----------------------|
| Overhage et al., 2005 | √ | | √ | | √ |
| Demiris et al., 2004 | | | √ | | |
| Khoja et al., 2007 | | | √ | | √ |
| Jennett et al., 2003; 2004; 2005 | | √ | √ | √ | √ |
| Campbell et al., 2001 | | | √ | | |
| Wickramasinghe et al., 2005 | | | √ | √ | √ |

Table 3.1: Frameworks' perspectives for assessing E-health Readiness (Li et al., 2010).

For the present work the researcher has chosen the Chan framework to assess the E-health Readiness in Libya. The next section will include a brief summary of the Chan Framework.

3.7.2 The Chan Framework

To explain the Chan Framework quite simply, it is structured by filters used for imposing certain constraints and for narrowing the parameters of possible decisions. Chan et al. (2010) describe the framework as consisting of three factors on different levels: (1) empirical evidence, (2) the technology and how it is related to target patients and health interventions, and (3) situational factors. Chan et al. (2010) demonstrate the uses of this framework with the example of mobile phones used for reducing the risks for those suffering from cardiovascular diseases. They state though that this framework can be used for health interventions from many domains, exploring the viability of those technologies to deliver the necessary support to the target populations. For the sake of this thesis, the target population will be the LNHS and its stakeholders. The Chan Framework is different from the other frameworks because it draws upon cognitive and social sciences to create an improved understanding of the technological healthcare requirements of target populations (Yin et al., 2015; Chan et al., 2010). The diagram in Figure 3.4 illustrates the dynamics of the Chan Framework.

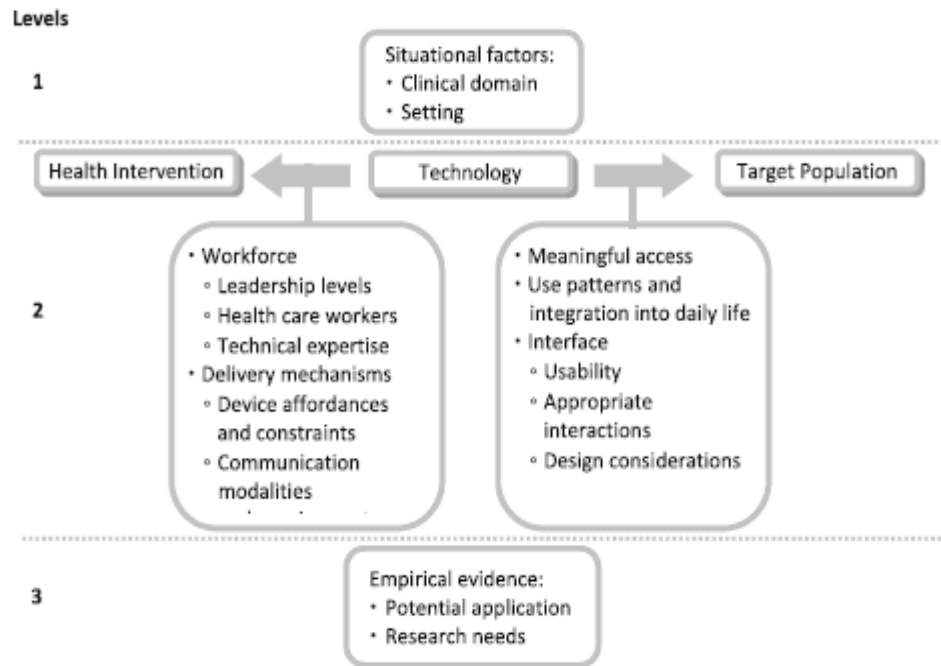


Figure 3.4: The 3 stages that need to be considered when selecting the appropriate technologies (Chan et al., 2010).

The Section 3.7 has discussed several E-health readiness assessment models. Khoja et al. (2007), however, argue that all E-health readiness assessment models have originated from developed countries and therefore contain a bias. Khoja et al. (2007) also point out that because there are contextual differences in developing and developed countries, it is possible to mismatch E-health readiness models if they are adopted without properly adapting them.

Chandrasekhar and Ghosh (2001) indicated that a majority of the readiness framework models have been created in Canada and the EU and have come from wealthy contexts where ICT infrastructures are well developed and support healthcare services. Chandrasekhar and Ghosh (2001) also point out that in developing countries with low incomes, which sometimes have infant mortality rates where one in seven children will die before the age of five and life expectancy may be as low as 48, the dominant context is poverty rather than wealth. The implication therefore is that appropriate models for E-health readiness assessments in developing countries may be slightly different to those used for developed countries. The next section will discuss the criteria that have been followed to formulate dimensions for the framework for this study.

3.8 Identifying the Components of E-health Readiness Assessments

Developing an E-health readiness assessment framework for the LNHS was very challenging. This is because a framework is produced by the analysis of a large amount of literature that is usually challenging to organise regarding a specific theme (Schwarz et al., 2007). For addressing this problem, Li et al. (2009) produced a set of criteria for guiding researchers for developing comprehensive frameworks in the E-health domain. The development of this framework has followed these criteria.

Through the integration of components of E-health readiness frameworks that have been reviewed in this research study, an E-health readiness framework will be formulated which has five dimensions: with the Chan framework (Section 3.7.2), motivation for change, engagement, technical resources readiness, and societal readiness.

Forces that Motivate Change result from evaluators realising problems and healthcare providers being dissatisfied with current systems for responding to epidemic. The performance of such an analysis for changing will help organisations to define the problems that they have with response systems for pandemics and to understand how they can meet the needs of improving their response systems for pandemics (for instance, sharing EHR systems) (Jennett et al., 2004). Workers in healthcare organisations need to be incentivised in order that their behaviour might be changed (Lehman et al., 2002). This could be caused by the motivational readiness assessment creating not just awareness within the community, but by helping individuals at grassroots levels to communicate openly (Jennett et al., 2004).

Engagement is created by healthcare providers being exposed to potential E-health applications (Jennett et al., 2003; Campbell et al., 2001). Healthcare providers are the most important driving force in the push to implement an E-health initiative (Wickramasinghe et al., 2005). Engagement gives an opportunity for expressing how much they understand about how beneficial E-health would be for responding to a pandemic and what concerns them or what they are afraid of regarding using E-health technology, including showing how willing they are to make investments in training staff (Jennett et al., 2003; Jennett et al., 2005).

A healthcare organisation's *Technical Readiness* is how able the software, hardware and IT support network is for supporting a clinical IT innovation and the IT skills of the

healthcare professionals (Demiris et al., 2004; Jennett et al., 2005; Snyder-Halpern, 2001).

Technical Resources Readiness assesses an organisation's ability to support clinical IT innovations. The assessments need decision makers with in-depth knowledge regarding the resources available in the organisation that are needed for adopting new IT systems and maintaining it when it is up and running (Snyder-Halpern, 2001). There are three main aspects to resource readiness, those being: the specific knowledge of the decision makers (for instance, managing IT project procurement), enough funding and policies that are supportive (Jennett et al., 2003; Jennett et al., 2005; Snyder-Halpern, 2001). It seems that certain levels of resource readiness are required for providers to become confident enough and comfortable enough to implement E-health systems (Jennett et al., 2005).

Societal readiness makes an assessment of an organisation's partnerships and communication within it. This type of readiness is concerned with the socio-cultural issues regarding E-health implementation within an organisation and regards the inter-group, inter-organisation and intra-group dynamics (Khoja et al., 2007).

Through the integration of the components discussed above and by adapting the Chan Framework for the present research study, an E-health readiness framework was formulated for this research study. The interview and questionnaire questions were based around these five dimensions.

Motivate Change dimension was used to formulate some of the interview and questionnaires questions to help the researcher to define the problems that the LNHS have with their systems, and to understand how LNHS can meet the needs of improving their systems.

The interview and questionnaires questions formulated from dimension of *Engagement* were used to measure any concern about potentially negative impacts, benefits of E-health systems and showing how willing the LNHS are to make investments in training staff to use new E-health system.

Technical Resources Readiness used to evaluate the technological readiness, and make an assessment to the existing ICT infrastructure for supporting E-health implementation,

and level of IT training and supported staff, as one of the dimensions that are required to support successful implementation of E-health in the LNHS. To become confident enough to implement E-health systems the dimension of *Resource Readiness* was used to make an assessment of healthcare institutions' non-technical capacity for supporting E-health implementation such as enough funds.

Societal Readiness used to assess the communication link between healthcare institutions, and how healthcare providers in collaborate with each other, plus the internal communication between healthcare staff within a healthcare institution.

This criteria was followed to formulated a framework for the present research study to assess the different levels of E-health readiness within the LNHS. Adapting this framework will ensure that the implementation of an E-health system for the LNHS will be successful.

Section 3.8 looked at the criteria needed to formulate the framework for this study. The next section will talk about Rural e-Healthcare Readiness Assessment (ReHRA) Models that are already in use to support healthcare providers.

3.9 Rural e-Healthcare Readiness Assessment (ReHRA) Model

There are recently been developed models for assessing E-health readiness, that are focused on rural areas in developing nations. An E-health readiness assessment model designed for use in rural areas is the Rural e-Healthcare Readiness Assessment (ReHRA) Model and has been created by Ojo et al. (2007). This model has incorporated the Technology Acceptance and Use (TAU) Model (Kowitlawakul, 2008). Kurkinen (2012) explain that it has been validated theoretically and empirically most rigorously. Kurkinen (2012) makes the point that all IT acceptance models ought to be made up of two main models; those being Technology Acceptance Models (TAM) and Technology Motivational Models (TMM).

Kurkinen (2012) explains that TAM implies that when a user is given a new technology, there are two prominent factors that will have an influence on their attitudes about the use of that application: (1) how useful the user perceives it to be, and (2) how easy it will be to use. Kurkinen (2012) points out that perceived usefulness means how much a user has the belief that the system they are using will improve the performance of the job they are doing, and perceived ease of use means how much the user believes

that the use of a specific system will mean they have to use less effort to perform a task. Kurkinen (2012) explains that these factors are a key to influencing the Behavioural Intention for using that particular technology.

Turner et al. (2010) point out that TAM ought to be measured as well as Technology Readiness Index (TRI). Godoe and Johansen (2012) state that Technology Readiness Index measure the ability of the future users to accept and make use of the new implemented technologies; thus a high score would suggest a population will attain high levels of comfort with using a particular technology. Because people are highly involved in the usage of healthcare technologies, Kurkinen (2012) have put TAMs into their ReHRA Model for use in developed nations and especially in places that are rural.

Davis's (1992) Technology Motivational Models (TMM) puts forward the proposal that Intrinsic Motivation (IM) and Extrinsic Motivation (EM) act as important factors in influencing Behavioural Intention. Turner et al. (2010) have indicated that in research about Technology Acceptance (TA), Behavioural Intention is normally taken as the dependent variable rather than actual usage; figure (3.5) illustrates TAM and TMM, and the integrated model resulting from combining the two models together (Turner et al., 2010).

Justice (2012) explains that the main components which ReHRA Models assess are: (1) Need-Change Readiness (NCR), (2) Structural Readiness (SR), (3) Engagement Readiness (ER), and (4) Acceptance and User Readiness (AUR). The components NCR, SR, and ER are adaptations from Engagement Readiness, Structural Readiness and Core Readiness, which were produced by The Alliance for Building Capacity (2008).

This research will be using the ReHRA Model for Developing Nations for assessing consultations with each stakeholder in the LNHS and the communities that will be participating in the assessment. The TRA will be conducted using the ReHRA Model,

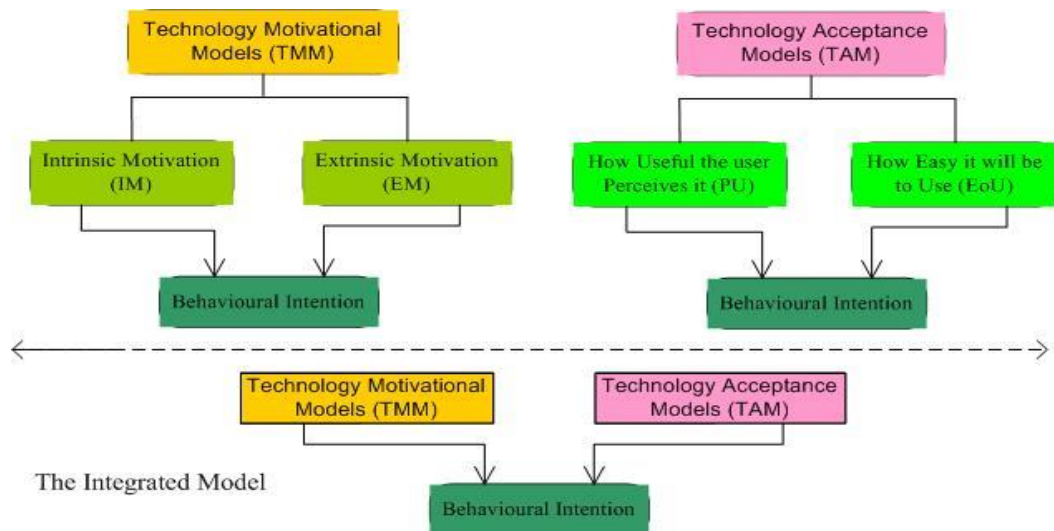


Figure 3.5: TAM and TMM, and the integrated model (Turner et al., 2010).

assessing the levels of interoperability inside and between healthcare institutions when using the healthcare system.

This section looked at Rural e-Healthcare Readiness Assessment (ReHRA) Model which was designed for use in rural areas to assess E-health readiness in developing nations. The following section shall look at community involvement in E-health readiness assessment and how to provide adequate involvement of target user communities in design processes.

3.10 The Involvement of Community in E-health Readiness Assessments

Solano-Lorente et al. (2013) have made the point that healthcare services differ from normal consumer services and that needing a service from a healthcare provider is generally seen as something negative. Even though healthcare services are needed by people, often to survive or improve quality of life, they are not likely to look forward to being vaccinated, having open heart surgery or a vasectomy. Pooler (2011) points out that people normally have a need for a healthcare service once their lives have become stressful in some way. Because it is so important to provide effective and efficient healthcare to maintain the wellbeing of the population, it is fitting that there should be more involvement from communities in the planning of improvements in these services, such as designing and assessing any innovations in healthcare technology. Therefore technology that is community orientated is essential for any implementations to be successful.

Longlett et al. (2001) explain that Community Oriented Technology Assessments are processes in which members of communities act as a partner in assessments. In an organisational setting, a community presents a unique context, thus necessitating its inclusion in assessment processes. Though the concept of a community is common, it is also complex and can be characterised by boundaries measured spatially and socially (Green and Haines, 2011; Al-Haydari, 2011). Humphreys and Wakerman (2008) explain that these are broad definitions of communities because they include healthcare professionals, patients with the same problems, multidisciplinary healthcare providers and geographically rural communities.

A community can be situated in a geographical location that creates all sorts of challenges for design and usage. Also a community often faces more stringent constraints financially than businesses or government organisations, thus necessitating more attention being paid to TAs and developmental processes; for instance they need to be technically supported and receive specialised training to cater for their requirements (Longlett et al., 2001). Bernstein et al. (2011) also recognise that for the unique characteristics of a community to be addressed, the process of design and development of systems needs to be user-centred. Viswanathan et al. (2009) argues that this is a necessity for TA as a community might be a provider of input into design processes. The implication is that TA processes need to be established and maintained in partnership with communities from the start to the finish of a project for facilitating user centred approaches.

According to Reiling, et al. (2008) and Buchannan et al. (1991) one of the biggest reasons for inferior designs is failing to gain adequate involvement of target-user communities in design processes. Thus, it is essential for there to be assessments of healthcare technologies carried out for a community, especially one including an E-health readiness assessment, in order to be community centred (Rowling, 2012; Khoja et al., 2007; O'Neill, 2013). If appropriate partnership or training is not provided though, a community will not properly embrace user centred processes.

In the present research community will be examined from the aspect communities based on place (geographical location) and communities based on shared of interest. The community involved includes healthcare professionals and multidisciplinary healthcare providers in urban and rural areas of Libya.

The selection of the participants was influenced by their profession's relevance to the answering of the research question. Those targeted are doctors, ward assistants, nurses, and administrators working at healthcare institutions in Libya to examine the community involvement in E-health readiness assessment, and how to provide adequate involvement of target user communities in design processes in order to be community centred.

This will give a clearer view of what technical support and specialised training is needed to cater for the community's requirements, and to maintain a partnership with the community from the start to the finish of the implementation of an E-health system.

The next section presents an E-health Maturity Model in an E-health Readiness Assessment that will be employed to measure the data harvested from the study.

3.11 The E-health Maturity Model in E-health Readiness Assessment

It is possible to use E-health maturity models for measuring, managing and optimising all the parts of an E-health system, along with the healthcare system where the implementation occurs (Backus, 2001; WHO, 2012). Using a maturity models allows for the measurement of a specific domain's capability maturity. Additionally, it promotes a process for making improvements that would suit an enterprise and which follows the best practices that are recommended for that domain (Dyk and Schutte, 2012; WHO, 2012).

There are four stages involved in the E-health Maturity Model, these being presence, interaction, transaction and transformation (Figure 3.6). The remainder of this section gives a summary of each of these phases (Dyk and Schutte, 2012; Backus, 2001).

The *Information* phase involves setting up websites that are not interactive, but are designed to disseminate information. In the *Interaction* phase services are offered that are more advanced than in the presence phase. Larger quantities of information aid healthcare professionals in searching for content that is relevant, communicating with healthcare workers, participating in discussions online about cases and submitting opinions and what they require. Costs can potentially be cut by reducing usage of communication channels used traditionally, such as telephoning; interaction services

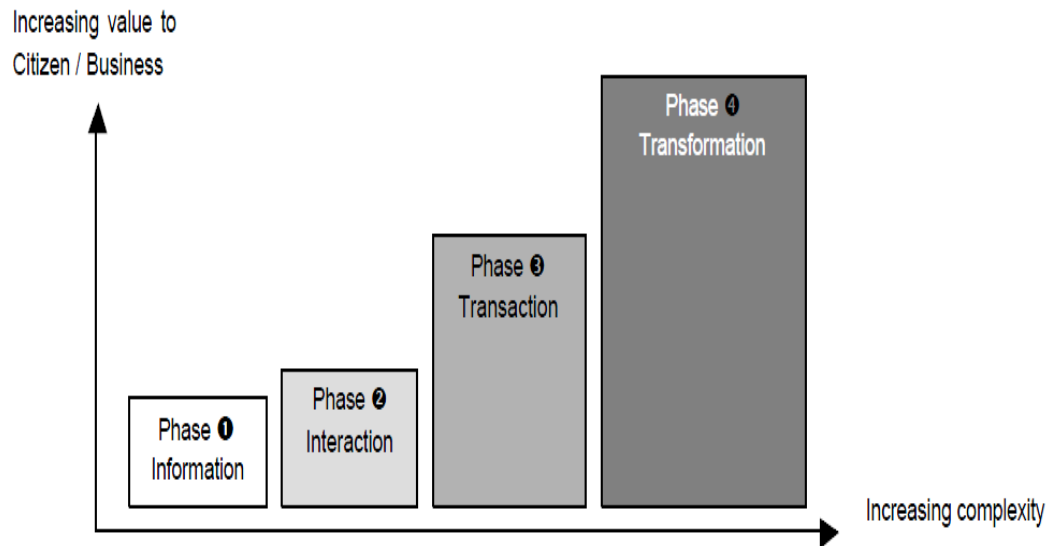


Figure 3.6: A maturity model for implementing an E-health system (Backus, 2001).

could also be used for extending the range of and how intense communication is between healthcare workers, therefore increasing levels to which they are participating in discussions and the making of decisions. The implementation of an interactive service is more complicated and expensive and there might be a need for data to be accessed and back office and departmental systems to be integrated somewhat for it to work effectively.

The focus of the *Transaction* phase is to build channels for accessing services online, thus enabling the whole task to be completed electronically. These services could be making appointments, retrieving clinical data, updating and maintaining patient records, requests for tests and referrals. Furthermore, using online facilities for establishing if specialist healthcare workers and facilities are available and ordering and delivering medication is possible. It is also possible to use transactional services for increasing how convenient and efficient interactions are between healthcare institutions, therefore reducing costs. Integrating with other systems could be used for streamlining processes and eliminating errors that have been caused by data being entered manually. Submissions made online are also subjected to strict legal guidelines regarding, for instance privacy, non-repudiation and archiving.

The *Transformation* phase sees present workflows and processes in business being rationalised and redefined for taking advantage of improved delivery capacities. Methods traditionally used, such as users interacting face to face between various

healthcare institutions, find themselves being replaced with aggregated services that are more user-centric, thus isolating consumers from the many systems and services and presenting a view that is unified and more appropriate for users. The biggest advantages gained from this phase come from new types of services that are streamlined, efficient and joined up and are designed for suiting the preferences and requirements of the end user, instead of expecting them to make adjustments to ways that the operating of systems in healthcare institutions differ. Implementing the transformation phase makes use of the foundation created for the transaction phase.

Section 3.11 looked at E-health Maturity Models in E-health Readiness Assessments. The following section will examine interoperability in E-health systems, giving examples that illustrate how they interoperate with one another.

3.12 The Interoperability of Healthcare Systems

It is important for there to be Interoperability in E-health systems as it delivers better levels of healthcare and reduces the cost of healthcare. Interoperability for example makes possible the coordination of chronic patient's healthcare by helping different E-health systems to cooperate, i.e. EHRs, medical sensor instruments that are wireless and Personal Health Record Systems (PHRs); allowing EHRs to have a secondary use by being used for clinical research; the sharing of lifelong EHRs between various healthcare providers (Ciampi et al., 2016). Even though creating E-health interoperability is rather challenging (clinical information can be very complex because of competing standards), there have been several successful initiatives that were carried out, for instance Integrating the Healthcare Enterprise (IHE) profiles and big deployments like the National Health Information System of Turkey (NHIS-T) (Mair et al., 2009; Dogac et al., 2011; NHS England, 2015) that is an infrastructure operated across the nation designed to help patient healthcare records to be shared. At the moment, 60% of university and private hospitals and 98% of public hospitals have a connection to NHIS-T, receiving feeds on a daily basis of the EHRs of their patients. The population of Turkey is 74 million, out of which 60 million have EHRs in the NHIS-T (Dogac et al., 2011).

Another example of a project for sharing information is EPSOS (EPSOS, 2012) used to share documents of prescriptions and patient summaries across Europe. EPSOS is used for targeting people living in Europe when they travel from country to country so that

healthcare professionals can access their EHRs, thus allowing continuity of healthcare. It began in 2008 and composes 47 beneficiaries in 23 countries in Europe. 2013 will see it being operated fully in all the countries participating (Dogac, 2012).

In the USA a point-of-care HIS is being built that will be comparable to the electronic banking worldwide system. By using healthcare information exchanges and interoperability, healthcare professionals will be able to access longitudinal medical records. Interoperability is one of the basic requirements that is needed in operating healthcare systems so that they are as beneficial for society as possible and that are available when adopting EHRs (Brailer, 2005).

The Zettel (2008) makes the proposal of defining the interoperability of a healthcare system in three parts (Figure 3.7), these being: the main focus of *technical interoperability* is physically transmitting and receiving healthcare data and transporting it from one participating system to another; the focus of *semantic interoperability* is to ensure shared meaning is received from the partner that sends and receives. This ensures that there is a consistency in the meaning perceived by the receiver and sender; and the focus of *process interoperability* is on making and sharing a better experience by using higher-order workflow concepts.

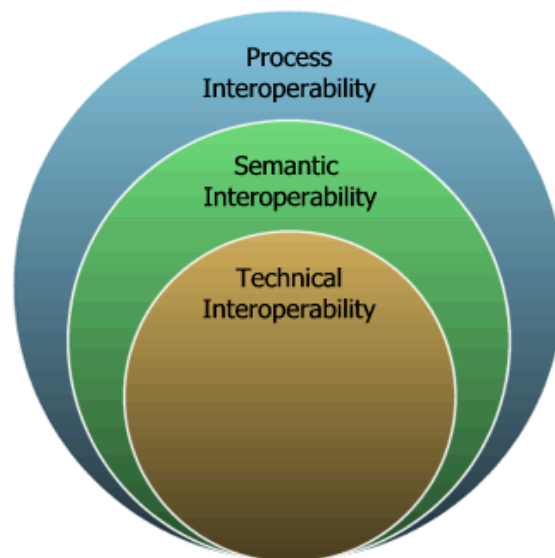


Figure 3.7: Categorisation of Interoperability (HL7EHR, 2008).

Artz et al. (2007) point out that there are various interoperability models (Figure 3.8) that can be adopted by organisations, for instance the Centralized Model, and the Distributed Model.



Figure 3.8: Interoperability models (Artz, 2007).

From those two models is the *Centralised Model* which uses a centralised server for registering, matching and de-duplicating all the records of the patients. Though data collection carries on behind the scenes from a variety of sources, a user can only gain access to suites of applications or a consolidated application on its own. Because applications and data are more centralised, there is a tendency for data security to become more straightforward. Figure 3.9 illustrates the centralised model.

The *Distributed Model* is self-sustained for most parts, and only some connectivity is required to the main data-centre for data backup and to access other site's patient medical records. *Distributed Model* uses a separate server for each site and, hosts its own Shared Files and patients' records, and manages its own backups. The main benefit of using a *Distributed Model* is that it is not using a centralised server, where each site can survive on its own and have its own server (there is no single point of failure), and connecting over the internet. The disadvantages of using this model, obviously, are cost as it will require additional hardware and software, and the backup architecture bandwidth.

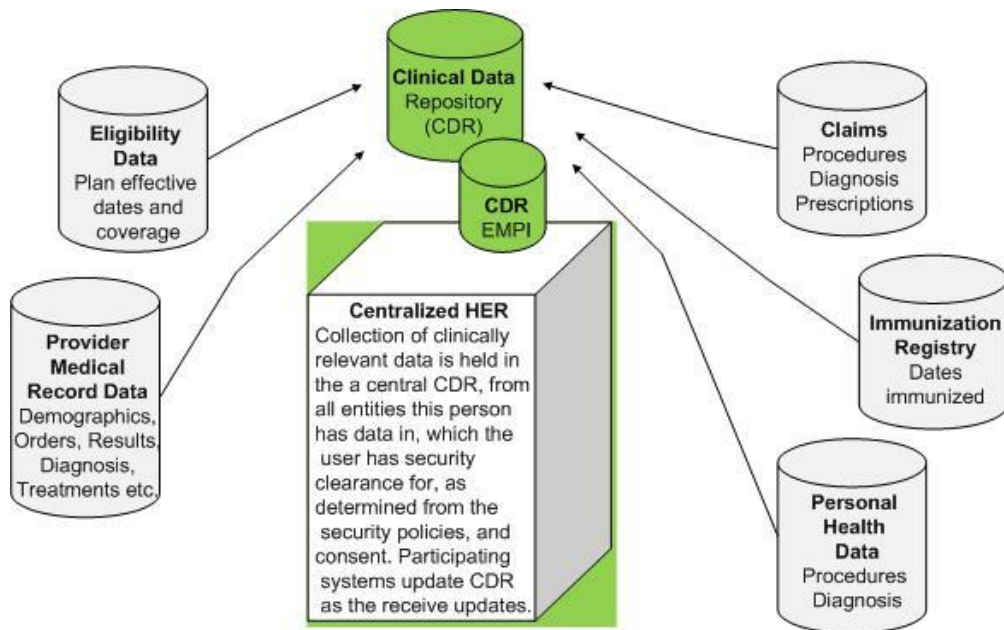


Figure 3.9: Centralised Model (HIMSS, 2009).

3.13 Chapter Summary

This chapter focused on approaches that have been used for applying E-health readiness assessment and have provided a theoretical background. It has examined productivity and service quality in the provision of healthcare, and focused on how HTA evolved. Furthermore conceptual frameworks of assessment models and E-health assessment models were examined.

The researcher has defined E-health readiness assessment and identified E-health readiness assessment models currently used in developing countries. Through the integration of components of E-health readiness frameworks (motivation for change, engagement, technical resources readiness, and societal readiness) that have been reviewed in this chapter an E-health readiness assessment framework was formulated. The Chan Framework was selected by the researcher for the present research study to construct E-health Readiness Assessment Framework for the LNHS to assess their readiness for implementing E-health systems. These five dimensions were used to formulate the interview and questionnaires questions to help answering the research question.

The Rural e-Healthcare Readiness Assessment (ReHRA) Model for Developing Nations created by Ghazizadeh et al. (2012) which incorporates the Technology Acceptance and Use (TAU) Model was used to assess levels of interoperability inside and between healthcare institutions when using the healthcare system.

The community involvement in E-health readiness assessment was examined by involving healthcare professionals and multidisciplinary healthcare providers in the present research study from different geographical locations in Libya (urban and rural areas). Their selection was influenced by their profession's relevance to the answering of the research question.

This chapter has also discussed the E-health Maturity Model in E-health readiness assessment and explained its four stages (presence, interaction, transaction and transformation). E-health Maturity Model promotes a process for making improvement and measuring data harvested from the present study when assessing E-health readiness. The interoperability of healthcare systems and its importance to deliver better levels of healthcare and reduces the cost of healthcare was also discussed, and the Centralized and Distributed Models were briefly explained.

The next chapter will discuss the research methodology and will create a clearer understanding of the methodology used in the present research study and the methods followed.

Chapter Four
Research Methodology

4.1 Introduction

This chapter provides a description of the mixed method approach (quantitative and qualitative) that was adopted as the methodology for the research presented in this thesis. This methodology was used to achieve the aims of the research study as laid out in the introduction (Chapter One). In order to collect the required data for the study in Libya, interviews and questionnaires were conducted at predetermined medical centres. Questionnaires and interviews are the main tools employed in the collection of data about the development of medical information systems in the Libyan National Health Service (LNHS); such data can be utilised in testing conclusions or finding out how particular factors might differ from one another in their effect upon the adoption of E-health in the LNHS (Gray, 2009; Curry, Nembhard and Bradley, 2009). Research can be used as a tool to study the factors associated with healthcare IS development within developing nations, and aid in becoming more educated about them and realising how interconnected they are. Therefore, it is essential to select the most suitable methods for successfully researching the subject matter (Baran, 2016; Creswell, 2014; Driscoll, Yeboah, Combs et al., 2010; Salib and Douglas, 2007; Johnson, 2014).

This chapter is divided in the following manner: Section 4.2 presents, for ease of reference, a brief summary of the research objectives and questions that were outlined in more detail in Chapter One. Section 4.3 gives a description of the theoretical approach for conducting case study research. Section 4.4 describes the individual methods and overall methodology that were employed in the study. Section 4.5 describes the way in which the data for this research was collected; and also presents the pilot study, questionnaire survey, interview, expert opinion, document analysis, participants, response rate, and sample size of the research study; this section also describes the process of analysing the data and goes through the ways in which the methodology is limited. Section 4.6 discuss the ethical considerations.

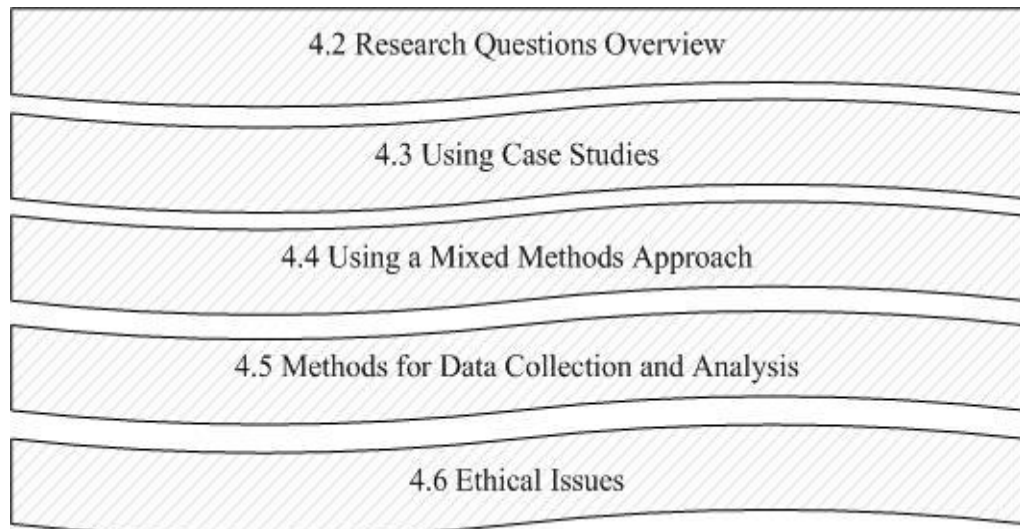


Figure 4.1: Relation of chapter sections to research process.

4.2 Research Questions Overview

The research questions which this study addresses were presented in Chapter 1, p. 10. This section provides a brief summary for ease of reference. The primary research question is:

- *How could an E-health framework that has been designed to enhance the delivery of healthcare services in Libya be composed?*

The primary research question was divided into two sub-research questions and various measuring instruments were utilised for collecting data as discussed in Chapter One. The sub-research questions are shown in figure 4.2.

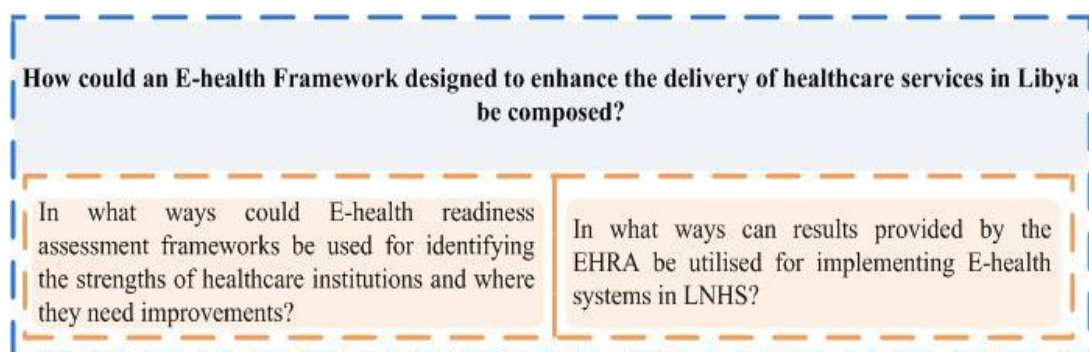


Figure 4.2: Primary research question and sub-research questions.

4.3 Using Case Studies

In this section and the next section the two main methods which were used in this research study are discussed. The first method that the researcher has chosen for this

research is the Case Study Method. The reasons why this method was chosen are discussed in the course of the next sub-sections.

4.3.1 Case Study Method

In fields where innovation research takes place, for instance the Information Systems field, case studies have proven themselves to be important research methods (Williams, 2007; Tolley et al., 2016). They allow complex and contemporary social phenomena to be studied in their natural context (Man, 2003; Orlikowski, 1991; Hyett et al., 2014). There have also been some studies that made an evaluation of the usefulness of the case study method in the Information Systems sector (Baran, 2016; Myers, 1998; Curry et al., 2009; Markus, 1983; Darke and Shanks, 1997).

The approach taken in this thesis to the case study is an interpretivism one (Crotty, 1998; Howe and McKay, 2007; Combs et al., 2010). A positivist believes that the world we live in is one where the laws of causation are so powerful that everything conforms to them and that this can be tested objectively (Mertens, 2015; Darke, Shanks, and Broadbent, 1998; Creswell, 2014). This is in contrast to interpretivism which believes that the mind can contain subjective constructs of multiple realities. Their view of the world is that it is socially constructed. They try to create understandings of phenomena by analysing the meaning people have assigned to them. The interpretivism approach has a strong focus on the preparatory stages of research, and concentrates upon the interpretation and discovery of social patterns. Because these perspectives are so dissimilar, the different criteria that apply to the two perspectives need to be highlighted (Cavaye, 1996; Doolin, 1996; Shalin, 2014; Willcocks et al., 2016; Fowler and Jeffs, 1998; Creswell, 2014).

The above findings indicate that the Case Study Method which was selected by the researcher has been used by other researchers successfully, yielding good outcomes and results and a clear understanding of the research problem. This study adopted an interpretivism approach for investigating its case studies. The researcher has employed the case study method in order to be able to more easily triangulate data due to the analysis techniques and multiple data that is collected, and to strengthen the findings and conclusions of the research.

The present research study used multiple case studies (five rural clinics and five urban medical centres) to investigate and examine the technological, political, healthcare services, and social factors needed when future E-health systems are planned. The main aim of this research is to create an E-health framework to assess the E-health readiness levels within the LNHS. The next sub-section addresses the procedures for carrying out a case study research.

4.3.2 Approach for Conducting Case Study Research

There is more than one way in which case studies can be carried out (Darke, Shanks, and Broadbent, 1998; Creswell, 2014; Tolley et al., 2016). The present researcher has employed the following six steps for conducting this research study which were proposed by Runeson and Host (2009):

1. **Determining and defining the research question:** The first step taken in the case study part of the research was establishing a solid research focus. The research question was then formulated (for full details refer to Chapter One). Establishing a solid research process (section 1.6) helped in focusing on answering the research question while carrying out the research.
2. **Selecting the research study and determining techniques for analysing and collecting data:** The researcher selected multiple real life cases in the LNHS to carry out the research study (see Table 1.1); this helped in examining the case study in more depth. Each case was treated as if it was a single case. Whatever conclusion was arrived at in each case also contributed to the study as a whole. The methods for data collection and analysis employed for the purpose of this study are discussed in section 4.5.
3. **Preparing to gather the information:** The researcher developed their interview (section 4.5.3) and questionnaires (section 4.5.2.2) techniques to collect data. Appendix A contains the questionnaires questions, and appendix B contains the interviews questions. Mixed method approach was selected to prepare for gathering data for the purpose of this research study.
4. **Gathering the required information in the field:** The researcher used the interviews and questionnaires to gather the required information in the field by interviewing healthcare staff at LNHS healthcare institutions and distributing the

questionnaires (section 4.5.2.3 and 4.5.3.3). Because there were a lot of different pieces of information that needed to be collected, the researcher decided to store the information in a highly systematic manner, so that they could be easily found and referenced (section 4.5.2.4 and 4.5.3.4). The objects of the case study (section 4.3.1) were carefully observed by the researcher and causal factors associated with what has been observed has been identified.

5. **Evaluating and analysing multiple sources:** The raw data collected from multiple real life cases in the LNHS in this case study were analysed carefully. The researcher has discussed the analysis techniques used in this research in more details (section 4.5.2.5 and 4.5.3.5); in the process it was continuously verified that results were contributing towards addressing the research objectives, at all times referring to the research questions. For more detail see Chapter Five.
6. **Preparing conclusions and reports:** In Chapter Six the researcher prepared the reports of the various case studies in this research in ways that transform complex issues into ones that can be more easily understood. Chapter Seven includes the outcomes and conclusions from the case studies, and the recommendations made by the researcher.

4.4 Using a Mixed Methods Approach

When designing a piece of research choices need to be made about what methods to employ. There is a tendency for researchers to make their study either predominantly quantitative or predominantly qualitative. Tolley et al. (2016) and Sechrebatn and Sidani (1995) explain that there are alternatives to using an approach that is either quantitative or qualitative, as there is no mutual exclusivity. Additionally, Sechrebatn and Sidani state that selecting an approach ought to have the purpose of the study and the questions it is asking as its basis, rather than aligning with a specific paradigm. In this section, the two methods will be closely examined before conclusions are presented about which approach is best suited to the present research context.

4.4.1 Quantitative versus Qualitative Research Methods

When looking at the design process for the research, it is necessary to make a decision regarding which strategy to employ; either qualitative, quantitative or a mixed methodology (both qualitative and quantitative).

The *quantitative* method of research is a strategy centred on quantification, on collecting and analysing numerical data, whereas the *qualitative* method of research is a strategy centred on words, on collecting and analysing textual data (Creswell, 2014; Mertens, 2015). Wyse (2016) suggests that the quantitative method of research depends on figures and numbers, and the qualitative method of research is based on portraying data in sentences, narratives and words. Higginbotham (2010) also expresses the same view, distinguishing between qualitative and quantitative methods of research by defining qualitative as focusing upon non-numeric, and quantitative as focusing upon numeric. Higginbotham (2010) also states that the word quantitative can be used as a synonym for data collection techniques, (e.g. questionnaires), and data analysis procedures, (e.g. statistics and graphs) that generate or use numerical data; this is in contrast with qualitative which is mainly synonymous with techniques for collecting data (e.g. interviews), or procedures for analysing data (e.g. categorising data), that generate or use non-numerical data. The following table shows the basic difference between the two approaches:

| | Quantitative | Qualitative |
|--|--|--------------------------------|
| Main orientation in the roles of theories for research | Deductive; to test theories | Inductive; generating theories |
| Epistemological orientation | Model for natural science, | Interpretivism |
| Ontological orientation | particularly positivism Objectivism | Constructionism |

Table 4.1: The basic differences between quantitative and qualitative research strategies (Brennen, 2013).

There are however, particular assumptions underlying qualitative and quantitative research methods; when using quantitative research methods, reality can be examined

objectively as it exists independently of the researcher and thus the researcher stays distant from and independent of the phenomena being studied and measured.

In contrast, within research using qualitative methods there can be many perceived realities occurring within a single situation that will influence the research; these being the individuals being investigated and the reader who interprets the results (Brennen, 2013; Hancock, 2009). While carrying out this study, the researcher will strive to make reductions in the distances between themselves and the participants.

Abusabha and Woelfel (2003), Bahari (2010) and Punch (2013) have listed the positives and negatives that can be expected when employing a *quantitative* method for carrying out research, as can be seen below:

| Strengths | Limitations |
|--|---|
| <p><i>Reliable:</i> If carried out correctly, using quantitative methods for research can produce results that accurately represent a study population.</p> <p><i>Large scale:</i> Using quantitative methods for research make it necessary to standardise questionnaires and techniques for interviews; thus they are applicable across multiple countries and can be used for targeting entire populations.</p> <p><i>In-depth analysis:</i> It is possible to carry out techniques for statistical analysis using quantitative data, ranging from uncomplicated statistics (averages and frequencies), to more complex statistics (factor, conjoint and cluster analysis).</p> | <p><i>Limited for explorations:</i> When using quantitative methods for research, the use of questionnaires and interviews will normally only test predetermined hypotheses, thus potentially missing spontaneous or tangential information that might be available.</p> <p><i>Response to innovative concepts:</i> This method is of more benefit when trying to understand an established, as opposed to innovative, concept, as it is more difficult to communicate innovative concepts to participants.</p> <p><i>Accessibility:</i> The data collected from quantitative research is an abstraction and can be challenging to interpret.</p> <p><i>Potentially misleading:</i> The legitimacy of data from quantitative methods can suffer</p> |

| | |
|---|---|
| <p><i>Replicable and tractable:</i> When quantitative methods are used for research on the same population, highly similar results can be expected.</p> | <p>in various ways, for instance a questionnaire could contain a method for collecting data that might create a bias.</p> <p><i>Neglecting phenomena:</i> Using quantitative methods for research means that people are reduced to being treated as if they are a part of the natural world, neglecting phenomena such as self-reflection.</p> <p><i>Static:</i> Using quantitative methods for research is limited because only a static view of life is captured.</p> |
|---|---|

Table 4.2: The Strengths and Limitations of using Quantitative Methods for Research (Abusabha and Woelfel, 2003; Bahari, 2010; Punch, 2013).

Abusabh and Woelfel (2003), Punch (2013) and Mack et al. (2005) also give positives and negatives of qualitative methods for research, as can be seen below:

| Strengths | Limitations |
|--|---|
| <p><i>Ideal exploratory tool:</i> Research using qualitative methods allows investigation to be more flexible if the researcher is accessing a customer's ideas and views directly.</p> <p><i>Causes the value of subsequent quantitative research to increase:</i> Can be used very effectively as a planning tool prior to undertaking quantitative research of a more expensive and sophisticated nature.</p> <p><i>Deeper feedback is provided, instead of just number crunching data:</i> It can provide richer insights than data-</p> | <p><i>Smaller numbers of participants:</i> It is too expensive to use large survey groups for this method.</p> <p><i>Representativeness of results:</i> Because sample groups tend not to be very big, results are often not totally representative, and it is also possible that significant differences exist between participants and the population as a whole.</p> <p><i>Selective data interpretation:</i> Results can be tainted by a researcher</p> |

| | |
|--|--|
| <p>centric research methods and provides a context to interpreting the findings.</p> <p><i>Group dynamics improve results:</i> It is possible for participants to interact with other participants and therefore opinions can be drawn out that might not have become apparent otherwise.</p> <p><i>Provides human perspectives:</i> Results emerging from research using qualitative research can be more easily understood and accessed.</p> | <p>projecting their bias onto the interpretation of the data, thus leading the conclusion of the study to support the theoretical conclusion that they want.</p> <p><i>Lack of ability for tracking small differences:</i> As an example, in marketing, often the difference between success and failure can be attributed to an inability to distinguish subtle differences in views expressed by respondents; qualitative methods of research cannot be used for effectively distinguishing between these minor differences.</p> |
|--|--|

Table 4.3: The strengths and limitations of using Qualitative Methods for Research (Abusabha and Woelfel, 2003; Bahari, 2010, Punch, 2013).

Additionally, Madrigal and McClain (2012), Hsieh (2007) and Abusabha and Woelfel (2003) expressed their views on the differences that can be found in using either a quantitative or qualitative approach as:

| Quantitative Research | Qualitative Research |
|---|--|
| <p>Its primary purpose is determining causes and effects and describing ongoing relationships.</p> <p>Before starting an investigation, a precise hypothesis is established and the investigations purpose is governed by theories in a deductive manner.</p> <p>It is possible to control and manipulate the independent variable.</p> | <p>Main purpose is describing processes that are ongoing.</p> <p>The development of hypotheses occurs during the investigation; the investigations purpose is governed by questions; the development of theories happens inductively.</p> <p>There are no specific independent variables; it is concerned with studying phenomena that occur naturally with no</p> |

| | |
|--|--|
| <p>Data must be collected objectively.</p> <p>Before the investigation begins; the research design must be specified.</p> <p>The representation of the research data can happen verbally or numerically.</p> <p>In order to test how valid or reliable the research is, it is tested logically and statistically.</p> <p>The population is represented by selecting samples from the population.</p> <p>Studies of behaviours have natural or artificial settings.</p> <p>Uses design or statistical analysis for controlling for anything that threatens internal validity.</p> <p>Uses inferential statistical procedures for demonstrating external validity (in particular, population validity).</p> <p>Relies upon research design and instruments for gathering data instruments for controlling against procedural bias.</p> <p>For the study, phenomena is made simpler or broken down.</p> <p>When a conclusion is stated, it is</p> | <p>interference.</p> <p>Data does not need to be collecting objectively; the data collector can interact with a participant.</p> <p>The researches design is changeable and will develop during an investigation.</p> <p>The representation and summarising of the data is in a verbal form or narrative numerical form.</p> <p>Determination of validity and reliability occurs from employing multiple information sources (triangulation).</p> <p>The selection of samples occurs purposefully or single cases are chosen to study.</p> <p>Behaviour is studied in the natural setting.</p> <p>Alternative explanations are controlled or accounted for using logical analysis.</p> <p>Similar cases are used for determining if findings can be generalised, if at all.</p> <p>The researcher is relied upon for coming to terms with procedural bias.</p> <p>The study of phenomena is carried out holistically and treated as a complex system.</p> <p>Each conclusion is tentative and subject to</p> |
|--|--|

| | |
|--|----------------------|
| done with a degree of certainty that is predetermined. | ongoing examination. |
|--|----------------------|

Table 4.4: The Difference effects of using a qualitative or quantitative approach (Abusabha and Woelfel, 2003; Bahari, 2010).

It has been the approach of some researchers to carry out research with both quantitative and qualitative methods in order to increase the reliability of research findings (Creswell, 2009; Mertens, 2015). There is a school of thought that using both methods will mean they complement one another in answering specific research questions (Creswell, 2009). Mengshoel (2012) confirms that using these methods is very efficient at finding answers to certain research questions.

An approach that uses both quantitative and qualitative methods, known as the mixed methods approach, can enhance the reliability of research, and can be very efficient at finding answers to certain research questions, the present research used both quantitative and qualitative methods for the case studies. In accordance with what is discussed above, it is the belief of the researcher that using both qualitative and quantitative strategies for this research is appropriate and would be the most suitable to provide accurate answers to the research questions. A more detailed justification for the mixed methods approach is provided in the following section.

4.4.2 Justification for the Use of Mixed Methods Approach

Creswell (2014) and Rittichainuwat et al. (2015) explained that a lot of researchers acknowledged that using quantitative and qualitative methods may complement one another in many research approaches. This is the main reason why the mixed methods method has been chosen for the case study work in this thesis, using mixed methodologies will allow a greater breadth of information to be collected. The following is a list of more detailed reasons why a mixed method approach was chosen:

- Using mixed methodologies allows researchers to test out theories with larger sample sizes and it is possible to survey a lot of people by using a questionnaire. Boosting the statistical power allows for other studies to be compared more easily.
- Using a mixed methods approach allows reality to be conceptualised into variables and to explain the relationships that they have to one another. Harrison

(2012) reports that surveys that have studied relationships between variables are often more accepted in academic work.

- In a mixed methods approach, the survey design produces numerical data and measures variables. Baran (2016) and Schembri (2002) suggest that a mixed-method, interpretivist approach permits the researcher to find answers to the questions they are investigating by combining data analysis and interacting with human responses.

The arguments given above justify an interpretivist and mixed methods research strategy, using both questionnaires and interviews to investigate the readiness of the LNHS to implement E-health systems. As mentioned before, selecting strategies and methods for a piece of research will be influenced by the type of research that is being carried out, and it is because of the specific requirements of the research that using both qualitative and quantitative strategies was thought to be the most appropriate. This is because this research seeks to measure the opinions and experience of healthcare professionals in Libya and will include many participants. To survey all participants qualitatively would be too much of a challenge and would take too long. A subset of participants will be surveyed qualitatively in the form of interviews to provide more depth to the research findings and uncover any ideas that were not considered by the researcher in the questionnaire.

4.5 Methods for Data Collection and Analysis

The main objectives when deciding on research methods and overall methodology are: (a) guiding the research in the best direction possible, (b) aiding in the understanding of the research process, and (c) addressing the research objectives as effectively as possible. The most important question for the researcher in this section is: “which method should I employ to yield the best results possible?”

This section will discuss the techniques employed for collecting and analysing data, and the methods employed for sampling. In total, four data collection instruments are discussed: expert opinion (Section 4.5.1), questionnaires (Section 4.5.2), interviews (Section 4.5.3), and document analysis (Section 4.5.4). Each instrument is described and discussed in detail, in terms of justification for using it, limitations, data collection procedures including details such as participant numbers and sample sizes, analysis methods, and in some cases a description of a pilot study.

4.5.1 Expert Opinion

4.5.1.1 Justification and Background

Expert opinion is classified as a method for collecting data that uses experts' knowledge and opinions in the areas where the researcher is working in order to achieve program outcomes (Cook, 2016; Ouchi, 2004; Kubler et al., 2013). For the benefit of this research, the researcher consulted several types of expert working in different fields such as: E-health model development, medical research, and health technology assessment. When interacting with the experts, the researcher presented the research case study to them, and asked for their feedback and comments to help improve the quality of the E-health framework. The experts' opinions and recommendations were then refined by the researcher to help produce the E-health framework proposed in this thesis which will help to implement E-health systems for the LNHS.

4.5.1.2 Instrument Design and Procedure

In order to construct the framework for the case study research, and ensure that it was creditable and applicable, the design of the framework was based around the recommendations, comments and reviews made by a group of experts at the Vision For a Future Conference. This conference was organised and sponsored by the Libyan Government in 2013 in London. At this conference the researcher met with some of the top management of the LNHS, the Libyan Health Minister Dr. Fatema Elhamroush, healthcare professionals, and other healthcare researchers from Libya.

The researcher presented their research case study at the conference, and received feedback from those present. The researcher also conducted various meetings with some of the experts and the Health Minister, and discussed the case study work in more detail and asked for their expert opinions. The outcomes of those meetings helped the researcher to improve the quality of the framework.

The researcher also sent a copy of their work to one of the healthcare institutions in the south of Libya (Sabha Medical Centre (SMC)), which has started to implement E-health systems in the form of Electronic Health Records, E-Consultations and E-Prescriptions. The researcher received a letter from SMC with a positive feedback on the research results, this letter is attached in appendix D.

The researcher also presented their work at the Second International Conference on Information and Communication Technology for Ageing Well and e-Health 2016 in Rome. The researcher received good feedback and comments of those who were present at the conference. The researcher's work and presentation was awarded the best student paper in the conference, the award certificate is attached in appendix E. This gives good credit to this research study and the results achieved.

4.5.1.3 Limitations

Even though this method is less costly and simple to use, it has its limitations which can be described as follows:

- The evaluation of E-health frameworks for the LNHS are based on the views of the experts met at Vision For a Future Conference (see above) which are in turn informed by their individual skills and experiences. These experiences and opinions differ somewhat from one to another, but were very supportive;
- There is a general lack of experience and expert knowledge in the E-health field in Libya at the time of conducting this research because of the conflicts and civil war in Libya.

4.5.2 Questionnaires

4.5.2.1 Justification and Background

Data for finding answers to research questions is collected in various different ways. A survey might take the form of an interview or a questionnaire (Creswell, 2014; Gray, 2009). Written questionnaires (Appendix A) and interviews (Appendix B) were carried out for the purposes of the present research. In the field of social research these tools for data collection are commonly considered to be the best for answering closed questions "questions which have a yes or no answer only, multiple choice, and tick boxes" (Farrell, 2016). Anonymous questionnaires attain the highest rates of response, perhaps because it is treated confidentially and is impersonal (Trochim, 2001). The questionnaires in the present research were carried out voluntarily and anonymously, in order to collect a significant level of data from participants.

Both interviews and questionnaires were used in this study because the combination of these two methods is capable of gathering large amounts of data with both economical and effective advantages (questionnaires are more economical, and interviews are more

effective). This combination of methods has allowed the results of the case study work to be compared and to have a better understanding of the issues surrounding the implementation of E-health systems in Libya; it is considered to be a dependable approach subject to the comprehensibility of the wording of questions (Saunders, Lewis and Thornhill, 2007; Tolley et al., 2016). The greatest plus points of questionnaires are identifying and describing an array of answers about particular subjects and being able to correlate the points of one group of questions to that of another (Gray, 2009). Another reason the questionnaire was employed in this study was that it can give protection to the privacy of those participating; this is because the responses submitted remained both confidential and anonymous.

4.5.2.2 Instrument Design and Pilot Study

In a questionnaire those participating give a personal response to a group of questions in written form (Creswell, 2014). How big the questionnaire is will be dependent upon what sort of respondents there are, the purpose of the research, what resources are available and what analytical methods will be employed. The total number of questions could be anything from a handful to hundreds; the emphasis though ought on asking as many questions as are needed, but no more than are necessary (Anderson and Holloway-Libell, 2014; Seidman, 2006).

The questionnaire that was employed during this research contains 41 questions. The questionnaire's translation into Arabic happened through several different stages. Firstly, with the help of previously used questionnaires, the questionnaire was modified before being converted into Arabic. Secondly, an academic from Libya who is a specialist in English, converted the questionnaires back into English. Thirdly, two English versions were compared with one another for inconsistencies. Lastly, the finished product was tested on Libyan students residing in the UK, to check if the translation was clear and comprehensible. The questionnaire was written so that it could be completed in about 20 minutes. Appendix A contains the questionnaire which is split into 5 sections and consists of 16 pages when printed onto one sided A4 paper. Because the questionnaire appeared quite big, and therefore slightly daunting to potential respondents, the questionnaire was printed out as a booklet with both sides of paper printed on. The date when the questionnaire was distributed was printed on the cover, along with the title of the research in large font. The questionnaire covered several areas

to assess the readiness to implement E-health systems for the LNHS, namely: technological, political, social, cultural and medical issues (Appendix A).

Form of Questions

The questionnaire was designed on the basis of information gathered during the literature review. It inquiries about various types of information, one of which was the opinions that healthcare staff have (in this part participants were invited to share their feelings about the subject). Other types of questions were included too, please refer to Appendix A. The questionnaire consisted of two different types of questions: open-ended and closed questions. The main reason for having open-ended as well as closed questions for this research was because open-ended questions do not have a predetermined set of responses supplied and the participants have the freedom to express their own opinion. In closed question formats participants are offered a choice of answers and invited to indicate which one most closely resembles how they feel; such questions are presented in an easy-to-understand format that are straightforward to analyse.

The downside of having open-ended questions is that the questions can be challenging to give an answer to and later analyse. However, the most positive benefit of this is that the participants can express themselves very clearly and be extremely precise in their answer. The biggest drawback of closed questions was that a bias may well be introduced into the results as the choice may not include exactly what the participants wish to answer (Anderson and Holloway-Libell, 2014; Seidman, 2006). The following is an example of a closed question in the questionnaire:

1.2 Please indicate using an X whether or not your department is conducted as a multidisciplinary clinical team?

Yes No

The main reason for choosing closed questions was to identify some of the issues affecting the implementation of E-health systems in the LNHS, such that the results can be compared critically with those in other countries, which happens to be a primary aim for this research. And the reason for having open-ended questions was to allow participants to give their personal opinions or to give them additional options. An example of an open-ended question in the questionnaire is the following:

3.5 Please indicate below the typical time required to retrieve the records of a patient.

| |
|--|
| |
|--|

The decision as to which question type to use in the questionnaire depended in each case on the specific aims behind the question. Factors considered in decisions included estimating how likely participants were to have considered the subject previously, how much participants already knew about the subject, and to what extent participants might be inspired to share their feelings and thoughts about the subject.

Respondent Burden

In a study such as this it is very important not to place too much of a burden upon the participants. The pilot study showed that not everyone read the whole questionnaire and that some participants indicated that they felt the questionnaire was much too long. It was thought that this might put off some potential participants; therefore, some of the long questions were removed or shortened, to allow a larger number of participants to respond and not to burden them too much.

Shortening some of the questions in turn imposed some limitations upon how deeply some issues could be covered, as can be seen in the following shortened version of one of the questions:

“Please provide a brief description of the whereabouts of your medical institution in the spaces provided below”,

Some of the questions were turned into multiple-choice question to make them easier to understand and to get a focused answer, and to reduce time spent to complete the questionnaire; for example:

6. Does your medical institution provide any information communication technology applications in the categories listed below?

Please indicate those that apply to your medical institution with an X.

| | | | | | | | |
|----------------|--|--------------------|--|-------------|--|--------------------|--|
| Dermatology | | ECG Diagnostics | | Radiology | | Telemedicine | |
| E-diagnosis | | E-prescription | | E-referrals | | E-health record | |
| Histopathology | | E-consultation | | Others | | | |
| | | | | | | | |

Pilot Study

The present researcher refrained from beginning the study until it was ascertained whether or not the methodologies they were intending to employ were in fact likely to work suitably, validly, reliably and effectively. The aim was to have questions as free as possible either errors or problems, and to do everything possible to avoid any hiccups in the preliminary stages of the study.

The questionnaires were assessed by the researcher's supervisors (Dr Lyn Pemberton and Dr Graham Winstanley) to check if it was comprehensible, clear, unambiguous and not too difficult to respond to. Because of this an exploratory set of questions were assembled to test for weakness, inadequacy, ambiguity and unidentified problems that could be present and which might be resolved prior to commencement of the research; thus increasing the likelihood that the research would be effective. Another purpose of the pilot study was to ensure that the questions would be responded to by the participants in a quick, easy and confident manner.

This research was carried out using a self-administered questionnaire which was converted into Arabic after being developed in English. Firstly, the original questionnaires were translated by two professional translators in Libya, independently of one another, with the resulting translations being checked by the researcher for inconsistencies before the final versions of questions were decided upon. Figure (4.3) gives an example of the translation process for one of the questions.

15. At your medical institution, how many outpatients are treated on average per day?

Questionnaire

| Day of Week | Sat | Sun | Mon | Tues | Wed | Thurs | Fri |
|-------------|-----|-----|-----|------|-----|-------|-----|
| Minimum | | | | | | | |
| Maximum | | | | | | | |

Step 1:
Converted into Arabic
by two independent sources

15. في المؤسسة الطبية الخاصة بك، كم مريضاً يعالجون في المتوسط في اليوم الواحد؟

| ايام الاسبوع | الاحد | الاثنين | الثلاثاء | الاربعاء | الخميس | الجمعة |
|--------------|-------|---------|----------|----------|--------|--------|
| أقل | | | | | | |
| أكثر | | | | | | |

15. كم عدد المرضى الذين يأتون الي مصحة التي تعمل بها ويتم معالجتهم في اليوم الواحد؟

| ايام الاسبوع | الاحد | الاثنين | الثلاثاء | الاربعاء | الخميس | الجمعة |
|--------------|-------|---------|----------|----------|--------|--------|
| أقل | | | | | | |
| أكثر | | | | | | |

Step 2:
Final copy of the question

15. في المصحة الطبية التي تعمل بها، ما هو معدل الحالات التي يتم معالجتها في اليوم الواحد؟

| ايام الاسبوع | الاحد | الاثنين | الثلاثاء | الاربعاء | الخميس | الجمعة |
|--------------|-------|---------|----------|----------|--------|--------|
| أقل | | | | | | |
| أكثر | | | | | | |

Figure 4.3: An example of the translation process.

Secondly, a copy of the preliminary questionnaires in Arabic were distributed among 11 participants from various hospitals that were not later included in the principal research. The outcome of this pilot study helped the researcher to adjust or eliminate some of the questions, for example there was an overlap between the ground covered by questions, and where a question was not readily understood by the participants.

4.5.2.3 Sample Selection

Dooley (2002) explains that a study population is the total aggregation of elements that a sample is made up of. The research population used in the questionnaire for this study consisted of four groups: doctors, ward assistants, hospital administrators and nurses from the Libyan healthcare institutions that were selected to participate in this study. Bartlett, Kotrlik, and Higin (2001) put forward the alternative viewpoint that a sample is a collection of people that a researcher has selected from a predefined population. This is made up of individuals who have provided information for the purposes of the research. Tuckett (2004), states that the strategy for qualitative research sampling can be guided by the principle of getting “in-depth information”. The healthcare staff who participated in this research were selected using a purposive sample technique.

The sampling frame and techniques were based on the research goals and objectives. Furthermore, the characteristics of those who participated were based on several different models to assess E-health readiness, and was influenced by their profession's relevance to answer the research questions. Guetterman (2015), Emmel (2014) and Curtis, et al. (2000) have referred to purposive sampling as being where the researcher chooses the elements or units which are the most representative or will be of most use to the research. Thus, a selection was made in which 80 participants in total were selected, eight participants from each hospital and clinic. Those who participated are doctors, ward assistants, nurses and administrators. As shown in Table 4.6, each category of participants was represented by two participants.

The final questionnaires were initially sent to 165 potential participants at the participating healthcare institutions, as indicated in Figure 4.4.

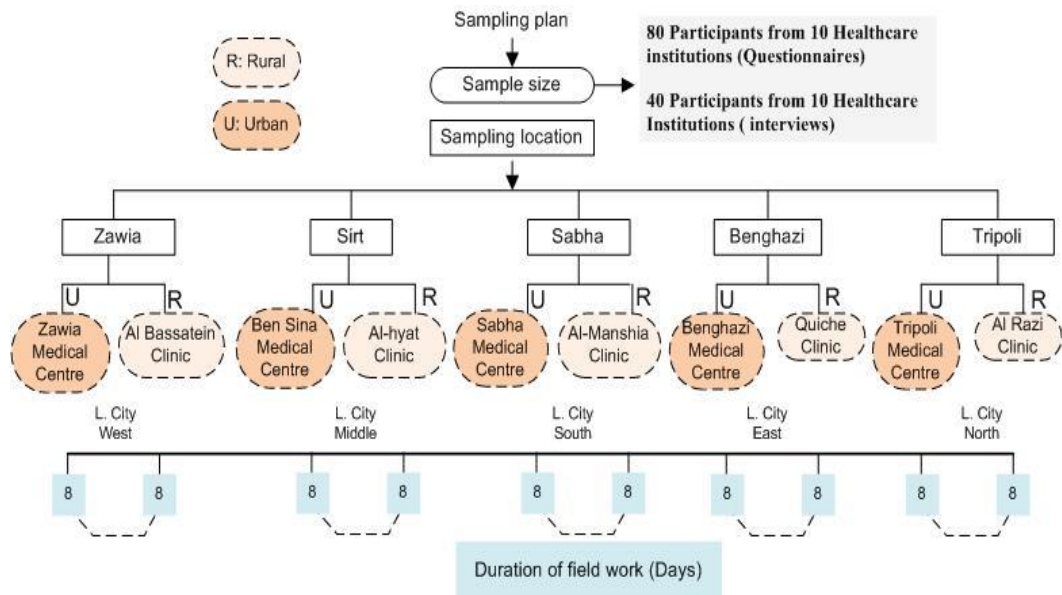


Figure 4.4: Sample distribution and size.

4.5.2.4 Procedure of Data Collection

The way in which data is collected can have a strong effect upon the quality levels of the data; this includes approaching participants ethically and professionally. By carefully preparing and planning, the researcher influenced the participants into answering in a conscientious and honest manner, and have them respond back. The

researcher was looking to achieve no less than 60% of the responses being valid; thus some careful planning was required.

For this sort of survey, the most commonly seen method for collecting data is the self-administered questionnaire; this was the method employed for this survey. Initially, information sheets were distributed within the institutions chosen for the study. and then appointments were made to arrange distribution and completion of questionnaires.

The first step taken in this research study was to apply for permission to carry out the survey at the investigated healthcare institutions within LNHS, granted permissions are attached in appendix C. The study was carried out in different regions of Libya in the cities of Zawia, Misrata, Sirt, Benghazi, Tripoli, and Sabha (see Table 4.5 and Figure 4.5), and was focussed upon both rural and urban areas. Participants were found in various disciplines, such as: nursing, doctoring, ward attendants, medical science and technology and hospital administration. A number of healthcare institutions in urban and rural areas were used in this study (see Table 4.5). The research was carried out from March 2013 to May 2013.

| City | Healthcare institution | Urban/Rural |
|-------------|-------------------------------|--------------------|
| Tripoli | Tripoli Medical Centre | Urban |
| | Al-Razi Clinic | Rural |
| Benghazi | Benghazi Medical Centre | Urban |
| | Al-Quiche Clinic | Rural |
| Sabha | Sabha Medical Centre | Urban |
| | Al-Manshia Clinic | Rural |
| Sirt | Ibn Sina Medical centre | Urban |
| | Al-Hyat Clinic | Rural |
| Zawia | Zawia Medical Centre | Urban |
| | Al-Bassatein Clinic | Rural |

Table 4.5: The healthcare institutions which participated from rural and urban areas of Libya.

Five different regions from Libya were selected for the purpose of this research study, a rural and urban healthcare institutions from each region. A total of ten healthcare institutions were selected to participate in this research.

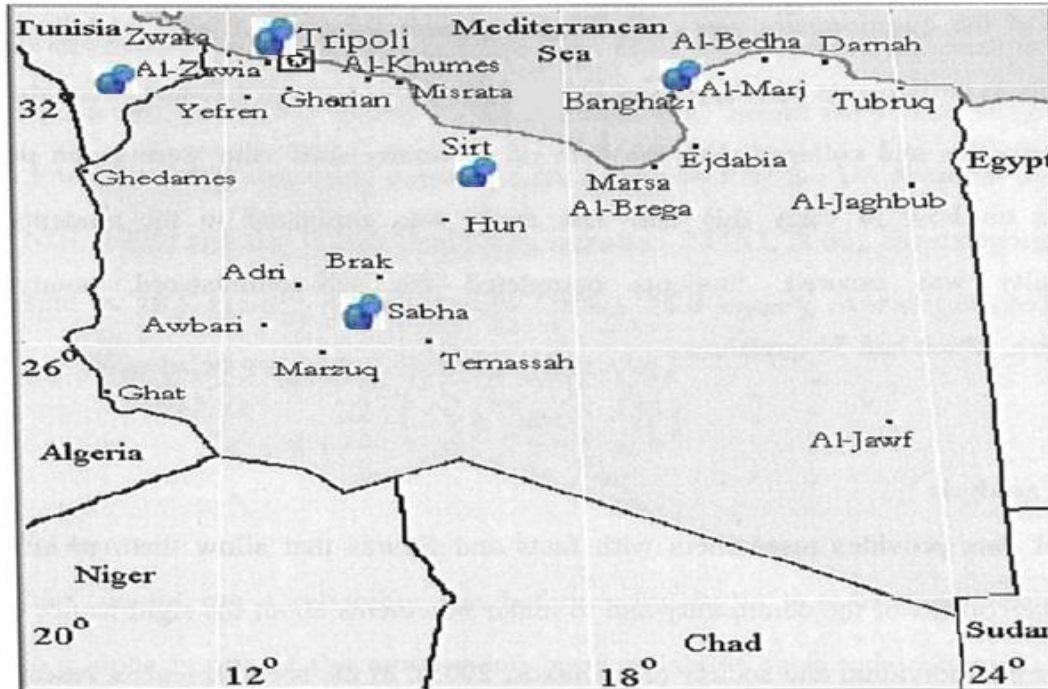


Figure 4.5: Location of Libyan cites surveyed in this study in data collection.

Prior to the distribution of the questionnaires, each participant was briefed about the objectives of this research, though they were not briefed on what was being analysed by the questionnaires, as this might have had an effect upon the responses given, hence making them less reliable. The study was presented as: investigating the implementation of healthcare ISs in developing nations and the creation of a framework for aiding in designing and developing the implementation of healthcare ISs in the future. Assurances were made to those participating that there were no correct or incorrect answers so it was not meant to be a test. It was emphasised that the most important thing was to answer honestly, independently and accurately, while participants were assured their answers were 100% confidential. Before every questionnaire, great care was taken in giving a thorough explanation of how the participant should respond.

To achieve a better rate of return and response, the questionnaires were both sent out by email and distributed in person on site, at the clinics and hospitals. The advantage of the email method is that should someone not wish to participate, then no questionnaire has been wasted, and it allows those involved to not feel like they have been pressured. The first page of the questionnaire had a consent form on it which had an explanation of the

rights enjoyed by the participants (see Appendix A). Staff helped in distributing the questionnaires in the clinics and hospitals. These staff were instructed as to how they should carry out this task in precise detail by providing them with the research background, and the importance of carrying out these questionnaires. The next section looks at the data analysis techniques used in this research.

4.5.2.5 Analysis of Results

Out of the 165 questionnaires that were given to potential participants, 138 were returned. The responses to these questionnaires were examined closely to reveal errors such as more than one answer being given to multiple choice questions, or some questions being left unanswered. Of the 138 questionnaires that were returned, 21 were filled out incorrectly and were discarded. The remaining 117 included at least two participants from each profession, in each healthcare institution.

It was difficult to get the right balance between the number of participants from each category and the location of the healthcare institutions, as the researcher aim was to compare between rural and urban healthcare institutions and to measure the similarities and differences between their E-health readiness levels.

The number was further whittled down so that only 80 were left to achieve the right balance between region/area and category. This was done by randomly choosing to discard responses (when there were more than 2 from any profession at a healthcare institution returned), in order to achieve an even distribution of responses over the four professions and 10 healthcare institutions. The final numbers and distribution are shown in Table 4.6.

| Categories of participants | Healthcare institutions | | | | | | | | | | |
|----------------------------|-------------------------|----------------|-------------------------|------------------|----------------------|-------------------|-------------------------|----------------|----------------------|---------------------|----|
| | Tripoli Medical Centre | Al-Razi Clinic | Benghazi Medical Centre | Al-Quiche Clinic | Sabha Medical Centre | Al-Manshia Clinic | Ibn Sina Medical centre | Al-Hyat Clinic | Zawia Medical Centre | Al-Bassatein Clinic | |
| Administrators | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 20 |

| | | | | | | | | | | | |
|--------------------|---|---|---|---|---|---|---|---|---|---|----|
| Doctors | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 20 |
| Nurses | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 20 |
| Ward assistants | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 20 |
| Total participants | | | | | | | | | | | 80 |

Table 4.6: Participating healthcare institutions and final numbers included in analyses.

Thereafter all data collected from the questionnaires were entered into a computer to be electronically processed. The researcher looked at many techniques for analysing the questionnaires and came to the conclusion that the optimum system to employ would be the SPSS statistical package.

Once the questionnaires had been completed the data collected from them was fed into SPSS (version 16.0), to calculate descriptive statistics from the data such as percentages and frequencies. The data was set out in frequency tables; this provides a way of setting out how many participants there were and the percentage that belonged to each category for each variable, this research results are presented in Chapter Five.

4.5.2.6 Limitations

Sarantakos (2005) states that for collecting data within social sciences, the questionnaire is one of the most effective methods. However, there are positives and negatives to this method to collect data, which were pinpointed by the present researcher, some of the positives being:

- Producing results happens quicker than in interviews.
- Emailing or posting the questionnaire is cheaper than conducting an interview.
- Participants can be guaranteed to stay anonymous.
- The questionnaire can be filled in at the participant's leisure.
- The questionnaire can cover a wide selection and great number of participants.

On the other hand, questionnaires have limitations including the following which were pinpointed by the researcher are:

- It is not possible to guarantee that the questionnaire was answered in the right order, and no extra information is provided.

- The answers given are not always complete. That was why the researcher used the interviews as a complement to the questionnaires to cover the missed areas, to ensure fulfilment of the research objectives and goals.
- Sometimes a participant is unable to fully comprehend the meaning of a complex questions.
- There is no assurance that the questionnaire will be filled out completely or returned back. For example, out of 165 questionnaires which were used in this research only 138 were returned, out of which 21 were filled out incorrectly.

4.5.3 Interviews

4.5.3.1 Justification and Background

Interviews are especially useful in acquiring an in-depth history of the experiences of those participating. There are some participants where it proved very useful to interview them after they completed the questionnaire. In order to benefit from the fact that in this method the researcher works directly with the participants, and can ask follow-up questions or probe deeper, a mixed method approach involving both questionnaires and interviews, was chosen for this research with the aim of getting a better understanding of the subject and to achieve its objectives and goals.

Seidman (2006) stated that interviews do have some drawbacks though:

- The resources required and time consumed in interviews.
- The person interviewing is taken into consideration as part of the measurement instrument and needs to be able to deal with any contingencies that might occur.
- A lot of training is required for the interview process.
- It is necessary to be aware of all the ways in which the interviewer can create a bias in the results, so as to avoid doing so.

The mixed-method approach was found to be the most common method for collecting data in social sciences. The main aim of using this approach for collecting data in this research study was to enhance validity and reliability of the research final results, to ensure fulfilment of the research objectives and goals.

4.5.3.2 Instrument Design

The interview template that was employed for this research study contained seven questions. The Chan framework (2010) and several other models were used for the

formulation of the questions. The interview questions were then translated into Arabic, and the finished product was tested on Libyan students residing in the UK to check the quality of the translation and to make sure that it was clear and comprehensible.

The translated version of the interview's questions along with the interview and research objectives and the title of the research in large font were printed out. The questions covered several areas which could have an impact on E-health implementation such as the technical, political, and social issues. To assess the E-health readiness within LNHS. The interview questions can be found in appendix B.

4.5.3.3 Sample Selection

A total of 40 volunteers participated from different professions (doctors, ward assistants, administrators and nurses) were interviewed in Arabic using semi-structured interview techniques. The sampling frame and techniques were based on the research goals and objectives. Furthermore, the characteristics of those who participated were based on several different models to assess E-health readiness, and was influenced by their profession's relevance to answer the research questions. Table 4.7 shows the number of participants and the selection criteria. During the interview seven questions were put to those who participated in the interviews. For example, Question 6 was:

6. How do you feel about accessing Ehealth applications outside of your job? Is this something you would like to do and why?

6. ماهو شعورك حول الوصول إلى تطبيقات الصحة الإلكترونية من خارج عملك؟ هل هذا شيء كنت ترغب في القيام به، ولماذا؟

4.5.3.4 Procedure of Data Collection

Each interview was carried out face-to-face and took between twenty to forty minutes, which averaged out at approximately thirty minutes for each interview. The researcher required approximately twenty hours to interview all of those who participated; details of the interviews are illustrated below in the next section in table 4.7. Before every interview the researcher introduced themselves and explained the research structure and purpose. The participants were assured that measures were being taken to ensure that all the information recorded during the interview would remain private and confidential. Once a participant had expressed consent, an appointment was made for carrying out the interview itself at the participant's convenience. Some interviews were returned to once

or twice as some of the participants' responses needed to be clarified, and to gather more information.

Some of the participants agreed for their interviews to be recorded, however, 27 of them asked for a recording not to be made. All recordings were destroyed by the researcher in a safe manner after emptying the recorded information on paper to guarantee anonymity. Table 4.7 shows the details of the interviews which were carried out.

As well as the interviews, the researcher participated in informal conversations with the participants; this occurred frequently during their normal lunch or tea breaks (see also Section 4.5.3.6). These conversations turned out to be very productive as a lot of additional information was collected, perhaps because the participants were more relaxed in the informal atmosphere.

A professional transcriptionist was employed to transcribe each interview and each interview was cross-checked by the researcher to make certain that the transcriptions are identical with the sources. The material that was transcribed and checked in a thorough fashion to ensure it was correct.

The overall aim in the interview was to collect information directly relevant to the study's aims and objectives. The researcher concentrated upon trying to identify issues that might promote or stop E-health technology being adopted within the healthcare institutions where the participants worked; looking to see what ideas might arise about how E-health systems could be adopted successfully. If a factor was considered to hinder or favour the adoption of E-health systems, then it was noted, and if a participant

| Categories of participants: | Healthcare institution | | | | | | | | | | Total participants | No. of interviews |
|-----------------------------|------------------------|----------------|-------------------------|------------------|----------------------|-------------------|-------------------------|----------------|----------------------|---------------------|--------------------|-------------------|
| | Tripoli Medical Centre | Al-Razi Clinic | Benghazi Medical Centre | Al-Quiche Clinic | Sabha Medical Centre | Al-Manshia Clinic | Ibn Sina Medical centre | Al-Hyat Clinic | Zawia Medical Centre | Al-Bassatein Clinic | | |
| Administrators | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 4 |
| Doctors | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 2 |

| | | | | | | | | | | | | |
|-----------------|---|---|---|---|---|---|---|---|---|---|----|---|
| Nurses | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 2 |
| Ward assistants | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 | 1 |
| Totals | | | | | | | | | | | 40 | 9 |

Table 4.7: Details of the interviews carried out for this research.

said that a particular topic concerned them that topic was concentrated on in their interview as a matter of priority.

4.5.3.5 Analysis of Results

According to Darke et al. (1998) it is possible to counteract biases that might be present in the data collected and then analysed by a researcher by using evidence from multiple sources for providing multiple instances that come from more than one source. Any findings from a case study are made stronger when information from different sources is pooled to provide several measurements of the research subject (Tolley et al., 2016; Creswell, 2014; Yin, 1994; Cavaye, 1996). Moreover Walsham, (1995) advocates taking care of certain methodological issues when undertaking interpretive case studies: the epistemological stance should always be explicitly stated; a fine-grained and detailed description in which anthropological tradition is used should be provided; and the ways in which theory is employed as a guide for data collection should be discussed, and included in the iterative process for analysing and collecting data, and should inform the research's final product.

Furthermore, researchers are also advised to discuss their role in collecting data: that of being an observer looking in from the outside or being more involved in some way. Darke (1998) recommend providing precise details about: research sites, criteria for selecting sites, how many participants and what organisational positions they held, sources of data, period of time over which the study was carried out and the techniques used for analysing data.

When selecting participating healthcare institutions, the researcher took into account their geographical locations, and have contacted several healthcare institutions to obtain a permission to carry out this research study. From those who replied the researcher carried out another selection to choose five large medical centres in urban areas of Libya, and five clinics in rural areas.

A proposal for what principles to employ when interpretive case studies are conducted and evaluated has been put forward by Klein et al. (1999, pp.67-94). These are based upon hermeneutic philosophical perspectives and can for the most part be applied to a research study such as this. The principles used to evaluate and carry out interpretive research are given in Table 4.8.

| Fundamental principles for the evaluation and carrying out of interpretive studies. | Where and how they have been applied in this research study. |
|---|---|
| <p>The Principles of the Researcher’s and Participants’ Interactions: There is a requirement here for reflecting upon the ways in which the material or data used for the research were socially constructed by the interactions of participants and researchers.</p> | <p>The researcher’s role is the observer as participant. This can be seen from the fact that the researcher visits the healthcare institutions, observing the physical conditions in the healthcare institutions and interacting with those participating in the study.</p> |
| <p>The Fundamental Principle of the Hermeneutic Circle: The suggestion made by this principle is that the achievement of all understanding is carried out by repeatedly going between thinking about how different parts relate to each other and the entirety of the whole. This facet of the process of understanding by humans is fundamental to all other principles of human understanding.</p> | <p>This principle is applied in the results analysis in Chapter Five. The researcher has used holistic-case, cross-case and within-case analysis templates to clarify how different parts relate to each other.</p> |
| <p>The Dialogical Reasoning Principle: There is a requirement for being sensitive to whether or not there is a contradiction between actual findings and theoretical preconceptions that</p> | <p>The researcher has compared the research findings with the theoretical preconceptions that guided the research design in the literature review chapters (two and three). The</p> |

| | |
|---|---|
| guides the research design with cycles of revision that subsequently occur. | reasoning principle was applied in chapters (six and seven). |
| <p>The Contextualization Principle:</p> <p>It is necessary to critically reflect upon the historical and social backgrounds of the subject of the study so that a reader can better understand the evolution of the phenomena currently being investigated.</p> | This was applied in chapter five and was used for highlighting the background histories of the multiple case studies in the healthcare institutions which led to the research question being positioned as it was. |
| <p>The Principle of Suspicion:</p> <p>There is a requirement for being sensitive to any distortions and biases in the statements given by the participants.</p> | To avoid “false preconceptions” the collection of data from those who participated was carried out anonymously. Data was collected from multiple sources and data was collected using multiple measures (document analysis, interviews and questionnaires). |
| <p>The Principles of Generalisation and Abstraction:</p> <p>For this the idiographic details shown by interpreting the data by applying (The Principles of the Researcher’s and Participants’ Interactions, and The Contextualization Principle) to general and theoretical concepts that are descriptions of social action and human understanding.</p> | No generalisation; the details shown by the data are based on content-specific data, which focuses on relationships between E-health readiness assessment and healthcare institutions issues in Libya. |
| <p>The Principle of Multiple Interpretations:</p> <p>There is a requirement for being sensitive to possibly different interpretations by those participating, as are sometimes given in multiple</p> | The researcher used the principle of multiple interpretations to examine influences that the research participants (administrators, doctors, nurses and ward assistants) have upon the E-health readiness assessment, and |

| | |
|--|---|
| narratives about the same phenomena. This has similarities to accounts by multiple witnesses, where all saw the same event and recall it exactly as they experienced it. | documenting multiple view points by using mixed method. |
|--|---|

Table 4.8: Principles used to evaluate and carry out interpretive research.

Researchers are required by the Hermeneutic Circle and Multiple Interpretation principles to examine and understand a situation in parts, then to look at it as a whole, and their interrelationships (Polit and Beck, 2005). Therefore, all data from this research study were processed and analysed systematically in order to detect relationship patterns or trends. And because analysing some of the data required interpreting data and text, the researcher's choice was to utilise the Khan and Van Wynsberghe (2008) template for analysing their case study, involving within-case, cross-case and holistic-case analyses. Mitchell et al. (2016); Melinda et al. (2016) and Khan and Van Wynsberghe (2008) explain the three methods as follows:

- **Within-case analysis:** This method applies to multiple collective or single case studies and the researcher analyses each individual case for themes. While studying multiple cases, researchers can make comparisons within case themes, across multiple cases, in cross-case analysis.
- **Cross-case analysis:** This type of analysis applies to collective case studies when more than one case is examined by the researcher. It entails the examination of themes across given cases for discerning themes that are evident in all cases under consideration.
- **Holistic-case analysis:** This type of data analysis entails the researcher examining all cases together and presenting themes, descriptions and assertions that relate to all cases.

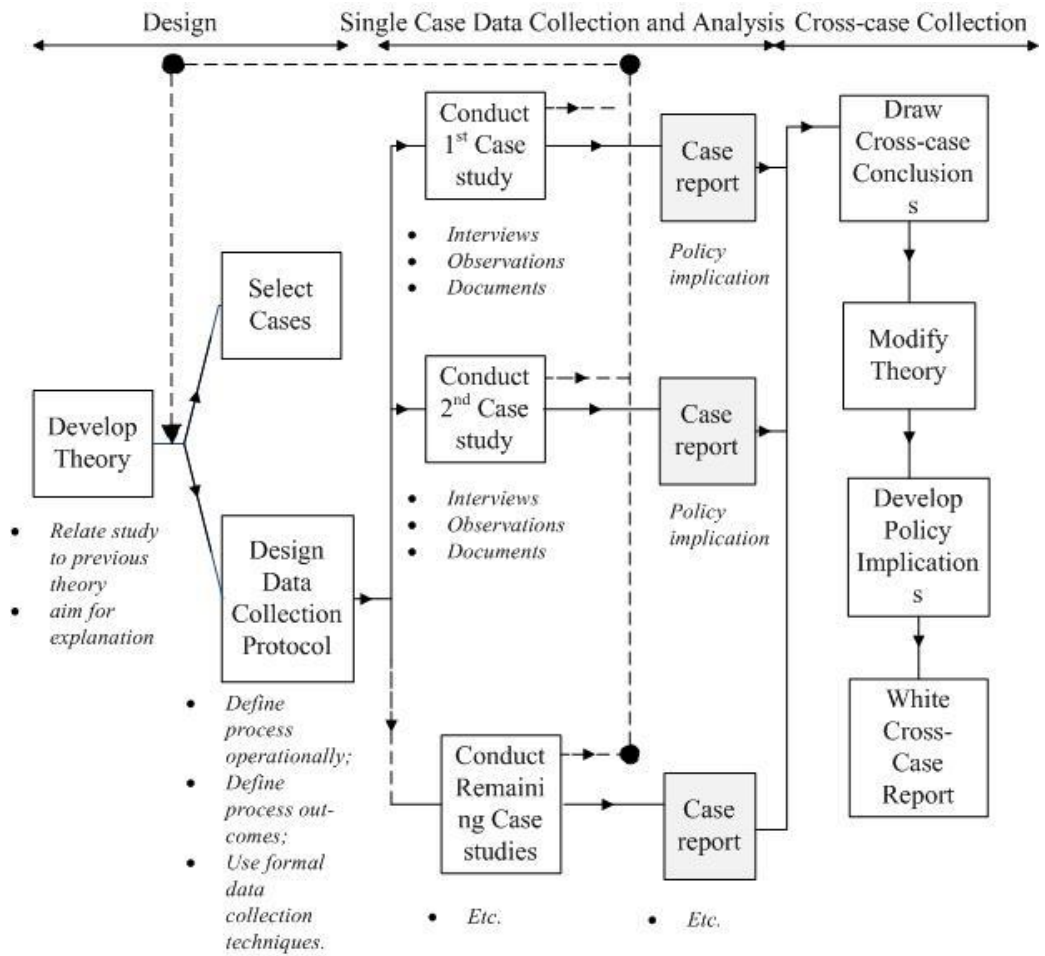


Figure 4.6: Case Study Method (Yin, 1994).

The researcher has chosen to use the three techniques discussed above (*Within-case analysis, Cross-case analysis and Holistic-case analysis*) for analysing data. This is because the research study investigates how much information communication technology is available and being used in each healthcare institution involved in this study. First, all data collected from each healthcare institution was analysed separately. Next, E-health assessments of urban and rural healthcare institutions were compared, where data was analysed in separate categories for rural and urban healthcare institutions. Then, all data collected from this research study was put into a single category together for analysis.

For the purpose of carrying out the analysis comprehensively, the data will be coded and categorised for all parts of the research. The process for coding and analysing data for this research study was carried out following the suggestions of Roberts and Priest (2010, p. 165):

- Create a picture of the whole by reading through the transcript carefully while making notes;
- Go through each document individually, while making sense of its content and make notes in the margins;
- Once this has been carried out for a number of documents, a list should be made of the topics covered. Group similar topics together and make them into columns that can be sorted as leftovers, unique topics and major topics;
- Taking the list, return to the data. Abbreviating the topics as codes, the codes should be written next to the relevant segment of text in order to ascertain if new codes and categories are emerging;
- Come up with wording that best describes each topic and transform them into categories. Make a reduction in the total number of categories by grouping together topics that are related. The interrelationship of categories can be indicated by drawing lines between them;
- Take a decision about what abbreviation will be used for each of the categories and arrange them in alphabetical order;
- Collect together any information that is available from all of the categories and carry out preparatory analysis;
- If necessary, all of the data must be recoded.

The researcher has also looked at many techniques for analysing semi-structured interviews qualitatively. One of the major challenges of carrying out a qualitative analysis is to find an automatic system that will aid in managing the data that was collected during the interviews. One method would be to do it manually by writing it out on paper using coloured pens and cutting out coloured passages that could be grouped together. Alternatively, there are several programs that can be used on computers that have been designed for carrying out qualitative analyses, such as: NVIVO, QDA, MAX and Atlas Ti.

The researcher came to the conclusion that the optimum system to employ would be a combined deductive and inductive approach. Hence, the researcher found that NVIVO (version 10) was one of the best suited for the needs of this research study. The reason for choosing NVIVO version 10 is because of its ability to analyse semi-structured

interviews qualitatively, and makes the qualitative data that was collected during the interviews manageable and amenable to analysis.

By using the approach suggested by Christoph et al. (2016); Melinda et al. (2016) and Roberts and Priest (2010, p. 165) the researcher read through all the interviews transcript and made notes on topics talked about, ideas, thoughts, and feelings to create a picture of the whole. After reading through all the transcripts the researcher made notes on the general themes (see appendix G).

In the next stage the researcher read through each document individually to summarise and categorise all aspects of each interview content. Once this has been carried out for a number of interviews' transcripts the researcher started to make a list of covered topics, by listing similar topics together to look for similar or overlapping categories and combine them together where possible. Each topic was then given a code, abbreviating the topics as codes in order to ascertain if new codes and categories are emerging. This process was carried out for all interviews' transcripts, at the end of this process a list of categorised covered topics was produced. This process is covered in more details in appendix G.

When the above process was complete the research made further reduction in the total number of categories by grouping together topics that are related. The final categories were then put into a list in alphabetical order with abbreviation used for each category (see appendix G). Preparatory analysis was then carried out on all available information. For more details on data analysis and results please refer to Chapter Five.

4.5.3.6 Obstacles Faced when Carrying out the Interviews

Hurdle placed in the researcher's way when carrying out the interviews was that of gender. That is because of the restrictions within the Libyan culture regarding the mixing of males and females. As participation to this research study was made voluntary, the majority of applying participants were males and only few females came forward to participate.

Furthermore, time presented serious limitations to this research study. Some of the healthcare institutions allowed interviews to be for no longer than 25 minutes only; this was because the management of those healthcare institutions did not want the medical

staff's time intruded upon. The researcher overcame this limitation by carrying out informal meetings with participants during their normal tea and lunch breaks, and whenever that was possible, to gather as much information as possible for the purpose of this research, and to clarify on some the information given and points made during the formal interviews.

4.5.4 Document Review

4.5.4.1 Justification and Background

Document analysis was another technique utilised for gathering information about the readiness of the LNHS to implement E-health systems. The emerging information from documents and published papers showed that there were no E-health technologies being used in the LNHS at the time of this research study, it was not necessary to assess existing levels of E-health usage. This derived information served as supportive and confirmative evidence regarding the data collected while carrying out the interviews and questionnaires.

The information derived from documents provided the researcher with good background information and historical insight, tracking change and development. The information gained from these documents helped the researcher to understand the root of specific issues that could affect the implementation of E-health system in LNHS.

Furthermore, the information gained from documents helped the researcher to generate new questions that needed to be asked during interviews or to inform observations made by the researcher in the course of the research study, questions such as:

4. Is there technology in your medical institution at this time that might support such an E-Health application? Please be specific.

Analysis of documents provided the research study with additional valuable information and insights by covering a long span of time. The researcher employed this method because it works in conjunction with the other research methods selected for this study to increase the trustworthiness of the findings.

4.5.4.2 Sample Selection

A wide range of documents that are publicly available and would not endanger patient confidentiality or break classified information rules of the Department of Health (DoH)

were examined. An example of a DoH publication used is the Draft E-health White Paper Discussion Document that has been produced by the Libyan National Health Department and has been used by the LNHS. This document is available and can be found at healthcare institutions in Libya.

The researcher has used some of the information available from those available documents for the purpose of this research study. The documents used are attached in appendix F.

4.5.4.3 Procedure of Data Collection

The researcher gathered a number of useful and usable documents for the purpose of this research study, and followed certain criteria to conduct document analysis. Firstly, after securing the permission to carry out this research study at LNHS healthcare institutions (granted permission letters are attached in appendix C), the researcher conducted an assessment on the available documents provided by the LNHS, which could help in answering the research question. The researcher took privacy and confidentiality measures when conducting the stage of information gathering for the purpose of this research study, as to not publish any private and confidential information. A consent form was signed by the researcher upon arrival at each investigated healthcare institution as requested by their managements.

To gain better understanding of the context of those documents, the researcher asked members of staff for help. The accuracy of the documents was also checked by comparing them with other similar information. Lastly, the researcher created a process to summarise the information collected from those documents to use for the purpose of this research.

4.5.4.4 Limitations

One of the major challenges to collect documented information from Libya for this research study was the insecurity and civil war in some parts of the country, and the widespread looting and destruction. That is why some documents were inaccessible because of the instability of situation and the place they were stored in.

Furthermore, there were no data repositories to provide a better sense of direction to help the researcher find the required information quickly and save time. From this

point we can see the need for implementing E-health systems and online resources for the LNHS.

4.6 Ethical Issues

Research ethics are handled differently across the globe, depending upon which continent or country one goes to. In some countries it is compulsory for a study proposal to have a review board and review how ethical it is before allowing it. However, in some other countries such rules do not apply and there are no requirements for a board to review how ethical a proposal might be (Runeson and Host, 2009).

The nature of this research study and the use of participants and sensitive information were taken into consideration, the research's ethical issues were deemed an important part of the study and were seen as being crucial to successfully completing this research.

The project

proposal was approved as being in accordance with the University's research ethics guidelines.

Srivastava (2010) states that ethics are behavioural standards that provide guidance for moral choices regarding the way we behave and our relationships with others. It was the researcher's intention throughout this study to respond to any ethical issues that became evident. The first step was the practical observation of any ethical matters that might arise during the process of collecting the data that might occur due to the culture in Libya. The researcher was also vigilant to make sure that the participants were not harmed in any way because of this research study. Therefore, ethical guidelines discussed below would protect all those participating in the research when they answered interview questions or questionnaires.

The main points that the researcher observed when carrying out this research are that confidentiality was always protected, and informed consent was always sought from all those who participated in interviews or questionnaires. De Leeuw, Hox and Dillman (2008) have given explanations regarding how these two points can be ensured:

- *Informed consent*: Any information available about any potential harm that may befall the participants should be provided to the participants by the researcher, while ensuring that the participants have fully understood this information. It is

especially important that the researcher does not influence the response of the participants to the informed consent in any way and that it can be proven that participants were not coerced into participating, but of their own free will signed agreements giving their consent.

- *Protecting confidentiality*: A breach of confidentiality is one of the greatest risks that a participant faces. In the most extreme cases, this might result in a criminal prosecution, losing their job or public embarrassment. A participant's confidentiality could be breached by not removing their name or contact details. If the information from an interview or questionnaire is stored incorrectly it could be accessed by an unauthorised individual and misused. In the present research study the researcher aims to assure research participants that all data is stored anonymously and securely and the provided information cannot be traced back to research participants in research outcomes.

This research study questionnaire included a consent agreement on the first page of the questionnaire that the participants received, and contained the information below:

- The researcher's contact details and name.
- The study's aims and purpose.
- What actions will be taken in order to carry out this study, for instance describing what the participants will be required to do in the study and what the researcher will be doing during that time.
- A clear statement that participants are taking part voluntarily and that all the information provided will remain anonymous.
- The research study carried out for academic purposes does not expose the research participants to harm.
- All the benefits for the participants were listed, for instance that they will experience a technique they have not experienced, and possible outcomes that might occur when implementing E-health systems.
- How confidentiality would be preserved was described.
- The researcher and participants signed and dated the form.

One perhaps unexpected concern in connection with ethical issues expressed is that of cultural sensitivity. Harris and Brown (2010) argue that the participant's and

researcher's relationship while an interview is taking place should take into consideration the participant's values and cultural aspects. Thus, the researcher took the appropriate steps required for adhering to culturally appropriate ethical principles, so that the participant's anonymity, privacy, confidentiality, dignity and rights were protected. In the following the ways in which ethical issues were addressed are described:

- *Informed consent*: Those taking part in the pilot studies were told about the research's purposes when they received Informed Consent Forms. Those participating in the main study were made aware of the research's purposes and objectives on the first page of the questionnaire.
- *Harm and risk*: During carrying out this research study, the researcher will do his best to ensure that nobody participating in the study would be put into a situation where they would be exposed to harm because of their participation, whether physically or psychologically.
- *Honesty and trust*: The researcher spoke the truth and explained the purpose and nature of research study to the research participants, and the rights and freedom of research participants to participate or not were respected. The right of research participant to withdraw from the research study was an issue that was taken into consideration by the researcher.
- *Privacy, confidentiality, and anonymity*: The participants in the pilot and main study were asked not to supply any personal details so that their confidentiality might be maintained. Additionally they were not asked any questions of a personal nature; thus it was not potentially possible that any of the participants would come to any harm because of a loss of confidentiality.
- *Voluntary participation*: It was further explained to participants that the study was being carried out just for academic purposes, that they were participating completely voluntarily and could drop out at any time.

4.7 Chapter Summary

This chapter reviewed a range of theoretical and philosophical viewpoints in relation to the methods and methodology used in research. It provided a description of the mixed method approach (quantitative and qualitative) that was adopted as the methodology for

the research presented in this thesis. This methodology was used to achieve the aims and objectives of this research study.

Ostlund, Kidd, Wengstr and Dewar (2011) explained that a lot of researchers acknowledged that using quantitative and qualitative methods may complement one another in many research approaches. This was the main reason why for the researcher to choose to use the mixed methods method, where using a mixed method will allow for a greater breadth of information to be collected for the purpose of the present research study.

As seen in this chapter the approach taken in this research study is an interpretivism one. The reason for taking this approach is because the interpretivism approach has a strong focus on the preparatory stages of the research, and concentrates upon the interpretation and discovery of social patterns.

These findings indicate that the Case Study Method which was selected by the researcher has been used by other researchers successfully, yielding good outcomes and results and a clear understanding of the research problem. This method was employed in order to be able to more easily triangulate data, due to the analysis techniques and multiple data that is collected, and to strengthen the findings and conclusions of this research. The present research study used multiple case studies (five rural clinics and five urban medical centres) to investigate and assess the E-health readiness levels within the LNHS.

This chapter discussed the range of possible methods and argued and justified that the most suitable were interpretivist and mixed methods research strategy, using both questionnaires and interviews to investigate and assess the readiness levels of the LNHS to implement E-health systems. The employed instruments were used to investigate what factors would affect the implementation of E-health systems in Libya from healthcare professionals' perspectives.

The research population used in the questionnaires and the interviews consisted of four groups (doctors, ward assistants, hospital administrators and nurses) working at the investigated healthcare institutions. From 10 healthcare institutions the total of 80 participants were used in the questionnaires, and 40 participants were used in the

interviews. The healthcare staff who participated in this research were selected using a purposive sample technique, and their participations were voluntary.

For all data collected from this research study to be processed and analysed systematically in order to detect relationship patterns or trends between them. The researcher's choice was to utilise the Khan and Van Wynsberghe (2008) template for analysing their case study, involving within-case, cross-case and holistic-case analyses.

The researcher came to the conclusion that the optimum system to employ would be a combined deductive and inductive approach. NVIVO (version 10) was selected to help analysing the interviews because of its ability to analyse semi-structured interviews qualitatively, and makes the qualitative data that was collected during the interviews manageable and amenable to analysis. SPSS statistical package (version 16.0) was selected to help analysing the questionnaires, and to calculate descriptive statistics from the data such as percentages and frequencies.

The appropriate steps required for adhering to ethical principles were taken into consideration in this research study, so that the participant's anonymity, privacy, confidentiality, dignity and rights are protected. The following chapter will present the data analysis and the research results and findings.

Chapter Five
Results and Analysis

5.1 Introduction

Chapter Four presented the research methodology and described the mixed methods approach that has been adopted for the purpose of this research study. This chapter presents the research findings and explains the methods used to analyse and interpret the data collected from the questionnaires and interviews.

Creswell's (2007) framework for the analysis of multiple and collective case studies has been used, this framework contains four phases which are used in data analysis in this chapter (Conway et al., 2016; Theiler, 2012; Nelson and Martin, 2013). Figure 5.1 shows the framework and its four phases, and indicates how it maps onto the sections of this chapter.

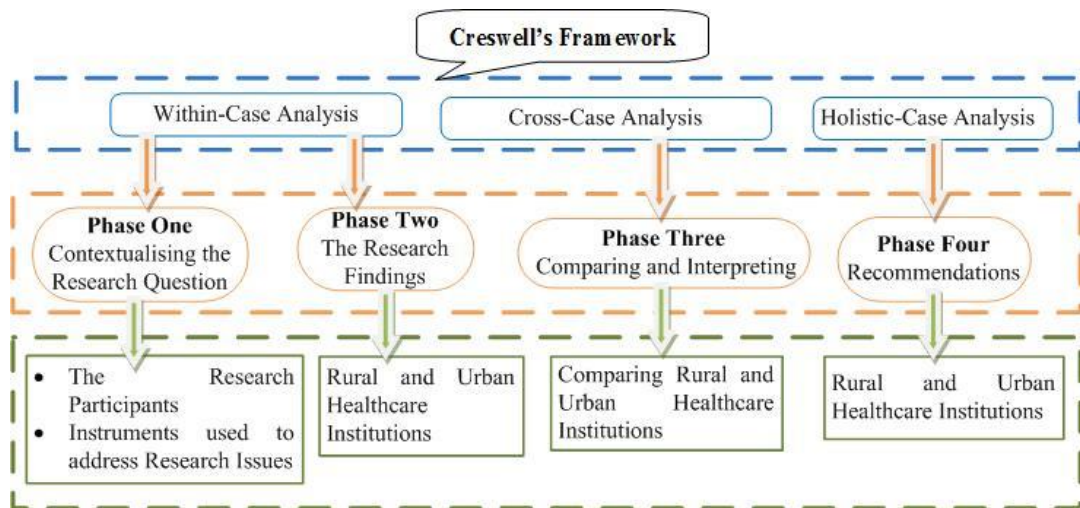


Figure 5.1: Creswell's framework.

Creswell's (2007) overall view of analysis is that information is broken down into smaller components and reconstituted, forming a larger picture. The process begins with Phase One which focusses on contextualising the research question, followed by Phase Two which focuses on presenting the research findings (in the present work, this is divided into two parts, urban settings and rural settings), and Phase Three which concentrates on comparing and interpreting these research findings. Phase Four presents the recommendations made by the researcher following these findings.

5.2 Phase One: Contextualising the Research Question

The primary research question that this study addresses is (repeated here for ease of reference):

How could an E-health Framework designed to enhance the delivery of healthcare services in Libya be composed?

The primary research question was divided into two Research Sub-Questions (see Figure 5.2), and various measuring instruments were utilised for collecting data. There were several different instruments were utilised for analysis in this research in order that a deeper understanding of the analysis of the investigation might be achieved. Moline and Cameron (2010) state that the use of several different methods for analysis allows more detail to be obtained about the subject being investigated.

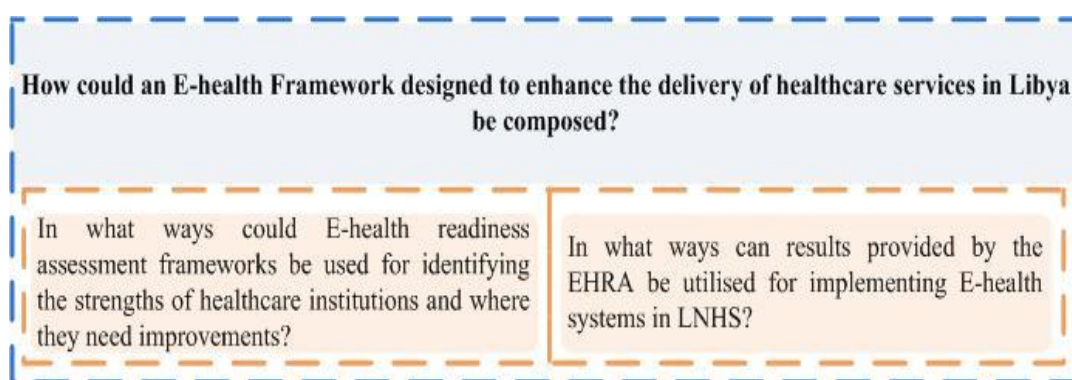


Figure 5.2: Research Sub-Questions 1 and 2.

The E-health readiness framework which was formulated to assess the readiness of the Libyan National Health Service (LNHS) to implement E-health systems (Chapter 3) for the purpose of this research study has been utilised to construct the questionnaire questions and interview questions to answer the main research question and its two sub-questions (Figure 5.2).

5.2.1 The Research Participants

As previously mentioned, purposive sampling was utilised for selecting the participants from urban and rural healthcare institutions in order to achieve the aim of the research study. In total there were eighty participants chosen from healthcare institutions. In each institution two examples of role holders were selected from each of the following groups: doctors, nurses, ward attendants and administrators.

All the participants were told that their participation in the research was completely voluntary and they were assured about the confidentiality of their responses to the

questions. Consequently they all agreed to participate voluntarily. The ten healthcare institutions that were chosen were divided into rural and urban categories and given reference codes. The participating healthcare institutions are listed in Tables 5.4 and 5.11. Figure 5.3 shows the participating urban and rural healthcare institutions and their locations, as well as the sampling plan.

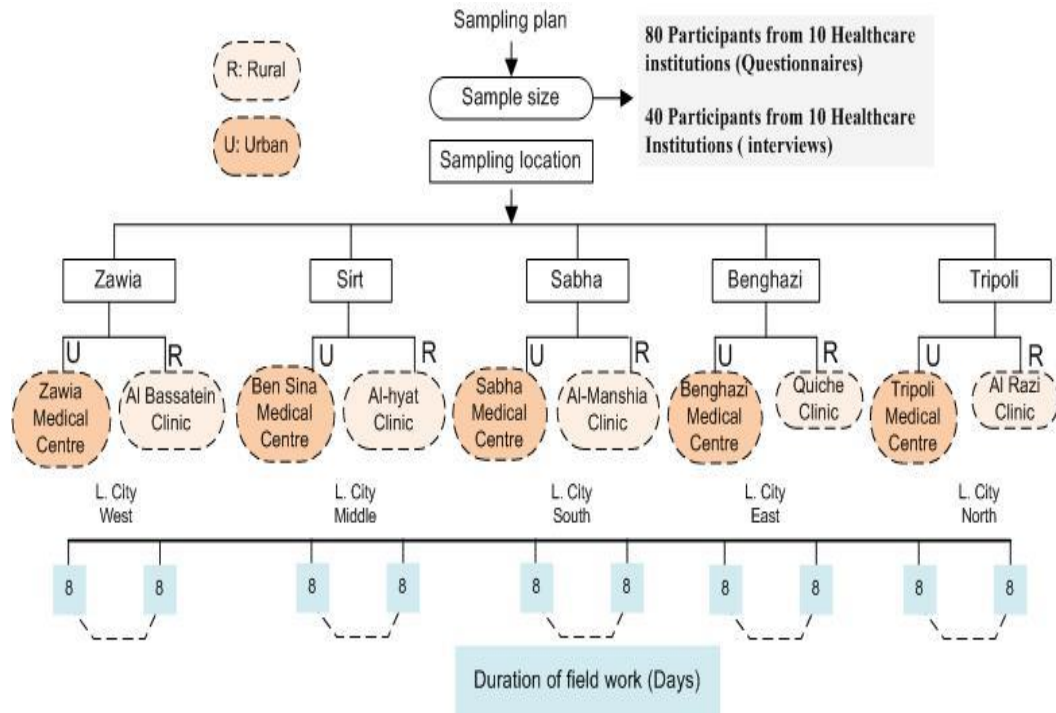


Figure 5.3: Participating healthcare institutions, and sampling plan.

5.2.2 Instruments used to Address Research Issues

This section presents the instruments that were used to address the research issues. The researcher has used interviews and questionnaires as explained in the Methodology Chapter to answer the main research question. In this section these two instruments will be explained in more detail to show how each question has been used to gather the most possible data for the purpose of this research study, and how the collected data has been interpreted and analysed.

5.2.2.1 Interviews

One of the instruments that were employed for collecting data for the purpose of this research study was interviews. Those who participated in the interviews were staff working at the healthcare institutions which are listed in Tables (5.4 and 5.11). The

interviews were carried out separately for each participating healthcare centre, as each centre formed a separate case study for the whole research.

Table 5.1 presents the issues that were addressed by using the interviews instrument, and shows a summary of the objectives behind each question asked at the interview. Only questions number are included in this table, for interview questions please see appendix B.

| Types of participants | Themes (NVivo) | Objectives | | | | | |
|---|---|--|--|------------------------|------------------------|--------------------|---------------------|
| <p>1. How would you expect your medical institution to benefit from the installation of the following Ehealth applications?</p> <table border="1"> <tr> <td> <p>E-patient health record systems</p> <ul style="list-style-type: none"> ➤ Time for recording patient information ➤ Time for retrieving patient information ➤ Diagnosis and treatment time ➤ Confidentiality of patient information </td> </tr> <tr> <td>E-consultation systems</td> </tr> <tr> <td>E-prescription systems</td> </tr> <tr> <td>E-referral systems</td> </tr> <tr> <td>E- training systems</td> </tr> </table> | | | <p>E-patient health record systems</p> <ul style="list-style-type: none"> ➤ Time for recording patient information ➤ Time for retrieving patient information ➤ Diagnosis and treatment time ➤ Confidentiality of patient information | E-consultation systems | E-prescription systems | E-referral systems | E- training systems |
| <p>E-patient health record systems</p> <ul style="list-style-type: none"> ➤ Time for recording patient information ➤ Time for retrieving patient information ➤ Diagnosis and treatment time ➤ Confidentiality of patient information | | | | | | | |
| E-consultation systems | | | | | | | |
| E-prescription systems | | | | | | | |
| E-referral systems | | | | | | | |
| E- training systems | | | | | | | |
| Administrators, doctors, nurses and ward attendants | E-prescriptions E-consultations E-referrals E-training | <p>Determining how each theme would be accepted, and how beneficial participants felt that they would be if implemented in their healthcare institution in relation to:</p> <ul style="list-style-type: none"> ○ How much time is required for recording patient data. ○ How long it takes to retrieve patient data. ○ Maintaining patient confidentiality. ○ The improvement of | | | | | |

| | | |
|---|---|--|
| | | <p>work systems.</p> <ul style="list-style-type: none"> ○ How easy the system is to operate. |
| <p>2. How do you think any of the applications above would improve efficiency in your medical institution? Please be specific about the system and your expectations.</p> | | |
| | Current E-health challenges in the healthcare institutions | Determining which E-health systems are needed for each healthcare institution relative to their requirements. |
| <p>3. Do you feel that the implementation of any of the systems you detailed above would create any problems? Be specific about the system and problem.</p> | | |
| | Anticipated challenges | Establishing which challenges are likely to occur once the technology is installed. |
| <p>4. Is there technology in your medical institution at this time that might support such an E-Health application? Please be specific.</p> | | |
| | Available E-health systems | Determining which E-health systems are currently in use in the healthcare institutions. |
| <p>5. Would it be to your liking to be trained in the use of computers so that your job performance might be enhanced?</p> | | |
| | Training requirements | Establishing the computer literacy levels of staff and how much they need to be trained to operate E-health systems. |
| <p>6. How do you feel about accessing E-health applications outside of your job? Is this something you would like to do and why?</p> | | |
| | E-health systems accessible outside the working environment | Determining whether E-health systems should be accessible by healthcare staff outside the work |

| | | |
|---|--------------------------|---|
| | | environment. |
| 7. Is there something else you would like to add or something you feel needs recommending or commenting upon? | | |
| | Recommendations by staff | To gain extra ideas that might contribute towards the development of the E-health framework that could have been omitted from the interviews or questionnaires. |

Table 5.1: Explanation of the questions in the interviews.

To cover areas which are not covered in the interviews and to reduce time spent for each interview a second instrument was utilised. The following section will describe how the questionnaire instrument was used to collect data for the purpose of the present research.

5.2.2.2 Questionnaires

The second instrument that was used by the researcher to collect data for the purpose of this research is questionnaires. Two questionnaires were produced where each questionnaire contained different sets of questions. One set of questions targeted administrators working at healthcare centres, and the other set of questions targeted doctors, ward attendants and nurses, to obtain more specific information for assessing the E-health readiness. The questions in the questionnaires were drawn up using the formulated E-health readiness assessment framework.

Table 5.2 presents the issues that were addressed by the questionnaires for hospital administrators (Appendix A) and shows a summary of the objectives behind each question asked, and how it was used to gather the most data possible to answer the main research question. The questions are included in the main tables (5.8 and 5.11) and only questions number are included in this table, for administrators questionnaire's questions please see appendix A.

| Type of participants | Question Number | Themes | Objectives |
|----------------------|-----------------------------|--|--|
| Administrators | Q1.-Q4. See Appendix A | General information | Establishing background and setting of the healthcare institution. |
| | Q5.-Q9. See Appendix A | ICT facilities | Establishing what ICT technology has been installed in the healthcare institutions. |
| | Q10.-Q14. See Appendix A | E-health systems | Eliciting what E-health systems are available at the moment in the healthcare institution. |
| | Q15.-Q19. See Appendix A | The work processes of healthcare staff | Determining what services the healthcare institutions provide and the ways in which the healthcare staff carry these out. |
| | Q20.-Q23. See Appendix A | Linking to other healthcare institutions | Establishing how frequently referral cases occur and the ways in which other healthcare staff conduct their consultations. |

Table 5.2: Explanation of the questions in the questionnaire for administrators.

Table 5.3 presents the issues that were addressed by questionnaire for doctors, nurses, and ward attendants (Appendix A) and show a summary of the objectives behind each question asked, and how it was used to gather the most data possible for the purpose of this research. The questions are included in the main tables (5.8 and 5.11) and only

questions number are included in this table, for doctors, nurses, and ward attendants questionnaire's questions please see appendix A.

| Type of participant | Question number | Themes | Objectives |
|--|----------------------------------|---|--|
| Nurses, doctors and ward attendants | Q1.1.-Q1.3. See Appendix A | Processes for the use of patient health records | Establishing whether doctors carry out their work in multidisciplinary teams and whether they are sharing patient health records. |
| | Q2.1.-Q7.4. See Appendix A | Patient health records | Finding out how patient health records are currently created, maintained and stored. |
| | Q8.-Q10. See Appendix A | Consultations | Determining how healthcare staff consult with each other for healthcare advice. |
| | Q11.-Q12. See Appendix A | Referrals and prescriptions | Establishing how patients are referred between departments, and they are referred to the pharmacy within the healthcare institution. |
| | Q13.-Q18. See Appendix A | Training | Establishing how competent staff are at operating ICT technology and how much they will need to be trained once E- health systems have |

| | | | |
|--|--|--|-------------------|
| | | | been implemented. |
|--|--|--|-------------------|

Table 5.3: Explanation of the questions in the questionnaire for doctors, nurses, and ward attendants.

The following section gives a brief overview of the mixed methods data analysis method selected for this research study.

5.2.2.3 Mixed Methods Data Analysis Method

In Chapter Four the researcher looked at many techniques for analysing data collected from semi-structured interviews qualitatively and from questionnaires quantitatively. One of the major challenges of carrying out a qualitative analysis was to find a good system to help manage the data collected during the interviews. One method would be to do it manually by writing it out on paper, and using coloured pens to mark and group similar data together. Alternatively, there are several programmes that can be used on computers to carry out qualitative analyses, such as NVivo, QDA, MAX and Atlas Ti.

The researcher came to the conclusion that the optimum system to employ would be a combination of deductive/inductive approach, and found that NVivo version 10 was the best suited for the needs of the present research study. SPSS version 21 was employed for the quantitative analysis of the questionnaires.

By using the approach discussed in section (4.5.3.5) suggested by Roberts and Priest (2010, p. 165) the researcher read through all the interviews' transcript and made notes on topics talked about, ideas, thoughts, and feelings to create a picture of the whole. After reading through all the transcripts the researcher made notes on the general themes (see appendix G).

In the next stage the researcher read through each interview transcript individually to summarise and categorise all aspects of each interview content. Once this has been carried out for a number of interviews' transcripts the researcher started to make a list of covered topics, by listing similar topics together to look for similar or overlapping categories and combine them together where possible. Each topic was then given a code, abbreviating the topics as codes in order to ascertain if new codes and categories are emerging. This process was carried out for all interviews' transcripts, at the end of

this process a list of categorised covered topics was produced. This process is covered in more details in appendix G.

When the above process was complete the research made further reduction in the total number of categories by grouping together topics that are related. The final categories were then put into a list in alphabetical order with abbreviation used for each category (see appendix G). Preparatory analysis was then carried out on all available information. For more details on the way how data was analysed please refer to appendix G. The next section is the second phase of the Creswell's Framework, which presents the research findings.

5.3 Phase Two: Research Findings

In this section the research findings from the investigated rural and urban healthcare institutions are presented, corresponding to rural and urban healthcare institutions, respectively. The first part focuses upon those findings that were acquired from rural healthcare institutions and the second part focus upon those findings that were acquired from urban healthcare institutions. This way was selected to discover and find out the differences and similarities between rural and urban healthcare institutions in terms of E-health readiness levels. The following section presents the research findings in rural healthcare clinics.

5.3.1 Research Findings: Rural Healthcare Clinics

This section presents the research findings from the rural healthcare clinics. The information included in this section was gained from doctors, nurses and administrators working at the rural healthcare clinics listed in Table 5.4. Participants in this research study have completed the questionnaires (Appendix A), and attended the interviews (Appendix B); as well as observations that were made by the researcher while visiting the rural healthcare clinics and these are combined to create an overview of the rural healthcare institutions.

The questions in the questionnaires aimed to provide the researcher with the histories of the healthcare institutions, as well as information about their ICT infrastructures. It was not easy most of the time for the researcher to find information about ICT infrastructure, and in some cases the researcher had to carry out their own investigations, and count the

IT equipment available at the healthcare institutions. Managers and staff were very helpful to provide the researcher with information needed for the present research study.

This section includes an overview of the participating rural healthcare clinics, and will give a brief description of each clinic’s background, infrastructure, and how easy it is to access and use ICT and E-health solutions and what their availability is. Table 5.4 shows a list of the participating clinics in rural areas of Libya and their locations (see also Section 4.5.2.4 for a map showing the clinics’ locations).

| Code (NVivo) | Clinic name | Location |
|---------------------|---------------------|-----------------|
| Ref: E | Al-Manshia Clinic | Southern Libya |
| Ref: F | Al-Hyat Clinic | Central Libya |
| Ref: H | Al Bassatein Clinic | Western Libya |
| Ref: I | Al-Razi Clinic | Northern Libya |
| Ref: J | Al-Quiche Clinic | Eastern Libya |

Table 5.4: List of rural clinics.

5.3.1.1 Participating Rural Healthcare Clinics

This section gives a brief overview of the five participating clinics in rural areas of Libya.

Al-Manshia Healthcare Clinic (Ref: E)

Al-Manshia Clinic in Sabha city is located in the southern region of Libya. It caters for approximately 100 patients every week, and is built on approximately 550 m² of land. Patients who require serious medical treatment are referred to the Sabha Medical Centre (SMC); however, patients requiring minor medical treatment are treated at Al-Manshia Clinic.

In the time of carrying out this research study between March and May 2013, the IT and other electronic facilities available at Al-Manshia Clinic are: two laptops, six desktop PCs, three photocopiers, two faxes, four phone lines, and four printers. This means that there is one computer for every two doctors. It was also observed that there are no computers in consultation rooms, thus it can be concluded that doctors do not utilise computers when carrying out their work. All the IT equipment were in working order and Windows XP is used as an operation system.

The clinic uses telephone calls to communicate with SMC and other medical centres in Libya. Patient referral letters and medical records are sent via fax. The clinic does not have X-ray facilities or teleconference equipment.

The clinic does not utilise the Department of Health Central Database to record and collect patients' medical records because of unstable internet and telephone connections. The clinic does not have an E-health system, and the researcher found staff working at this clinic to be very optimistic, with a positive attitude towards implementing E-health systems and improving healthcare services provided for their patients.

The buildings at Al-Manshia Clinic are well built and are well maintained. There are no wards at this clinic, so only patients who require outpatient care are treated here. The clinic has three consultation rooms which are used by four doctors who come from Sabha Medical Centre (SMC); no consultants are available at this clinic.

Al-Hyat Healthcare Clinic (Ref: F)

Al-Hyat Clinic in Sirt is located in the central part of Libya. This clinic looks after approximately 90 patients every week and is built on approximately 500 m² of land. This clinic acts as a gateway to the Ibn Sina Medical Centre.

In the time of carrying out this research study between March and May 2013, the IT facilities available at Al-Hyat Clinic are: five desktop PCs, three laptops, five printers, two faxes, three phone lines, and four photocopiers. Though there is one computer for every two doctors, there were no computers available in the consultation rooms. Most of the available computers are for administrative use only to write reports and patient referral letters. All computers use Windows XP as an operation system.

Staff at this clinic uses the phone to communicate with Ibn Sina Medical Centre, and faxes are used to send patient's referral letters and medical records. This clinic does not have X-ray or teleconferencing facilities. No E-health system is available at this clinic.

Al-Hyat Clinic is well built and maintained; it has four consultation rooms. This clinic has 7 doctors visiting every week from the Ibn Sina Medical Centre in Sirt to provide

healthcare services for patients in this rural area. The services offered at the clinic are: antenatal healthcare, minor healthcare ailments, dentistry and pharmacy.

Al-Bassatein Healthcare Clinic (Ref: H)

This clinic is located in the western region of Libya in the rural area of Zawia; it serves approximately 1500 patients a week.

In the time of carrying out this research study between March and May 2013, the IT facilities available at this clinic are: four laptops, five desktop PCs, five printers, four photocopiers, three phone lines, and two faxes. No computers were available in the consultation rooms at this clinic, and most of the computers were used by administrators to write patient referral letters and to produce reports. The operating system on the computers is Windows XP.

This clinic has an internet connection but still uses phone calls to communicate with Zawia Medical Centre (ZMC) and Tripoli Medical Centre (TMC), and uses faxes to send referral letters and reports. Al-Bassatein clinic has an access to Department of Health Central Database (DHCDB) to connect and upload patients' health information and their demographics every four months. However, they have no E-health systems.

This clinic is well built and is kept clean inside and outside, and has five consultation rooms. There are three doctors and four consultants working at this clinic, the doctors in this healthcare institution operate as a team and it offers ophthalmological, paediatric, neonatal, and maternity services. Additionally, there are specialised services such as a pharmacy, renal dialysis, and speech therapy.

Al-Razi Healthcare Clinic (Ref: I)

Al-Razi Clinic is situated in Tripoli in the northern region of Libya. There are approximately 467 patients treated at this clinic every week.

In the time of carrying out this research study between March and May 2013, the IT facilities available at this clinic are: two laptops, four desktop PCs, two printers, a fax, three telephone lines, and a photocopying machine. The desktop PCs are utilised by the administration department, though if the doctors used them there would be one per

doctor. The researcher concluded that the doctors do not use the desktop PCs as they are not in the consultation rooms. All computers use Windows XP.

The clinic is connected to the internet and has an access to DHCDB. This clinic does not have E-health systems.

The clinic buildings are well constructed and have seven consultation rooms in total, five of which are used by doctors and two consultation rooms for use by consultants.

Al-Quiche Healthcare Clinic (Ref: J)

Al-Quiche Clinic is located in the eastern part of Libya in the rural area of Benghazi. It caters for approximately 204 patients weekly and only treats minor ailments, with anything serious being referred to Benghazi Medical Centre (BMC).

In the time of carrying out this research study between March and May 2013, there was no internet connection at this clinic; and there is only one desktop PC (that uses Windows XP), one printer, one telephone line, one fax, and one photocopying machine. The computer is used by the administrators to write referral letters and record medical records. This clinic has no access to DHCDB, and data get sent to Department of Health on CDs every six months. This clinic does not have E-health systems.

The clinic building is well built and has five consultation rooms, three of which are used by doctors, with the other two used by nurses working at this clinic. The clinic provides immunisation services, counselling, antenatal services and looks after minor health problems.

5.3.1.2 Overview Summary of the Participating Rural Healthcare Clinics

From the overview of participating rural healthcare clinics given in the previous subsection it can be noticed that all clinics are well maintained, and look after large numbers of patients in their areas. Table 5.5 gives a summary of how accessible, available and usable ICT is in these clinics.

It is noticeable that the clinics in the rural areas do not have central databases from which to transmit patient data to the main Department of Health Central Database

offices, and they do not have E-health systems. The participating rural healthcare clinics face the following problems:

- The reliability of telephone lines is questionable;
- Electrical supplies are inconsistent and liable to breaking down on a regular basis;
- The IT support services are very poor; and internet connections are unreliable;
- The doctors are overloaded with work in rural areas due to there being far too few of them available;
- There is a lack of E-health systems, such as E-prescriptions, E-consultations, E-referrals and electronic patient health records;
- There is a lack of training in basic ICT skills;
- There are not enough computers for wards and consultation rooms.

| Service | | Rural Healthcare Clinics | | | | | | | | | |
|----------|-------------|--------------------------------|--|--------------------------------|--|--------------------------------|--|--------------------------------|--|--------------------------------|--|
| | | Al-Razi Clinic | | Al-Bassatein Clinic | | Al-Manshia Clinic | | Al-Hyat Clinic | | Al-Quiche Clinic | |
| | | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services |
| Hardware | Laptop | 2 | Admin and medical staff | 4 | Admin and medical staff | 2 | Admin | 3 | Admin | 0 | ----- |
| | Desktop | 4 | Admin and medical staff | 5 | Admin and medical staff | 6 | medical staff | 5 | Admin and medical staff | 1 | Admin |
| | Printer | 2 | Admin, staff and doctor | 5 | Admin, staff and doctor | 4 | Admin and staff | 5 | Admin and staff | 1 | Admin, staff |
| | Photocopier | 1 | Admin, staff and doctor | 4 | Admin, staff and doctor | 3 | Admin and staff | 4 | Admin and staff | 1 | Admin, staff |
| | Fax | 1 | Admin, | 2 | Admin, | 2 | Admin, | 2 | Admin | 1 | Admin, |

| | | | | | | | | | | | |
|------------------------|---------------------------------------|-----------|-----------------|-----------|-----------------|-------------|----------------|-------------|----------------|-------------|----------------|
| | | | staff | | staff | | staff | | | | staff |
| | Telephone | 1 | Admin, staff | 3 | Admin, staff | 4 | Admin, staff | 3 | Admin | 1 | Admin, staff |
| | E-conference | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible |
| | digital cam monitored on a Microscope | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible |
| | digitalised equipment for X-rays | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible |
| Network | Internet | Available | Admin and staff | Available | Admin and staff | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible |
| IT support Personnel | Technical support personnel | Available | Frequently | Available | Frequently | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible |
| Previous IT experience | Frequency of computer use | Rarely | Not often | Rarely | Not often | Rarely | Not always | Rarely | Not always | Rarely | Not always |
| | Frequency of using | Rarely | Not often | Rarely | Not often | Rarely | Not | Rarely | Not | Rarely | Not often |

| | | | | | | | | | | | |
|--|---------------------------------------|-----------------|----------------|-----------------|----------------|-------------|----------------|-------------|----------------|-------------|----------------|
| | emails | | | | | | always | | always | | |
| | Using a computer for E-health systems | DHCDB (CD-Room) | Admin | DHCDB (CD-Room) | Admin | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible |
| | Training in using E-health systems | Unavailable | Not accessible | Unavailable | Not accessible | unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible |
| | Experience in using E-health systems | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible | Unavailable | Not accessible |

Table 5.5: Overview of ICT access levels at participating rural healthcare clinics.

The following sections present the results from the interviews carried out in the participating rural healthcare clinics.

5.3.1.3 Summary of Responses from Interviews in Rural Healthcare Clinics

For the purposes of this research study in each participating clinic the selected participants were two doctors, two nurses, two ward attendants, and two administrators (see also Section 4.5.3.4, Table 5.4).

Table 5.6 summarises the answers given to the questions asked at the interviews. The column on the left contains the main areas of operation and the right column contains a summary of the answers given and some direct quotations from responses that were given. The researcher has included a code for the type of respondents to maintain the respondent confidentiality (Kaiser, 2009). The codes are: (A: Administrators, D: Doctors, N: Nurses, and W: Ward Attendants).

The interviews that were carried out in the clinics took place in the clinic’s boardrooms or the offices of the administrators. The wording of the questions was aimed at establishing to what extent the respondents saw E-health implementations as being useful, as being beneficial and how much they accepted them.

The findings of the interviews allowed the researcher to better understand what answers were needed for Research Sub-Question One. The clinics were selected because they were located in rural areas and the participants were chosen because of their professions.

| Q.1. How would you expect your medical institution to benefit from the installation of the following E-health applications? | |
|--|--|
| The main operational areas | A summary of the answers and responses given and some quotes in rural healthcare institutions |
| E-prescription system | Medicine can be dispensed more easily and mistakes avoided. Respondent (D): “this system will be very beneficial as the patient will be able to go directly to the dispensary while the doctor loads the prescription |

| | |
|--------------------|--|
| | <p>onto the system”.</p> <p>Respondent (D): “there will no longer be the danger of a pharmacist misreading a doctor’s handwriting because it is not legible and dispensing the wrong medication”.</p> <p>Respondent (D): “it will save a lot of time as the patients will not have to wait so long to get their prescriptions”.</p> |
| E-referrals | <p>This will save a lot of time as the staff at the healthcare institution the patient has been referred to, will not have to write out the patient’s healthcare history again, as it is already loaded onto the system. Staff will also be able to monitor a patient’s progress at the healthcare institution they have been referred to.</p> <p>Respondent (N): “if there is a patient referred because their condition has not improved then the staff referring them can take more responsibility for their future treatment”.</p> <p>Respondent (D): “this system will save a lot of time as the doctor at the hospital that the patient is referred to will not have to start the diagnoses from scratch”.</p> <p>Respondent (N): “often there is no feedback available when we refer patients, so this will allow us to monitor what is happening to our patient once they have been referred”.</p> <p>Respondent (D): “the advantage of this system is that a patient once a patient is on the system then they can be traced wherever they go, allowing staff to instantly be aware of the treatment they have received”.</p> |
| EPHR | Patients records can be recorded faster, time saved in |

| | |
|-------------------------------|---|
| | <p>diagnosing and treating patients and patient confidentiality will be better protected.</p> <p>Respondent (N): “I envisage the E-health system Implementation making it take longer to record patient data at first, but eventually it will speed up the process of diagnosing and referring and safeguard sensitive patient data”.</p> <p>Respondent (A): “there will a lot of time saved and therefore a lot of money saved that can be spent on other things”.</p> <p>Respondent (W): “the implementation will be very helpful and beneficial to everybody. There are so many files that need filing at the moment it takes a lot of time to do”.</p> <p>Respondent (A): “the hospital staff do not have any knowledge or experience about E-health systems. The money would be better spent on essentials such as more medical supplies and trained staff”.</p> |
| E-training | <p>This can create improvements in the skills bases of staff, therefore improving their performances at work.</p> <p>Respondent (N): “I think that training face to face is better because we can ask questions, but because this is expensive we can do more learning with this method”.</p> <p>Respondent (D): “this is going to take a long time to learn so we will not have to waste time travelling somewhere for training”.</p> <p>Respondent (W): “this is will improve our ability to operate computers and do our jobs more efficiently”.</p> |
| E-consultation systems | <p>Work will be carried out more efficiently, because staff can ask other healthcare professionals for help</p> |

| | |
|--|--|
| | <p>in diagnosing and treating patients.</p> <p>Respondent (D): “it will be helpful for doctors to make referrals as often they are wasting time phoning for a referral and there is no response or some other problem”.</p> <p>Respondent (D): “if we are not 100% sure when administering drugs to a patient then asking for advice will prevent the administering of wrong or hazardous doses of drugs”.</p> |
|--|--|

Table 5.6: Interview responses in rural areas clinics.

The first question asked in the interviews, and some of the responses to it, can be seen in Table 5.6; there were several other questions asked in the interviews. The responses to those are summarised in Table 5.7. The left column shows the major operational areas, and the right column contains a summary of responses along with few selected direct quotations from the responses.

| Key areas of operation and questions given in the interviews | A summary of responses with some quotations from rural healthcare clinics |
|---|---|
| Q.2. How do you think any of the applications above would improve efficiency in your medical institution? Please be specific about the system and your expectations. | |
| Problems currently occurring with E-health in the healthcare clinics | |
| Q.2. (Appendix B) | <p>Improvement of filing systems in order to prevent files being lost.</p> <p>Respondent (A): “it will save a lot of money on materials as so much money is spent on paper for case histories and patient forms etc. and it will save a lot of time for our staff as they will not have to retrieve files from filing rooms situated away from treatment rooms”.</p> <p>Respondent (W): “there will be benefits because</p> |

| | |
|--|---|
| | <p>patients' files are often getting misplaced and it is not possible to find them, this referral system will help the doctors immensely and communication will be greatly improved".</p> <p>Respondent (D): "the system will provide the possibility of better communication and exchange of data".</p> <p>Respondent (A): "patients will no longer need to spend unnecessarily long periods of time queuing at pharmacies or OPDs as the patient medical data will be retrieved much faster due to improved filing".</p> |
| <p>Q.3. Do you feel that the implementation of any of the systems you detailed above would create any problems? Be specific about the system and problem.</p> | |
| <p>Anticipated problems</p> | |
| <p>Q.3. (Appendix B)</p> | <p>Unreliable electrical supplies:</p> <p>Respondent (A): "if there is no electrical supply then the computers cannot be operated"</p> <p>Not having enough computer equipment and the computers getting viruses.</p> <p>Respondent (D): "if a prescription needs to be recalled then it takes a long time to recall it from the pharmacy dispensary before correcting it and sending it back and there may also be the issue of handwriting that is illegible and abbreviations in the system that are difficult to learn".</p> <p>Respondent (D): "the computers may well pick up viruses, especially through use of the E-consultation system".</p> <p>If a mistake is made on a prescription form then it is not possible to recall it.</p> |

| | |
|---|---|
| Q.4. Is there any technology in your medical institution at this time that might support such an E-health application? Please be specific. | |
| Basic E-health technology that is available | |
| Q.4. (Appendix B) | The Department of Health Central Database. Respondent (A): “the only E-health system available for use at this moment is the Department of Health central database. This system often loses information though so it does not contain diagnostic histories, but it does have background histories of the patients”. |
| Q.5. Would it be to your liking to be trained in the use of computers so that your job performance might be enhanced? | |
| Training needs | |
| Q.5. (Appendix B) | More training is required in how to use computers. Respondent (N): “when the system is not working very fast we need to be trained in how to deal with this problem”. Respondent (W): “the training is absolutely necessary for us to be able to carry out our work effectively. Without the basics in computer literacy we can do nothing with the computers”. |
| Q.6. How do you feel about accessing E-health applications outside of your job? Is this something you would like to do and why? | |
| Accessing E-health application from outside the workplace | |
| Q.6. (Appendix B) | Reactions were mixed with doctors giving positive responses, but nurses and other staff responding negatively. Respondent (D): “it is better if the system is closed in order to protect the patient’s confidentiality”. Respondent (D): “if someone forgets to do something at work that is important for a patient, |

| | |
|--|--|
| | then the website can be accessed in order to correct the mistake”. |
| Q.7. Is there something else you would like to add or something you feel needs recommending or commenting upon? | |
| Suggestions made by respondents | |
| Q.7. (Appendix B) | <p>Things the respondents have suggested:</p> <p>Respondent (A): “the systems that will be implemented need to be: user friendly, linked to all the healthcare institutions in the area, have emergency power supplies and have user signatures so that if mistakes occur it can be seen who did it”.</p> <p>Respondent (A): “as far as I can see this new system will benefit the healthcare institution a lot, though it may take some time for the benefits to become evident”.</p> <p>Respondent (W): “I think that this method will end up saving patients a lot of time as the clerks require so much time for filing and this would no longer be necessary with this strategy”.</p> |

Table 5.7: Interview responses in rural areas clinics.

5.3.1.4 Findings from Interviews in Rural Healthcare Clinics

The interviews carried out indicated that all the healthcare clinics had no access to the Department of Health Central Database (DHCDB). The DHCDB aids in collecting patients’ health information and their demographic. Additionally, the results showed that the respondents thought that the implementation of E-health systems would help them perform better at work, delivering better healthcare services to patients.

The interviews carried out in sets of eight per clinic allowed the research findings to have more depth. The responses given during the interviews show what views the majority of respondent has about the implementation of E-health systems. This summary reflects majority opinion among respondents:

A system for E-training will:

- Create improvements in staff skills in operating ICT equipment, thus improving their performances in the workplace if they have face-to-face training too.

Additionally, the respondents answered that if E-health systems were implemented in their clinics, it will aid in solving certain problems such as:

- Queuing will not be so bad at the pharmacy or the OPD;
- Communications will be improved;
- Patients will be prevented from taking their prescription from more than one healthcare institution at a time; and
- The filing system will be improved so that files do not get lost.

A system for making E-referrals will:

- Assist in patient follow ups by the clinic that referred the patient; and
- Doctors will save a lot of time by not having to write out patients' histories again when they are referred to them.

EPR will:

- Save a lot of time currently spent looking for patient records and paperwork;
- Create time savings in recording patient data and treating and diagnosing patients;
- Aid in capturing statistics in real-time about patients;
- Make patient records more confidential.

A system for E-consultations will:

- Give assistance to staff in sharing ideas in their work and giving advice to each other.

Some of the responses in the interviews indicated that the following challenges may be encountered in the implementation of E-health systems in rural areas:

- Not enough computers and the ones with old operating systems would suffer from a vulnerability to virus infections;
- Unreliable electrical supplies;

- Not enough trained staff for entering information into the system.

A system for E-prescriptions will:

- Stop mistakes being made when medication is prescribed; and
- Create time savings for patients and pharmacists.

The following section will focus on the findings from the questionnaire.

5.3.1.5 Summary of Responses from Questionnaires in Rural Healthcare Clinics

This section gives a summary of the results that were obtained from the questionnaire given out in the participating rural healthcare clinics. Table 5.8 presents a summary of the answers given in response to the questionnaire (see Appendix A for full wording of questions, only question numbers are given in the table). The left column in the table refers to the question’s number on the questionnaire, and the right column contains a summary of the responses that were given.

138 copies of the questionnaire were returned of which one hundred and seventeen were fully and correctly completed. However, the total number selected for this research is 80 questionnaires so as to achieve the right balance between rural clinics and urban medical centres (40 each), and their selection was based on participants’ professions and their place of work (2 doctors, 2 ward assistants, 2 nurses, and 2 administrators were selected from each participating Clinic and Medical Centre).

| | |
|--|---|
| <i>Only questions number included, for questionnaires please see appendix A.</i> | |
| <i>General (Appendix A)</i> | |
| Main areas of operation and questions posed | Answers are classified upon the majority of responses given in the questionnaires in rural healthcare clinics. |
| 1.2 Please indicate using an X whether or not your department is conducted as a multidisciplinary clinical team? | |
| Yes <input type="radio"/> No <input type="radio"/> | |
| Healthcare staff conducted their work in multidisciplinary teams. | |

| |
|---|
| <p>1.3 Please indicate using an X whether or not health records of your patients need to be shared with other healthcare professionals?</p> <p>Yes <input type="radio"/> No <input type="radio"/></p> |
| <p>Yes, healthcare staff shared patients' health information files.</p> |
| <p><i>Electronic patient healthcare record system (Appendix A)</i></p> |
| <p>2.1 Please write in the box provided below, the way in which patient health records are currently created in your medical institution.</p> <p><input type="text"/></p> |
| <p>Patient healthcare records are created manually (files and paper).</p> |
| <p>2.2 Please write in the box provided below, the system presently used in your medical institution for the maintenance of patient health records.</p> <p><input type="text"/></p> |
| <p>New information is recorded by hand and stored in filing cabinets.</p> |
| <p>2.3 please indicate using an X in either of the boxes below, whether or not it is the responsibility of each individual doctor to personally look after the maintenance individual's medical records or is that the responsibility of a central authority?</p> <p>Maintain each patient's record <input type="radio"/> Centralised <input type="radio"/></p> |
| <p>Patients' health information files are centralised and stored in lockers.</p> |
| <p>2.4 Please write in the box below the ways in which records are kept, for instance are they written by hand, by use of a word processor or Dictaphone or Tran-scripted etc.</p> <p>State the means of recording. (E.g. handwritten, Dictaphone, transcription, word processor, etc)</p> <p><input type="text"/></p> |
| <p>Written by hand.</p> |
| <p>2.5 Please indicate using an X whose job it is to record the patient records.</p> <p>Doctors <input type="radio"/> Nurses <input type="radio"/> Ward attendants <input type="radio"/> Other (specify) <input type="radio"/></p> |
| <p>When patients first arrive at the outpatient department by clerks. When the patient contacts a nurse or doctor to be consulted, then the information is recorded in the patient's file.</p> |

2.6. Please write below the way in which patient records are normally collected, for instance by use of a form or with minimum fields etc.

Various forms are used, such as a form for case histories, when a patient is asked questions, which a clerk records and stores in a room for keeping records.

2.7. Please indicate in the box below how much time would typically be used daily for maintaining the health records of patients.

The time averaged between 30 and 40 minutes.

3.1 Please indicate in the box below where the usual place is for storing patient healthcare files.

The files are stored in the registry room and then taken to the records store room at a later date.

3.2 Please indicate below the normal procedures for storing and retrieving patient healthcare files, for instance: how it is stored – in secure cupboards or filing-cabinets etc.

Filed in a cupboard or cabinet which are secured and in a locked room for storing records.

3.3 Please indicate below the pattern of arrangement for your patient health records; for instance are they stored in an alphabetical or chronological sequence or depending upon security or how many copies there are etc.

Storage is done on an alphabetical basis and according date and number.

3.4 Please indicate below what staffs possess the authority to see patient records without permission; for instance doctors and nurses etc.

Nurses that have been authorised, doctors and clerks in the record office. Staff can

only access the files during work hours. If an emergency occurs at the weekend or at night then access is granted.

3.5 Please indicate below the typical time required to retrieve the records of a patient.

This averages between fifteen and twenty minutes.

4. Please indicate using an X whether or not you think that the system currently used for recording patient health records is providing a good service accurately and thoroughly and then indicate in the box provided why you gave this answer. Yes No

A majority of respondents responded no, saying that access is challenging due to staffing shortages.

Access for admissions is 'hit and miss' due to a lack of staff for retrieving files when patients are admitted. It can also be a struggle to get files retrieved on follow up visits. There are also times when files cannot be found, so staff find it very challenging fill out files when patients are discharged as they are missing.

5. Please answer with an X, whether you think that the quality and format in which patient health records are recorded is good enough for healthcare workers to share it effectively and then write down in the box below the reasons for your answer. Yes No

No: this is because some staff have handwriting that is not easy to read, the filing system is not administered correctly and patient. No: patient confidentiality is secure.

6. In your opinion, does the way in which patient health records are currently stored give good value for money and do the best job possible in delivering healthcare services in allowing:

6.1 The retrieval of patient health records in the minimum/optimal amount of time?

Yes No

Please indicate why you answered yes or no

No: as so much paper and so many files are used monthly.

No: as so many files of patients' healthcare records go missing or put in the wrong place so this requires a lot of time to locate them.

6.2 Minimising the time needed for diagnosing and treating ailments?

Yes No

Please indicate why you answered yes or no

No: patients will spend a long time before they can be admitted.

6.3 Patient health records to be as confidential as possible?

Yes No

Please indicate you answered yes or no.

No: as there is not a code for gaining access so it can be accessed by anybody.

7. What are the principle ways in which the present system is limited:

7.1 The creation of patient health records?

Information is often incorrect, files are misplaced and it takes a lot of time. There are occasions when there is no stationary. The records can only be accessed between 7am and 10pm.

7.2 The maintenance of patient health records?

There is not much space for storing records; records are misplaced. When a file is used on a ward it is sometimes misplaced and then not returned to the room for storing files.

7.3 The storage of patient health records?

A cupboard that is not locked is a security risk. There is only a small area for the storage of files.

| |
|--|
| 7.4 The retrieval of patient health records? |
| <input type="text"/> |
| It can be very challenging to locate files after extended periods. It takes a lot of time. Out of hours there are no staff available for retrieving patient files. |
| Determining E-consultations, E-prescriptions and E-referrals (Appendix A) |
| 8. What is the present procedure for consulting between patient and doctor? |
| Face-to-face <input type="radio"/> Through electronic means <input type="radio"/> |
| One to one and occasionally electronically |
| 8.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable) |
| E-mail (computer) <input type="radio"/> E-mail (cell phone) <input type="radio"/> Telephone <input type="radio"/> SMS <input type="radio"/> |
| Other <input type="radio"/> Specify |
| <input type="text"/> |
| By telephone and electronically by email. |
| 9. What system is currently used for consultations between healthcare professionals? |
| 9.1 Within the medical institution? |
| Face-to-face <input type="radio"/> Through electronic means <input type="radio"/> |
| Telephone, electronically, one to one and with a letter of referral. |
| 9.1.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable) |
| E-mail (computer) <input type="radio"/> E-mail (cell phone) <input type="radio"/> Intranet <input type="radio"/> SMS <input type="radio"/> |
| Telephone <input type="radio"/> Other <input type="radio"/> Specify |
| <input type="text"/> |
| Telephone, mobile phone and email. |
| 9.2 With other medical institutions? |
| Face-to-face <input type="radio"/> E-video consultation <input type="radio"/> Through electronic means <input type="radio"/> |
| Emails, one to one, mobile phone and letters of referral. |

9.2.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable)

E-mail (computer) E-mail (cell phone) Internet SMS

Telephone Other Specify

mobile phone and email

10. Are there Ehealth facilities within your medical institution?

Yes No

If yes, describe in what ways it is utilised.

There are no telemedicine systems at the rural healthcare clinics.

11. How are patients referred to the pharmacy to collect their prescriptions? For instance are they given a piece of paper or is it transferred electronically. Please write in box provided below

Patients receive prescriptions written on paper to go to the pharmacy with.

12. What do you see as the pluses and minuses about the way in which patients are currently referred to the pharmacy to collect their prescription in your medical institution?

| | |
|----------------------|--|
| Advantages | |
| Disadvantages | |

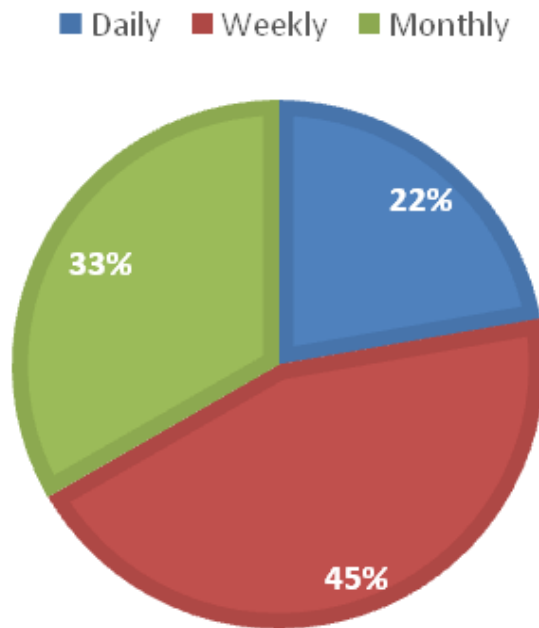
Advantage: the patient receives instructions on how to take the medicine from the pharmacist in person.

How training opportunities are determined (Appendix A)

13. How frequently do you access a personal computer? Indicate with an X the appropriate answer please.

Daily Weekly Monthly Never

Q13. HOW FREQUENTLY DO YOU ACCESS A PERSONAL COMPUTER?

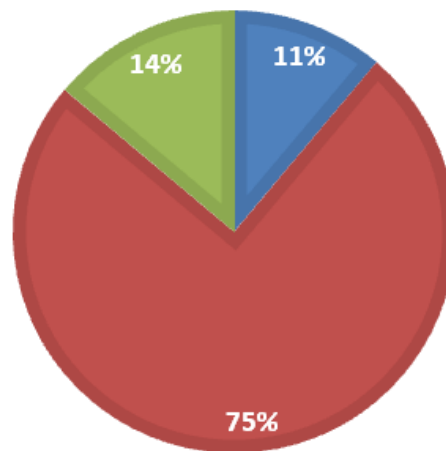


Approximately 22% said that they use a computer daily, where the majority of 45% use it weekly, and the remaining 33% said they use it once every month.

13.1 What tasks do you perform on your computer? Please be specific.

13.1 WHAT TASKS DO YOU PERFORM ON YOUR COMPUTER?

■ Compilation of statistics ■ Accessing the internet ■ Recording patient data



The statistics show that approximately 11% of those questioned used computers in

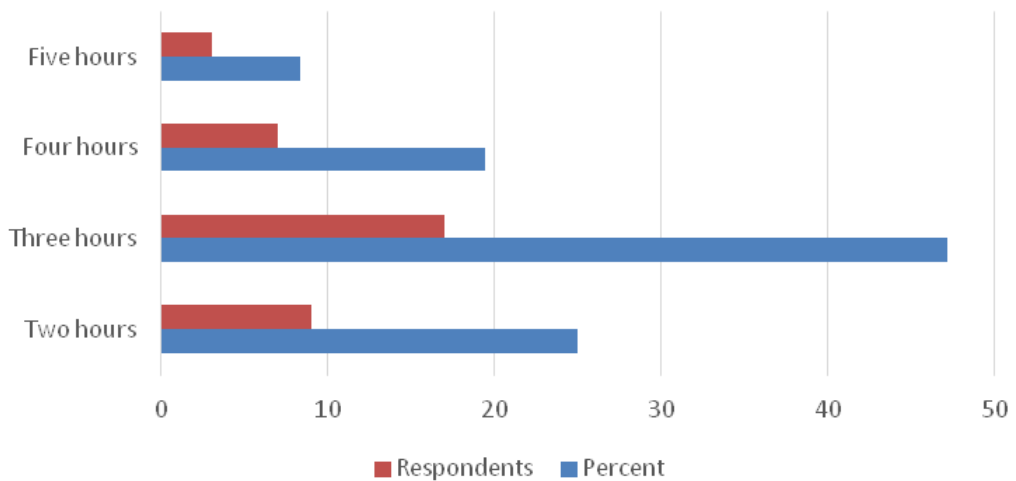
order to compile statistics, 14% used them for recording patient data and the majority of 75% used them in order to access the internet.

14. In what ways does the availability or unavailability of computers or the internet effect your work? Please specify below.

As paper is used for a majority of the work there is no direct impact. The people recording patient data felt not using computers has an impact on the work they carry out every day.

15. What is the total amount of time you spend on your computer each day? Please specify in hours below.

15. What is the total amount of time you spend on your computer each day?



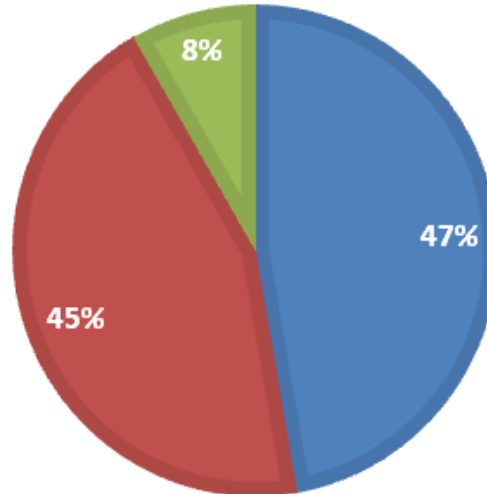
Many respondents stated that they had no spare time for using computers or the internet. The respondents who said they did use computers averaged between two and four hours every day.

16. How would you rate your ability to use a computer? Indicate with an X please.

Novice Average Experienced

16. HOW WOULD YOU RATE YOUR ABILITY TO USE A COMPUTER?

■ Novice ■ Average ■ Experienced

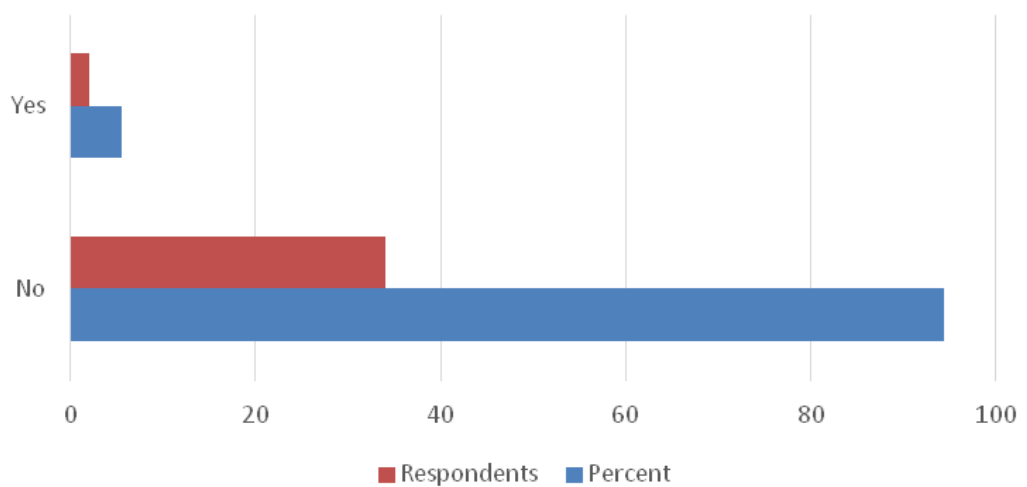


The majority of respondents 47% claim that they have no experience at all. Where approximately 8% of the respondents claimed to have had experience using computers, while 44% claim to be average.

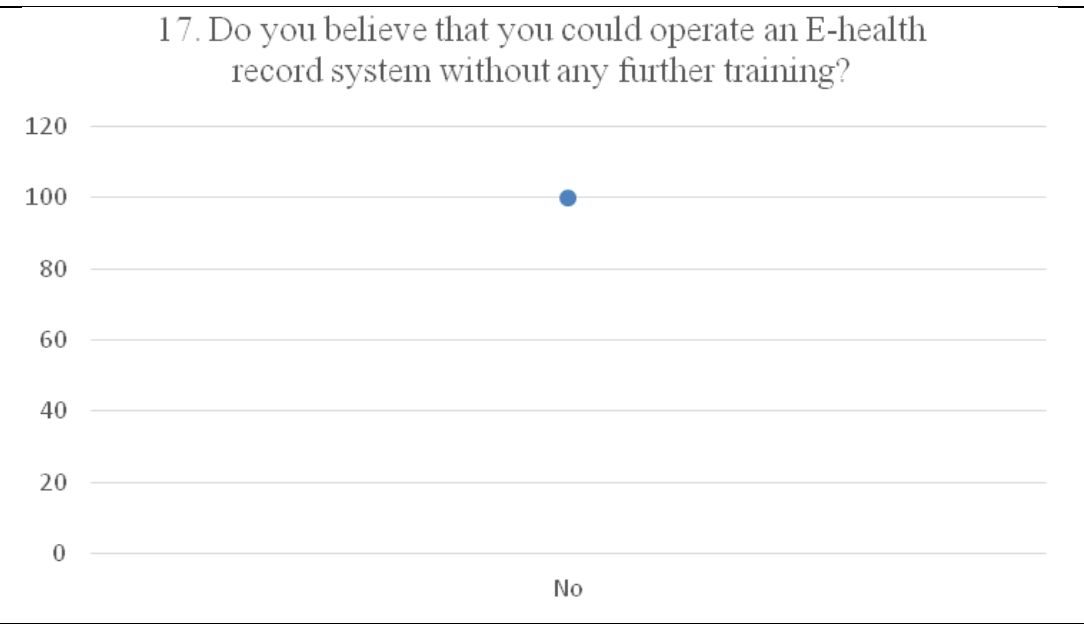
16.1 Have you ever been trained to use an Ehealth record system or had any experience operating one? Yes No

If you have, then what type of experience or training was it?

16.1. Have you ever been trained to use an E-health record system?



Just over 94% of respondents said they had not been trained how to use electronic health records and the other 6% said they had experienced using them while working or training abroad.



17. In your opinion, do you believe that you could operate an Ehealth record system without any further training?

Yes No

If you indicated yes, then which system are you referring to?

100% of the respondents thought that they would need to be trained in how to use a computer or an E-health system, but would be willing to use any E-health technology that was implemented.

18. Is there anything that you would like to add, such as a recommendation or to comment upon something that has occurred to you?

Please, write down your thoughts below.

Staff need to be trained in how to use E-health technology or a computer: respondent (D): “if the E-health technology could be positioned so there are no delays in patients’ treatment”, respondent (D): “if its installation takes place now, it will mean no delays in a patient being treated”, respondent (W): “if all the staff receive training in how to use computers in order to make it safer and save time”.

Table 5.8: Responses to the questionnaires at rural healthcare institutions.

5.3.1.6 Findings from Questionnaires in Rural Healthcare Clinics

This section summarises the results of the questionnaires in the participating rural healthcare clinics. The headings presented correspond to the main headings shown in Table 5.8.

General

The data shown in Table 5.8 indicates that doctors and other healthcare staff in rural healthcare institutions share patient data with each other and operate in multidisciplinary groups.

E-consultations, E-referrals and E-prescriptions

The information in Table 5.8 shows that the majority of consultations between staff in rural healthcare clinics occur on a one-to-one basis, by telephone, email and through letters of referral. Communication by email occurs only between doctors in the same clinic as the clinics are not connected to the internet. Rather than meeting in person, doctors are more inclined to telephone each other in order to get advice. The junior doctors though do not know many people at other urban or rural healthcare institutions so are less likely to email or telephone for advice. The rural healthcare clinics do not possess any facilities for making E-prescriptions or E-referrals. Patients are given paper prescriptions to pick up from the pharmacy. If a patient needs to be referred within a healthcare clinic, then they are given a letter of referral written on paper. If a patient is too seriously ill to be treated at a healthcare clinic, but the case is not an emergency, then they are transferred to a medical centre that can treat them with a piece of paper describing their condition. Generally, the consultant whom the patient is referred to does not receive enough information about the patient's medical history, and therefore has to perform all the steps to diagnosis all over again.

EPR systems

The responses in Table 5.8 indicate that there are no electronic patient health record systems in rural healthcare clinics. The patient's healthcare records are written by hand and filed manually. The data that is stored is accessed by healthcare staff for treating the patients locally. The files are stored in cabinets in a central room used for storing the records in the healthcare clinic.

E-training opportunities

The respondents were asked how often they used computers in order to assess their computer skills and then ascertain how much training would be needed so that they could use computers competently. The results showed that approximately 22% said that they had used a computer daily and the remaining 78% said they used one every week or every month. An illustration of this can be seen in Figures 5.4 (a, b), Table 5.9 and Table 5.10 below.

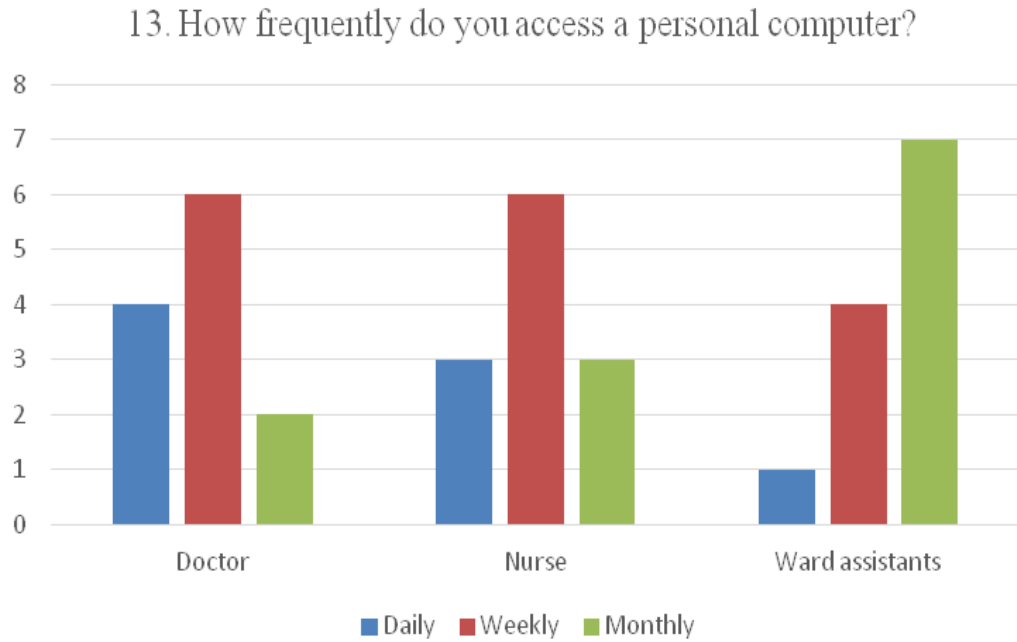


Figure 5.4a: How frequently do you access a personal computer?.

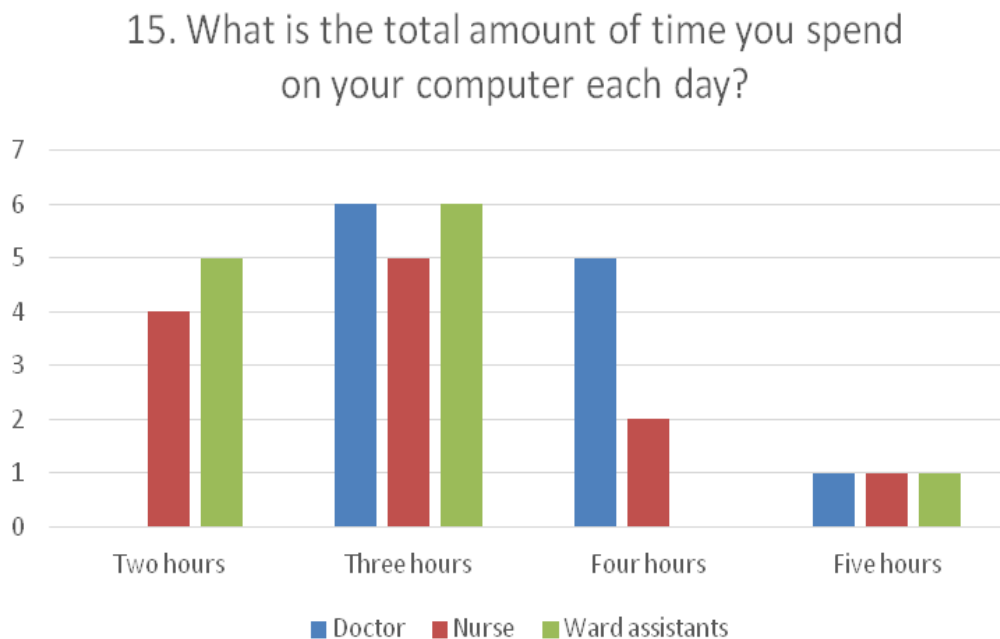


Figure 5.4b: How frequently do you access a personal computer?.

| | | 13. How frequently do you access a personal computer? | | | Total | |
|---------------------------|---|---|--------|---------|--------|--------|
| | | Daily | Weekly | Monthly | | |
| Research participants job | Doctor | Number of respondents | 4 | 6 | 2 | 12 |
| | | Percentage within Research participants job | 33.3% | 50.0% | 16.7% | 100.0% |
| | | Percentage within 13. How frequently do you access a personal computer? | 50.0% | 37.5% | 16.7% | 33.3% |
| | Nurse | Number of respondents | 3 | 6 | 3 | 12 |
| | | Percentage within Research participants job | 25.0% | 50.0% | 25.0% | 100.0% |
| | | Percentage within 13. How frequently do you access a personal computer? | 37.5% | 37.5% | 25.0% | 33.3% |
| | Ward assistants | Number of respondents | 1 | 4 | 7 | 12 |
| | | Percentage within Research participants job | 8.3% | 33.3% | 58.3% | 100.0% |
| | | Percentage within 13. How frequently do you access a personal computer? | 12.5% | 25.0% | 58.3% | 33.3% |
| Total | Number of respondents | 8 | 16 | 12 | 36 | |
| | Percentage within Research participants job | 22.2% | 44.4% | 33.3% | 100.0% | |
| | Percentage within 13. How frequently do you access a personal computer? | 100.0% | 100.0% | 100.0% | 100.0% | |

Table 5.9: How frequently do you access a personal computer?.

| | | | 15. What is the total amount of time you spend on your computer each day? | | | | Total |
|---------------------------|-----------------|---|---|-------------|------------|------------|--------|
| | | | Two hours | Three hours | Four hours | Five hours | |
| Research participants job | Doctor | Number of respondents | 0 | 6 | 5 | 1 | 12 |
| | | Percentage within Research participants job | 0.0% | 50.0% | 41.7% | 8.3% | 100.0% |
| | | Percentage within 15. What is the total amount of time you spend on your computer each day? | 0.0% | 35.3% | 71.4% | 33.3% | 33.3% |
| | Nurse | Number of respondents | 4 | 5 | 2 | 1 | 12 |
| | | Percentage within Research participants job | 33.3% | 41.7% | 16.7% | 8.3% | 100.0% |
| | | Percentage within 15. What is the total amount of time you spend on your computer each day? | 44.4% | 29.4% | 28.6% | 33.3% | 33.3% |
| | Ward assistants | Number of respondents | 5 | 6 | 0 | 1 | 12 |
| | | Percentage within Research participants job | 41.7% | 50.0% | 0.0% | 8.3% | 100.0% |

| | | | | | | | |
|-------|--|---|--------|--------|--------|------------|------------|
| | | Percentage within 15. What is the total amount of time you spend on your computer each day? | 55.6% | 35.3% | 0.0% | 33.3% | 33.3% |
| Total | | Number of respondents | 9 | 17 | 7 | 3 | 36 |
| | | Percentage within Research participants job | 25.0% | 47.2% | 19.4% | 8.3% | 100.0 % |
| | | Percentage within 15. What is the total amount of time you spend on your computer each day? | 100.0% | 100.0% | 100.0% | 100.0 % | 100.0 % |

Table 5.10: The utilisation of computers and the internet by healthcare staff.

Figures 5.5 (a, b and c) illustrate that the vast majority of respondents felt that they had not received enough training or did not have enough experience to operate E-health systems if they were installed in the healthcare institutions where they worked at the present time. A further depiction of this can be seen in Figures 5.5 (a, b, and c).

16. HOW WOULD YOU RATE YOUR ABILITY TO USE A COMPUTER?

■ Novice ■ Average ■ Experienced

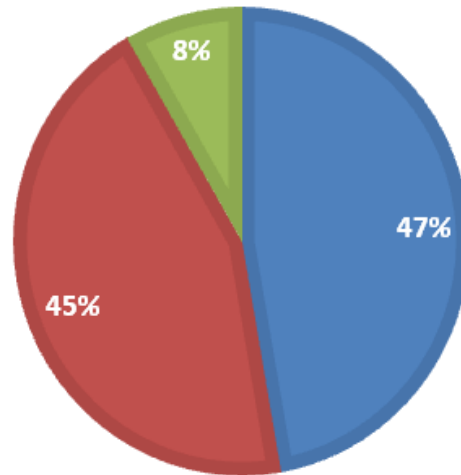
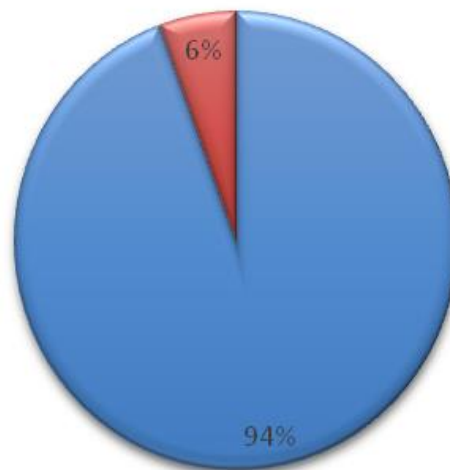


Figure 5.5a: Healthcare staff's experience in using computers in rural areas.

16.1. Have you ever been trained to use an E-health record system?



■ No ■ Yes

Figure 5.5b: Healthcare staff's experience in using computers in rural areas.

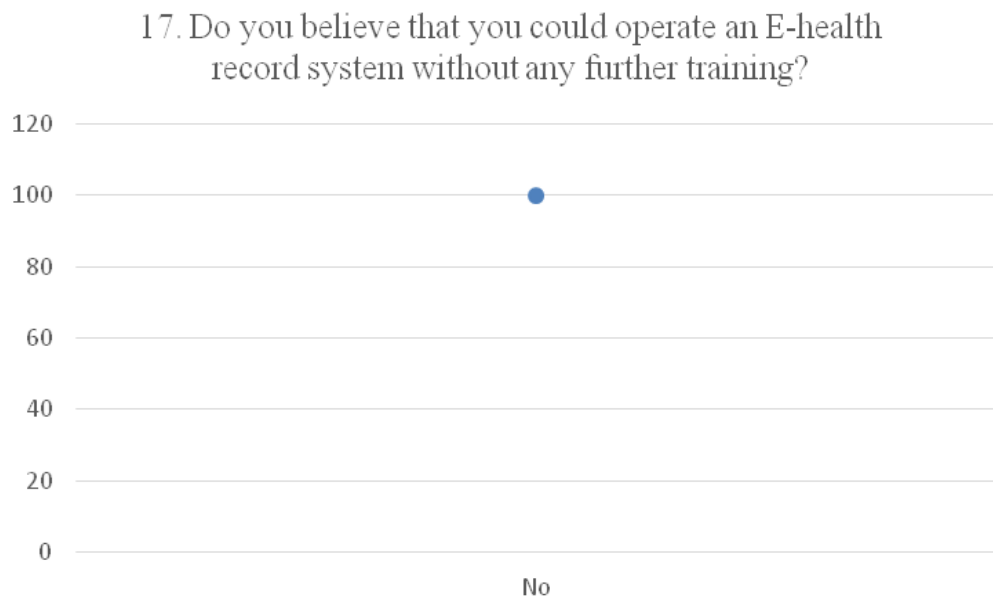


Figure 5.5c: Healthcare staff's experience in using computers in rural areas.

The vast majority of respondents in rural healthcare clinics said that they do not have previous experience on how to operate E-health systems, but were ready to be trained on how to use it if they had to. The idea of E-training did not appeal to the majority of respondents, however, it was recognised by the vast majority that it would be a more time-efficient. The following subsection discusses the common themes in results across rural healthcare clinics.

5.3.1.7 Common Themes in Results across Rural Healthcare Clinics

This subsection presents an analysis of common themes emerging from the results from the individual cases in the study through a consideration of the responses given in the questionnaires and interviews in the rural healthcare clinics. This type of analysis is referred to as 'cross-case analysis' (e.g. Creswell, 2007). Ryan (2012) and Lynna et al. (2009) state that for cross-case analysis, researchers investigate multiple cases in parallel, so that commonly occurring themes might be discerned. When the results of the E-health readiness assessment in rural healthcare clinics were analysed, the commonly occurring themes in the questionnaires and interviews that addressed Research Sub-Question One were as follows.

The perception of E-health systems and their acceptance levels

The majority of healthcare staff, who would be the users of the E-health system, showed that they would accept them and the E-health systems would be very useful and could

help them to perform their work. The staff thought that an E-health system would enable them to keep medical records, diagnoses, medications, and referrals which will help in providing better healthcare services to patients.

The vast majority of respondents also said that the implementation of E-prescription services would stop mistakes in prescribed and dispensed medications. The respondents also said that the implementation of an E-consultation system would help healthcare staff to talk to each other in order to advise one another and share ideas.

These findings indicate that the implementation of E-health systems in the rural healthcare clinics surveyed would be accepted. This is very important as the healthcare staff operating a newly installed IT system need to be as accepting of, and enthusiastic about it, as possible in order for it to be successful.

Availability of ICT infrastructure and training on how to use the technology

The survey's results indicate that there was insufficient IT equipment in the rural healthcare clinics investigated; there was an average of one computer to every two doctors.

The survey showed that no computers were available in the consultation rooms, and doctors do not use computers to record patient's medical histories. The computers are used by administrators to collect and save patients' demographic information, and by the personnel and finance departments. This means that the available IT equipment is not utilised for medical purposes and there were no E-health systems implemented at the rural healthcare clinics.

This research showed that the challenge is made more difficult than it might be due to the fact that ICT infrastructures are very poor in the investigated rural healthcare clinics. The Clinics did not have sufficient IT equipment, and in some cases there were no network or internet connection in place, and telephone lines are disconnected so often. Furthermore, the electric power supply is unstable and gets interrupted very often in the rural areas. These facts show that the implementation of E-health systems is likely to be affected by poor ICT infrastructures, poor internet connection, and the interrupted electric power supply. These findings back up Brahim and ITU (2013) report which

concluded that internet usage in developed countries is at 31% of the population only, and 77% of the population in developing countries.

The research findings show that only a small proportion of healthcare staff are computer-literate, and training will be needed. ITU (2013) in their report state that a computer operator should not only be competent in the use of a computer, but also needs to know the necessary software programs to help them perform their work. The findings also showed that the respondents wanted not only E-training, but felt it is necessary to be also trained in person.

Shortages of healthcare staff in rural healthcare clinics

The results of the questionnaires and interviews indicate that there is a lack of healthcare staff in the rural healthcare clinics investigated; this results in staff having too much work to do. This is typical for rural areas; e.g. Canadian rural inhabitants have 50% fewer doctors than those living in urban areas and normally live an average of five times further away from healthcare institutions (Cannon et al., 2014; Grover, 2015; AAMC, 2012; Casey et al., 2005).

Because of these facts, the need for implementing E-health systems in rural areas is much greater than in urban areas. E-health systems can allow patients to contact their healthcare clinics without the need to go in person and seek medical advice; doctors and nurses can also use the E-health systems to contact their patients and other healthcare providers.

Availability of E-health systems

The research findings show that there are no E-health systems in use at the investigated rural healthcare clinics. However, data were collected and recorded by administrators on the available computers at the clinics; the collected patients' information and data then get sent to the Department of Health Central Database (DHCDB) on CDs, except one of the clinics that have an internet connection and have access to DHCDB. The vast majority of rural healthcare clinics have no access to data available on DHCDB.

5.3.1.8 Rural Clinics' E-health Maturity Model

The facts that rural healthcare clinics (i) have no E-health systems, (ii) the vast majority cannot access data stored on the DHCDB, and (iii) have poor ICT infrastructure, place them at 'Presence Level (Level Zero)' when graded according to the E-health Maturity Model (Section 3.11) (Figure 5.9a). This level indicates that IT equipment are available at the rural healthcare clinics, but there are no available E-health systems, the IT equipment is mainly used by administrators to record patient information and medical records, and to print out reports and referral letters.

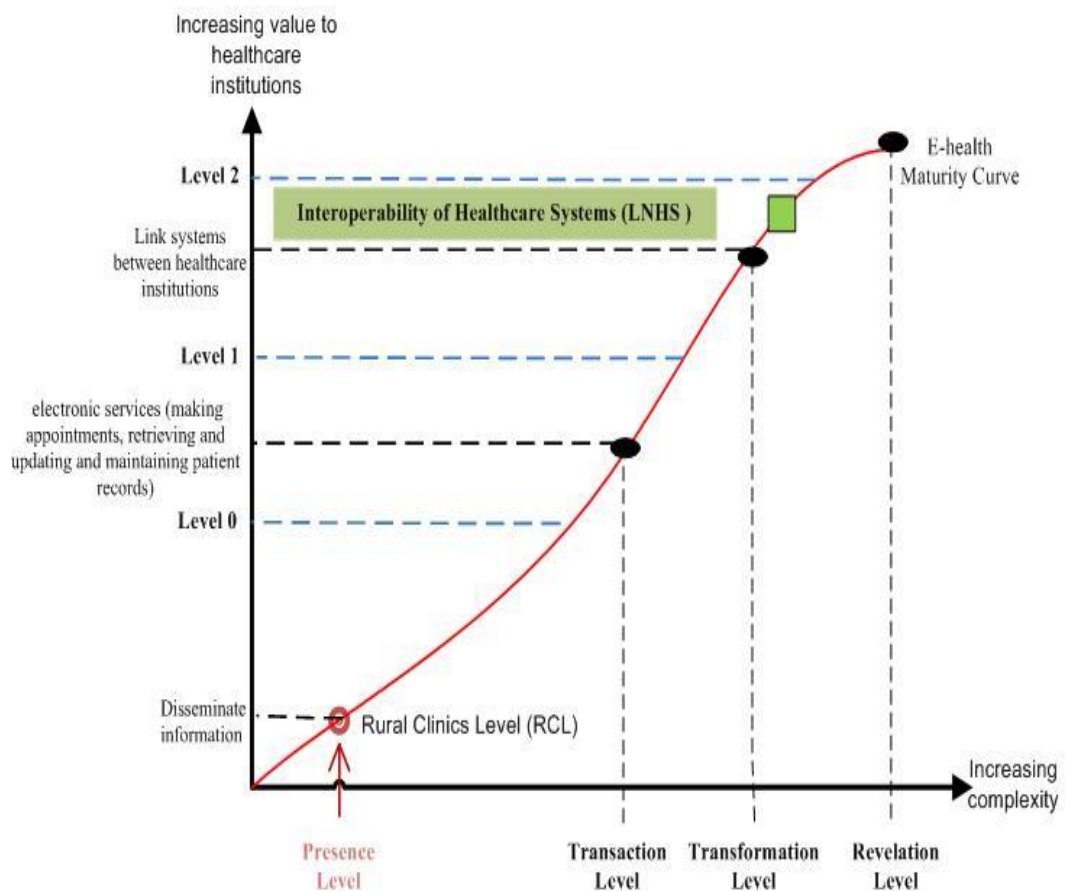


Figure 5.9a: Rural Clinics' E-health Maturity Model.

Jude (2013) says that the primary benefit of implementing E-health systems is to deliver a healthcare service that meets the specific needs of patients. The goal of this study is to improve the standards of E-health systems in healthcare institutions, so they become more efficient and effective. The following section presents the research findings in the investigated urban healthcare medical centres.

5.3.2 Research Findings: Urban Healthcare Medical Centres

This section presents the research findings from the urban medical centres investigated. The information included in this section was gained from doctors, nurses and administrators working at the urban medical centres in Table 5.11. The participants in this research study have both completed the questionnaires (Appendix A), and attended the interviews (Appendix B); findings also include observations that were made by the researcher.

This section includes an overview of the participating urban medical centres, and will give a brief description of their background, their infrastructure, and how easy is it to access and use ICT and E-health systems and what their availability are. Upon visiting these medical centres, the researcher discovered that several had changed their names, hence their new names are listed along with their original names.

| Code (NVivo) | Medical centre old name | Medical centre present name | Location |
|---------------------|--------------------------------|------------------------------------|-----------------|
| Ref: A | Ethnain Mares Hospital | Sabha Medical Centre (SMC) | Southern Libya |
| Ref: B | Ibn Sina Medical Centre | Ibn Sina Medical Centre (ISMC) | Central Libya |
| Ref: C | Zawia University Hospital | Zawia Medical Centre (ZMC) | Western Libya |
| Ref: D | Benghazi Medical Centre (BMC) | Benghazi Medical Centre (BMC) | Eastern Libya |
| Ref: G | Tripoli Medical Centre (TMC) | Tripoli Medical Centre (TMC) | Northern Libya |

Table 5.11: List of participating urban healthcare institutions.

5.3.2.1 Participating Urban Healthcare Medical Centres

This section gives an overview of the investigated urban healthcare medical centres participating in this research study.

Sabha Medical Centre (Ref: A)

Sabha Medical Centre (SMC) is located in southern part of Libya in the district of Fezzan. This medical centre provides healthcare services for the entire southern region, and is built on an area of about 70,000 m² of land, and approximately 3070 people attend it weekly.

In the time of carrying out this research study between March and May 2013, the medical centre has 113 laptops which are used mainly by administrators and doctors, 79 desktop PCs 4 of them broken, 128 printers, 36 photocopying machines, 68 phones, and 28 faxes. This makes it one computer for every 3 doctors. All computers operate on Windows XP.

There were no computers available in the consultation rooms to be used by doctors and nurses. The main use of computers is to record patient's health information; they are also used by the personnel finance departments. The available E-health system in this medical centre is used to record patients' health information, and to upload this information to DHCDB via the internet. The available internet connection is generally quite poor and slow. The medical centre does not have E-conference facilities.

Most of the buildings in SMC are new and well looked after. SMC has 85 consultation rooms, 17 main wards that cater for up to 29,000 patients every year, and 480 beds. In spite of the large array of services which SMC provides, higher-end healthcare equipment is somewhat limited or not available, resulting in some cases in referrals to Tripoli Medical Centre (TMC).

Ibn Sina Medical Centre (Ref: B)

Ibn Sina Medical Centre (ISMC) is located in the central region of Libya in the city of Sirt. ISMC provides healthcare services for about 128,000 inhabitants of that area. It is built on an area of 4,000 m² of land, and approximately 2800 people attend it weekly.

In the time of carrying out this research study between March and May 2013, ISMC has 65 laptops, 42 desktop PCs, 62 printers, 4 faxes, 18 phones, and 18 photocopiers. This makes it one computer for every four doctors. No computers are available in the consultation rooms, and all computers operate on Windows XP.

Though internet connections are available in this medical centre, not all healthcare staff have access to the internet. The internet connection is mainly used by administration departments, and to connect to Department of Health Central Database (DHCDB) to access and upload patients' health information, and to record patients' demographic information. The available internet connection is slow and gets disconnected quite often.

The available E-health system is used to record patients' health information and their demographics to upload them to DHCDB. ISMC has no E-conference facilities available.

The main electric power supply gets interrupted and disconnected on a daily basis at this healthcare institution, ISMC has their own power generator which covers the periods of time when the main power supply disconnects.

The buildings at this healthcare institution are well built and the environment within and around it is clean. ISMC has 9 main wards with the capacity of 223 beds. There are 43 consultation rooms, 25 of which are used by consultants and 18 are used for general consultations. The consultation rooms are used by 28 doctors and 122 consultants who work as one team.

Zawia Medical Centre (Ref: C)

Geographically Zawia Medical Centre (ZMC) is approximately 48 kilometres west of Tripoli. ZMC is the second largest healthcare institution in the western part of Libya, and provides healthcare service for 168,000 people living in Zawia and surrounding towns and villages. This medical centre is built on area of about 54,000 m² of land. The healthcare institution receives approximately 2030 patients every week.

In the time of carrying out this research study between March and May 2013, ZMC has 21 laptops out of which 13 are used by administrators and 8 by healthcare staff, 58 desktop PCs, 67 printers, 39 phones, 9 fax machines, and 27 photocopiers. The operating system used for all computers in this medical centre is Windows XP. There were no computers used in the consultation rooms.

ZMC has an internet connection which is quite fast if compared to the internet connection at SMC and ISMC. Only administrators and some of the healthcare staff

have access to the internet. The internet connection is used to connect to DHCDB to access and upload patients' health information records and their demographics information through the local E-health system network installed at ZMC. Even though this medical centre has E-health system doctors are still using faxes to send and receive medical reports and referral letters.

The buildings at this healthcare institution are well built. ZMC has 13 wards, with the capacity of 481 beds, and 62 consultation rooms which are used by 41 doctors and 29 consultants who operate as one team.

Benghazi Medical Centre (Ref: D)

Benghazi Medical Centre (BMC) is located in the eastern part of Libya in Benghazi, the second largest city in Libya.

The EU and France agreed in 2007 to build this medical centre after signing an agreement with the Libyan government, with the capacity of 1200 beds. The agreement included healthcare staff training programmes to provide first class healthcare services. The opening of the BMC took place in 2009 and now serves 1.1 million people living in the Benghazi area.

There are 5,400 people working at the BMC in addition to 1,230 medical professionals, 2,700 people working in the engineering and administration departments, and 1,470 healthcare assistants.

In the time of carrying out this research study between March and May 2013, BMC has a very strong ICT infrastructure, and has new IT facilities and medical equipment. However, these facilities unfortunately have not been well maintained and looked after due to the unrest and civil war the country has experienced since 2011.

In 2013 a French company (Paris-based Ideal Medical Products Engineering (IMPE)) was contracted to provide modern and efficient ICT facilities to BMC, and to provide training to staff so that when E-health technology is implemented the medical staff would be well prepared for using it.

BMC's E-health system is not currently used by healthcare staff, even though there appears to be adequate ICT equipment installed, as staff do not feel very confident on how to use it. During the interviews the researcher noticed that staff did not feel that they received enough training to make them feel confident on how to use the newly implemented E-health systems at BMC. The researcher also observed that communication between the different departments of BMC is still very antiquated as it was often carried out through paper notes being sent, and did not use emails.

The only E-health system used is to access and upload patients' health information and their demographics information onto DHCDB, and most computers were used by administrators. Though there were computers and IT equipment available in consultation rooms, they were not used by healthcare staff to record patients' medical records.

Tripoli Medical Centre (Ref: G)

Tripoli Medical Centre (TMC) is located in the northern part of Libya and is the second largest hospital in the capital Tripoli.

The trauma unit at the TMC was the first one to be built in Tripoli and remains the most important one. The TMC is also the only healthcare institution in Libya where organs can be transplanted and it serves a population of approximately 1.2 million people, and receives approximately 1650 patients a week.

In the time of carrying out this research study between March and May 2013, TMC has adequate IT equipment installed, and has strong ICT infrastructure. However, staff did not feel as if they had enough training on how to use installed system in place. The researcher observed that most computers are used by administrators, and not as might be expected by medical staff, and the available system is not used to communicate between TMC different departments. The available computers in the consultation rooms are not used by healthcare staff.

The only E-health system currently in use at TMC is to access and upload patients' health information and their demographics to DHCDB.

In 2006 the Libyan government funded an education and training programme in the TMC that was supported by the Medical University of Vienna (MUV). The programme allowed expert medical knowledge to be transferred from international consultants to Libyan consultants to improve the healthcare provision. Unfortunately, the programme has been halted until the political situation in Libya improves.

TMC has been well constructed and is one of the two university hospitals of Tripoli Medical School. TMC has the capacity of 1,485 beds and runs at an average rate of 70% capacity. TMC has approximately 3,000 staff and 1,000 doctors; the latter operate as a team.

5.3.2.2 Overview Summary of the Participating Urban Healthcare Medical Centres

The urban healthcare medical centres that were surveyed have been built with solid infrastructures and serve large numbers of patients. Table 5.12 is a summary of how available, usable and accessible ICT technology is in the investigated medical centres. Note that only three of the medical centres are included in this table, because there were no information available about the other two (TMC and TMC) at the time of carrying out the survey in the time between March and May 2013.

| Service | | Medical Centres | | | | | |
|----------|--------|--------------------------------|--|--------------------------------|--|--------------------------------|--|
| | | Sabha Medical Centre | | Ibn Sina Medical Centre | | Zawia Medical Centre | |
| | | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services | How available are ICT services | How accessible and usable are ICT services |
| Hardware | Laptop | 113 | Admin and medical | 65 | Admin and medical | 21 | Admin and doctor |

| | | | | | | | |
|--|--|-----------|-------------------------|-----------|-------------------------|-----------|-------------------------|
| | | | staff | | staff | | |
| | Desktop | 79 | Admin and medical staff | 42 | Admin and medical staff | 58 | Admin and medical staff |
| | Printer | 128 | Admin, staff and doctor | 62 | Admin, staff and doctor | 67 | Admin, staff and doctor |
| | Photocopier | 36 | Admin, staff and doctor | 18 | Admin, staff and doctor | 27 | Admin, staff and doctor |
| | Fax | 28 | Admin, staff | 4 | Admin, staff | 9 | Admin, staff |
| | Telephone | 68 | Admin, staff | 18 | Admin, staff | 39 | Admin, staff |
| | E-conference | 0 | Not accessible | 0 | Not accessible | 0 | Not accessible |
| | digital cam monitor ed on a Microscope | Available | Doctor | Available | Doctor | Available | Doctor |
| | digitalis ed | Available | Staff | Available | Staff | Available | Staff |

| | | | | | | | |
|------------------------|---------------------------------------|-------------|-----------------|-------------|----------------|-------------|----------------|
| | equipment for X-rays | | | | | | |
| Network | Internet | Available | Admin and staff | Available | Admin | Available | Admin |
| IT support Personnel | Technical support personnel | Available | Frequently | Available | Frequently | Often | Frequently |
| Previous IT experience | Frequency of computer use | Rarely | Not often | Rarely | Not often | available | Not always |
| | Frequency of using emails | Rarely | Not often | Rarely | Not often | Rarely | Not often |
| | Using a computer for E-health systems | DHCDB | Admin | DHCD B | Admin | DHCD B | Admin |
| | Training in using E-health systems | Unavailable | Not accessible | unavailable | Not accessible | unavailable | Not accessible |
| | Experience | Very | Doctors | Very | Doctors | unavailable | Not |

| | nce in using E- health systems | low | and medical staff | low | and medical staff | ble | accessi ble |
|--|---|-----|-------------------------|-----|-------------------------|-----|----------------|
| For available information on Benghazi Medical Centre (BMC) see Section 5.3.2.1 | | | | | | | |
| For available information on Tripoli Medical Centre (TMC) see Section 5.3.2.1 | | | | | | | |

Table 5.12: Overview of ICT access levels at participating urban medical centres.

Table 5.12 shows that the three urban medical centres included in the table use the DHCDB. The medical centres have the equipment necessary for Tele-radiography so that they can transmit X-ray images to any department within the medical centre. The investigated medical centres have similar challenging issues, such as:

- Staff are not well trained, or not trained at all in how to use ICT technology;
- Electrical power supplies are interrupted often;
- Not enough IT equipment to utilise E-health systems, and no database to save patients electronic medical records except DHCDB which is limited for patients' health information and their demographics only;
- The telephone connections are not reliable and healthcare institutions are frequently left without telephone connections;
- Internet connections are not very good;
- There are not enough IT support services and they take too long to deliver their services;
- Too much work for the doctors, and more doctors needed;
- There is not enough equipment, such as PCs, faxes, printers and photocopying machines in most healthcare centres.

5.3.2.3 Results and Findings from Interviews in Urban Healthcare Medical Centres

This section presents the research findings from the interviews carried out in the investigated urban healthcare medical centres. Participants also completed the questionnaires prior to their interviews. The results from the interviews helped in answering the Research Sub-Question one.

Table 5.13 summarises the responses. The main aim of the questions asked was to establish what the respondents think of E-health technologies, and how they would potentially benefit from implementing such systems, and whether these systems will be accepted and used if implemented. The left column of the table is a list of the main areas of operation, and the questions asked during the interviews; the right hand column contains a summary of the answers given and direct quotes from responses. The researcher has included a code for the type of respondents to maintain the respondent confidentiality (Kaiser, 2009). The codes are: (A: Administrators, D: Doctors, N: Nurses, and W: Ward Attendants).

| Q.1. How would you expect your medical institution to benefit from the installation of the following E-health applications? | |
|--|--|
| The main operational areas | A summary of the answers given during the interviews and some quotes in the urban healthcare institutions |
| E-prescription system | <p>There will be fewer errors when medication is dispensed and time will be saved.</p> <p>Respondent (A): “as pharmacists will have details of prescriptions before the patient arrives, it is possible that the prescription will be ready when the patient arrives at the pharmacy and so save time”.</p> <p>Respondent (D): “patients will no longer be able to lose or change prescriptions”.</p> <p>Respondent (D): “because some doctors have bad handwriting, this system will save time and ensure fewer mistakes are made when dispensing medicines”.</p> |
| E-referrals | <p>Time will be saved as doctors will no longer need to write a patient’s treatment history as it will be accessible from the electronic records. A patient’s further treatment can be followed by the healthcare institution that referred them.</p> <p>Respondent (W): “this will be helpful as some patients</p> |

| | |
|-------------------------------|---|
| | <p>lose their way or decide they will not attend their appointment, but if the hospital is alerted to expect them then they can contact them if they do not attend”.</p> <p>Respondent (N): “doctors can prepare for the arrival of patients”.</p> <p>Respondent (D): “time will be saved as a doctor no longer needs to begin their examination from scratch as initial examinations have already been carried out”.</p> |
| EPHR | <p>Time will be saved while making records of patient data, treating patients and making diagnoses. Patient confidentiality will be more secure.</p> <p>Respondent (W): “often it takes a long time for patient’s medical records to be retrieved. These patients will therefore receive better treatment”.</p> <p>Respondent (D): “electronic patient health records will mean time will be saved as data will be recorded and retrieved systematically and will therefore be much easier, hence saving time”.</p> <p>Respondent (A): “the rooms we use for storing files are overstocked and badly organised. This system will save a lot of time”.</p> |
| E-training | <p>Our skills base will be improved and we will perform better in our jobs, especially if we receive training in person too.</p> <p>Respondent (N): “the best way to do this would be to be trained in person at first and use e-training afterwards if we need to remember something or need to be supported in our work”.</p> |
| E-consultation systems | <p>The work of healthcare staff will become more efficient as it will be easier and quicker to ask questions of other healthcare staff when diagnosing and treating a patient.</p> |

| | |
|--|--|
| | <p>Respondent (A): “doctors will no longer need to go to another department or healthcare institution to ask for advice, so money and time will be saved”.</p> <p>Respondent (D): “consultations with doctors can be carried out more efficiently if they can consult a colleague, so time will be saved”.</p> |
|--|--|

Table 5.13: Findings from interviews: urban healthcare medical centres.

In addition to question Q1 there were several other questions put to the respondents in the interviews. Table 5.14 is an overview of responses to the other questions. The left column has a list of the main areas of operation and questions and in the right column there are quotes from respondents and a summary of their answers.

| | |
|---|---|
| Key areas of operation and questions asked in the interviews | A summary of answers and responses to some of the questions asked during the interviews at urban healthcare institutions |
| Q.2. How do you think any of the applications above would improve efficiency in your medical institution? Please be specific about the system and your expectations. | |
| Problems currently occurring with E-health in the healthcare medical centres | |
| Q.2. (Appendix B) | <p>E-prescriptions - communications will be improved and a patient who decides to use their prescription at multiple pharmacies will no longer be able to do so.</p> <p>Respondent (A): “any patients using false identity cards will be more easily traceable if they attempt to get their prescription from multiple pharmacies”.</p> <p>EPR and E-prescriptions - there will be much less queuing necessary at pharmacies.</p> <p>Respondent (W): “queuing will be reduced as patient data can be retrieved quickly and records can be filed easily”.</p> <p>EPR - filing systems will be improved and files will not</p> |

| | |
|--|---|
| | <p>get lost.</p> <p>Respondent (A): “documents will be much safer and will be able to be found from many years before very easily”.</p> <p>(All of the systems)</p> <p>Costs will be reduced.</p> <p>Respondent (A): “less money will need to be spent and it will no longer be necessary to buy so much stationary”.</p> |
| <p>Q.3. Do you feel that the implementation of any of the systems you detailed above would create any problems? Be specific about the system and problem.</p> | |
| <p>Anticipated problems</p> | |
| <p>Q.3. (Appendix B)</p> | <p>All of the systems – no consistency in electrical supplies and keeping patient data confidential.</p> <p>Respondent (A): “staff from rural areas are not educated enough so can cause problems with the system. There are not enough efficient workers and the internet is too slow”.</p> <p>Respondent (A): “the electrical supply is inconsistent and it is very hard to ensure that patient data remains confidential”.</p> <p>Respondent (A): “there is not enough money to buy all of the equipment that is needed”.</p> <p>The staff are not well trained well and human resources are not used efficiently.</p> <p>All of the systems – there is a lack of finance.</p> |
| <p>Q.4. Is there technology in your medical institution at this time that might support such an E-health application? Please be specific.</p> | |
| <p>Basic E-health technology that is available</p> | |
| <p>Q.4. (Appendix B)</p> | <p>Tele-radiography.</p> <p>Respondent (A): “there is Tele-radiology equipment, but it is just in three of the hospitals in this region”.</p> |

| | |
|--|---|
| | <p>The Department of Health Central Database.</p> <p>Respondent (D): “the administration department has a system called DHCDB database. This does not aid us much in treating patients, it only allows us to trace information about their background but has nothing to do with their diagnosis”.</p> |
| <p>Q.5. Would it be to your liking to be trained in the use of computers so that your job performance might be enhanced?</p> | |
| <p>Training needs</p> | |
| <p>Q.5. (Appendix B)</p> | <p>We believe that we need to be trained more.</p> <p>Respondent (A): “it would be good to be trained more so that if there are minor problems we can deal with them if there is no technician present”.</p> <p>Respondent (N): “it is necessary for us to be trained more if we want to operate at the optimal level”.</p> |
| <p>Q.6. How do you feel about accessing Ehealth applications outside of your job? Is this something you would like to do and why?</p> | |
| <p>Accessing E-health application outside the workplace</p> | |
| <p>Q.6. (Appendix B)</p> | <p>Most of the respondents said that they would prefer it if E-health applications were accessible to them while outside of the workplace”.</p> <p>Respondent (D): “I would like to know how my patients are doing and if they are recovering or responding to their medical treatment, and to have advance warnings of their conditions”.</p> <p>Respondent (D): “I would like to be able to find out test results of my patients so I can respond quicker if needed”.</p> |
| <p>Q.7. Is there something else you would like to add or something you feel needs recommending or commenting upon?</p> | |
| <p>Suggestions made by respondents</p> | |

| | |
|---------------------------------|--|
| <p>Q.7. (Appendix B)</p> | <p>Any suggestions that the respondents wanted to make, and any comments they felt were relevant</p> <ul style="list-style-type: none"> • We need to have pilots before any systems are implemented. • It is necessary for the servers to be more powerful, to buy much more computer equipment, increase security levels and have well trained medical secretaries for the doctors. • Both money and time will be saved. <p>Respondent (D): “if there are medical secretaries then they can be typing while the doctor is carrying out the diagnosis so that as soon as the diagnosis is complete it would be recorded on the system”.</p> <p>Respondent (A): “some of the larger hospitals can be used for running pilot schemes before the new systems are implemented”.</p> <p>Respondent (A): “for this to be successful bigger servers will be needed for data backup”.</p> <p>Respondent (A): “a lot of time and money can be saved if such systems implemented”.</p> <p>Respondent (A): “much more computer equipment will be needed and security must be improved”.</p> |
|---------------------------------|--|

Table 5.14 Findings from the interviews in urban healthcare medical centres.

5.3.2.4 Findings from Interviews in Urban Healthcare Medical Centres

The researcher has gained a lot of information from interviewing the healthcare staff at the investigated urban healthcare medical centres. Healthcare staff expressed that if E-health systems would be implemented in their place of work then:

E-referrals would:

- Help a patient’s progress to be tracked by staff in the healthcare institution they have been referred from;

- Mean that doctors at the healthcare medical centre which a patient has been referred to do not need to write out a patient's medical history again as it can be accessed on the system.

E-consultation systems would:

- Improve the efficiency of treatment patients receive as staff can contact each other for advice while treating and diagnosing a patient.

E-prescriptions would:

- Lead to fewer mistakes made by doctors when prescribing medication;
- Lead to pharmacists making fewer mistakes when dispensing prescriptions;
- Save patients and pharmacists time when medicines are dispensed;
- Result in all prescribed and dispensed medications being recorded.

E-training would:

- Create improved performance in the workplace if staff receive training in person prior to the E-training;
- Allow healthcare staff to make improvements to their ICT skills base.

EPR would:

- Help with communicating and protecting confidentiality of patient data;
- Help in saving time when retrieving patients' medical records, which would help when making diagnoses and treating patients.

Additionally, the responses received during the interviews showed that healthcare staff think that if E-health systems are implemented in their healthcare medical centres, they would provide solutions to some challenging issues by:

- Saving time needed by healthcare staff to ask their colleagues for advice;
- Reducing time spent queuing at pharmacies;
- Improving the filing process by filing and saving files electronically;
- Improving communication between healthcare institutions;
- Reducing the cost of travel.

The results of the interviews showed that only one medical centre has Tele-radiography equipment which helps in transmitting X-ray images, and all investigated urban medical centres have E-health systems which are used to connect to Department of Health Central Database to access and upload patients' health information and their demographics.

The respondents also expressed that they anticipated some challenges that might occur when the E-health systems would be implemented in their healthcare medical centres:

- There is not enough computers and IT equipment available;
- Weak ICT infrastructure;
- Data protection and security will be a big challenge;
- The electrical power supply is not consistent.

The participants in the interviews felt that the implementation of E-health systems in their workplaces would bring improvements in their performances at work and allow them to provide improved levels of care to their patients. Additionally, the participants expressed the opinion that using trained medical secretaries would help doctors to do a better job for the patients by recording the diagnosis of the doctor on electronic patient health records. The following subsection looks in more depth at the questionnaires findings.

5.3.2.5 Summary of Responses from Questionnaires in Urban Healthcare Medical Centres

This section presents a discussion of the questionnaire results, and what was found after analysing the completed questionnaires (see Appendix A for the complete questionnaire).

Table 5.15 presents an overview of the findings from the questionnaire. The column on the left is for the main areas of operation and question numbers, and the right column contains summaries of the answers given by the respondents.

Question 1.1 asked the respondents about the role that they carry out in their healthcare institution.

| | |
|--|--|
| <i>Only questions number included, for questionnaires please see appendix A.</i> | |
| <i>General (Appendix A)</i> | |
| Main areas of operation and questions posed | Answers are classified upon the majority of responses given in the questionnaires in urban healthcare medical centres |
| 1.2 Please indicate using an X whether or not your department is conducted as a multidisciplinary clinical team? Yes <input type="radio"/> No <input type="radio"/> | |
| Healthcare staff carry out their work in multidisciplinary teams. | |
| 1.3 Please indicate using an X whether or not health records of your patients need to be shared with other healthcare professionals? Yes <input type="radio"/> No <input type="radio"/> | |
| Yes, healthcare staff are sharing the healthcare records of patients. | |
| <i>Electronic patient healthcare record system (Appendix A)</i> | |
| 2.1 Please write in the box provided below, the way in which patient health records are currently created in your medical institution. <input type="text"/> | |
| Electronically – a DHCDB is utilised for capturing patient’s medical data. Manually – written by hand with pens onto paper and then stored in files. | |
| 2.2 Please write in the box provided below, the system presently used in your medical institution for the maintenance of patient health records. <input type="text"/> | |
| New information is filled out by hand, and stored in filing cabinet. | |
| 2.3 please indicate using an X in either of the boxes below, whether or not it is the responsibility of each individual doctor to personally look after the maintenance individual’s medical records or is that the responsibility of a central authority? Maintain each patient’s record <input type="radio"/> Centralised <input type="radio"/> | |
| The patients’ health records are stored on DHCDB in Tripoli. | |

2.4 Please write in the box below the ways in which records are kept, for instance are they written by hand, by use of a word processor or Dictaphone or Tran-scripted etc.

State the means of recording. (E.g. handwritten, Dictaphone, transcription, word processor, etc)

Written by hand.

2.5 Please indicate using an X whose job it is to record the patient records.

Doctors Nurses Ward attendants Other (specify)

The clerks at the Outpatients Department, when a patient first arrives at the healthcare institution, doctors and nurses.

2.6. Please write below the way in which patient records or normally collected, for instance by use of a form or with minimum fields etc.

The format differs in different medical domains, though in each domain a form is utilised. At the Outpatients Department demographic data is recorded and medical histories are captured in the consulting rooms.

2.7. Please indicate in the box below how much time would typically be used daily for maintaining the health records of patients.

Between twenty and thirty minutes on average.

3.1 Please indicate in the box below where the usual place is for storing patient healthcare files.

In the records room and then moved to the archive room afterwards.

3.2 Please indicate below the normal procedures for storing and retrieving patient healthcare files, for instance: how it is stored – in secure cupboards or filing-cabinets etc.

The cabinet is not locked, but the filing room is.

3.3 Please indicate below the pattern of arrangement for your patient health records; for instance are they stored in an alphabetical or chronological sequence or depending upon security or how many copies there are etc.

Alphabetically.

3.4 Please indicate below what staffs possess the authority to see patient records without permission; for instance doctors and nurses etc.

Nurses, doctors, hospital administrators and the rest of the healthcare staff.

3.5 Please indicate below the typical time required to retrieve the records of a patient.

Between 15 and 20 minutes on average.

4. Please indicate using an X whether or not you think that the system currently used for recording patient health records is providing a good service accurately and thoroughly and then indicate in the box provided why you gave this answer. Yes No

No, because files are constantly being lost.

5. Please answer with an X, whether you think that the quality and format in which patient health records are recorded is good enough for healthcare workers to share it effectively and then write down in the box below the reasons for your answer. Yes No

Yes, as the patient's health record contains a document from the doctor along with one from the nurse. The file includes all of the information.

6. In your opinion, does the way in which patient health records are currently stored give good value for money and do the best job possible in delivering healthcare services in allowing:

6.1 The retrieval of patient health records in the minimum/optimal amount of time?

Yes No

Please indicate why you answered yes or no

Yes, because of the loss or misplacement of patient files, a lot of time is required to find them.

6.2 Minimising the time needed for diagnosing and treating ailments?

Yes No

Please indicate why you answered yes or no

No, patients will spend a long time before being admitted without a file.

6.3 Patient health records to be as confidential as possible?

Yes No

Please indicate you answered yes or no.

No, as all healthcare staff can look at the files as they are stored by the patient's bed in cabinets that are left unlocked.

7. What are the principle ways in which the present system is limited:

7.1 The creation of patient health records?

A lot of time is spent creating patient files. Labour intensive.

7.2 The maintenance of patient health records?

Not enough room for storing records. On wards the files get lost and are not returned to be stored.

| |
|---|
| 7.3 The storage of patient health records? |
| <input type="text"/> |
| They are not stored securely, too many old files taking up too much space and a lack of confidentiality. |
| 7.4 The retrieval of patient health records? |
| <input type="text"/> |
| There regularly are problems in the retrieval of records and it is time consuming to locate patients' files. |
| Determining E-consultations, E-prescriptions and E-referrals (Appendix A) |
| 8. What is the present procedure for consulting between patient and doctor? |
| Face-to-face <input type="radio"/> Through electronic means <input type="radio"/> |
| Face-to-face. |
| 8.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable) |
| E-mail (computer) <input type="radio"/> E-mail (cell phone) <input type="radio"/> Telephone <input type="radio"/> SMS <input type="radio"/> |
| Other <input type="radio"/> Specify |
| <input type="text"/> |
| Telephone. |
| 9. What system is currently used for consultations between healthcare professionals? |
| 9.1 Within the medical institution? |
| Face-to-face <input type="radio"/> Through electronic means <input type="radio"/> |
| Face-to-face and electronic means. |
| 9.1.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable) |
| E-mail (computer) <input type="radio"/> E-mail (cell phone) <input type="radio"/> Intranet <input type="radio"/> SMS <input type="radio"/> |
| Telephone <input type="radio"/> Other <input type="radio"/> Specify |
| <input type="text"/> |
| E-mail, telephones. |

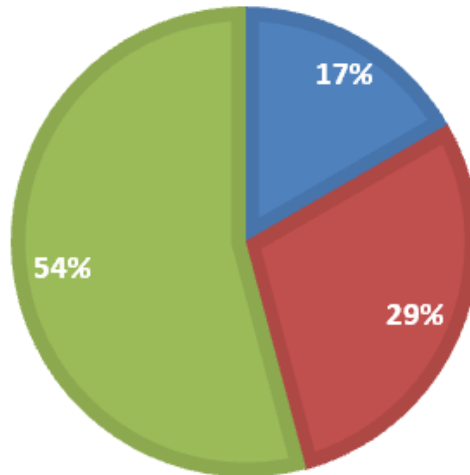
| |
|---|
| <p>9.2 With other medical institutions?</p> <p>Face-to-face <input type="radio"/> E-video consultation <input type="radio"/> Through electronic means <input type="radio"/></p> |
| <p>Face-to-face, electronic means.</p> |
| <p>9.2.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable)</p> <p>E-mail (computer) <input type="radio"/> E-mail (cell phone) <input type="radio"/> Internet <input type="radio"/> SMS <input type="radio"/></p> <p>Telephone <input type="radio"/> Other <input type="radio"/> Specify</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| <p>Mobile phone, text messaging, e-mails.</p> |
| <p>10. Are there Ehealth facilities within your medical institution?</p> <p>Yes <input type="radio"/> No <input type="radio"/></p> <p>If yes, describe in what ways it is utilised.</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| <p>There is only one Tele-radiography machine at TMC, the images are transferred so that they can be assessed by consultants and reprinted.</p> |
| <p>11. How are patients referred to the pharmacy to collect their prescriptions? For instance are they given a piece of paper or is it transferred electronically. Please write in box provided below</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| <p>Prescriptions are written on paper and given to patients to take to the pharmacy.</p> |
| <p>11. How are patients referred to the pharmacy to collect their prescriptions? For instance are they given a piece of paper or is it transferred electronically. Please write in box provided below</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| <p>Pluses: The prescription once used is stored together in the patient's file. The prescription can be authenticated by the pharmacist.</p> <p>Minuses: The prescription can be delayed if the pharmacist cannot understand the handwriting.</p> |
| <p>How training opportunities are determined (Appendix A)</p> |

13. How frequently do you access a personal computer? Indicate with an X the appropriate answer please.

Daily Weekly Monthly Never

13. HOW FREQUENTLY DO YOU ACCESS A PERSONAL COMPUTER?

■ Daily ■ Weekly ■ Monthly

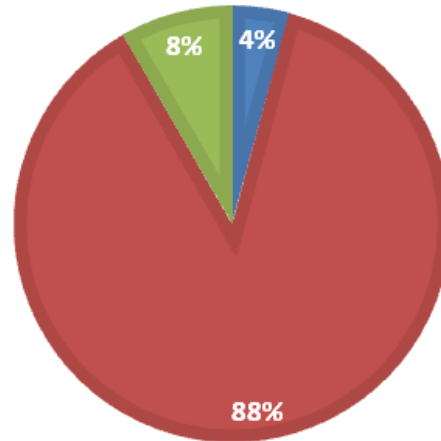


Approximately 17% said that they had used a computer daily and the remaining majority of 83% said they used one every week or every month.

13.1 What tasks do you perform on your computer? Please be specific.

13.1 WHAT TASKS DO YOU PERFORM ON YOUR COMPUTER?

■ Compilation of statistics ■ Accessing the internet ■ Recording patient data

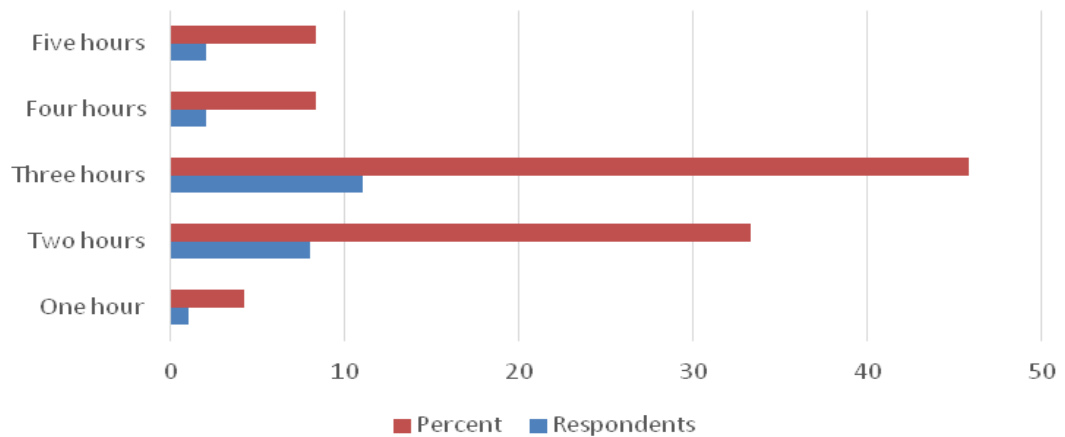


The statistics show that approximately 4% of those questioned used computers in order to compile statistics, 8% used them for recording patient data, and the remaining majority of 88% used them in order to access the internet.

14. In what ways does the availability or unavailability of computers or the internet effect your work? Please specify below.

As paper is used for a majority of the work there is no direct impact. The people recording patient data felt not using computers has an impact on the work they carry out every day.

15. What is the total amount of time you spend on your computer each day?



15. What is the total amount of time you spend on your computer each day? Please specify in hours below.

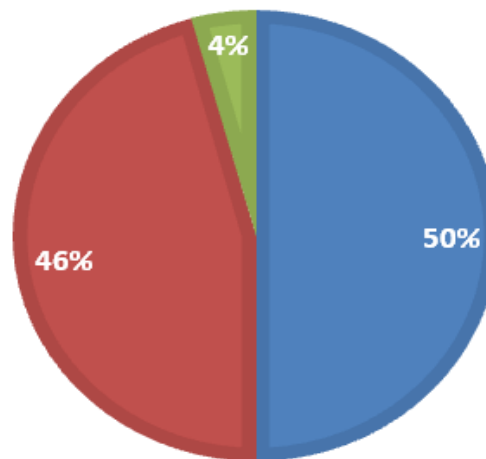
The majority of respondents stated that they had no spare time for using computers or the internet. The respondents who said they did use computers averaged between 2 and 3 hours every day.

16. How would you rate your ability to use a computer? Indicate with an X please.

Novice Average Experienced

16. HOW WOULD YOU RATE YOUR ABILITY TO USE A COMPUTER?

■ Novice ■ Average ■ Experienced

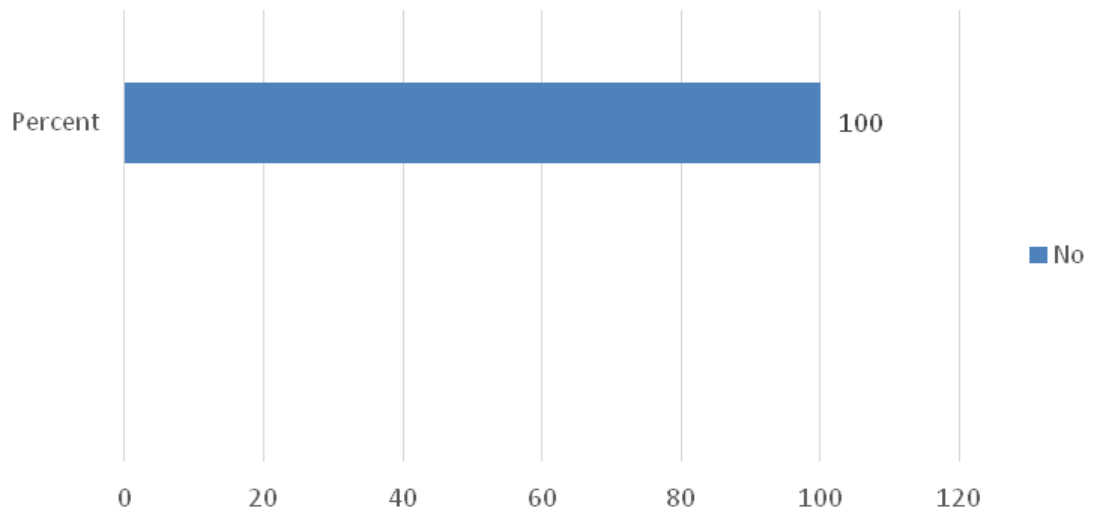


Approximately 4% of the respondents claimed to have had experience using computers, while 46% claim to be average and the majority of 50% claim that they have no experience at all.

16.1 Have you ever been trained to use an Ehealth record system or had any experience operating one? Yes No

If you have, then what type of experience or training was it?

16.1. Have you ever been trained to use an E-health record system?



All respondents said they had not been trained how to use electronic health records.

17. Do you believe that you could operate an E-health record system without any further training?



17. In your opinion, do you believe that you could operate an Ehealth record system without any further training?

Yes No

If you indicated yes, then which system are you referring to?

100% of the respondents thought that they would need to be trained in how to use a computer and any implemented E-health systems. They all showed willingness to

| |
|---|
| use an E-health technology when implemented if trained on how to use it. |
| <p>18. Is there anything that you would like to add, such as a recommendation or to comment upon something that has occurred to you?</p> <p>Please, write down your thoughts below.</p> <div style="border: 1px solid black; height: 20px; width: 100%;"></div> |
| <p>Most people were concerned about how secure the patient records were and how confidential they were. Security in a new system would need to be good to deter hackers from stealing patient information. The government needs to ensure security issues are taken into consideration when implementing new systems.</p> |

Table 5.15: Findings of the questionnaires: urban healthcare medical centres.

5.3.2.6 Findings from Questionnaires in Urban Healthcare Medical Centres

The responses from doctors, ward assistants, nurses, and administrators are summarised in this section.

General

Doctors and other healthcare staff operate in multidisciplinary teams in each of the medical centres investigated and share with each other the contents of the patient's files.

E-referrals and E-prescriptions

The investigated medical centres in urban areas do not have the technology for E-referrals or E-prescriptions. When a patient needs to be referred the process is carried out through using a referral letter. Likewise when prescribing medication for a patient, it is written by hand on paper and given in person to the pharmacist. The participants in the study indicated though that the handwriting can be of a very low quality and pharmacists are liable to make mistakes and have been known to dispense the wrong medications, which can have a serious impact upon a patient's health. When a patient takes a handwritten prescription to a pharmacist they will need to wait for it to be prepared and may also be forced to queue, often for a long time, not a great thing for an ill person to have to do.

When a patient is referred to another medical centre for treatment, because they need a level of healthcare that cannot be offered where they are, then the referral letter they are given is written on paper.

E-consultations

The E-consultations that are discussed in this study refer to consultations taking place between healthcare staff, who are not in the same place. Currently healthcare staff in the investigated urban medical centres consults with each other over the phone or by written letters, and in some cases by their personal email.

EPR

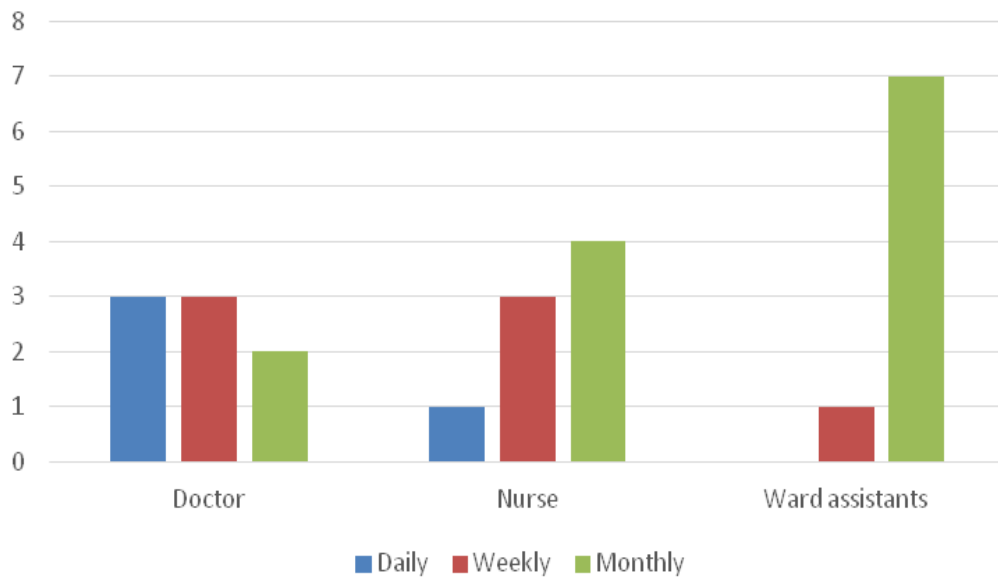
There are no patients' electronic medical records in the investigated urban medical centres. However they are all connected to DHCDB to access or upload patients' health information and their demographics. TMC is the only hospital that has Tele-radiography equipment for transmitting images of X-rays within its departments.

Patients' medical records is recorded by hand on paper and filed at the medical centre. The patient's healthcare records are kept in filing cabinets in alphabetic order, in a secure central storage room within the medical centre. Despite all of this, it can be very hard to find patients' medical records, because so many files are not filed or stored in the correct manner.

E-training

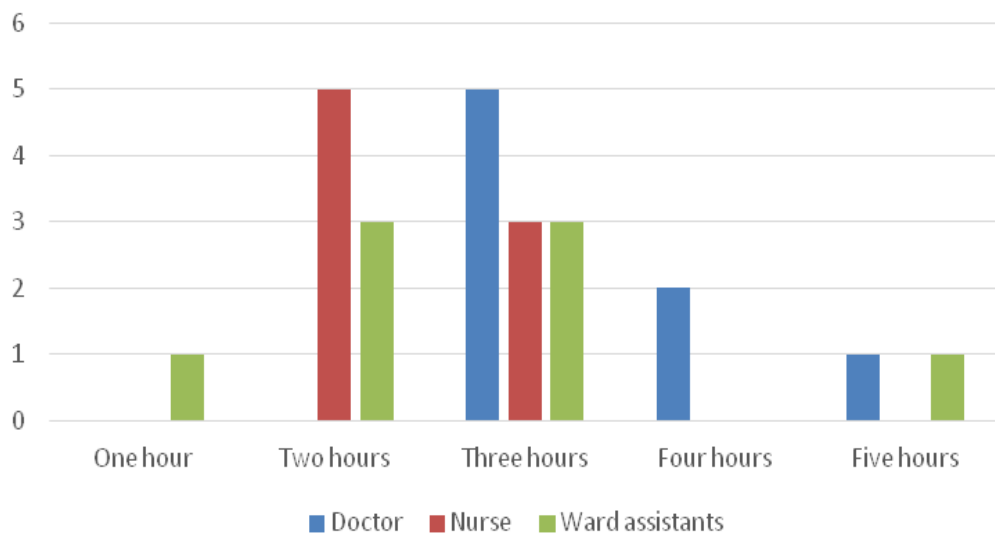
The researcher carried out an assessment to determine how frequently healthcare staff in the investigated urban medical centres used the internet or computers. This assessment was made in order to see how much E-training might be required. The results showed that approximately 17% said that they had used a computer daily and the remaining majority of 83% said they used one every week or every month. Figures 5.6 (a, b, c and d) show the assessment findings.

13. How frequently do you access a personal computer?



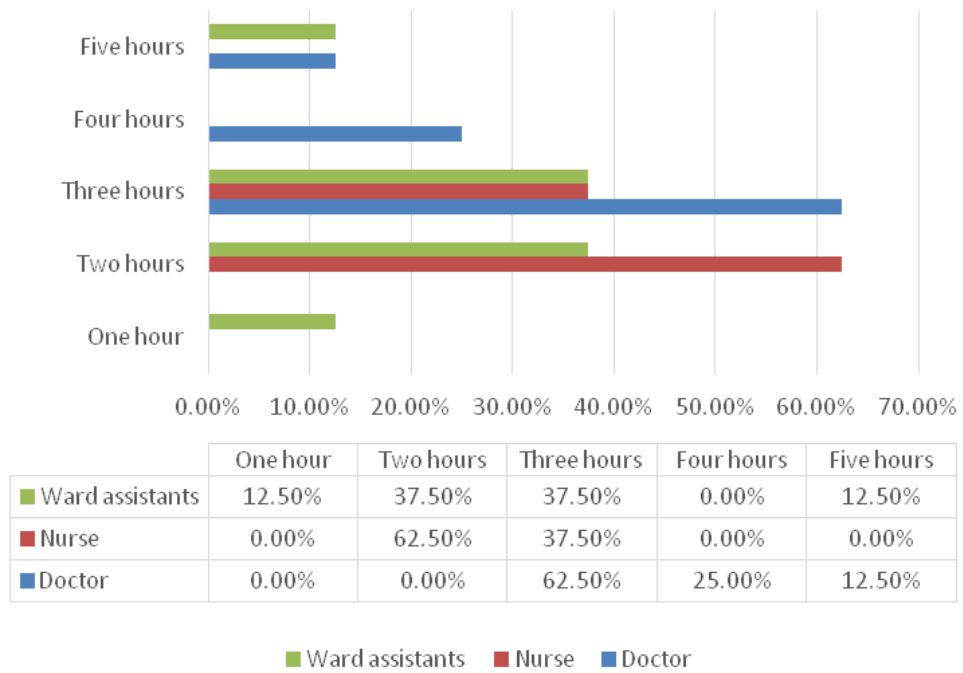
Figures 5.6a: Frequency of computer/Internet usage: urban medical centres.

15. What is the total amount of time you spend on your computer each day?



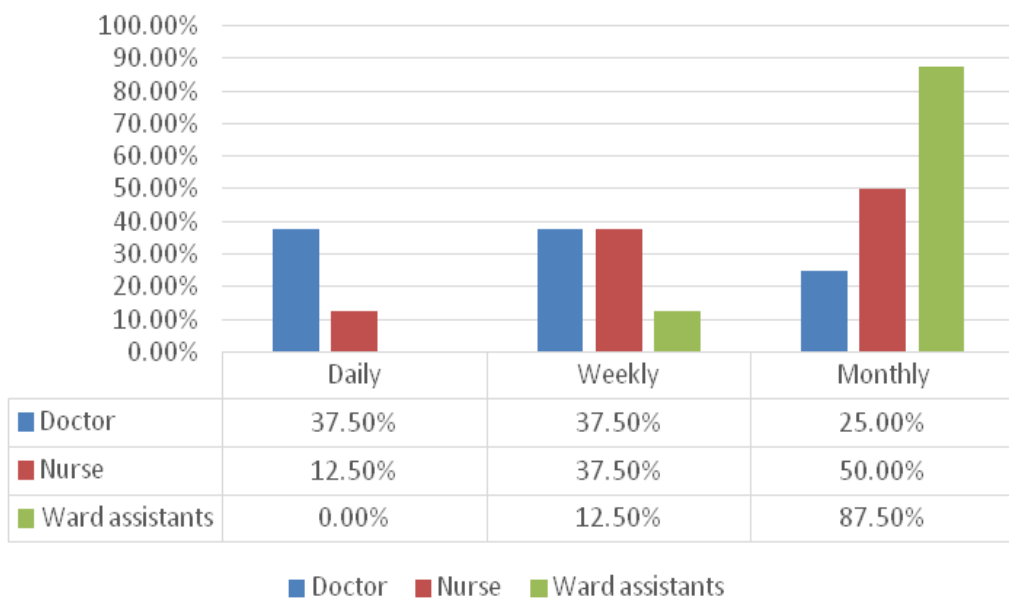
Figures 5.6b: The total amount of time spent on using computer each day: urban medical centres.

15. What is the total amount of time you spend on your computer each day?



Figures 5.6c: The total amount of time spent on using computer each day: urban medical centres.

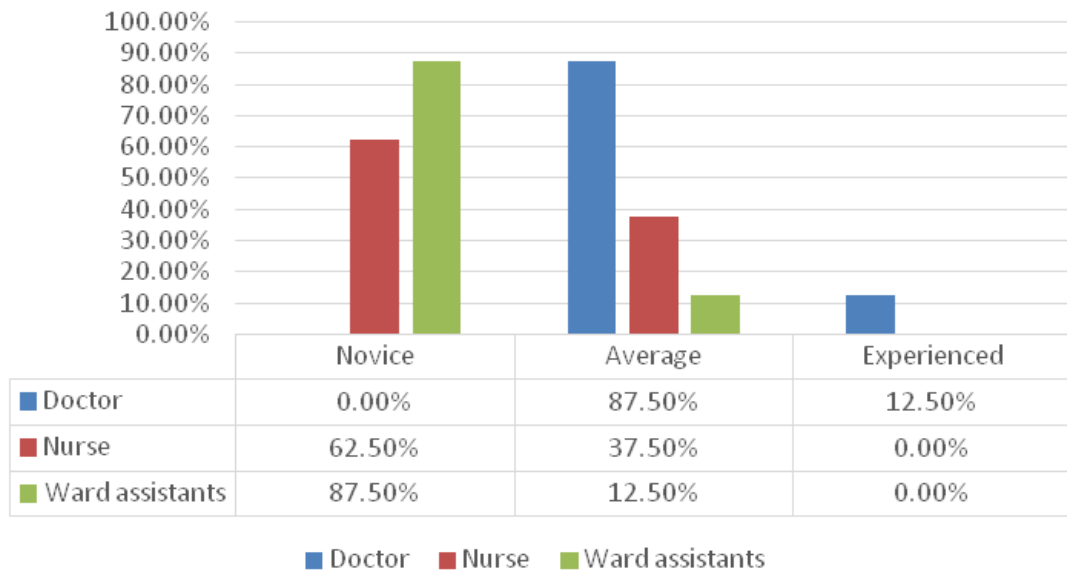
13. How frequently do you access a personal computer?



Figures 5.6d: Frequency of computer/Internet usage: urban medical centres.

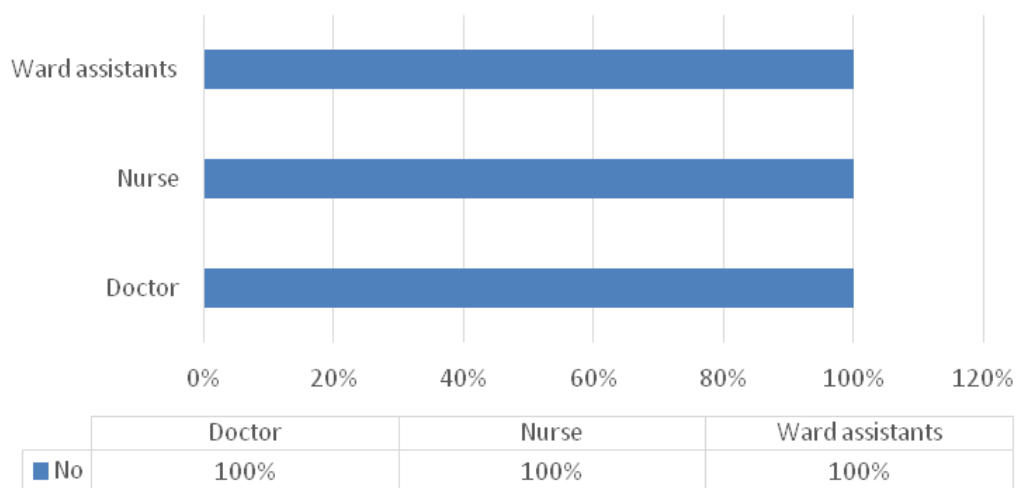
Figures 5.7 (a, b and c) illustrate that the vast majority of respondents felt that they had not received enough training, or did not have enough experience to operate E-health systems if they were implemented in their medical centres. A further depiction of this can be seen in Figures 5.7 (a, b and c).

16. How would you rate your ability to use a computer?



Figures 5.7a: Rate ability to use a computer: urban medical centres.

16.1. Have you ever been trained to use an E-health record system?



Figures 5.7b: Received training on using an E-health record system: urban medical centres.

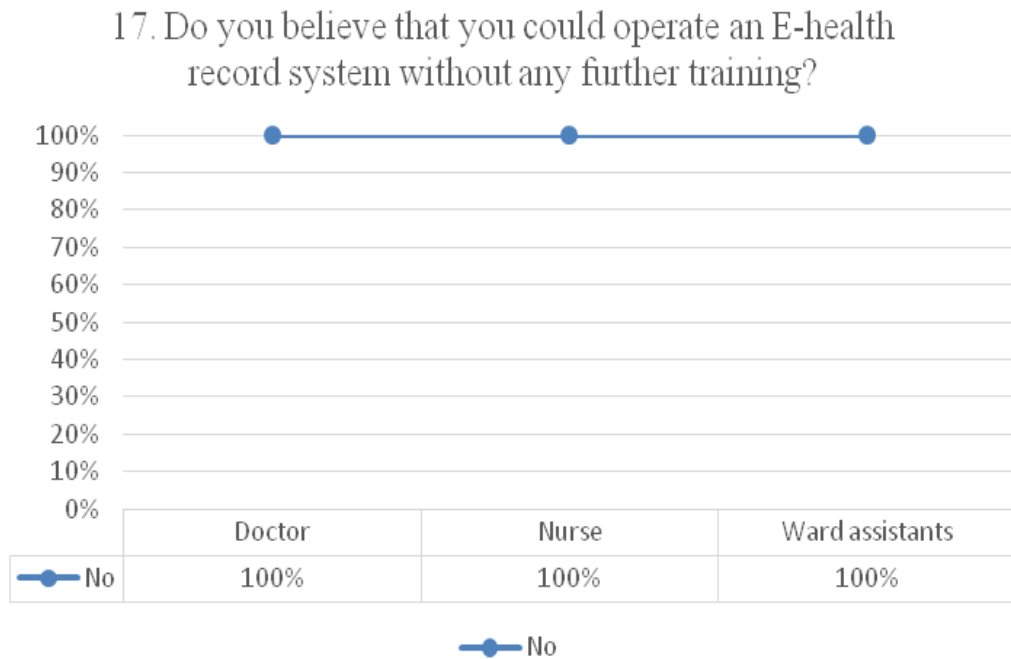


Figure 5.7c: Levels of staff knowledge about computers: urban medical centres.

Almost all of the respondents in the investigated urban medical centres said that they had no past experience of operating E-health systems; however, they expressed their readiness to be trained on how to use it. The idea of E-training did not appeal to most of the respondents, but said that it would be alright if they received training in person.

The following subsection focuses on summarising the findings from the investigated urban medical centres in order to answer the Research Sub-Question one.

5.3.2.7 Common Themes in Results across Urban Healthcare Medical Centres

By summarising the responses and answers given by the participants in the investigated urban medical centres in the questionnaires and interviews, the researcher has been able to carry out a thematic analysis of the cases in this section.

As in section 5.3.1.7, where a cross-case analysis was carried out for rural clinics, this section will provide a thematic analysis by taking multiple cases into consideration so that common themes between rural and urban healthcare institutions can be examined.

The analysis of findings from the E-health readiness assessment indicated that the themes that the urban medical centres had in common, which answered Research Sub-Question 1 were as follows.

The perception of E-health systems and their acceptance levels

The healthcare staff working at the investigated urban medical centres, who will be the users of the E-health systems when implemented, expressed the view that E-health systems would save them time when performing their work, and such systems would improve the quality of healthcare services they provide to patients at their medical centres. This confirms what was noted by Laeum et al. (2004) and Jennett et al. (2005) that when a user is presented with new technologies, there are two primary factors influencing the attitudes that they adopt toward the use of this technology. These are the perception of how useful it might be and how easy it will be to use.

These findings show that healthcare staff who are the main users of E-health systems would use such systems as they believe E-health systems would be useful and helpful. Jennett et al. (2005) defined perceived usefulness as how much the user believes that the use of a system will mean their job performance will be enhanced and perceived ease of use means the level to which the user thinks the use of a system will mean they do not need to exert so much effort.

ICT infrastructure and training availability on how to use the technology

This research showed that there were a lot of computers in the investigated urban medical centres that were not used by healthcare staff. The main users of the available computers were administrators to perform their daily job, and to connect to DHCDB to access and upload patients' health information and their demographics. This shows that the available technology in these urban medical centres is not utilised for medical purposes, and the available E-health system is to connect to DHCDB only.

The electric power supply is unstable and gets interrupted often in urban areas, and the investigated medical centres overcame this problem by having their own power generators. Also the available internet connection was found to be slow and frequently disrupted, and only few members of staff have access to the internet. The healthcare staff expressed the need for training on how to use the technology before such systems

are implemented. These facts show that the implementation of E-health systems can be affected because of the poor ICT infrastructures, the lack of training on how to use the technology, poor internet connection, and the interrupted electric power supply.

Shortages of healthcare staff in urban medical centres

The research findings showed that there are shortages in healthcare staff in the investigated urban medical centres, resulting in increased work pressure on healthcare staff. According to Casey et al. (2005) and James (2008) a shortage of doctors is not prevalent only in developing countries healthcare institutions in though; this problem is experienced in developed and developing countries alike. Implementing E-health system would reduce the pressure created by staff shortages and improve healthcare services.

The availability of E-health systems

The urban medical centres investigated in this study had no systems for carrying out E-consultations, E-referrals, E-training, E-prescriptions and maintaining electronic patient health records, though they did all have access to the DHCDB for uploading patients' health information and their demographics information.

5.3.2.8 Urban Healthcare Medical Centres' E-health Maturity Model

From the research findings in the investigated urban medical centres, it can be said that the available E-health systems are used to access data stored on the DHCDB and upload patients' health information and their demographics only. Even though the urban medical centres has IT equipment and computer networks; the slow internet connection, lack of training on how to use the technology, the interrupted power supply, plus the poor ICT infrastructure places the urban medical centres at 'Interaction Stage (also Level Zero)' when graded according to the E-health Maturity Model (Section 3.11) (Figure 5.9b). Section 5.4 will discuss and compare themes that the rural and urban healthcare institutions have in common.

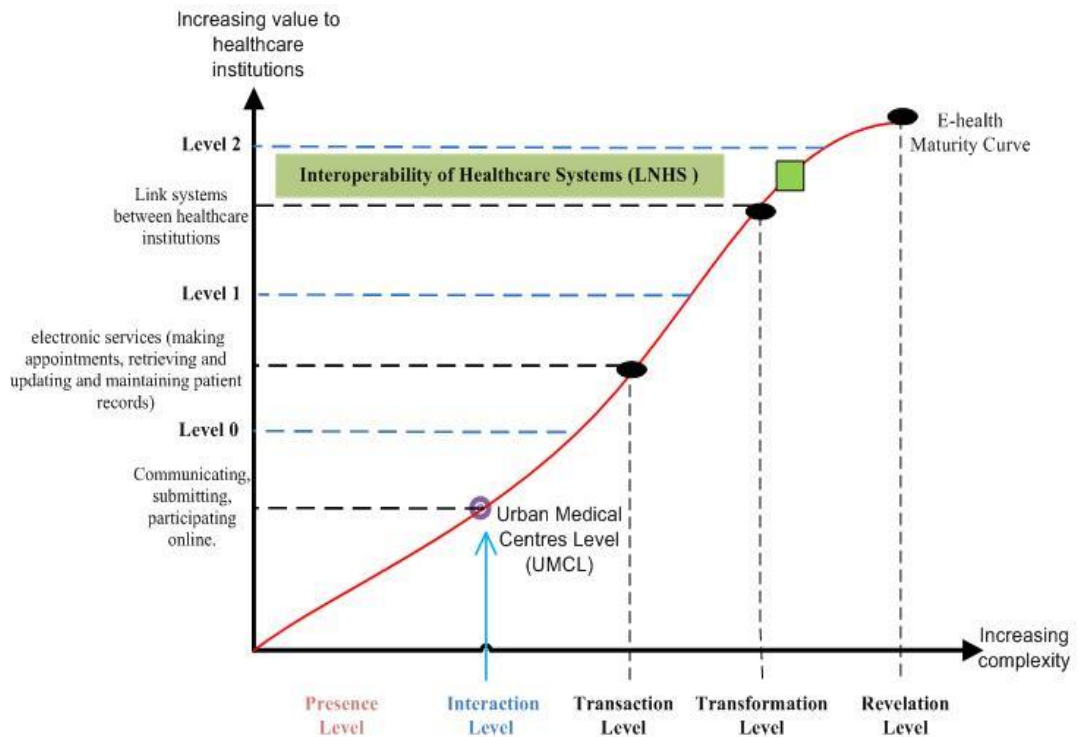


Figure 5.9b: Urban Medical Centres' E-health Maturity Model.

5.4 Phase Three: Comparing Urban and Rural Healthcare Institutions

This section will compare the research findings in urban and rural healthcare institutions investigated for the purpose of this research study, and will propose actions which can aid in developing the E-health framework. The comparative discussion will concentrate on the following specific subjects:

- The perception of E-health systems and their acceptance levels;
- ICT infrastructure and availability of training in how to use the technology;
- Shortages of healthcare staff;
- The availability of E-health systems.

5.4.1 The perception of E-health systems and their acceptance levels

The research findings showed that healthcare staff working at both the urban and the rural healthcare institutions investigated expressed their willingness to accept and use E-health systems if they are implemented at their work place. The healthcare staff participating in this research also expressed their feelings that time could be saved and they would be able to perform their work much more effectively and efficiently, which will lead to delivering high level quality of healthcare services to patients in both urban and rural healthcare institutions.

These findings are backed up by the positive remarks made by the participants in the questionnaires and during the interviews. The participants considered it an urgent need to implement E-health systems in order to enable them to perform their work in much more easier way. The results were presented in Tables 5.6, 5.7, 5.8, 5.13, 5.14, and 5.15. These findings are backed-up by Lahti et al. (2014) who state that when staff show willingness to use a system and accept it, this is shown through their attitudes toward the utilisation of ICT technologies for the management of healthcare provisions.

5.4.2 ICT infrastructure and availability of training in how to use the technology

The results of this research study indicate that medical centres in urban areas have more IT equipment and better ICT infrastructure than clinics in rural areas; this can be seen in Tables 5.5 and 5.12. The consultation rooms in rural clinics have no computers, where as consultation rooms in urban medical centres have computers, however, the available computers are not utilised by healthcare staff to help them perform their work. Most computers available are used by administrators in both urban and rural healthcare institutions.

Furthermore internet connections at urban medical centres are better than the ones in rural clinics. Internet connections at the rural clinics are very slow and get disconnected few times a week due to the poor cable telephone lines in rural areas.

The participants expressed their concerns about the frequently interrupted electrical power supply and how it could affect the performance of E-health systems, especially in rural clinics, as urban medical clinics have their own backup power generators.

This research also showed that both urban and rural healthcare institutions would need to buy new IT equipment, and to improve their ICT infrastructure for the implementation of E-health systems. The healthcare staff in both urban and rural healthcare institutions need training on how to use such technology, Figure 5.8 shows the results of computer literacy assessment.

13. How frequently do you access a personal computer?

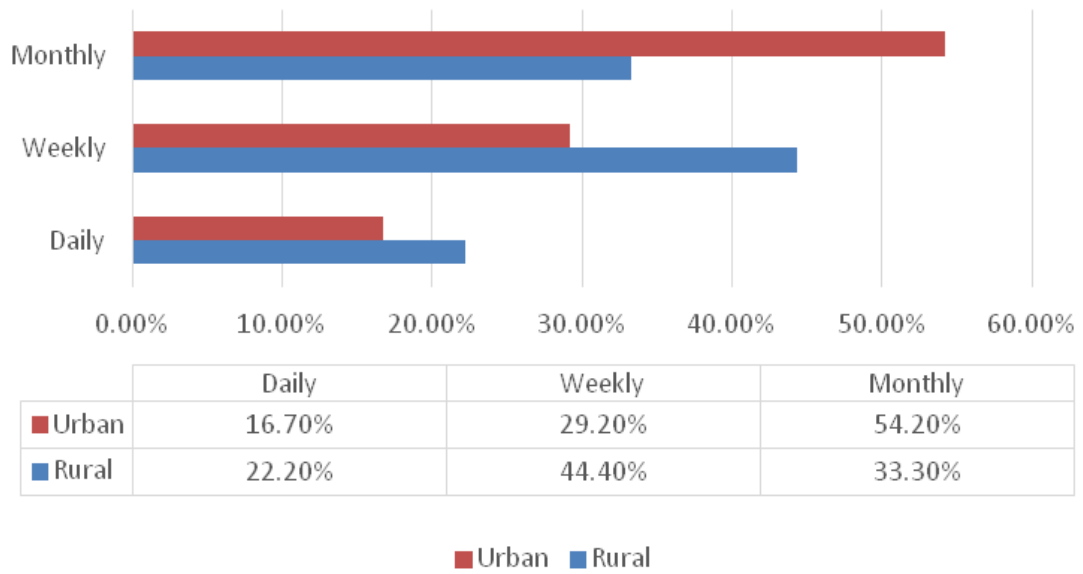


Figure 5.8: Computer literacy assessment in urban and rural healthcare institutions.

Figure 5.8 indicates that in rural clinics 22% of staff access a computer daily, 44% on a weekly basis and 33% every month, whereas in urban medical centres 17% of staff access a computer on a daily basis, 29% on a weekly basis and the remaining 54% on a monthly basis. This indicates that the daily usage of computers is a bit higher in rural clinics (22%), than in urban medical centres (17%). Some of the factors contributing to lower levels of computer usage in urban medical centres could be because healthcare staff having too much work to do, a lack of laptops and desktops in the rooms used for consultations, telephone lines that frequently out of order, a lack of IT technicians, not being well trained in how to use computers, and slow and unreliable internet connections; these can be seen in Tables 5.5 and 5.12.

On the basis of these findings, and using these results, the researcher was able to place Libyan rural and urban healthcare institutions on the E-health maturity curve as shown in Figure 5.9.

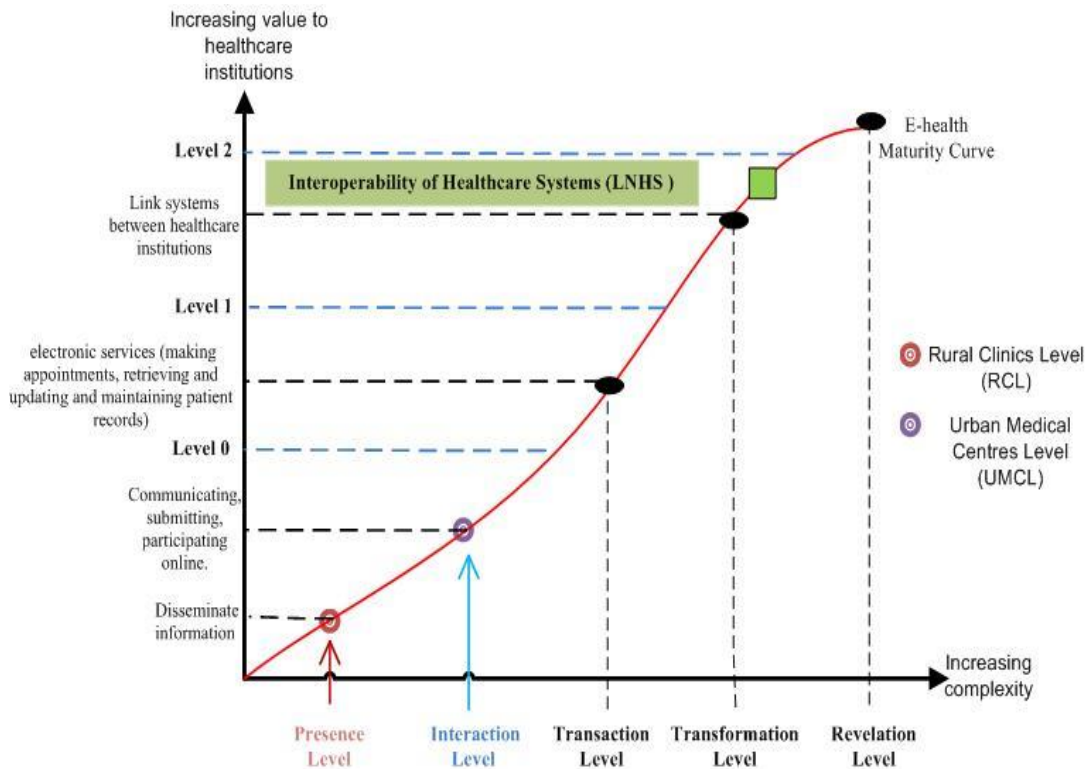


Figure 5.9: Maturity model of Electronic Healthcare System (Backus, 2001).

Figure 5.9 shows that the maturity levels for the development of E-health systems in rural clinics is presently at the lowest point it can be, ‘presence level’ (namely zero). The E-health system currently used in the rural clinics is utilised for transmitting data to the DHCDB only every three to four months.

However, the maturity levels of the E-health systems in urban medical centres are presently situated at the ‘interaction stages’ (also level zero). The interaction stage means that the services being offered at this level are more developed than those services being offered at the presence level. At the interaction stage, healthcare staff have better access to the information available on the E-health systems, and can communicate with each other via email.

The produced E-health framework (Chapter 6) will show how Libyan healthcare institutions can go from Level Zero to Level Two via Level One on the E-health maturity curve in the most efficient and effective way possible.

5.4.3 Shortages of healthcare staff

The issue of doctor shortages is far more pressing in rural clinics than in urban medical centres. Grover (2015) indicates that there are many challenges to providing healthcare services in rural areas because of the distances between populations that are dispersed and isolated. Because of these challenges in rural areas there have often been problems in the recruitment of staff, and of staff leaving to join urban medical centres. In the Libyan National Health Service (LNHS) most of the skilled healthcare staff choose to work in urban areas (8,280) whereas rural areas have fewer (3,043) (see appendix F). A lot of rural areas do not have any healthcare staff to provide healthcare to those that require it.

The lack of healthcare staff in rural clinics has to be the driving force for increasing investment in E-health systems. Healthcare staff can be helped to provide improved healthcare with appropriate localised E-health frameworks such as the framework offered in this research study.

Appendix F contains a comparison between the availability of doctors in urban and rural healthcare institutions in Libya. Appendix F also includes tables that summarise the number of doctors working in the investigated rural and urban healthcare institutions. The tables show that on average, approximately 73% of doctors working at rural clinics work at urban medical centres as well as in rural clinics. The figures in those tables indicate that there are 20 doctors for every 10,000 local inhabitants in rural areas.

5.4.4 The availability of E-health systems

The research findings showed that in terms of E-health system availability and accessibility in urban and rural healthcare institutions, there is no technology for making E-prescriptions, E-consultations, E-referrals, E-training, and electronic patient health records in either urban or rural healthcare institutions.

Urban medical centres have internet connections, whereas only some of the rural clinics have internet connections. The internet connections are only used for emailing and looking up information, and to access DHADB to connect and upload patients' health information and their demographics. The available E-health systems are used to access and upload patients' health information and demographics only.

Only two of the medical centres (TMC and BMC) have Tele-radiography equipment in the urban areas. These are utilised for transmitting X-rays between departments within the medical centre only.

5.5 Phase Four: Recommendations

From using the E-health readiness framework and looking at the difficulties and opportunities in the urban and rural healthcare institutions investigated for the purpose of this research, recommendations are made in connection with engagement readiness, learning readiness, technological readiness, need-change readiness, integrating applications, and acceptance and use readiness, as detailed in the remainder of this section.

Engagement readiness

Healthcare staff showed they had engagement readiness when they said that they performed their work in multidisciplinary teams and shared patients' data (Tables 5.6, 5.7, 5.8, 5.13, 5.14 and 5.15). For the successful implementation of E-health systems the healthcare staff have to cooperate with each other and share patients' data. Hence, it is recommended that:

1. Doctors and healthcare staff cooperate with each other;
2. Medical staff in the healthcare institutions communicate openly with each other and are respectful to each other;
3. There needs to be a desire to make extra investments initially.

Learning readiness

Tsai (2012) states that learning readiness is when ICT is used to enhance the education of healthcare staff, this agrees with this research findings illustrated in (Tables 5.6, 5.7, 5.8, 5.13, 5.14 and 5.15). E-training is a part of E-learning and is where the use of computers for work is learnt (Department of Health, 2011; Al Shorbaji et al., 2015). The survey results indicated that fewer rural healthcare staff had any prior experience of using a computer than urban healthcare staff (Figures 5.4 and 5.6).

These results imply that healthcare staff need training in the use of E-health systems and in how to use computers. Importantly, healthcare staff responded that they were willing

to be trained in using ICT and E-health systems if they are installed (Table 5.15). Hence, it is recommended that:

1. The contents of E-training equip healthcare staff with the knowledge and skills to operate E-health systems and computers;
2. E-training is incorporated into the proposed E-health framework;
3. E-training is carried out in person as well as online;
4. E-training is carried out prior to the implementation of E-health solutions and ICT and that healthcare staff receive further training when necessary.

This advice is based on the findings of the survey and will be utilised for compiling the E-health framework that will be constructed for assisting in the transition of the healthcare institutions in the LNHS from Point 0 to Point 2 on the E-health maturity curve (Figure 5.9).

Technological readiness

The research findings showed that urban medical centres have superior levels of ICT compared to rural clinics. Internet connections were superior in speed and reliability in urban medical centres in comparison to rural ones, though staff in all healthcare institutions limited their online activities to email and looking up information.

The research findings revealed that there were no E-health systems in any of the healthcare institutions apart from the DHCDB that was found in urban and rural healthcare institutions. Although the DHCDB is available in some of the healthcare institutions, the ICT is not configured for connecting departments and healthcare institutions together. Hence, it is recommended that:

1. Networks are created for delivering healthcare services;
2. More computers are provided for healthcare institutions, not just for administration departments, but on wards and consultation rooms;
3. Systems are made interoperable so that different systems and information sources are brought together into more powerful integrated systems;
4. All the healthcare institutions are connected to high-speed broadband services;

5. The electrical supplies to healthcare institutions are made more reliable and generators are acquired for when electrical supplies fail.

Need-change readiness

Need-change occurs when a group voices dissatisfaction with the way things are currently and expresses a willingness to be aggressive in adopting fresh practices in order that the changes can occur how they would like them to. Need-change was noticeable from the results in the study that indicated there were not enough doctors in healthcare institutions, resulting in the delivery of healthcare services being not as good as it could be.

The participants in the research study indicated that they were dissatisfied with various aspects of their workplace like the time people spent queuing at the Outpatients Department and they said that they thought that the implementation of the relevant E-health systems could help in the reduction of such problems (Tables 5.6, 5.7, 5.8, 5.13, 5.14 and 5.15). The implementation of E-health systems is perceived as being able to balance addressing the shortfall in doctors with delivery of improved healthcare services.

E-health systems allow healthcare staff who are less qualified than doctors to carry out medical procedures without a doctor being present, by using E-health systems. When this occurs, a doctor can advise through use of E-health systems to guide in the delivery of healthcare practices that a member of staff has not trained for, saving money and lives.

Integrating the applications

The ICT in the different healthcare institutions in the Libyan National Health Service needs to be integrated. The proposed E-health framework can help achieve this through:

1. Providing the necessary patient data for treating patients (electronic patient health records);
2. Promoting the use of E-prescriptions where healthcare staff can send a patient's prescription using a computer to a pharmacy.
3. Helping healthcare staff in healthcare institutions in the creation, maintenance and sharing of electronic patient health records;

4. Facilitating E-consultations by utilising integrated networks of healthcare staff for consulting with other healthcare staff in order to be professionally advised and informed;
5. Assisting in creating E-referrals so that healthcare staff can use ICT for transferring healthcare information about patients to other healthcare institutions or departments within a healthcare institution.

Acceptance and use readiness

Kurkinen (2012), states that when new technology is introduced, the user of this new technology will be influenced by two main factors in the attitude that they develop towards it; how easy they find it to use and how useful they think it will be.

The research results indicated that healthcare staff felt that implementing E-health systems would improve their work performance by stopping patient healthcare files getting lost, eradicating queuing at the pharmacy and prescriptions being misread and the wrong medication being administered. Hence, it is recommended that:

1. User interfaces facilitate positive experiences for users;
2. Design of programs used for E-consultations, E-prescriptions, E-referrals, E-training and keeping electronic patient health records are simple and easy to use;
3. Healthcare staff are appropriately incentivised to use E-health systems in their healthcare institutions to ensure that they are motivated to use them.

5.6 Chapter Summary

This chapter analysed the results from the research study that has been carried out using the Creswell's (2007) framework for collective or multiple case studies. It began by attempting to contextualise the research question (Step 1 in Creswell's framework) by discussing the participants in the study and the instruments used in the research.

Following the second step of Creswell's framework (Step 2: Research Findings), the chapter then described how available and accessible ICT infrastructure and E-health systems are in the healthcare institutions in urban and rural areas. The research findings in the rural clinics showed that not enough doctors are available, not enough IT equipment, no computers in the consultation rooms, the internet and telephone

connections are often out of order, the internet speeds are very slow, and most importantly there are virtually no E-health systems available.

The results in the urban medical centres were similar except for the lack of doctors and staff shortages, the telephone lines are more reliable, there is more computer equipment available and they have a Tele-radiography system.

When a cross-case analysis was carried out between the healthcare institutions in rural and urban areas, it showed that there were no facilities for making E-referrals, E-consultations, E-prescriptions, E-training and keeping electronic patient health records, though DHCDB was locally available and used to store patients' health information and their demographics.

When the findings of the questionnaires and interviews for the investigated rural and urban healthcare institutions were comparatively analysed and interpreted using the E-health maturity curve, it showed that urban medical centres were at the interaction stage and rural clinics were at the presence stage. Both stages though are at Level 0. These results were utilised for making the recommendations above and for compiling the E-health framework proposed for the LNHS.

The following chapter will focus upon the ways in which the outcomes and recommendations from this chapter can be utilised for the compilation of an E-health framework for the Libyan National Health Service.

Chapter Six

Design and Development of an E-health Framework for the Libyan National Health Service

6.1 Introduction

Chapter Five discussed findings from the questionnaires and interviews carried out in the Libyan urban and rural healthcare institutions for the purpose of this research study, more particularly for the purpose of answering Research Sub-Question One. What is revealed in the findings is that across the board rural healthcare institutions are short of doctors in comparison to healthcare institutions in urban areas. In addition to this it was revealed that healthcare institutions in urban areas also experienced a shortfall in the number of doctors working there. The implication of these findings is that it reveals an imbalance in healthcare services between healthcare institutions in urban and rural areas. It can be concluded from the analysis of the research findings that implementing E-health systems in the LNHS would create a reduction in the gaps that have been shown in the services provided by healthcare institutions in urban and rural areas.

This chapter's objectives are to utilise the research findings from Chapter Five, the literature review in Chapters Two and Three, the recommendations for E-health readiness assessments in Table 6.1, and the document analysis in section 6.2, as the inputs to the process of creating an E-health framework for the Libyan National Health Service, which we will refer to as the **LNHS E-health Framework**.

The findings from this research indicated that the healthcare staff in all the healthcare institutions showed a willingness to accept any E-health systems that might be implemented in their workplaces. They said in their responses that they felt that E-health systems would create improvements in their job performance and would be good for saving time. This was shown in their positive attitudes and comments about E-health and the urgency that they indicated for E-health implementations for easing the burdens of their workloads, this can be seen in (Section 5.3.1.3, Table 5.7, Section 5.3.2.3, and Table 5.14). This conclusion is backed up by Jennett et al. (2005), Lahti et al. (2015), and Ward et al. (2008) who found that intentions to accept and readiness for using E-health systems can be gauged through attitudes toward the use of ICT for healthcare provision.

An important finding from the results analysis was that there were virtually no E-health systems in the investigated healthcare institutions being used. The only systems that were found to be used were for supporting the collection of patients' health information and their demographic information on the Department of Health's Central Database

(DHCDB) for government statistics. In addition to this, some urban healthcare institutions (Tripoli Medical Centre and Benghazi Medical Centre) were found to have Tele-radiography facilities for sending X-ray images from one department to another within the same healthcare institution.

What was even more significant were the findings from the rural healthcare institutions about employees' ability to operate a computer. It was discovered that many employees in rural healthcare institutions had no experience at all in using a computer in their workplaces (Sections 5.3.1.5, Table 5.8). These findings imply that should E-health systems be implemented in rural healthcare institutions, the healthcare professionals working there would require training in the use of computers and E-health technologies.

The research analysis also indicated that urban healthcare institutions had better IT equipment like printers and computing equipment than was found in rural healthcare institutions. Internet connections and speeds for sending information were discovered to be working more reliably in urban healthcare institutions than in rural healthcare institutions. These findings though were not as significant as they might have been, because the internet was only used for emails and looking up information and connecting to DHCDB, rather than supporting E-health systems.

In spite of these basic E-health technologies being available, it was found that there was no system integration between healthcare institutions, or often even within the same healthcare institution, thus not allowing healthcare professionals to benefit from E-health systems such as EHRs or E-consultation, E-referral, E-training, and E-prescription systems. These results from the rural and urban healthcare institutions place them on the E-health Maturity Curve at the Presence and Interaction stages, respectively (Figure 5.9). Joseph (2013) states that the Presence and Interaction stage of the E-health Maturity Curve is thought of as Level 0. In order to move E-health technology usage in the participating Libyan healthcare institutions from Level 0 to Level 2 in the E-health Maturity Curve levels, it is essential for specific E-health frameworks to be created that are based on the findings for these same institutions.

An important first step is making sure that Level 1, Integration, is achieved in an efficient and effective manner. There is evidence that many of the difficulties encountered in healthcare institutions, such as losing patient files, lack of consultation

between doctors for guidance, lack of security for patient health information, long waiting times for patients to be seen by consultants, waiting times at pharmacies and Outpatients Departments, inability to find patient records after long periods of time, medicine being wrongly prescribed and ‘IN’ being dishonestly used for collecting medicine from more than one healthcare institution simultaneously (Sections 5.3.1.4 , 5.3.1.6, 5.3.2.4 , 5.2.2.4 and 5.3.2.6), could be dealt with effectively if E-health technology usage were to reach Level 1 in these healthcare institutions.

On the basis of the findings in the last chapter, a set of recommendations were made that can be put into categories based upon the five primary components of E-health readiness assessment as illustrated in Figure 6.1. The recommendations themselves are repeated from Chapter 5, Section 5.5., for ease of reference in Table 6.1.

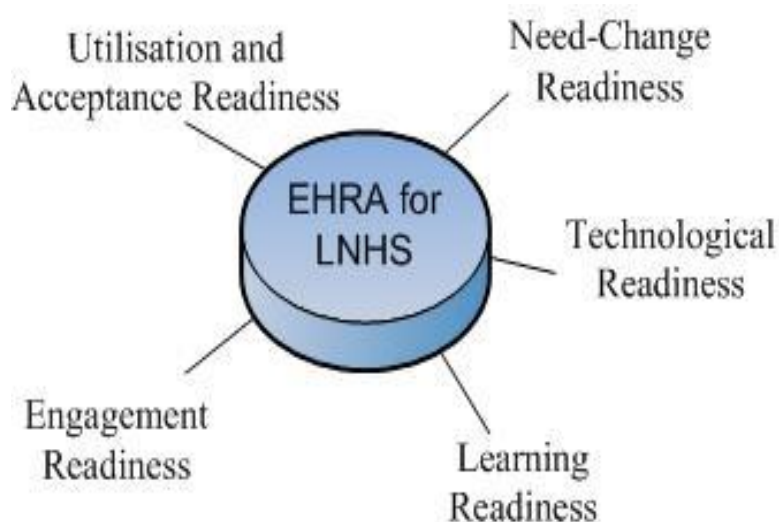


Figure 6.1: E-health Readiness Assessment (EHRA) components.

| | E-health readiness structures for assessment | Recommendation |
|----|---|--|
| ER | Engagement Readiness | <ol style="list-style-type: none"> 1. Being willing to provide extra investments initially. 2. Healthcare professionals cooperating in groups. 3. Communicating openly and respectfully with each |

| | | |
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| | | another. |
| LR | Learning Readiness | <ol style="list-style-type: none"> 1. Providing E-training for healthcare staff before E-health implementations and continuing it after implantation too. 2. Incorporating E-training for use within planned E-health frameworks. 3. E-training needs to incorporate face to face sessions in its programme with healthcare staff. 4. Ensuring that E-training contents equip healthcare staff with the ability to operate computers and E-health applications. |
| TR | Technological Readiness | <p>Systems need to be interoperable for:</p> <ol style="list-style-type: none"> 1. Providing each healthcare institution with internet access of high speeds and ensuring electrical supplies are reliable by making sure generators are installed for back up electrical supplies. 2. Bringing data sources and diverse systems together with one another in controlled coherent environments. 3. Increasing the numbers of computers being used in |

| | | |
|-----|-----------------------|--|
| | | <p>healthcare institutions, for instances in wards for patients and consultation rooms.</p> <p>4. Incorporating E-health technologies already in use, such as Tele-radiography, into new E-health systems.</p> <p>5. Creating networks for delivering healthcare services.</p> |
| NCR | Need-change Readiness | <p>The integration of ICT: these applications in each healthcare institution in the LNHS need to be embraced by using the E-health framework for:</p> <p>1. Assisting in making E-referrals for transferring EHRs to different departments within healthcare institutions and to other healthcare institutions.</p> <p>2. Providing integrated EHRs in healthcare institutions.</p> <p>3. Helping staff in healthcare institutions in creating, maintaining and sharing EHRs.</p> <p>4. Facilitating E-consulting by utilising integrated networks of healthcare workers for consulting with one another for getting second opinions and advice.</p> <p>5. Promoting E-prescriptions</p> |

| | | |
|-----|---|---|
| | | when healthcare professionals need to send a prescription to a pharmacy within a healthcare institution. |
| UAR | Utilisation and acceptance Readiness | <ol style="list-style-type: none"> 1. Providing incentives for motivating healthcare staff to use E-health technologies in healthcare institutions. 2. Designing user friendly processes for facilitating E-consultations, EHRs, E-prescriptions, E-referrals and E-training courses. 3. Ensuring that each user interface can be used for facilitating user experiences that are more positive. |

Table 6.1: Recommendations for E-health readiness.

Creswell (2009), Colton et al. (2007), HIMSS (2009), and Li et al. (2009) explain that frameworks are fundamental assumptions and theoretical constructs that can define a concept, a value, and a practice, including guiding any subsequent implementation of further functionality. The proposal for the LNHS E-Health Framework shall include:

- Basic requirements;
- Processes to find E-health solutions that are needed;
- Principles for guidance, objectives, aims and desirable characteristics;
- An architectural strategy;
- Guidelines for ensuring that information is securely managed in the E-health framework proposals;
- Guiding principles for implementing E-health systems.

These items are not the only possible option for implementing the LNHS E-Health Framework. It needs to be noted that because the LNHS lacks a solid ICT infrastructure, the E-health framework for LNHS will appear rather different from other frameworks used in other countries, this framework is designed specifically for the LNHS based on this research findings. Developing such a framework provides an answer to Research Sub-Question 2.

“In what ways can results provided by the EHRA be utilised for implementing E-health systems in LNHS?”

To construct the framework and ensure that it was creditable and applicable, work on it was informed directly by the findings from document analysis, literature review, and expert feedback, in conjunction with the primary research findings presented in Chapter Five. The next three sections will summarise the relevant findings from document analysis, literature review, and expert feedback. For full details of these, see Chapter Two and Three.

6.2 Summaries of Relevant Findings

6.2.1 Document Review

Documentation that is publicly available and would not endanger patient confidentiality or break classified information rules of the Health Department was examined; one of these documents was the “Draft E-health Strategy White Paper Discussion Document” that has been produced by the Libyan National Health Department and has been used by the LNHS (Khalil and Al-Bousify, 2008; Swehli, 2010; Daw and Elkhammas, 2008; Sharif et al., 2014; Kumar et al., 2010; IITM, 2008; Nakkas et al., 2015). This document can be found in healthcare institutions in Libya and its goals are as follows:

- Focusing on working together with all stakeholders for improving healthcare delivery on all levels of the system, in particular preventative healthcare and promoting healthy lifestyles;
- Improving healthcare access for everybody and reducing inequality in healthcare service no matter where people are living;
- Developing a comprehensive health information system that ensures healthcare will be delivered and managed efficiently and effectively;

- Ensuring healthcare information is accessible for healthcare staff and members of the public.

The white paper argues that an inclusive and comprehensive healthcare ICT promotion policy needs to be developed and implemented which should include:

- Developing strategies for EHRs;
- Developing ICT and human resource strategies;
- Promoting E-health being researched and developed so local innovations might occur.

The document also suggests that for achieving the goals above, the following is needed:

- An expansive and inclusive healthcare information system needs to be developed;
- A healthcare information standard needs be developed;
- All healthcare staff need to be able to access adequate ICT;
- A nationwide telemedicine program needs to be developed.

The white paper documents reviewed show that seven policies have been considered in 2013, and plans have been put forward for addressing them. These policies are aimed at (i) allowing ICT infrastructures to be accessed, (ii) allowing systems to be more secure and confidential, (iii) causing administration and management to be more efficient and effective, (iv) promoting the building of capacities, (v) creating interoperability, (vi) raising standards and (vii) improving access to funding and resources. These documents align the aims of a prospective E-health framework with the aims of the LNHS, as regards E-health systems.

The white paper documents also indicated the objectives for the provision of an inclusive and expansive health information system that will ensure healthcare is delivered and managed efficiently and effectively, thus providing the principles to guide the development of the LNHS E-Health Framework. Most importantly, the policies proposed in the documents for making systems more secure and confidential were examined and adapted for use with LNHS E-Health Framework.

6.2.2 Literature Review

When compiling the E-health framework presented in this chapter several things were taken into consideration, such as: the globally recognised healthcare standards and health information informatics guidelines (Section 2.2, 2.3, 2.4, 2.5, 2.6). As Kwankam (2009) and Mugo and Nzuki (2014) point out, when E-health systems and frameworks are created in developed countries such as Canada and EU countries this takes place in the context of a wealthy country that has well developed ICT infrastructures.

In contrast to this, E-health systems formulated in developing countries are carried out in the context of poverty. The E-health framework formulated for this study for the LNHS, a healthcare system lacking in strong ICT infrastructure, shall appear quite different from frameworks that have been developed in developed nations.

The E-health framework that is presented in this chapter has nonetheless been developed while paying close attention to guidelines for healthcare information and global healthcare standards. In Chapter Two several E-health related frameworks and models were reviewed, which include those used for E-consultation, E-referral, E-medical records, and E-prescription systems (Section 2.4). All of these frameworks and models are aimed at particular E-health domains and are not designed for providing blanket frameworks that cover any and all E-health technologies. That, however, is what is required in Libya, if E-health systems are to be brought to the LNHS an EHRA has to be carried out to assess the E-health readiness levels within healthcare institutions, to be able to design and develop a suitable E-health framework for the LNHS. The LNHS E-Health Framework being proposed here is based upon a service-oriented architectural style that integrates all the services (Section 2.6).

The service-oriented architecture provides suitable architectural guidance for the E-health framework as it allows healthcare institutions to be autonomous and flexible and be in charge of their information technology environments, while simultaneously allowing inter-organisational business synthesis (Chalasan et al., 2014; Lynch, 2005; Sukys, 2011; Taylor, 2009a; Juneja et al., 2008; leader, 2010).

The following section focuses on the experts' opinions and feedback.

6.2.3 Expert Feedback

In addition to the literature review, consulting medical and E-health experts on their views was thought to be of considerable importance; especially regarding the usability, applicability and adaptability of the proposed LNHS E-health Framework, and more particularly of the infrastructure network and process proposals for EHRs, the E-consultation system, the E-prescription system, the E-referrals system, and the E-training system.

The LNHS chose three experts in the field of healthcare for serving as advisors to the present researcher in developing the proposed LNHS E-health Framework. The experts asked for their details to be anonymous.

The researcher, when attending the Vision for a Future Conference in London 2014, met up with the Libyan Minister for Health, various healthcare researchers and some of the management of the LNHS. The researcher gave a presentation of their work, listened to feedback from several of the attendees and discussed this with them. The attendees' opinions were that the framework was formulated appropriately and would be of use to the LNHS as it was designed specifically for Libya. A suggestion put forward by those present was that it might be of great use to propose a mechanism for incorporating data previously recorded on paper files. The proposal was to use a scanner for scanning paper health records so that patients could be given it on USB sticks. This was viewed as an action that could take place while the framework was being implemented.

It is the researcher's view that as each document is scanned it would be best to simply store it on databases. This is because providing millions of USB sticks would put added pressure on the budget for implementing E-health systems, not to mention the costs involved in maintaining patient privacy and confidentiality. There are also likely to be many people who do not have access to computers and many might simply sell the memory stick as they feel no need to hold onto it.

An alternative suggestion, more useful in this researcher's view, was that a patient's scanned healthcare records should be available upon request; this would create less confusion as probably very few people would want a copy of their records.

The following are some examples of the experts' responses during the conference (Vision for a Future Conference in London 2014) in regards of this research study and proposed framework, these remarks were from face to face conversations:

Expert 1:

“This presentation will be shown by us to the meeting for management planning, in order for the LNHS to provide funding for its implementation. As soon as there is adequate funding available from the Libyan government, I would like to think that this framework will be utilised as part of the implementation of E-health systems in Libya”.

Expert 2:

“This is a great idea as we have waited for so long for it and we are hoping it will not be long before it is operational as the implementation of E-health systems in the LNHS will improve the levels of healthcare provided to the public”.

The rest of this chapter is organised into subsections which begin with an overview of the proposed LNHS E-Health Framework and then show how the framework is structured, and how the structure relates to the framework. After this come the processes for EHRs, the E-consultation system, the E-prescription system, the E-referral system, and the E-training system, followed by guidelines for the use of the E-health framework. The final subsection goes into more detail on managing information security within the context of the E-health framework. The following section focuses on the respondents' opinions and feedback.

6.2.4 Respondents' Feedback

The LNHS E-Health Framework provides proposals for E-health systems based on the infrastructure network that will be developed. The processes addressed are electronic health records, E-consultations, E-prescriptions, E-referrals and E-training.

E-health utilisation can impact positively on healthcare provision in the Libyan National Health Service (LNHS) by making healthcare data more available, improving the continuity of healthcare for patients, reduce the time patients need to wait and cut down on medical mistakes.

The researcher has received very positive, even enthusiastic, feedback from research participants regarding the prospective usefulness of the LNHS E-Health Framework, and that expect the framework to be further developed and implemented by the LNHS in the near future.

The expectation of the LNHS healthcare staff that the implementation of E-health systems would impact the practice of healthcare significantly; healthcare structures will become harmonised, allowing healthcare services to be provided seamlessly and continuously; data could be retrieved reliably and accurately, when and where required; Electronic Patient Record (EPR) could be reviewed so that medical tests do not need to be repeated; healthcare staff could communicate independently of where they are located so that patients could be diagnosed faster and more effectively. Moreover, healthcare staff could be updated with new medical knowledge as soon as it is published online through E-training and could ask for advice from other healthcare staff from anywhere in the world if they were unable to deal with a case themselves.

Table (6.2) highlight some of the feedbacks received from this research participants from urban and rural healthcare institutions in the LNHS in this case study regarding the benefits of employing E-health framework. Codes were used to classify the types of respondent to maintain the respondent confidentiality (Kaiser, 2009) such as: (A: Administrators, D: Doctors, N: Nurses, and W: Ward Attendants):

| Responses from Rural Healthcare Clinics | |
|--|--|
| E-prescription | Respondent (D): “there will no longer be the danger of a pharmacist misreading a doctor’s handwriting because it is not legible and dispensing the wrong medication”. |
| E-referrals | Respondent (N): “often there is no feedback available when we refer patients, so this will allow us to monitor what is happening to our patient once they have been referred”. |
| EPHR | Respondent (N): “I envisage the E-health |

| | |
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| | <p>system Implementation making it take longer to record patient data at first, but eventually it will speed up the process of diagnosing and referring and safeguard sensitive patient data”.</p> <p>Respondent (A): “it will save a lot of money on materials as so much money is spent on paper for case histories and patient forms etc. and it will save a lot of time for our staff as they will not have to retrieve files from filing rooms situated away from treatment rooms”.</p> |
| E-training | Respondent (W): “this is will improve our ability to operate computers and do our jobs more efficiently”. |
| E-consultation | Respondent (D): “if we are not 100% sure when administering drugs to a patient then asking for advice will prevent the administering of wrong or hazardous doses of drugs”. |
| Responses from Urban Healthcare Medical Centres | |
| E-prescription | Respondent (D): “patients will no longer be able to lose or change prescriptions”. |
| E-referrals | Respondent (N): “doctors can prepare for the arrival of patients”. |
| EPHR | <p>Respondent (D): “electronic patient health records will mean time will be saved as data will be recorded and retrieved systematically and will therefore be much easier, hence saving time”.</p> <p>Respondent (A): “the rooms we use for storing files are overstocked and badly organised. This system will save a lot of</p> |

| | |
|-----------------------|---|
| | time”. |
| E-training | Respondent (N): “the best way to do this would be to be trained in person at first and use e-training afterwards if we need to remember something or need to be supported in our work”. |
| E-consultation | Respondent (A): “doctors will no longer need to go to another department or healthcare institution to ask for advice, so money and time will be saved”. |

Table (6.2) Feedbacks received from the respondents regarding the usefulness of the LNHS E-Health Framework.

As seen in (Chapter 5) the majority of healthcare staff, who would be the users of the E-health system, showed that they would accept them and the E-health systems would be very useful and could help them to perform their work. The staff thought that an E-health system would enable them to keep medical records (Section 6.5.3.3), diagnoses, medications, and referrals (Section 6.5.3.6) which will help in providing better healthcare services to patients.

The vast majority of respondents as seen in (Chapter 5) also said that the implementation of E-prescription services (Section 6.5.3.5) would stop mistakes in prescribed and dispensed medications. The respondents also said that the implementation of an E-consultation system (Section 6.5.3.2) would help healthcare staff to talk to each other in order to advise one another and share ideas.

Furthermore, the findings in (Chapter 5) indicate that the implementation of E-health systems in LNHS surveyed would be accepted. This is very important as the healthcare staff operating a newly installed IT system need to be as accepting of, and enthusiastic about it, as possible in order for it to be successful.

6.2.5 The Impact of the Government White Paper on the proposed LNHS E-Health Framework

The government white paper review was another source of information utilised for gathering information about the readiness of the LNHS to implement E-health systems.

The emerging information from documents showed that there were no E-health technologies being used in the LNHS at the time of this research study, therefore it was not necessary to assess existing levels of E-health usage. This derived information served as supportive and confirmative evidence regarding the data collected while carrying out the interviews and questionnaires.

The information derived from the government white papers provided the researcher with good background information and historical insight, tracking change and development. The information gained from these documents helped the researcher to understand the root of specific issues that could affect the implementation of E-health system in LNHS.

Furthermore, the information gained from these documents helped the researcher to generate new questions that needed to be asked during interviews or to inform observations made by the researcher in the course of the research study, questions such as:

4. Is there technology in your medical institution at this time that might support such an E-Health application? Please be specific.

As seen the Analysis of these documents provided the research study with additional valuable information and insights to design the LNHS E-Health Framework in this research study by covering a long span of time. The researcher employed this method because it works in conjunction with the other research methods selected for this study to increase the trustworthiness of the findings.

Reviewing the government white papers also show that seven policies have been considered in 2013, and plans have been put forward for addressing them in this research study. These policies are aimed at (i) allowing ICT infrastructures to be accessed, (ii) allowing systems to be more secure and confidential, (iii) causing administration and management to be more efficient and effective, (iv) promoting the building of capacities, (v) creating interoperability, (vi) raising standards and (vii) improving access to funding and resources. These documents align the aims of a prospective E-health framework with the aims of the LNHS, as regards E-health systems.

The researcher paid close attention to the healthcare guidelines and global healthcare standards while designing the LNHS E-Health Framework. A wide range of different factors from the government white paper were taken into consideration when compiling the LNHS E-Health Framework, such as the abilities of healthcare staff to operate and use the new systems, the needs of the healthcare institutions, and their existing ICT infrastructure. Therefore, the LNHS E-Health Framework presented an overview infrastructure network that will provide solutions for integrating services, such as EHRs, E-consultations, E-prescriptions, E-referrals and E-training, and the implementation of the infrastructure needed to enable information to be shared electronically and effectively throughout the LNHS (Foundations Work Stream). Guidance and strategies for compiling the E-health framework, and Health Information Systems security management were also clarified in this research study to ensure that the healthcare services are delivered and managed efficiently and effectively.

6.3 Overview of the LNHS E-Health Framework

When the LNHS E-Health Framework was compiled there were several things taken into consideration, such as: the abilities of the healthcare staff, the needs of the healthcare institutions and the existing ICT infrastructure that had been recorded in the E-readiness assessment which was carried out in the healthcare institutions (Chapter 5).

Figure 6.2 gives an outline of how the E-health framework was created, and shows each step in the development of the LNHS E-Health Framework, starting with the E-health assessment outcome, followed by Chapters Two and Three (the literature review), and the findings taken from the document review. Following these steps allowed the E-health framework's features, objectives and guiding principles to be formulated. These components will provide the basis for developing infrastructure and architecture network solutions for the healthcare institutions that are relevant. The infrastructure network solution proposal will integrate healthcare institutions, work processes, devices and applications for improving how knowledge is shared and aiding healthcare services in being delivered efficiently.

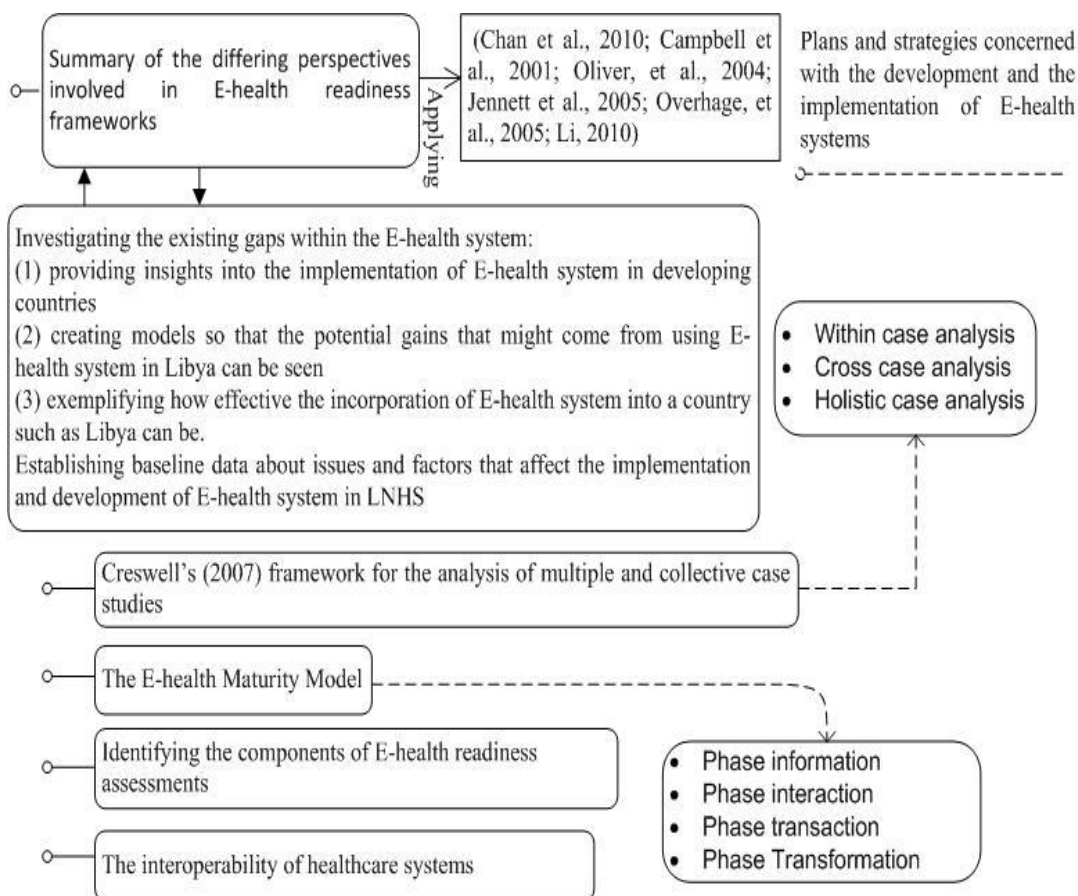


Figure 6.2: Stages needed to develop the E-health framework.

It became apparent while carrying out the research that healthcare institutions in urban areas had considerably more ICT than those in rural areas. Because of this finding the LNHS needs to invest in improving the ICT infrastructure in their healthcare institutions especially in rural healthcare institutions to bridge any disparities in ICT between the healthcare institutions in urban and rural areas.

The framework also provides proposals for E-health systems based on the infrastructure network that will be developed. The processes addressed are EHRs, E-consultations, E-prescriptions, E-referrals and E-training. The requirements for these E-health systems are emphasised; as was shown in Chapter Five that are currently no E-health systems in the healthcare institutions in the LNHS and thus, any E-health framework created for these healthcare institutions needs to include proposals to introduce them. Prior to designing the E-health systems required, the system designers and healthcare staff need to know what is required for a given E-health system to function. Therefore, the processes required for EHRs, E-consultations, E-prescriptions, E-referrals and E-training are clarified below.

The guidelines for implementing the E-health framework are needed, in addition to the E-health framework itself, because expertise and skills in E-health are in short supply and the computer-literacy levels of the stakeholders vary considerably. Within the guidelines there are broad operational approaches that can be used for assisting in implementing the E-health framework. The E-health framework also provides Information Security Management (ISM) strategies for protecting information about patients from being accidentally disclosed to inappropriate people, or being altered, destroyed or lost. The following section goes into more detail about the LNHS E-Health Framework's objectives and aims.

6.4 The Aims and Objectives of an E-health Framework

The primary aim of the LNHS E-Health Framework is the integration of E-health services for improving the delivery of healthcare within the LNHS. Hence there are specific objectives relating to:

- Creating service architecture solutions that are web-based and linked to the E-health framework;
- Creating processes for EHRs, E-prescriptions, E-consultations, E-training and E-referrals systems;
- Creating a holistic E-health framework for use at a local, provincial and national level in healthcare environments;
- Connecting software networks and systems that integrate different devices, healthcare institutions, applications and services;
- Incorporating the system already in place into the E-health framework.

For achieving these goals the framework follows the principles below:

- E-health applications already in use will be integrated;
- The systems in healthcare institutions will be interconnected and interoperable;
- ICT and services will be integrated;
- Computer networks will be used for transforming services to E-services.

This thesis's overarching objective is the compilation of an E-health framework for assisting healthcare staff in the healthcare institutions in Libya to provide better levels

of healthcare. The proposed E-health framework is based on the literature review, a review of documents found in the healthcare institutions in Libya, the results of the E-health readiness assessment, and recommendations from the E-health readiness assessment. The characteristics below demonstrate the relevance of E-health framework to healthcare staff in both urban and rural healthcare institutions:

- Strategies for authenticating and authorising;
- Features showing routers, hubs, connectors and adapters being used;
- Architecture with service orientations and web service technologies;
- Architectures with flexibility with centralised topography distribution;
- Scalability characteristics;
- Characteristics of the operations that occur synchronously and asynchronously.

The following section discusses architectural structures for the E-health Framework.

6.5 The LNHS E-Health Framework's Architectural Structure

The E-health framework was designed by using service-oriented architecture as its basis, which was mentioned in more detail in Chapter Three. The following subsection is a discussion of why service-oriented architecture was chosen for the E-health Framework.

6.5.1 Service-oriented Architecture (SOA)

Many researchers have indicated that using the SOA approach would be the best way to solve the many problems created by integrating organisations and their data (Chalasani et al., 2014; Leader, 2010; Petroski, 2004; Buschmann et al., 1996; Gorton, 2006; Hohmann, 2003; Taylor et al., 2009; Taylor, 2009a; Fowler, 2003; Kodali, 2005; Erl, 2005; Brown et al., 2012; Lynch, 2005). It has been indicated by Erl (2005) that using the SOA approach offers potential benefits that could improve organisations such as healthcare organisations. SOA is an approach that could be employed for formulating a system that is flexible, interoperable and follows standards-based computer protocols (Kirova and Kradjel, 1998; Taylor et al., 2009).

Choosing a service-oriented architecture allows for a comprehensive E-health framework to be provided for improving healthcare provision within the LNHS. Gorton (2006) pointed out that using a service-oriented architecture offers potential benefits

that can be used for improving organisations. Service-oriented architecture refers to new applications involving services from systems that already exist (Afshar, 2007; Demirkan et al., 2011). It lets organisations become more autonomous and flexible, thus allowing their information technology systems to be better controlled, while enabling business between organisations. Service-oriented architecture enables each healthcare institution to carry out its operations in an independent manner in the domain it is situated within, though when collaborating with other healthcare institutions in bigger environments, it can carry this out by using numerous services that have been defined (Gonzalez et al., 2010). Thus, the researcher for the purposes of this research has chosen service-oriented architecture as the most suitable for developing the E-health Framework, as has the most respect for each healthcare institution's internal autonomy.

When carrying out an assessment of how effective SOA might be for an E-health system, there is a strong need to differentiate between which clinical processes it could support. The four primary groupings of clinical processes are diagnosis, monitoring of patient conditions, prognosis and therapeutic and palliative healthcare. All these processes are supported by monitoring through collecting data, analysing, notifying about alerts, and the sharing of information (Natis, 2008; Eze et al., 2010; Kabaso, 2014; Chryssanthou et al., 2011; Vavoulas et al., 2016).

SOA is beginning to be employed within modern clinical ISs and is well suited to use with therapeutic and palliative care, as these processes generally entail a synchronous interaction or a point-to-point interaction (Bali and Gibbons, 2010; Herand et al., 2013; Eze, 2012; Gong and Chen, 2010; Yang et al., 2010; Schooley et al., 2011). On the otherhand though, SOA is not ideal for diagnosing and monitoring procedures that rely upon collecting data, as they tend to be point-to-many-points. SOA cannot be employed for supporting these sorts of applications through Business to Business (B2B) networks as is necessary when utilising E-health technology (Chhabra and Kumar, 2009; Papazoglou and Ribbers, 2006; Eze et al., 2010; Benyoucef et al., 2015; Doshi and Peyton, 2008).

Using SOA identifies individuals participating in the E-health Framework and gives a description of the role they have in the system and their relationship to the system. The relationship and roles of the healthcare institutions in the study have implied sets of business services that they provide to the whole system. Each service needs detailed

definitions of business rules, data and all the business protocols, though such specifics are not provided within the architecture framework, apart from acknowledgements that they will need to be used for guiding the system.

Once there is a definition of the services to be provided, it will become simpler to draw up specifications regarding the sorts of applications needed to enable each healthcare institution to providing those services. For the purpose of this research the E-health systems that each healthcare institution needs have been determined with the aid of the E-health readiness assessment. The following is a discussion of the proposed architecture which incorporates these systems (applications and services).

6.5.2 The LNHS E-Health Framework's Architecture

Figure 6.3 describes the E-health framework's architecture and illustrates all its components and what their functions are. It emphasises how services in the healthcare institutions are integrated by the architecture and how it provides these services, via an E-health service hub, to the web.

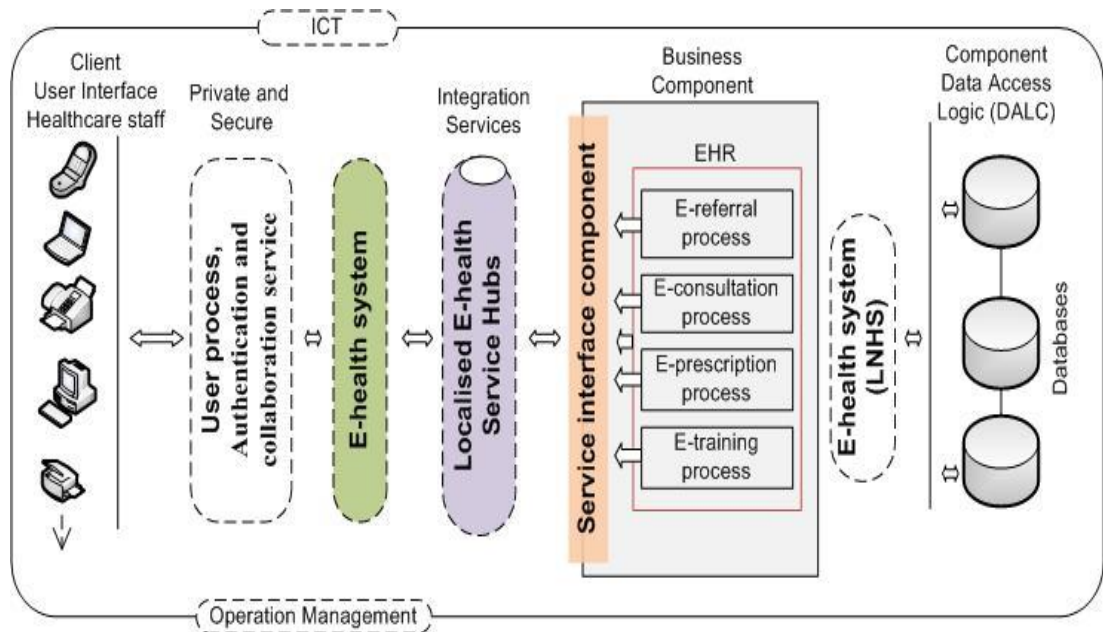


Figure 6.3: The E-health framework architecture.

The following is a list of the parts that the architecture is composed of and a brief discussion of what they entail.

- **Component Data Access Logic (DALC):** this is used in the E-health framework for managing the writing and reading of data and the sending of it to the

appropriate data storage facility for underpinning the application. The DALC generates an awareness of the physical place in which the data is stored. Thus, it translates a view of the data between the logical and physical. Data sharing between the various applications is enabled by this mechanism.

- **Service Interface Component (SIC):** this defines how business components and their owned data function as sets of services that are related. This entails giving support to the service contract that gives a description of the semantics, data availability and functionality, plus details regarding protocols, restrictions around security, accessibility and how messages are formatted.
- **Database:** this is where data is collected and organised so that it can be accessed, retrieved and utilised. The data in storage is used for underpinning particular applications which are operated by the application software via which users access and manage data stored in the database.
- **Business Component:** this is used for performing E-health-business tasks, managing the E-health-business data, applying the business rules and exposing services to be consumed by components of business processes need within the E-health systems.
- **Integration Services:** this is a function provided by the E-health service hub. Hubs provide strong sets of integration services that give connectivity between the E-health systems and stakeholders participating in a system. Integration services are used for ensuring that E-health systems and services are interoperable, providing required networks and relevant protocols, routing messages, organising messages, and managing transactions. The architecture environment that these services are available in is securely and reliably managed and is highly available.
- **Localised E-health Service Hubs:** these are service integration architectures of service infrastructures that consistently support business services within predefined areas. E-health service hubs are installed in SOA through the use of web-service interfaces. The E-health service hub's first job is identifying and authenticating users and showing the services that users are authorised to be using and what their status is. Plus, hubs need to be capable of routing a message to a back-end service. Secondly, E-health service hubs are needed for organising and managing processes that users perform.

- E-health Systems: this part integrates the business services of healthcare institutions that have transferred from using paper based records to using EHRs by way of service hubs. For the sake of this research, E-health services are EHRs, E-training, E-consultations, E-referrals, and E-prescriptions. These are characteristic of the move from paper records to electronic services.
- EHRs are an E-health system that captures, and provides access to, healthcare data about patients in detailed and summarised formats. EHRs are at the core of many E-health systems such as E-prescriptions, E-consultations and E-referrals. Although E-consultations in the present context are consultations between healthcare staff, the patient is still the subject of the consultation.
- User Interface Components: these provide interactions between healthcare staff and E-health system applications. A user interface component handles the provision of information for specific end user applications and computer devices.
- User Process Components: these components facilitate interactions between healthcare staff with E-health system applications and ensure that processes are both flexible and predictable. They make sure services remain private, collaborative, authenticated and authorised. User process components manage transactions of healthcare staff and deal with problems such as a cancellation and rollbacks if transactions are abandoned.
- Communication: this concerns components interacting from one layer to another. Within the communication layers, suitable transfer protocols are used to send messages. All parts of the E-health framework use a shared network infrastructure to communicate by use of agreed service protocols. Health Level 7 (HL7) messaging standards are proposed to be used as a messaging standards for the LNHS.
- Operation Management: this consists of the management of services, workflows, exceptions and maintenance. Managing maintainability means inserting mechanisms for updating E-health applications and components periodically. Managing exceptions means executing strategies for the detection and management of exceptions and mistakes, thus preventing a service from revealing data about how it was implemented internally if mistakes happen. Managing workflows means managing flows of complex processes in

predefined manners. Managing services means facilitating the minimum level of standardisation for supporting the delivery of computer systems, telecommunication and information to healthcare staff.

- Security: implementing the E-health systems proposed in the E-health framework needs to be carried out in an environment that has sufficient security. Therefore, there needs to be user identification, authentication and authorisation that can be relied upon and is secure. During fieldwork, issues around patient data needing to be secure and confidential became apparent and thus, the establishment of identification protocols was deemed highly important. One of the participants in the study pointed out a need for a password and signature for users in case of problems so that it was possible to trace who made the mistake (Table 5.14). The participants in the research pointed out the sensitivity surrounding patient's healthcare data and the need for its protection through the use of passwords (Table 5.15).

The following section is a discussion of the E-health framework's infrastructure network that has been proposed.

6.5.3 The E-health Framework's Infrastructure Network

In this section a web-based service architecture solution is proposed by the researcher for the healthcare institutions in the LNHS. The research carried out has shown that urban healthcare institutions have superior ICT than rural healthcare institutions. Thus, creating the infrastructure network has the goal of providing solutions that allow for the sharing of ICT between the healthcare institutions in rural and urban areas. The infrastructure network's goals are:

- 1) Incorporating present E-health systems into the new infrastructure system;
- 2) Storing and distributing healthcare data across the infrastructure system with hybrid distributed databases (HDDs);
- 3) Assisting healthcare institutions in pre-selected geographical regions and sharing healthcare data and information by integrating infrastructures;
- 4) Promoting fault-tolerant computer usage in the infrastructure networks;
- 5) Having an infrastructure system that is strong and durable and can be relied upon to deliver a connection all day every day.

The following section presents an overview of the infrastructure network. The processes for each E-health system are described in Sections 6.7.3.2 to 6.7.3.6.

6.5.3.1 Overview of the Infrastructure Network

Figure 6.4 shows an overview of the network infrastructure which will aid in the integration of services in the healthcare institutions, linking applications, work processes and devices to deliver improvements in the sharing of knowledge and provide a more efficient healthcare service. The development of the network infrastructure has as its basis the E-health framework's proposed architecture (Figure 6.3), the recommendations recorded in Table 6.1 (Section 6.1), the results reported in Chapter Five, and the literature review found in Chapters Two and Three.

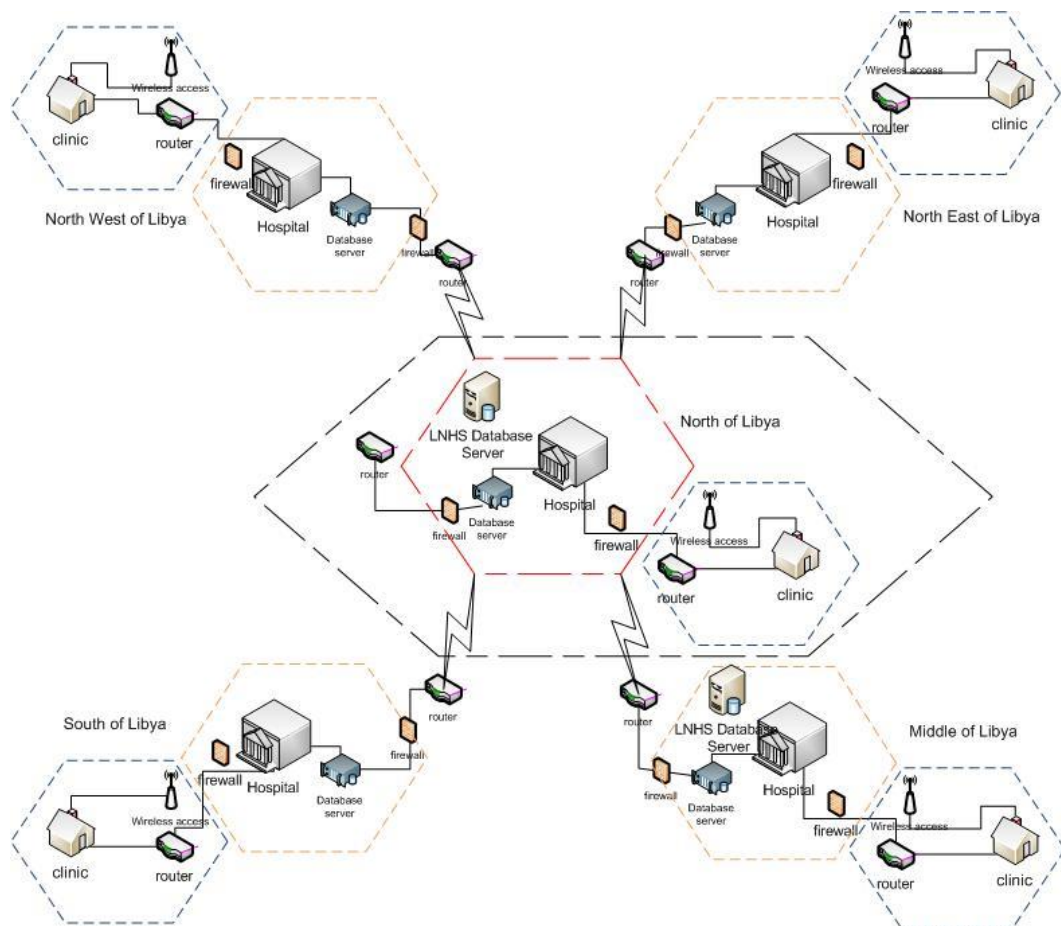


Figure 6.4: Overview of infrastructure network for healthcare institutions in the LNHS.

The infrastructure network was previously described in accordance with its goals (Section 6.5.3), and these are built upon in the remainder of this section.

(1) Incorporating present E-health systems into the new infrastructure system:

The results from the E-health readiness assessment (Chapter Five) indicated that one type of E-health system is already in use in some of the investigated healthcare institutions in the LNHS. This type of E-health system is for patient administration. The E-health system that this study proposes would incorporate patient administration systems already in use in the LNHS. Demographic patient data will be sent from local systems to the central database located in the North of Libya server (DHCDB).

(2) Storing and distributing healthcare data across the infrastructure system with hybrid distributed databases (HDDs):

HDDs as used in this infrastructure system combines data distribution models that are both centralised and federated. In centralised distribution models, all the information is kept in a central location and all the users can access it from one source. In contrast, in federated distributed models, information is not stored in one location but is stored in many smaller systems. Data that has been created by a given healthcare institution is then kept by them, but is copied and put into storage in central locations for the North-West, North-East, South and central healthcare institutions. The information held at the hub healthcare institutions is sent to the main database for the entire country located at Tripoli Medical Centre (TMC). Mechanisms for obtaining information from the healthcare institutions that are taking part need to be set in motion with each healthcare institution uploading the information that is needed to central database for that area during off-peak period.

(3) Assisting healthcare institutions in pre-selected geographical regions and sharing healthcare data and information by integrating infrastructures:

The healthcare institutions of the LNHS are concentrated in four different parts of Libya. Some of them are very close to one another and make it easy to divide them into four sections, North-East, North-West, Central, and South.

For example, if we take the healthcare institutions in the South of Libya as an example and have Sabha Medical Centre as their central database. Therefore, it is proposed that SMC be used as the central hub for the Southern region. Each healthcare institution has a database server, and all the database servers in the Southern region will link via Sabha Medical Centre's Database (SMCD) to the network. Each local network in each healthcare institution is connected to their local database server via wireless networks.

SMCD is home to the primary database for healthcare institutions in the South and is itself connected to Tripoli Medical Centre Database (TMCD). Tripoli Medical Centre is home to the primary database for the LNHS.

Other healthcare institutions in the other regions of Libya can be connected in similar ways to TMCD via regional hubs. Tripoli Medical Centre is the Database Centre for the four regions of Libya, and acts as an internet port for the infrastructure system. The design of the system allows data to be sent in any direction, as shown in Figure 6.4.

(4) Promoting fault-tolerant computer usage in the infrastructure networks

Computers that are fault-tolerant carry on operating if there is a failure in one part of its system, safeguarding against information being lost. Fault-tolerant computers have multiple essential parts so that if one of them breaks down then the computer will use the other part in order that it remains functioning. The infrastructure system has been designed so that all information is stored in two different locations, not including the local server. All the other healthcare institutions can transfer over to the host server at a healthcare institution in the central part of Libya if the whole system fails, as shown in Figure 6.4.

(5) Having an infrastructure system that is strong and durable and can be relied upon to deliver a connection all day every day

Information can be updated during quiet periods from the healthcare institutions in the network to the central database for the region. This avoids the network becoming congested and data being transmitted slowly between the healthcare institutions. The healthcare institutions use wireless networks with high transmission speeds.

The following five sections present details of the E-health systems that the E-health framework proposes in the example context of imagined operations.

6.5.3.2 Processes for E-consultation systems

E-consultations can aid healthcare staff in the sharing of healthcare information. The objectives of E-consultations are the improvement of the healthcare received by patients through the enhancement of skill and knowledge levels of local healthcare staff by specialist teams remotely situated. Remote E-consultations have significantly helped healthcare institutions in rural areas by mitigating against the dire lack of doctors in

those areas (Li et al., 2016; Kidholm et al., 2012; Epping et al., 2006; Stachura and Khasanshina, 2008). Figure 6.5 is an illustration of E-consultations occurring between rural healthcare institution in the North-West of Libya and an urban healthcare institution in the North-East of Libya.

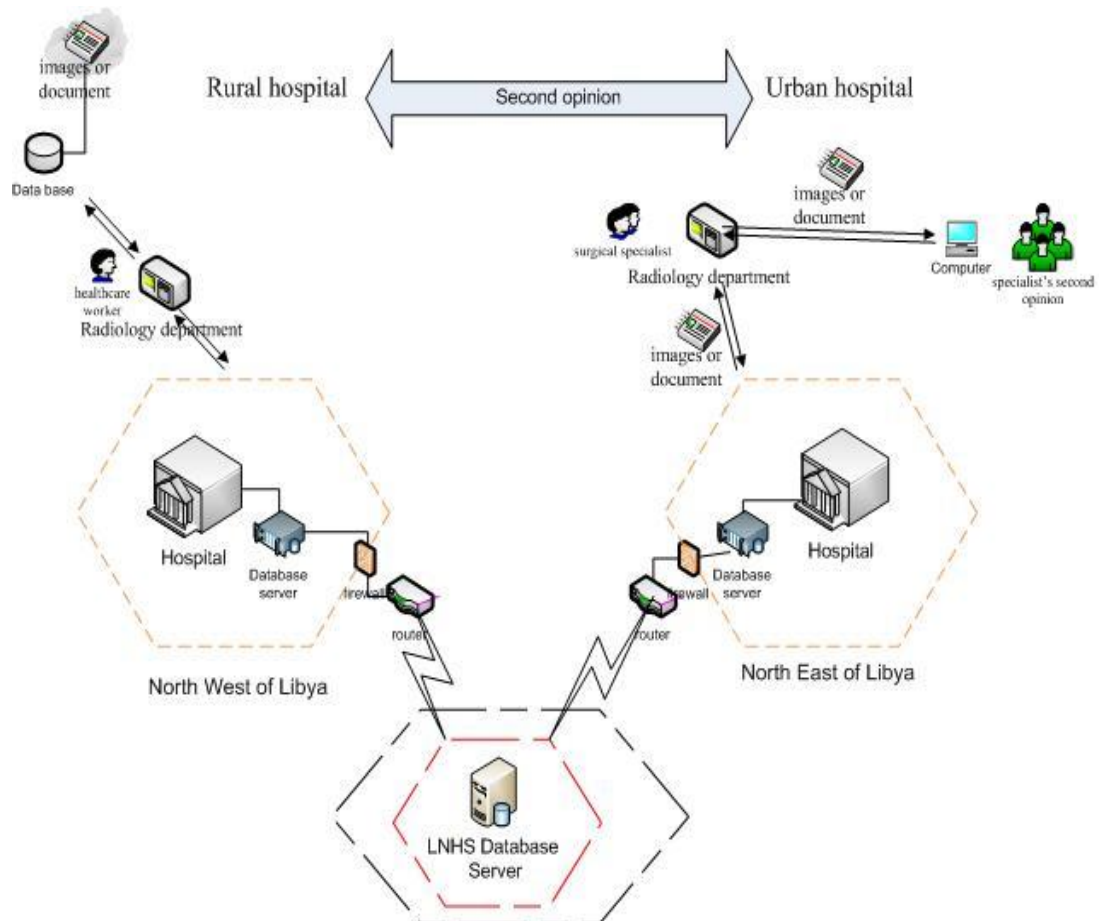


Figure 6.5: E-consultations between healthcare staff.

Figure 6.5 illustrates an example of a healthcare worker in a rurally located hospital (North-West of Libya), where they need a specialist's opinion about an image taken in the radiology department of that hospital. The healthcare staff uses the database host for sending the images or documents to the specialist's computer at the North-East hospital. A surgical specialist looks at the images and sends it to the radiology department for another specialist's second opinion. This specialist shares their opinion with the specialist surgeon who gives their answer to the healthcare staff at the radiology department in the North-West hospital.

In developed countries E-consultations are considered to need communications to occur synchronously, but in developing nations such as Libya the opposite is the case. Many rural healthcare institutions are severely economically affected and are technically severely limited as far the infrastructure of their networks go. Because bandwidths are unreliable and the doctors are overworked because of staff shortages in these regions, E-consultations will be unsupported by media operating in real time. Because of this the recommendations made in this study are for asynchronous communications to be used for E-consultations in rural areas. This technique requires healthcare institutions to store data in their databases and send it off when communication channels are at their quietest. Therefore, healthcare staff can put forward questions that are non-case-specific and not too big, but have importance to the running of the healthcare institution.

If the recommendations given in Chapter Five (Section 5.5) are possible to implement, then E-consultations can be carried out synchronously. In urban areas it was found that communicating for E-consultations could be carried out using real-time media, though research discovered that healthcare staff in urban areas were communicating by telephone, emails, letters and talking face to face (Section 5.3.1.3, 5.3.1.5, 5.3.2.3 and 5.3.2.5). From these points we can see the E-consultations would improve healthcare services provided in healthcare institutions in the LNHS.

6.5.3.3 Processes for Electronic Health Records (EHRs)

EHRs are essential to being able to successfully operate other E-health systems. EHRs can keep different sorts of information such as: history of the patient's medical care thus far; basic medical data such as allergic reactions and any medication already being used.

This information is created by different departments of a healthcare institution and then fed into the database server in that healthcare institution. Copies are made of this information and sent to the chosen central server. Figure 6.6 shows the ways in which information is created in a healthcare institution and then stored there.

For example, every department in Sabha Medical Centre (one of the regional hubs) will have computers that are connected to the central application host that is located within the hospital. This will collect all the data from all the departments and store it in the central data base host. Any clinic linked to a nearby hospital will send copies of the data they produce to the central database. Because this centralised stored data can so easily

be retrieved, if a patient shows up at an appointment with a doctor without paper medical records, medical information about them can be retrieved quickly and efficiently. The system will also lead to staff spending less time looking for paperwork and the data in the database in Sabha Medical Centre can be copied and sent to Tripoli Medical Centre, which serves the whole LNHS.

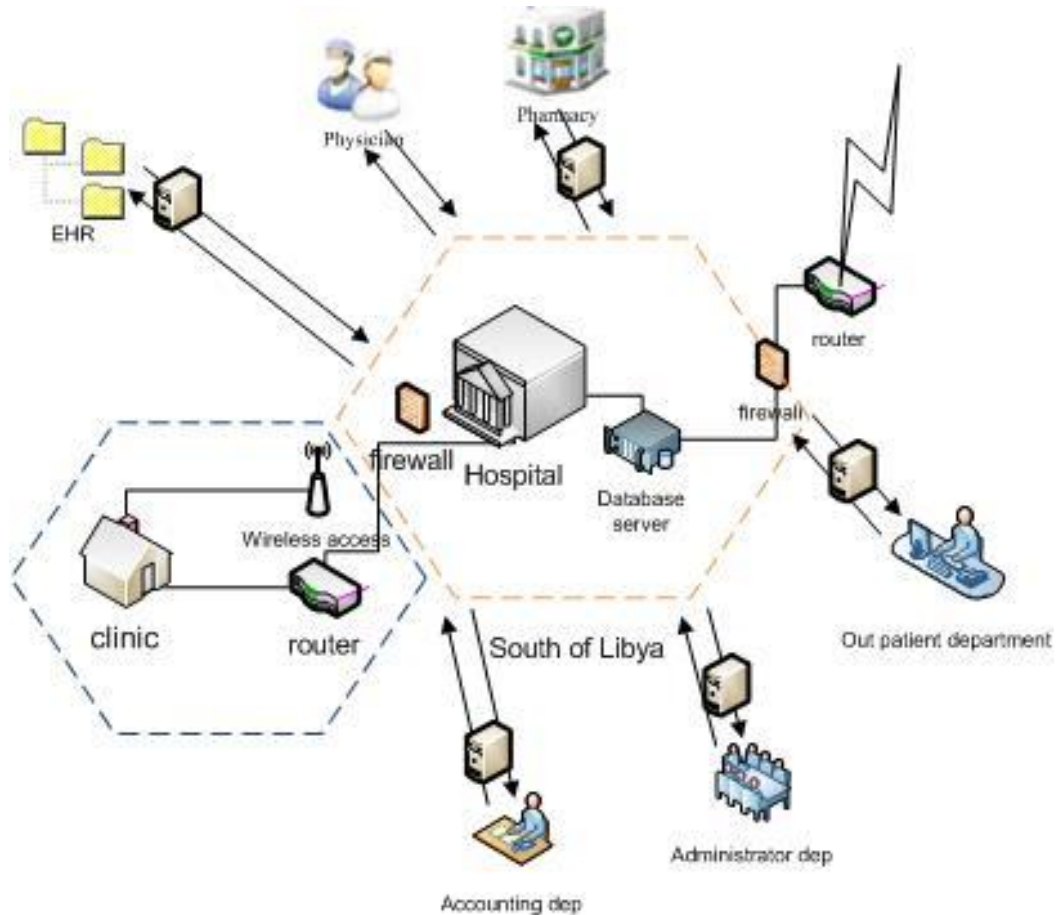


Figure 6.6: Linking departments in healthcare institutions.

6.5.3.4 Processes for E-training systems

When the healthcare staff at the healthcare institutions in the LNHS were assessed for computer literacy in this study, it was discovered that more staff at the rural healthcare institutions had never used a computer as part of their job on a daily basis than those working in urban healthcare institutions (Sections 5.3.1.5 and 5.3.2.5). These findings indicate that healthcare staff needs to be trained in the basics of computer usage as well as how to use E-health systems. The primary goal is providing E-training to enable staff to use E-health technologies for improving quality levels for the delivery of healthcare in healthcare institutions. E-training will be used for assisting doctors, nurses and other healthcare staff to learn the basics in using computers and in mastering the use of E-

health technologies that need to operate. Figure 6.7 shows how the E-training process would work.

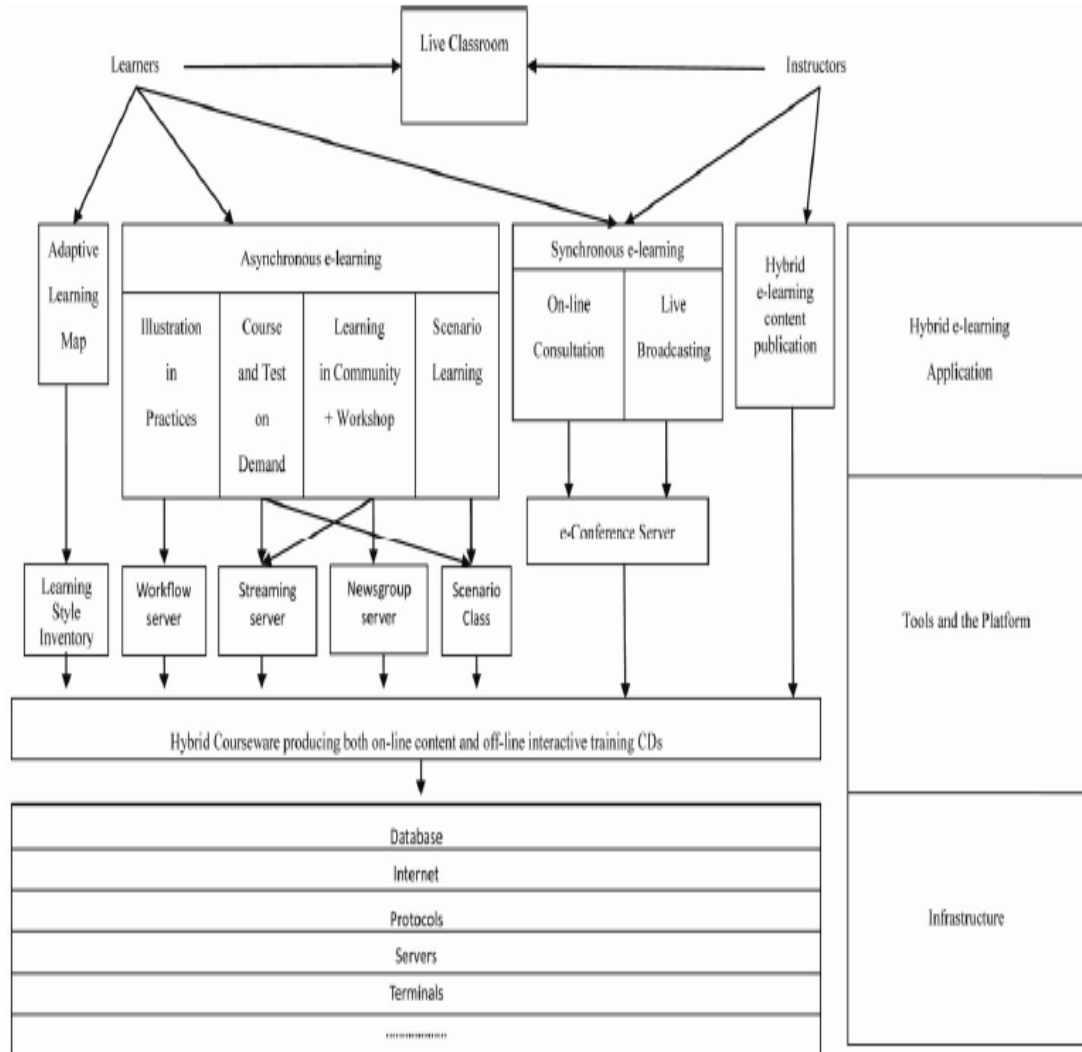


Figure 6.7: The E-training process (more clear in p.47).

To begin their training, healthcare staff must use the User Interface (UI) for registering as learners and for requesting the course's content. The course's content is split up into different programmes (lessons on using E-prescriptions, E-referrals, E-consultations, EHRs and simple computer skills). When healthcare staff register for learning and select a programme, they are assigned a mentor who will guide them and assess their learning. The healthcare staff on the course will request the materials they require for the programme they have chosen. The healthcare staff will complete the tasks assigned to them on the programme they have chosen and forward it to their mentor, who then assesses it and provides comments and evaluations to the healthcare staff studying the programme. While the healthcare staff are doing their coursework they may need some

assistance, therefore facilitators are provided in their healthcare institutions if they feel the need to consult with them when requiring assistance.

Learning Management Systems deliver content electronically in the shape of courses about using healthcare equipment. Learning Management Systems are incorporated as a part of E-health systems on local and regional healthcare institution database hosts. The Learning Management System supports learning interactively, though coursework needs to be completed and uploaded for submission. The Learning Management System allows healthcare staff to collaborate with one another in the form of forums for discussing their thoughts on what they are learning, ask one another questions and answer those queries that have some relevance to the healthcare staff. The Learning Management System has a search engine to help its users find relevant information for completing their coursework. Moreover, the Learning Management System has tools for visual authoring that can be used by authors with some experience for creating and updating assignments and completing tests. Healthcare staff have expressed a need however to receive lessons in the classroom, and such live training will be supported by E-training that is available at all times.

6.5.3.5 Processes for E-prescription systems

E-prescriptions involve transmitting, through use of electronic devices, prescriptions (or information about them) between prescribers and dispensers. In this study the term E-prescription refers to prescriptions that are transmitted and filled and electronically generated using computers, thus replacing prescriptions filled out on paper or faxed (Johnson and Lehmann, 2013; Tierney, 2005; Linder et al., 2004). E-prescription services are controlled prescription management systems. An illustration of the corresponding processes in a hospital can be seen in Figure 6.8.

If a patient is consulting a doctor in a healthcare institution and the doctor wishes to prescribe medication, the doctor can ask for the patient's medical history and information about any medicine currently being prescribed to the patient from the healthcare institution's central database host. The patient can be identified on the system by use of their Identity Number "IN" or using demographics. The doctor will inspect the medication lists and history of the patient and select the relevant medication for the patient's current condition. The prescription is completed by the doctor giving their

signature electronically to the drugs that have been chosen. The doctor then sends the prescription to the pharmacy via the healthcare institution's central database host. The

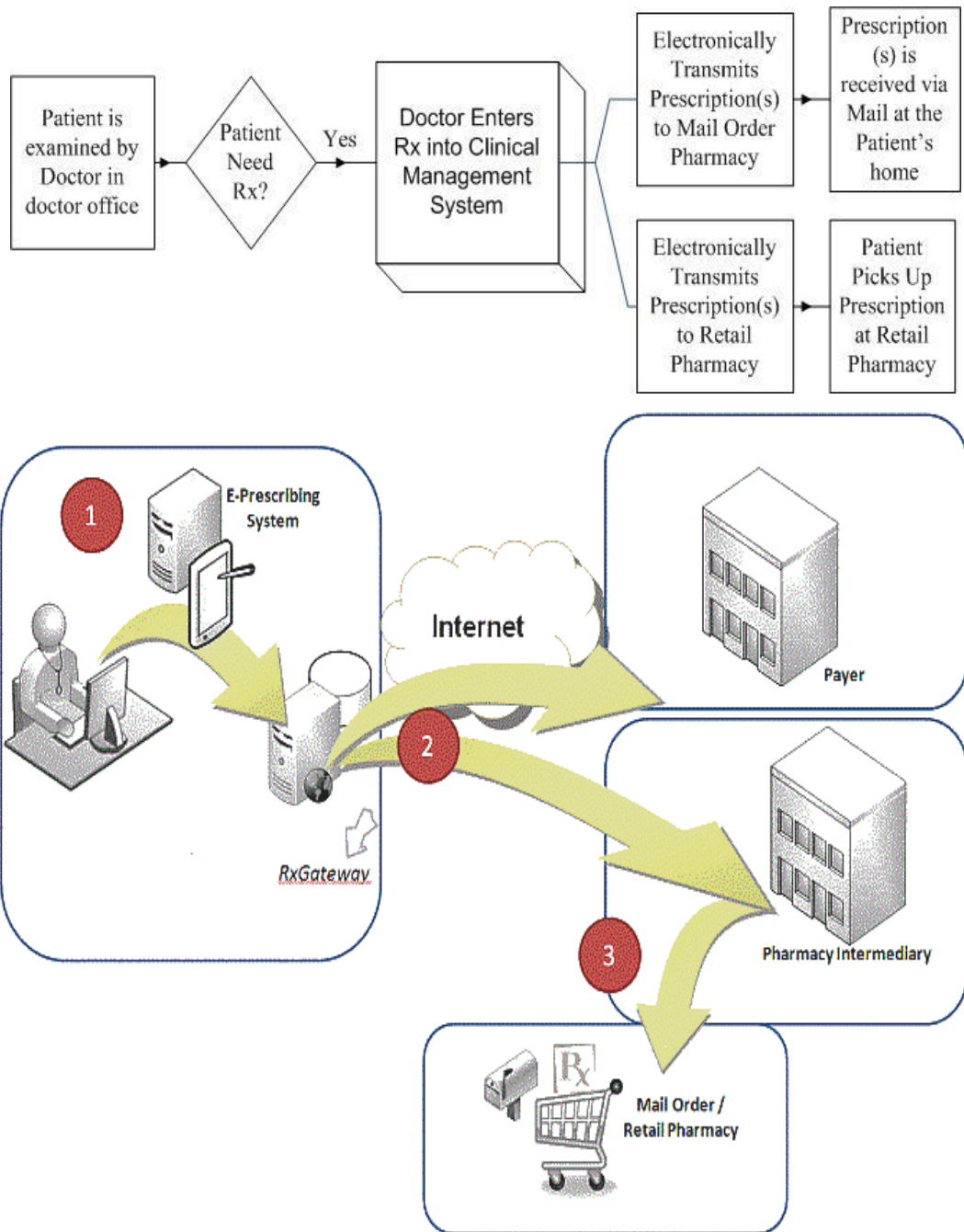


Figure 6.8: Processes for E-prescription systems.

pharmacist will then dispense the drugs to the patient and lets the doctor know the transaction has been completed by sending a message through the healthcare institution's database host. E-prescribing system was thought to be necessary because the research showed there to be a problem with queuing at pharmacies in healthcare

institutions and identified a need to stop errors occurring when medication is dispensed (Section 5.3.1.4 and 5.3.2.3).

6.5.3.6 Processes for E-referral Systems

The definition of referral given by the Kim et al., (2009) is: communication with the intention to initiate the transfer of care, from those already providing care to those that shall receive the patient. For the sake of this study, E-referrals means the transmission of electronic information from doctor to doctor, practitioner to central referral office (CRO), or doctor to another department, either within or outside of the healthcare institution by use of an E-referral management system.

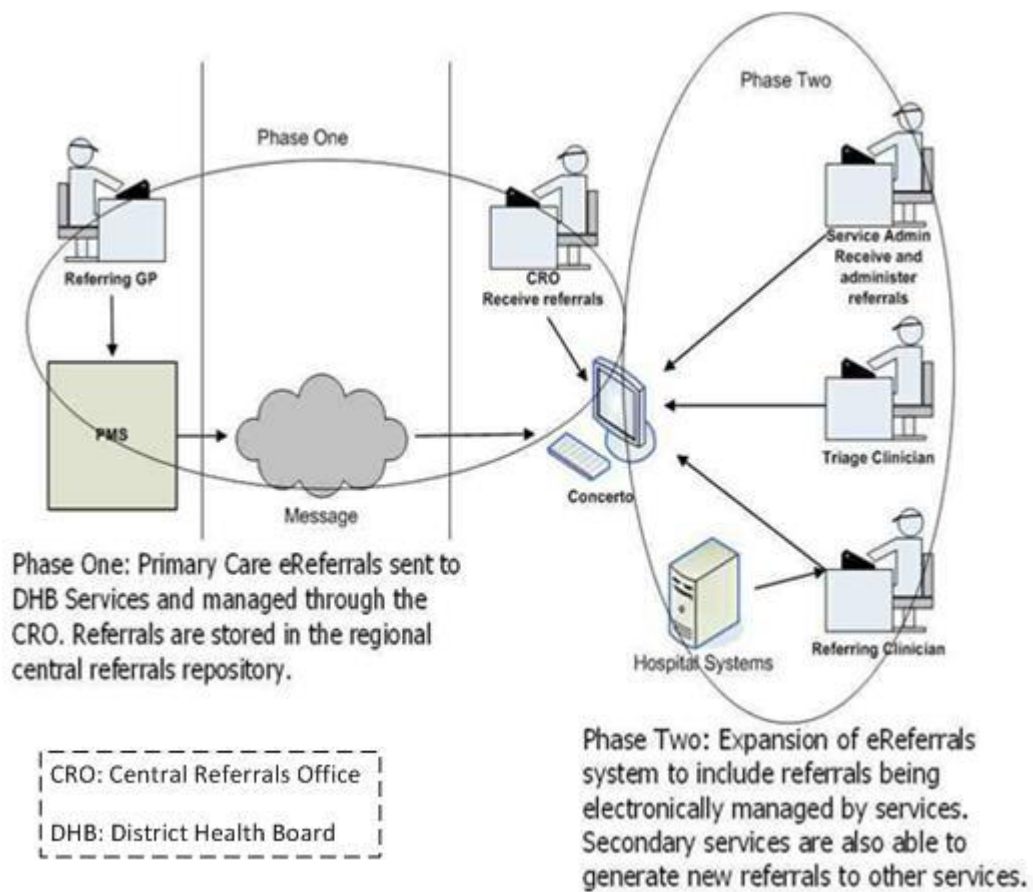


Figure 6.9: Examples of E-referral processes.

The research results in Chapter Five indicate a severe lack of doctors and consultants in rural healthcare institutions, though there are higher concentrations of them to be found in healthcare institutions in urban areas such as TMC, BMC and SMC. Because of this, a majority of patients needing specialised care will find themselves being referred to those medical centres; this process will usually entail a great deal of paper based labour.

Figure 6.9 shows an E-referral system that can be described with the 3 processes of referring, reporting and responding. The beginning of the referral is when the patient pays a visit to the doctor at a rural clinic and has to be referred to a specialist. The doctor at the rural clinic requests the patient's EHR via the healthcare institution's central database. The doctor records what they have diagnosed and updates the patient's EHR. The referral secretary at the rural clinic is alerted by the doctor about the patient's need to be referred. Using the E-referral management system, the referral secretary at the rural clinic then initiates and manages the process for the referral. A summarised version of the medical history of the patient is sent by the referral secretary at a rural clinic to the consultant's secretary at an urban hospital via the E-health database for their region. When the specialist secretary at the urban hospital has received the message, they retrieve any further data that might be available from the regional E-health database host. The consultant secretary will then report to the referral secretary that their message has been received and understood.

The patient will then attend an appointment with the consultant who will diagnose them and write it up in their notes on the EHR, which is then submitted to the central database host. The process is complete when the referral secretary from a rural clinic has received a report about the referral and any other information from the central database host about the patient's appointment at the urban hospital.

Referral processes also occur within a healthcare institution when a patient is referred from one department to another. When this happens a referral is transferred to the relevant department via the healthcare institution's database host. Once the department that the patient has been referred to has seen the patient, the department that sent the patient is notified. The findings from fieldwork indicated that when a patient's referral is carried out with paper documents then they are very unlikely to report back to the department or healthcare institution that has referred them. Because of this, the use of paper based referral systems makes it extremely challenging for a referring healthcare institutions to have any idea what happens to the patient after they leave their care. Therefore, E-referrals have been included in the E-health framework as a priority.

The following section shows the strategic plan for implementing E-health in the LNHS.

6.5.4 Strategic Plan for Implementing E-health in the LNHS

6.5.4.1 Implementation Principles and Desired Outcomes

The implementation principles and desired outcomes are based on this research findings, and the researcher used as guidelines some of the successful strategies used in other countries such as the Australian's National E-health Strategy, the Arizona Telemedicine Program, and the Canadian E-health Strategic Plan for implementing E-health systems. Underpinning and informing the implementation strategies and approaches proposed here are seven basic principles:

- 1) **National Infrastructure:** delivering basic essentials for the LNHS E-health infrastructure on a national scale, instead of repeating the same process regionally unnecessarily, thus wasting valuable resources.
- 2) **Stakeholder Engagement:** taking action towards the engagement of the stakeholders (patients, healthcare staff, and healthcare providers) involved in designing and delivering E-health technology for the LNHS.
- 3) **Incremental Approach:** constructing the E-health capabilities of the LNHS incrementally and pragmatically, while initially investing in E-health technologies that will afford the most benefits to users of the LNHS in the long term.
- 4) **Recognition of Different Starting Points:** providing help to those areas of the LNHS that require it, but not at the expensive of those that would like to develop at a faster pace.
- 5) **Leverage:** providing more effective support to E-health activity throughout the LNHS by encouraging healthcare staff to use the system.
- 6) **Balance Alignment and Independence:** making sure all E-health usage throughout the LNHS is aligned, without imposing limits on solutions being implemented locally when relevant.
- 7) **Relevant Skills:** making sure there are enough healthcare staff trained to the required standards ready to operate the E-health systems implemented in the national strategy of the LNHS.

The following six points provide a qualitative indication, in terms of desired outcomes, of what the Ministry of Health's intentions and targets for the implementation of E-health technologies should be.

- 1) Saving money and time by no longer utilising paper for recording patient data and managing information more efficiently.
- 2) Providing better healthcare services by integrating departments and hospitals.
- 3) Improving the effectiveness and safety of patient care through better delivery of the information required by making sure it is correct and delivered as fast as possible.
- 4) Enabling patients in rural areas to be able to gain access to healthcare interventions through electronic means.
- 5) Allowing carers, patients and doctors to share information electronically.
- 6) Making more accurate policy decisions by having comprehensive and accurate healthcare information that is provided electronically.

The above are complemented by the following set of principles which can be utilised for underpinning the planning, then the implementation, of E-health systems being implemented within the LNHS.

- 1) All patients should be guaranteed that any healthcare information that is recorded about them will be stored securely and confidentially.

When the new systems are installed, there must a very high priority placed upon ensuring that all patient healthcare records remain secure and are seen only by those authorised to do so.

- 2) New systems need to be within budget, run efficiently and create benefits for the LNHS and its users.

E-health systems need to be used, not only ICT solutions, but they need to be utilised primarily for healthcare purposes. The money invested will be drawn in through demonstrating the positive effects it can have on the LNHS and its users.

- 3) Using ICT infrastructure already in place and approaching the implementation of E-health systems incrementally.

Providing a long term utilisation plan can allow an HIS to be integrated within existing systems, while focusing primarily in those areas that will bring about the most effective outcomes.

4) ICT development, standardisation, and integration.

Below are the themes that underpin the development of the E-health systems being implemented:

- The usability of a system;
- Focusing on ICT systems that can be reused and are economically viable that can be managed easily;
- Standardisation of IT terminology and standards;
- Involving local stakeholders in the implementation of E-health systems.

5) Consulting and collaborating with local participants

The implementation of E-health systems requires the involvement of and consultation with local stakeholders.

6) Governance and leadership mechanisms that are robust and effective

To implement an E-health strategy nationally, it needs to be planned, directed and monitored by a strong mechanism for governing and leading the operation.

7) Making sure that enough skilled labour is available so that the E-health system will operate effectively.

To develop an E-health system it is necessary to employ the services of professionals with a lot of experience in that field as it can be a complicated process. It may be necessary for the LNHS to seek out the services of many professionals from around the world that have previous experience of implementing E-health systems. It is also highly practical though to ensure that there is an abundant supply of local labour that can operate the systems once they are up and running.

8) Guarantee.

Guarantee is needed to ensure that the business approach for the E-health technologies continues efficiently and effectively, this guarantee has to be given by the government to the LNHS. The biggest obstacle to the implementation of E-health systems is not having enough money to afford it. The financing of E-

health technology is most commonly provided by governments. Because governmental finances are cut more and more, this makes it very difficult to guarantee funds. For finance ministers to commit such large sums of money for the implementation of E-health technologies, they need to be certain that it is a sound investment for the population's healthcare for generations to come. Providing case studies of successful E-health implementations would provide evidence of the soundness of such an investment; case studies can also provide valuable lessons in how not to proceed.

The purpose of the proposed approach is to ensure that all the costs required for developing E-health systems within the LNHS are taken into consideration and that sufficient budgets are allocated by the government to the LNHS to implement E-health systems and for it to run effectively and efficiently after implementation.

9) ICT Skills.

It is generally acknowledged that the learning of ICT skills is needed for developing a modern society where information exchange is prevalent. It is essential for healthcare staff to develop their ICT skills at this time in order to be able to benefit from E-health technologies that can be introduced.

Two actions that can be taken are:

- Providing ICT training to healthcare students while at university.
- Training healthcare staff already working on how to use the technology.

One of the primary problems to E-health implementation given in this research's questionnaires and interviews was a lack of training in ICT for healthcare staff. The other big obstacle mentioned often was, the attitudes of healthcare staff to the changes E-health implementation would bring, with these being: fearing technology that they had not been trained to use and resisting change. The best way to deal with these problems is to educate healthcare staff, thus demystifying the work needed to be carried out to operate E-health technology. For a successful implementation of E-health systems in the LNHS, a comprehensive education programme for healthcare staff and healthcare students would need to be implemented.

The following sub-section discusses the primary work streams.

6.5.4.2 Primary Work Streams

For the purpose of addressing these principles the four primary work streams are proposed:

1. Foundations: establishing the required foundation for exchanging data electronically safely throughout the LNHS.
2. E-health Solutions: providing the necessary ICT and IT equipment to meet the needs of LNHS.
3. Change and Adoption: encouraging healthcare staff and management in the LNHS to adopt E-health systems. The purpose of this is to achieve a ‘tipping point’ of stakeholders adopting E-health technologies as rapidly as possible.
4. Governance: making sure that the LNHS E-health adoption programme is effectively coordinated, lead, and overseen. This will help to establish the necessary structures and mechanisms for governing E-health systems within the LNHS.

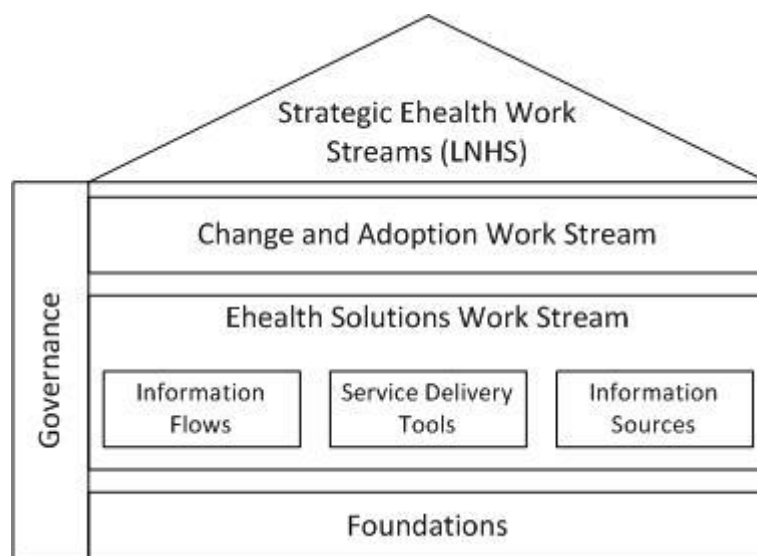


Figure 6.10: Strategic E-health work streams (LNHS).

Figure 6.10 shows how the four primary work streams fit together. The work streams need to be carried out in well-coordinated and synchronised operations so that E-health solutions are implemented as effectively as possible in the LNHS. All the work streams support one another and depend upon each other to be successful.

Suitable E-health foundations for the LNHS, such as adequate ICT infrastructure, regulations and IT standards are essential for healthcare data exchange across the large areas catered for by the LNHS and different healthcare departments. Without some order being implemented through standardised rules and regulations there will be no order in the data exchange in the LNHS and therefore inefficiencies.

Healthcare staff also needs to be able to use appropriate IT solutions so that they can send and view the required healthcare data. E-health technology provides concrete healthcare solutions that can aid in the construction of a connected ICT infrastructure in the LNHS.

There is no point in implementing E-health systems in the LNHS if it is not utilised by healthcare staff or patients. This will be dependent upon how well developed and operated the E-health systems are in the LNHS as stakeholders will not utilise new technologies if they are not effective.

Ultimately the success of the implementation program of E-health systems in the LNHS will be jeopardised unless it is supported by an effective governance regime that coordinates and oversees all LNHS E-health activities.

These are the areas that require attention in order for the LNHS to implement E-health systems. For each area strategic objectives (SOs) have been recorded, which should be followed in order to achieve strategic initiatives. The SOs will integrate the E-health systems into a nationwide Health Information System.

The following four sections discuss each of the four main work streams in turn. Incorporated into each section, but numbered consecutively from SO1 to SO16, are the strategic objectives that are required for achieving the implementation of E-health systems, and the healthcare targets, in the long term.

6.5.4.2.1 The Foundations Work Stream

The focus of the foundations work stream is the implementation of the basic infrastructure needed for enabling information to be shared electronically effectively throughout the LNHS.

The four areas essential for the foundations of E-health systems in the LNHS are:

- 1) Healthcare information requires a regime for identifying and authenticating information as quickly as the LNHS can manage so that it can be accessed and shared securely. Therefore, the LNHS needs to make this process obligatory across the board.
- 2) It is essential that the LNHS protects sensitive healthcare data so that it remains private. In order for this to succeed there needs to be a robust and secure security system implemented throughout the LNHS.
- 3) E-health information stored by the LNHS needs to be standardised throughout the LNHS in order that information can be exchanged effectively. This can be carried out through central planning establishing implementation procedures along with E-health implementation.
- 4) There needs to be large quantities of money spent on updating ICT infrastructure throughout the LNHS; as lack of investment coupled with widespread civil war and looting has left the LNHS in short supply of basic IT equipment.

At the moment most people outside of major cities can only dream of having broadband supplied to their home and are forced to rely upon satellite internet connections if they are lucky. In order for the LNHS to effectively implement E-health systems there needs to be reliable high speed broadband connections available across the LNHS. For this to be sustainable in Libya the country needs to become stable politically and then invest heavily in ICT infrastructure to ensure broadband availability.

The strategic objectives are to implement changes in the infrastructure that will allow information to be shared across the LNHS.

SO1. To build up ICT infrastructures so that information can be shared within the LNHS at the levels required.

The ICT infrastructure is the foundation of the network required in order to share information between different areas of Libya and different healthcare institutions. Included within this are the connectivity of the network and the primary services at the core of the system that hold together functional E-health systems. Though the Libyan government would like to establish a stronger ICT infrastructure within the LNHS, the civil war that is at present going on in Libya is severely limiting the realisation of these plans.

Strategic Initiatives:

- Supporting healthcare institutions in the establishment of ICT that are appropriate for their individual needs;
- Coordinating healthcare institutions to create ICT infrastructures that are sustainable;
- Supporting healthcare institutions to connect to a nationwide fibre optic network for sharing data and connecting to other healthcare institutions;
- Put into operation policies for the exchange of information between healthcare institutions that do not contravene any privacy laws.

SO2. To establish codes of practice for exchanging and protecting information.

To successfully implement E-health systems there need to be standardised procedures so that codes of practice are met nationally and internationally. Though international codes of practice are already established, the LNHS must also instigate its own on a local and a national level. Because of this the LNHS needs to set up standards that are easily accessible and cost effective and are within the international standards.

Strategic Initiatives:

- Establishing E-health standards around the exchange of information on a national level (e.g., Health Level Seven [HL7]);
- Establishing frameworks that safeguard privacy and the need for consent for accessing healthcare data;
- Reviewing present laws regarding the rights of patients, including the retaining of information and its privacy and security when used within an E-health system;
- Reviewing any laws regarding information sharing that could be considered in the interest of the public or for research purposes.

SO3. To create a registry with up-to-date information about healthcare facilities, clients and providers that satisfy the needs of all stakeholders.

The LNHS will need to recognise the need for listing information about healthcare institutions, the patients and the facilities they offer. The institution will need to recognise that compiling and maintaining these lists is needed in order to monitor

healthcare services and infrastructures and that would form the heart of the national Health Information System (HIS). It is widely recognised internationally that the best way to operate an E-health system is to focus upon the development of registry systems that record information regarding healthcare institutions, patients and facilities, so that they can be utilised for the management of extensive master lists of healthcare information (Alberta Health Services, 2015). Hence, for SO3, the LNHS needs to create an extensive master list of patients, healthcare institutions and facilities and create a standardised registry system for facilities that can interoperate with any systems already in place.

Strategic Initiatives:

- Developing harmonised data element specifications for the registry for healthcare institutions, patients, and facilities;
- Providing assistance to the healthcare institutions for using the revised registration processes;
- Implementing the registry system for the healthcare institutions, patients, and facilities;
- Developing guidelines that outline how registries for healthcare institutions and facilities need to be maintained and managed.

6.5.4.2.2 The E-health Solutions Work Stream

The focus of the E-health solutions work stream is to find out what can be done to help E-health systems to be implemented in the LNHS more effectively, and to see that the goals that are set nationally are achieved.

Research carried out in other countries has shown the E-health solutions that need to be prioritised are: sources of healthcare data, tools for the delivery of services, and the sharing of electronic information (The Australian Health Minister's Conference, 2008).

The SOs in this work stream (SO4-13) are focused on the implementation of the tools and the electronic systems needed to satisfy the demands of the patients, healthcare institutions and managers so that they may receive more effective and efficient services.

SO4. To enable financial management to be carried out electronically so that healthcare financial resources can be effectively collected, allocated and used in line with the healthcare plan priorities.

Strategies for the financing of healthcare and reforms in healthcare institutions are intended to bring about improvements in the services provided by healthcare institutions by making healthcare institution resource management more efficient.

Strategic Initiatives:

- Implementing a healthcare institution management IS for managing healthcare records and finances;
- Implementing data warehouses for fostering and supporting better decision making by stakeholders regarding healthcare resources;
- Implementing better financial and communication services for workers in isolated areas.

SO5. To strengthen healthcare record systems in order to allow healthcare professionals to be better managed.

Strategic Initiatives:

- Implementing a healthcare institution registry for healthcare staff;
- Identifying and integrating human resource systems into existing professional registries;
- Refining processes required in the management and maintenance of healthcare professional registries.

SO6. To set up electronic systems that deal with supplies and logistics, so that healthcare institutions always receive adequate healthcare commodities.

The strategy for providing supplies and medicine is intended to increase the capacity of management to know what medical supplies are currently needed and being used. The possession of reliable logistical data is vital for managing supply chains and procuring essential supplies. Currently there is a severe lack of reliable demand and logistical data, making it very challenging for LNHS management to maintain supply chains. The Libyan Ministry of Health needs to create a technology platform that will allow the

current system to be integrated into a new system that will collect data and process and disseminate it.

Strategic Initiatives:

- Implementing electronic Logistics Management Information Systems (LMIS) on a national scale, giving leverage to systems already in operation;
- Integrating it with other systems such as Health Management Information System (HMIS), Warehouse Management System (WMS), E-health.

SO7. To enable healthcare services to be delivered electronically in order to create reductions in maternal and child mortality and communicable and non-communicable illnesses.

The Ministry of Health has made a commitment to do the best that they can to achieve the Millennium Development Goals, including plans to provide better healthcare services for pregnant women, birthing and new-born babies. Hence, for this particular SO (SO7), the Ministry of Health should make improvements to ICT infrastructure so that patient records are more accessible and healthcare provision is improved. Additionally, the levels of healthcare education among patients and healthcare staff need to be improved.

Because so many non-communicable diseases are prevalent in modern day Libya and are increasing, the LNHS is becoming challenged to cope with so many patients. The introduction of EHRs would greatly improve treatment and lessen workloads for healthcare staff as so much of the healthcare provision involves record-keeping while illnesses are monitored.

Strategic Initiatives:

- Implementing and promoting electronic systems to allow patients to be tracked, monitored, identified and referred if at risk and information can be accurately communicated to patients;
- Implementing and promoting EHRs to improve decision making processes;
- Implementing and promoting the sharing of healthcare information and the exchange of healthcare data within the LNHS.

SO8. To strengthen healthcare management services by supporting monitoring and evaluation systems among healthcare institutions.

Monitoring and evaluation strategies are intended to make healthcare management services stronger and create improvements in administrative and clinical decision making. The Ministry of Health should adopt district healthcare strategies for its healthcare management information services, that include monitoring and evaluation and data managing services. This can be carried out by integrating current systems already in use to develop a true data warehouse that can be utilised for supporting decision making processes.

Strategic Initiatives:

- Integrating and linking related IS and existing systems into a new healthcare system,
- Collecting, linking and integrating healthcare information systems that are community based;
- Collecting, linking and integrating healthcare information from referral healthcare institutions into a new electronic healthcare system;
- Implementing a healthcare information system that links into Health Management Information System (HMIS) software.

SO9. To establish E-health systems for enabling improved healthcare services to be delivered to rural areas.

Referral healthcare institutions need to improve patient access to advanced healthcare services when needed, by using ICT to relay advice from healthcare institutions with highly qualified staff to ones that are lacking such expertise, such as in rural areas.

Strategic Initiatives:

- Developing E-health systems;
- Implementing the E-health infrastructure that is needed;
- Implementing E-health services.

SO10. To enable systems for the exchange of information electronically in order that the referral system will provide a higher standard of service.

Referral healthcare institutions intend to allow higher levels of healthcare services to be provided. There are not enough highly trained doctors to go around, and the healthcare institutions and the processes to allow access to them are very inefficient; therefore new strategies are required. Time and money is often wasted in Libya because patients are referred with little or no information being supplied by the referring healthcare institution. These shortfalls can be addressed using ICT to effectively transfer the required information easily and efficiently.

Strategic Initiatives:

- Developing collaborative networks between healthcare institutions using ICT, using pre-agreed guidelines for assisting each other;
- Implementing referral systems that operate electronically, and uses EHRs.

SO11. To enable healthcare staff to be able to access professional education online.

The strategy around this objective should include improvements in training practices for healthcare staff before they begin working for the LNHS and while they are employed there. For the LNHS to provide the best possible healthcare service to their patients the healthcare staff need to be well trained. Though much training is being provided in the use of ICT, ICT can be employed to train staff very effectively as well.

Strategic Initiatives:

- Developing and approving methodologies for the delivery of blended learning techniques, which include basic ICR education for healthcare staff, enabling them to utilise blended learning techniques;
- Developing programs and electronic contents for specific healthcare staff;
- Implementing healthcare institutions' E-learning platforms;
- Developing digital resources in order that areas with unreliable internet services can teach offline as well as online.

SO12. To strengthen the prevention, control and observation of diseases by utilising ICT solutions for facilitating, detecting, reporting and responding to diseases as early as possible.

Policies aimed at preventing and controlling diseases are intended to enhance the surveillance of diseases and also to promote healthier living and preventing disease within the community. Much information currently available regarding the detection of diseases is out of date or unavailable, therefore more up to date systems need to be installed for the more efficient detection of diseases. Hence, for this SO the Ministry of Health needs to utilise ICT for the implementation of much improved disease surveillance systems and to provide education about healthcare.

Strategic Initiatives:

- Implementing electronically integrated response and surveillance systems for disease that is connected to the HMIS;
- Implementing E-learning for improving education levels.

6.5.4.2.3 The Change and Adoption Work Stream

This work stream looks at what is needed to persuade LNHS staff and patients to adopt E-health systems. This can be carried out at a local level throughout the LNHS, though this will need to be orchestrated at a national level through training, education and programmes to encourage compliance and providing incentives. It would target patients, healthcare staff and LNHS management.

The drive to implement adoption and change throughout the LNHS needs to focus on five primary areas:

- 1) LNHS users need to be made aware of what is available to them through use of E-health in the LNHS through media and other sources and be shown the advantages of accessing their individual healthcare records.
- 2) Healthcare institutions need to be given financial aid with implementing E-health systems to encourage their widespread usage. This financial aid needs to be connected with how frequently the systems are being utilised to discourage installing them and not using them. The researcher observed that in the LNHS there are presently computers available but doctors are choosing not to use them. There needs to be a direct link between usage of E-health systems and funding on a national scale utilising funding schemes already in place.
- 3) Another method for encouraging the utilisation of E-health systems is to link them with accreditation of healthcare institutions, thus encouraging more of the

day-to-day usage of E-health systems. If it is required nationally for all LNHS healthcare institutions to achieve accreditation it will ensure budgets are created for creating and maintaining ICT infrastructures.

- 4) It is of great importance for a healthcare system utilising E-health technologies to ensure that sufficient numbers of healthcare staff have been trained to high enough standards to operate the technology effectively. For this to be successful in Libya a nationally coordinated training program needs to be implemented. A lot could be achieved in Libya by copying training of staff that has been carried out for instance in the USA, where there are many instances of E-health systems being successfully implemented and maintained.
- 5) Finally, it is recommended to establish stakeholder's council in Libya to exchange their individual viewpoints on what is and is not working and what might be done to improve E-health systems that are about to or have been implemented. This could save a lot of time and money as users at all different levels could make contributions that save money, time or even lives, and allow groups or individuals to express thoughts and feels that if not expressed could cause a lack of enthusiasm for the new technology, perhaps then leading its failure as a project.

6.5.4.2.4 Governance

Using a governance work stream will focus upon the establishment of a framework for effectively managing and overseeing a nationwide E-health strategy and an associated work approach.

The three primary areas that need focusing upon for the establishment effective governance within the LNHS are:

- 1) An E-health governance board needs to be established for the nationwide implementation of E-health systems in the LNHS, which needs to be accountable for establishing the direction developments take and what needs to be prioritised. It needs to review and approve strategies and coordinated where funding is channelled and to monitor progress.
- 2) An E-health support team needs to be established nationally that will be governed by the E-health governance board to coordinate the E-health implementation, overseeing E-health strategies, investments and executing E-

health work programmes. The model that it operates should focus on developing standards and complying with E-health solutions.

- 3) An E-health auditing team needs to be established nationally to create frameworks for regulating E-health systems and to enforce the regulations. The regulation framework needs to establish systems for creating a unique healthcare identifier for users and stakeholders and maintain security of sensitive healthcare data.

SO13. To establish E-health governance mechanisms and structures so that E-health implementation can be managed effectively and efficiently.

At the highest levels, the Ministry of Health should govern the implementation of E-health systems. They should also provide guidelines and structure for the running of E-health systems once they have been implemented.

The following section will focus on Information Security Management (ISM) as it applies to the E-health framework.

6.5.5 Information Security Management (ISM) in the E-health Framework

This researcher's recommendation is that for the deployment of the proposed E-health framework, and in order to ensure that it remains relevant (as environments shift and security issues in the governance of E-health systems develops rapidly), it is best to use the International Information Security Management Standard (ISMS, Chapter 2, Section 2.5). The ISMS standard is recognised globally as the standard for certification, design, improvement, maintenance, implementation and monitoring in the field of information security management systems.

Jyothirmmai and Ashwitha (2015) address the issues of making healthcare data freely available for those who need it, while ensuring it remains confidential and private. Additionally, this standard sets out particular actions for managing healthcare data and guidance for the best ways to keep security at optimum levels. Through the implementation of this standard healthcare institutions should be better equipped for ensuring that healthcare data remains confidential, private and available.

The LNHS is strongly committed to the protection of patient healthcare information from being accessed, used, stolen, modified, destroyed or disclosed by unauthorised

users and within the organisation all members of staff are expected to adopt responsibility for this common aim. This policy also upholds the LNHS's responsibilities in complying with the International Information Security Standards. It is through the implementation of such standards that healthcare organisations globally can ensure that personal healthcare information can be stored confidentially and with integrity, while ensuring it is available to those who need it.

The following section is a discussion of the reasons why the E-health framework is important to the LNHS.

6.5.6 Project Planning for the Implementation of the LNHS E-Health Framework

In order to implement efficient and effective E-health systems it is necessary to create a detailed project plan before the development starts in order to ensure a successful implementation in the short term and long term.

For ease of reference, the following is a high-level summary of the policies the researcher has developed on the basis of the research findings, the literature review, examples of E-health systems implemented around the world, and from current evaluations of the LNHS:

- Creating E-health systems that cover the whole of Libya through the LNHS.
- Establishing a governance framework for the project to implement the nationwide E-health programme which will have wide reaching authority to support the project's requirements.
- Running the project as a virtual organisation incorporating all healthcare institutions across Libya which will be appropriately incentivised to participate.
- Providing access to the project's ICT infrastructure for the whole of the LNHS.
- Encouraging all healthcare institutions with E-health technologies to make their systems interoperable.
- Developing open staff models for doctors to provide E-consultations to multiple healthcare institutions.
- Promoting guidelines for healthcare staff, guidelines that have been formulated through medical research.

The researcher's proposal for the LNHS E-Health Framework consists of the following five components:

- E-health services;
- Department for assessing technology implementation;
- E-health training programmes;
- E-learning education courses;
- Developing an E-health infrastructure that includes ICT networks and standardised E-health facilities throughout the LNHS.

Figure 6.11 shows how they combine to form the entire LNHS E-Health Framework.

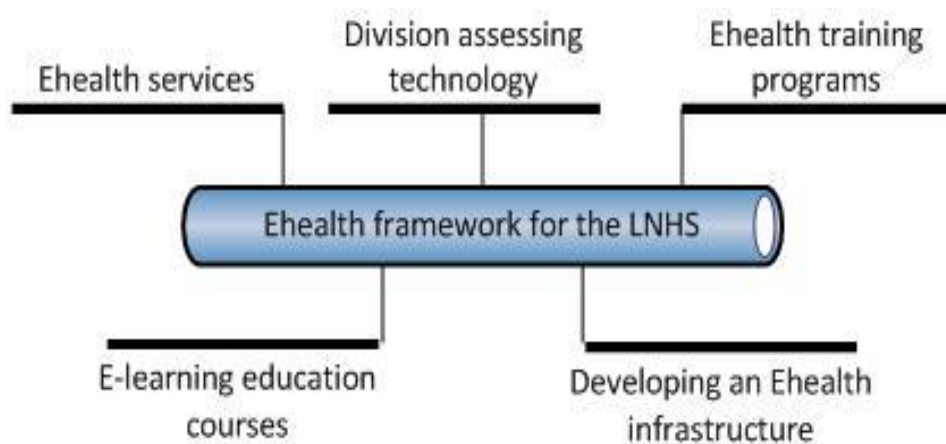


Figure 6.11: The E-health implementation project.

The researcher has noticed from the literature review that there are several key points during E-health implementation that can pose some puzzling questions. A very important place where this can often occur is at the beginning of a project when management can sometimes be somewhat perplexed as to where they should actually begin. Questions arise such as: is it best to set up local services first or just jump in with services on a national scale, and how receptive will the public and staff be?

The recommendation of the researcher is the creation of a council of stakeholders to coordinate each step of the project, but especially the beginning, as once it is underway it will possess a certain amount of momentum and direction that will not require quite as much attention.

The council needs to consist of key members of the Ministry of Health, private and public healthcare institutions, and members of the public that meet up every three months in order to discuss and monitor the development of E-health systems in the LNHS. This council would recommend a comprehensive framework for implementing E-health systems in the LNHS.

Establishing E-health systems across the LNHS with compatible technology so that healthcare institutions can communicate freely with one another is the primary goal of the council formed to coordinate E-health implementation in the LNHS.

The E-health service that would be offered by the LNHS will seriously increase levels of healthcare provision for rural areas, of which there are many in Libya, a very large and sparsely populated country. This technology will also spare healthcare staff having to travel through areas that are very dangerous due to control by aggressive militia factions.

Generally, only larger healthcare institutions possess large enough budgets to be able to afford the implementation of E-health systems on a large scale, though often it is the smaller ones that need such services more urgently. This is the advantage that a state run organisation such as the LNHS has over privately funded healthcare systems that operate in a vast majority of nations around the globe. In theory at least, the LNHS will be able to provide funding for E-health technologies to all healthcare institutions, large or small.

Initially there may be challenges with shortages of staff that are trained on how to use E-health systems, though this in theory could be averted through an extensive program of training for healthcare staff in operating E-health technologies.

Unfortunately, the researcher only had a limited period of time to carry out this research in Libya due to the unrest and civil war in Libya which placed his personal safety in jeopardy. The field of E-health systems available is far broader than the researcher has covered in this study and will most likely broaden even more in the future as technology develops.

6.5.7 Suggested Solutions for Overcoming Barriers for the LNHS E-Health Framework

One of the main challenges for implementing E-health systems within the Libyan healthcare institutions will be the lack of experience in operating such a system. The findings from the fieldwork (Chapter 5) showed that healthcare staff at the investigated healthcare institutions need training on how to use the E-health technologies. In order to alleviate this deficiency the LNHS needs to formulate a menu of training courses to be available for their staff, to help them learn on how to use the technology.

Training staff who have absolutely no experience in using the technology is an enormous challenge, especially as so few of them have experience in even how to use personal computers. IT training programmes should be introduced prior to the implementation of E-health systems. Healthcare staff should be trained on how to use and operate computers prior to their training on how to use E-health technologies, as basic computer skills will be needed in order to learn how to operate the future E-health system. Learning how to operate and use E-health technologies would increase the chances for successful implementation of E-health systems in the LNHS.

In order to gain existing staff loyalty, it would be very beneficial to incorporate a leader who will represent the healthcare staff. The incorporated leader who commands a lot of respect will assist in the planning stage of the project so that healthcare staff will be involved in the project and their views and opinions will be taken on and respected. In this way healthcare staff would feel the benefits of the project as they are involved in the project planning and implementation from the first stage, which will greatly influence the success rates.

It is a good idea for the LNHS to garner support within local communities for the transition to E-health prior to the appointment of a programme director. The director will then have an easier time in convincing locals in rural areas of the advantages of accessing healthcare via E-consultations rather than travelling long distances for consultations.

It is also advised to include a well-respected member of the local community in the planning committee. Their inclusion can influence the public levels of acceptance of the implementation of E-health systems, and the participation levels in E-learning

programmes. If a community is enthusiastic about an E-health implementation, then the chances are that more will enrol to train programmes on how to use the E-health systems. This has been tried in developed countries where it has had great success (Sunyaev, 2011), though in the view of the researcher this might be even more successful in Libya, as there is great respect held for community leaders in Libya.

Once the planning stage is completed and the project commences, the appointment of the program director is a very important move. They need to be skilled in many areas and be able to handle public speaking while communicating to the public the progress and visions of the project as well as managing many departments in the implementation of E-health systems.

The work entailed in gaining the support of communities may be time consuming and expensive, but ultimately brings many rewards such as the support of politicians, who not only feel great admiration for high tech developments that benefit the public, but if the public associate themselves with such developments their popularity may rise among voters (Cannon et al., 2014; Weinstein et al., 2008).

The users of the LNHS need to be confident that their personal healthcare data will remain private and confidential if EHRs are implemented in the LNHS. In order to do this the Libyan government would need to implement legislation to protect patients' health records in the LNHS. Patients' EHRs must always be private and confidential, and only those who are authorised should have access to this information.

6.6 Chapter Summary

This chapter has provided the answer to Research Sub-Question Two:

“In what ways can results provided by the EHRA be utilised for implementing E-health systems in LNHS?”

It discussed the implications for the design and development of an E-health framework for the LNHS. Based directly on the field study findings, and because the LNHS lacks a solid ICT infrastructure, the LNHS E-Health Framework appeared quite different from those frameworks that have been developed in developed countries.

To ensure that the created framework is creditable and applicable, it was based directly on the fieldwork findings, the literature review, document review, and the recommendations made by the group of Libyan experts met during the Vision for a Future Conference in London 2014 which was organised and sponsored by the Libyan Government.

The researcher paid close attention to guidelines for healthcare information and global healthcare standards while designing the LNHS E-Health Framework, and has taken a wide range of different factors into consideration when compiling the LNHS E-Health Framework, such as the abilities of healthcare staff to operate and use the new systems, the needs of the healthcare institutions, and their existing ICT infrastructure.

Additionally, this chapter pointed out the approaches that underpinned the construction of the framework, and the adoption of Service-oriented Architecture (SOA).

This chapter also presented an overview infrastructure network that will provide solutions for integrating services, such as EHRs, E-consultations, E-prescriptions, E-referrals and E-training, and the implementation of the infrastructure needed to enable information to be shared electronically and effectively throughout the LNHS (Foundations Work Stream).

Guidance and strategies for compiling the E-health framework, and Health Information Systems security management were also discussed in this chapter.

The next chapter will present the research conclusions and further work needed.

Chapter Seven
Reflection, Evaluation and Further Work

7.1 From Original Motivation to Specific Research Questions

The motivation for the researcher to carry out this study came from his experiences while researching healthcare delivery in rural parts of Libya. The researcher was also inspired by reading science journals that elaborated on the ways in which the provision of healthcare was being challenged in rural regions and white papers on transforming the Libyan National Health Service (LNHS).

The white paper that the researcher read in 2008 explained how the LNHS was being transformed and reported that most people in Libya enjoy less than adequate healthcare delivery where they live, and the majority of these people live in rural areas. Smith et al. (2008) state that a structural aspect of a rural environment may be that it will have more unemployed and impoverished citizens, be less populated and have different mixtures of occupations in comparison to an urban area. On top of this, a rural population may need to overcome larger and different barriers in accessing healthcare than those that challenge an urban population. For example, a rural resident needs to travel longer distances when accessing healthcare facilities as population densities are much lower and therefore there are less healthcare providers available (Smith et al., 2008). Most Libyans use as their primary healthcare provider the LNHS, which faces many challenges in providing a high level of healthcare, especially since the civil unrest there and the lack of funding provided by the previous dictatorship. The problems with the LNHS include clinical treatments that are outdated, shortages of healthcare workers, specialised skills, education about health and health information that is accurate. These factors lead to an increase in the loss of patients records, errors being made medically, delaying patients in being referred, and long waiting times for those attending clinics or hospitals (Al Ajeeli and Al-Bastaki, 2011; Khalil and Jones, 2007; Giaedi, 2008; Khalil and Al-Bousify, 2008; Cannon et al., 2014).

E-health can potentially be helpful in overcoming a great deal of the challenging issues facing those hospitals and clinics in rural locations (Gibson et al., 2011; Ouma and Herselman, 2008; Yellowlees, 2008; Al Ajeeli and Al-Bastaki, 2011; Dominguez-Mayo et al., 2015).

The research in this study concerned itself with those issues connected to the development of an E-health framework for the LNHS that are made evident through an E-health readiness assessment of healthcare institutions in Libya. For the purpose of

achieving this, several different models for assessing E-health readiness were considered, and the Chan framework was chosen specifically for measuring the E-health readiness in Libya. The questionnaires used in the fieldwork (Chapter 5) reported in this thesis used the Chan framework for the formulation of questions.

Similar ideas to this thesis have been expressed by other researchers, who have stated that E-health technologies can potentially aid healthcare providers in developing countries to overcome challenges being faced in providing healthcare services (Ruotsalainen et al., 2003; Iliakovidis et al., 2004). This study's primary motivation was to create an E-health framework that would create improvements in the delivery of healthcare services in the LNHS. Moreover, it was vital to make sure that the E-health framework catered for improving the all-important EHRs, E-training, E-referrals, E-prescriptions, and E-consultations systems that are needed so much in rural areas. This then brought about the study's primary research question:

How could an E-health framework that has been designed to enhance the delivery of healthcare services in Libya be composed?

The primary research question was then divided into two sub-research questions (Figure 7.1), and various measuring instruments were utilised for collecting the data more effectively and in order to achieve a deeper understanding of the analysis of the investigation. Moline and Cameron (2010) state that the use of several different methods for making measurements allows more details to be obtained about the subject being investigated. The researcher has utilised interviews, questionnaires, literature and observations as instruments to answer this research primary question.

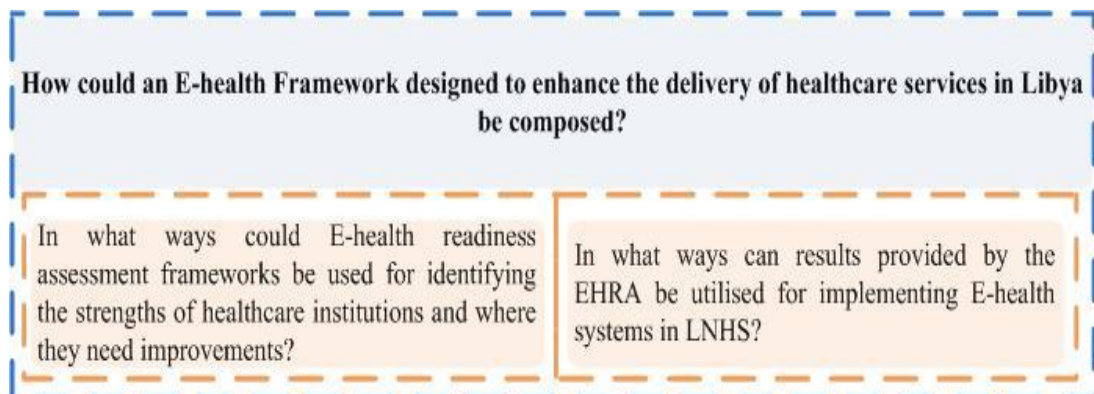


Figure 7.1: Research primary and sub-questions.

The remaining sections of this chapter provide a summary of the thesis (Section 7.2), before going through a systematic process of self-evaluation using principles from Lenore et al. and Pozzebon's work (Section 7.3). This is followed by a discussion of limitations (Section 7.4), and a summary of the contributions the thesis makes to the general pool of knowledge in this field (Section 7.5). The chapter concludes with directions for future research (Section 7.6), and a chapter summary (Section 7.7).

7.2 Significance of the Thesis and Chapter Summaries

The importance of this research is that it can be utilised to improve the healthcare services provided by the LNHS, among other things by enabling the Ministry of Health to assess the readiness levels within the LNHS for implementing E-health systems.

Such assessment is crucial, because, for example, if E-health technologies are implemented and conditions such as healthcare staff attitudes towards the newly implemented technologies are not at the required levels then this could cost the LNHS a vast amount of money for a technology which will not be used. This could put into jeopardy any future ICT development within the LNHS.

The research presented in this thesis looked at the contrasting attitudes of healthcare staff in rural and urban healthcare institutions towards the implementation of E-health systems, allowing the Ministry of Health to be aware of E-health readiness levels as never before in Libya. Libya, as a developing nation, has as yet not undertaken a great deal of research into this field, therefore this thesis has contributed much information to the pool of knowledge in general, and the Libyan Ministry of Health in particular, that was previously not available to researchers, decision makers, and developers in the LNHS.

The aim of this study has been to assess the E-health readiness levels of the LNHS by surveying the healthcare staff working within it in different regions of Libya in both rural and urban areas, using the responses of the participants to assess how willing those future users of E-health systems were to embrace such changes (a key factor in the successful implementation of E-health technologies).

It was decided by the researcher that it was important to include rural healthcare institutions in the research, as in the past there has been a history of decision making being made in urban environments with little regard being given to the needs and

opinions expressed in rural areas, where potentially E-health systems might have stronger claims to improving the delivery of healthcare services to patients and making the jobs of healthcare staff easier.

As well as interpreting the willingness of healthcare staff to embrace technological changes, the researcher sought to glean from the participants their opinions about how the new technology could best be used to improve healthcare delivery, and what they felt they most needed to make any implementation successful, namely to be well trained in using E-health systems as not everybody was confident in the use of ICT.

The first chapter of this research study gave a presentation of definitions of E-health and its various uses and applications, the research's rationale, the ways in which the study population was significant, the study's background, the research's aims and objectives and the questions that would be utilised for the research. The first chapter basically presented an outline of the structure of the research study.

The second chapter gave an outline of the general background of the subject being researched, including information about E-health systems, the advantages and disadvantages of their implementation and information about Libya and the LNHS.

The third chapter included a literature review, reviewing existing E-health frameworks. The fourth chapter was a summarisation of the research methodology and included the research questions, aims and objectives, the methods employed for collecting data, the questionnaires and interviews, the sample size, the programme utilised for data analysis and the response rates.

The fifth chapter showed the research findings and presented the results of the questionnaires and interviews by using the Cresswell framework as the basis of comprehensive analysis, in order to provide clear answers to the Research Sub-Question One.

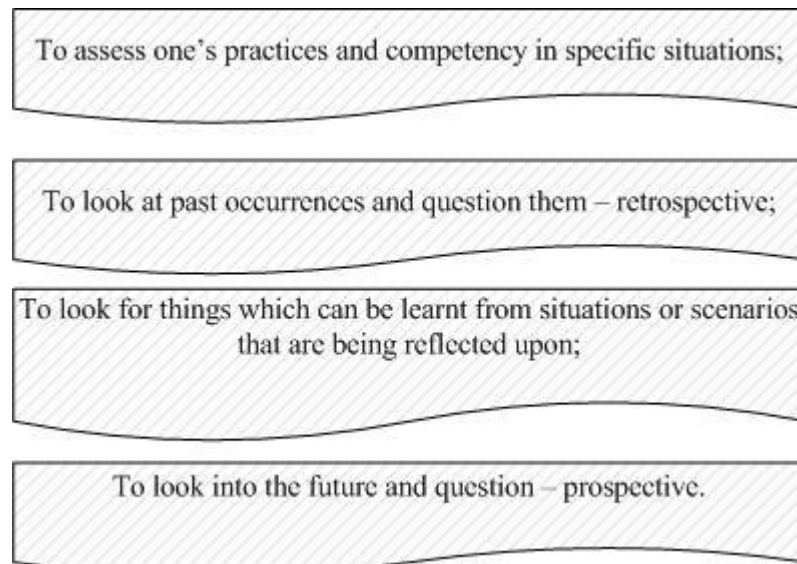
The sixth chapter presented the E-health framework formulated for the LNHS and provided recommendations and guidelines to aid in the implementation of E-health technologies, in order to provide clear answers to the Research Sub-Question Two.

7.3 Evaluation of the Thesis Research

Self-assessment is all about asking questions about our work, questioning if more work is needed and in what ways one can tell if it is not, and evaluating the validity of its content.

While writing up this research study, the researcher began posing questions to himself. In order to do this in a systematic fashion, the researcher decided to combine existing work on self-assessing, and available knowledge about student learning.

Kinne et al. (2014) explain that self-assessment occurs when reflecting on what has been described and analysed, and evaluating an assumption, belief, theory, action or a thought. Lenore et al. go on to say that reflecting entails thought processes such as:



The researcher conducted a review and compiled a set of principles for evaluating this research and taking an interpretivw view to develop a critical appreciation of the way in which information communication technology is involved with the delivery of healthcare services to the public. The remainder of this section, informed by an awareness of the importance of the above thought processes, reflects on the work presented in this thesis and evaluates it in terms of Pozzebon's (2004) fundamental principles, and in terms of an additional set of five evaluation questions compiled by the researcher.

The researcher has used Table 7.1 to present the research study evaluation in terms of the set of fundamental principles from Pozzebon (2004). The left column of the table is

a list of the main areas of operation, and the Criteria column is a list of the critical evaluation questions used to evaluate this research in accordance with Pozzzebbon (2004), and the left column presents answers of how these criteria is met by this research.

| Fundamental principles for the evaluation and carrying out of interpretive studies | Criteria | Examples from the research study | |
|---|---|--|---|
| The dialogical reasoning principle | Did the data's interpretation relate to the relevant literature? | Absolutely; the data analysis and results in Chapter 5 was carried out with the literature in Chapters 2 and 3 in mind. | √ |
| The subject and researcher interacting principle | Is there an indication of the role the researcher has played in the research while carrying out the research? | The part that the researcher has played is that of participating/observing. This can be seen when the researcher visited the healthcare institutions, observing their physical conditions and how healthcare staff interacted in the interviews. | √ |
| The suspicion principle Need to be sensitive to any bias or systematic distortion in information taken from those taking part in research. | Was data collected so that biases were avoided? | Absolutely; the data collection was carried out in a way to balance over regions (rural vs urban, but also north west, north east, south and central), and balance over professions. The data was collected from multiple sources and used multiple measures (interview, questionnaire and documents review) | √ |

| | | | |
|--|---|--|---|
| The abstraction and generalisation principle | Were the outcomes of the research study generalised to different contexts? | There were no generalisations; any details that the data uncovered were based on content specific information. | √ |
| The hermeneutic circle's basic principle | Is the data analysis taking into consideration independent meanings of different parts and the entirety of human understanding? | Scenarios in healthcare institutions were analysed using Creswell's (2007) within, cross and holistic-case templates for analysis. The application of this can be seen in Chapter 5 in the analysis of the data. | √ |
| The multiple interpretation principle | When the results were compiled were various ideologies and interpretations considered? | Absolutely; experts' opinions and various ideologies were considered in the healthcare institutions (doctors, ward attendant, administrators and nurses). | √ |
| The contextualisation principle | Is the research study providing a history of the situation so that the reader can appreciate how things currently stand? | In Sections (5.3.1.1, 5.3.2.1) the backgrounds of all the healthcare institutions are provided. | √ |

Table 7.1: Research study evaluation (Pozzebon, 2004; Myers, 2011).

The researcher additionally reviewed the thesis work by answering five specific evaluation questions. The corresponding five question and answer pairs are presented in the remainder of this section.

Did the methods employed provide satisfactory answers to the research questions?

This research employed qualitative and quantitative methods that used interpretive assumptions. The selection of a mixed-methods design for this research was made because the researcher was assessing and describing the E-health readiness levels of the LNHS healthcare institutions in both urban and rural areas, and what impacts the utilisation of ICT had in these healthcare institutions.

By assessing the E-health readiness levels, the researcher hoped to highlight any human or social issues that might be relevant. The choice of a mixed method was seen as the logical choice (Section 4.4). The use of a quantitative approach alone was deemed to be inappropriate, as it would be impossible for healthcare staff to express their perspective and feelings so accurately about the implementation of E-health technologies in the LNHS.

The researcher has provided examples of the advantages and disadvantages of utilising a mixed method approach (Section 4.4.1). This method was chosen as each method complemented the other, areas not covered by a quantitative approach were picked up using a qualitative approach and vice versa.

Using a mixed method approach has proven that satisfactory answers were provided to the Research Sub-Question One, this can be seen in the results achieved in Chapter Five (Section 5.3.1.7 and 5.3.2.7). The rural healthcare clinics are at Presence Level (Level Zero) on the E-health Maturity Model, and the urban healthcare medical centres are at Interaction Stage (also Level Zero) on the E-health Maturity Model.

In which ways did using case studies appear to be a more appropriate approach to the research and not another method?

The implementation of E-health technologies in developing countries is seen as a significant field of research in IT as the data about user feedback can affect how

sustainable newly installed E-health technologies are likely to be. The researcher employed a multi case study approach to make an assessment of various strata of the healthcare staff in the LNHS (Section 4.5). The researcher also explained his choice of a case study approach with more depth in Chapter Four.

Does the data that has been collected in the study convey the contextual complexity for supporting the findings of the research study?

This research studied the levels of E-health readiness and proposed a framework for healthcare institutions in rural and urban areas in Libya. The healthcare staff at the healthcare institutions were used as units for the analysis (Sections 4.5.2.3 and 4.5.3.3). The healthcare staff were asked questions in the interviews and given a questionnaire each to complete, and the researcher made observations over a period of six weeks at various healthcare institutions in Libya.

The selection of the participants was influenced by their profession's relevance to the answering of the research question and the location of their working places. A total of 40 individuals were interviewed in Arabic using semi-structured interview techniques, and a total of 80 individuals completed questionnaires. The researcher's opinion is that the healthcare staff in the research are representative of LNHS staff at large, and would not differ substantially from any others that are employed within the LNHS, therefore making the units appropriate for use in constructing an E-health framework that can be valid for the whole of the LNHS.

The case studies chosen for this research provide a good reflection of the population in Libya, as healthcare institutions were chosen in all the directions (North, South, East and West) from different regions in Libya where major population densities were to be found. Tables (e.g. Table 5.4 and Table 5.11) presented the participating healthcare institutions and their locations.

Can the findings from study be used to compile the Ehealth framework?

The findings of the research are outlaid in greater detail in Chapter Five. Chapter Six presented the E-health framework which was compiled on the basis of the literature

review and the fieldwork findings. In addition to this, the E-health framework was reviewed at various times while being compiled, every time something new comes up and when the experts' opinions received, until it was developed into the final finished product that could be utilised for assessing the LNHS for E-health implementation.

Is the research addressing the challenges experienced by the healthcare staff?

The findings of the research showed the feelings of the healthcare staff in the LNHS concerning the implementation of E-health technologies in the LNHS (Chapter 5), thus leading to the compilation of the E-health framework. The researcher has sent out copy of the research findings and the compiled E-health framework to the panel of the investigated healthcare institutions in order to receive their feedback.

The panel replied on a letter dated 19th of April 2016 (Appendix D), with positive feedback commenting that this would provide a major boost to the transformation of the LNHS into a more modern and efficient healthcare service provider. In their letter they a praised the results and outcomes of this research study and commented on the benefits of E-health systems.

7.4 Challenges Encountered and Limitations of the Study

The biggest challenge in carrying out this research study for the researcher was not just the long distances between the investigated healthcare institutions that were travelled to, in order to create as balanced a reflection as possible of opinions in the LNHS, but the state of warfare that existed in the country at the time between rival tribal factions.

The other limitation in this research study is that the framework has not been used in practice to see where it works and where it does not, so that it can be improved. This is because a lot of money would be required to test it, which is not currently available in Libya, though when the researcher presented the research findings to experts in Libya it was received positively.

Further factors affecting the effectiveness of the research were (i) the limits on staff time imposed by the LNHS, and (ii) the Libyan culture itself. Time presented a serious limitation to the researcher due to healthcare institutions allowing interviews to be for no longer than 25 minutes. This was because the LNHS authorities did not want the

medical staff time intruded upon, hence limiting interview time to that reserved for giving lectures, thus placing a limitation upon the quantity of variables that could be harvested.

Though this research has been as thorough as has been practically possible, the samples have been taken from just five rural and five urban healthcare institutions and so it is therefore a small reflection of attitudes and beliefs of healthcare staff in just a part of the LNHS.

It is hoped by the researcher that the healthcare staff that have been sampled in this research are indeed a pretty accurate reflection of the whole of the LNHS, but it would most likely be beneficial to undertake a more extensive survey with sample groups of more people before any concrete decision making is entered into regarding the implementation of E-health technologies in the LNHS.

7.5 Contribution to Knowledge

This research has contributed to the knowledge pool around the area of E-health readiness assessments in developing nations, and has examined the current beliefs and attitudes of healthcare staff in the LNHS. There has never been any research of this kind concerning E-health implementation carried out before in Libya. This is the first E-health readiness assessment for Libya, and the first proposed infrastructure network structure for the LNHS. It is the sincere hope of the researcher that this information will be utilised to positively guide policy decisions in the future of the LNHS, possibly affecting the lives of many of its patients in the future.

This research provides valuable contributions in the fields of E-health and healthcare delivery within the Libyan National Health Service, in particular offering a solution for balancing the inequalities in the healthcare services provided to rural and urban populations in Libya.

The gaps in knowledge which existed in this area of study and which this research aimed to address have been filled in the following ways:

- ▶ providing insights into the implementation of E-health systems in developing countries and proposing a new framework to aid future designs and development;

- ▶ creating a model that will show people the advantages that would be gained through the implementation of E-health technologies in Libya and other countries;
- ▶ exemplifying how much effect the incorporation of E-health systems into a country such as Libya can potentially have;
- ▶ helping in establishing baseline data about issues and factors that affect the implementation and development of E-health systems;
- ▶ acting as an extension of studies previously carried out;
- ▶ utilising the outcome of this study by healthcare professionals, information systems operators, and hospital managers can;
- ▶ providing gaudiness and assistance for those wishing to study or research health informatics, in future research on E-health systems.

7.6 Further Work

Though this research study has been rigorous and thorough in its investigations of the research questions, there are however other areas of this field that could be explored through research. The researcher only investigated the beliefs and opinions of a specific stratum of healthcare staff within the LNHS and there is therefore the potential to investigate employees both higher up and lower down in the hierarchy of the LNHS, the general public and healthcare staff working in the private healthcare sector. There is also potentially important information that could be collected in the economic and political spheres that could contribute valuable data for the formulation of E-health frameworks in the future.

This research will potentially be utilised for implementing E-health systems in the LNHS by promoting it to those making decisions regarding the future development of the LNHS in the Ministry of Health and the Libyan government. It will increase awareness of the various advantages of utilising E-health technologies and will hopefully contribute to the LNHS implementing E-health technologies at a future date. This research study needs not to limit its usefulness to Libya alone though as it could also prove useful to other developing nations that express a desire to implement E-health systems.

The E-health readiness assessment was produced using the recorded experiences of the researcher and the findings of the research. In case the researcher would have failed to observe or record relevant pieces of information that could have contributed to the construction of the E-health framework. It would then be logical to assume that the researcher could carry out further research in the future to improve the work that has already been carried out, if areas that had been missed were pinpointed.

The issue of how secure and private patients' healthcare data is in the LNHS was not covered in great detail in this thesis, and more research can be carried out in order to identify the best ways to protect this information, as it is a highly sensitive topic.

7.7 Chapter Summary

This chapter provides the research conclusions and presents the research evaluation process, limitations, contribution of knowledge, and further work needed.

The researcher motivation for carrying out this research study came from reading science journals and the experience he had while researching healthcare delivery in the rural areas of Libya.

The research is based around the primary research question which was then divided into two sub-research questions.

Primary research question:

How could an E-health framework that has been designed to enhance the delivery of healthcare services in Libya be composed?

Research Sub-Questions:

Q1. In what ways could E-health readiness assessment frameworks be used for identifying the strengths of healthcare institutions and where they need improvements?

Q2. In what ways can results provided by the EHRA be utilised for implementing E-health systems in LNHS?

As seen from the research primary and sub-questions this research concerns itself with the issues relating to the development of an E-health framework, and the use of E-health readiness assessment frameworks for the LNHS to implement E-health systems.

As measuring instruments the researcher used questionnaires, interviews, observation made during his visits to the investigated healthcare institutions, and the literature review to gain a deeper understanding of the problem and to answer the research primary question.

The research question was answered by combining the E-health readiness assessment and the literature review, as a final result an E-health framework for the LNHS is compiled.

The researcher reviewed and evaluated this research study by adopting Pozzebon (2004) and putting forward five relevant questions to evaluate it.

The main aim of this research study is to compile an E-health framework to assess the E-health readiness levels of the LNHS to implement E-health systems. This research surveyed the LNHS healthcare staff working in different regions of Libya in both rural and urban areas, and using their responses to assess how willing those future users were to embrace such changes.

The research faced few challenges while carrying out this research study such as the state of warfare and political unrest, time limitations imposed by the LNHS, cost, and travelling long distances between the investigated healthcare institutions.

This research study contributed to the knowledge pool around the area of E-health readiness assessments in developing nations such as Libya. It has examined the attitudes and beliefs of an important success factor for E-health systems implementation which is the LNHS healthcare staff. This research is counted as one of the first researches of its kind concerning E-health implementation carried out in Libya.

The researcher hopes that this research will help in guiding any future plans to implement E-health systems for the LNHS to improve the healthcare services provided, especially to rural population. The researcher also hopes that this research study has

helped in establishing baseline data about issues and factors that affect the implementation and development of E-health systems.

Furthermore, the researcher hopes that the outcome of this study get utilised by healthcare professionals, and providing guidance and assistance for those wishing to study or research health informatics, in future research on E-health systems.

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Appendix A

Consent agreement

Dear respondent,

Many thanks for your participation in this research. The objective of this research is the analysis of the many aspects of possible outcomes that might occur when developing medical information systems in countries that are developing and to suggest a framework of criteria to assist development and design within Libya. The plan to implement improved medical information systems will be investigated technologically, politically, socially, culturally and medically. The questionnaire constitutes a segment of the research that I am carrying out for my PhD at Brighton University.

The effort that you have contributed is very much appreciated. Please be aware that all participants shall receive complete anonymity and that all responses shall remain totally confidential and participants will not reveal any personal information at any time. If you would be so kind as to fill in the questionnaire that would be much appreciated. Should you feel like adding any extra comments, please feel free to write them down too. Should you need anything at all clarified, please spare no hesitation to send me an email at M.Ahwidy1@uni.brighton.ac.uk.

In my estimation it ought to take about 25-30 minutes to fill out the questionnaire. I really appreciate the effort you have put into filling out this questionnaire and your time contribution. It is really important that all the questions are answered or the questionnaire will not be used and all your efforts will have been in vain.

Yours sincerely,

Mansour Ahwidy

Researcher signature: _____ Participant signature: _____

Date: _____

Date: _____

QUESTIONNAIRE FOR HOSPITAL ADMINISTRATORS

About this questionnaire

All data collected from this questionnaire is guaranteed to be treated confidentially. Those completing this questionnaire do so totally voluntarily and will be appreciated immensely by the researcher.

Objective: This questionnaires aim is to:

- Establish a setting and background history of the medical institution.
- Assess electronic resources and infrastructure already in existence.

1. Please provide a brief description of the whereabouts of your medical institution in the spaces provided below.

| | |
|-----------------------------|--|
| Name of medical institution | |
| Postal Address | |
| Street | |
| State | |
| | |
| Telephone Number | |

2. How many people live within the area served by your medical institution?

| |
|--|
| |
|--|

3. What is the area covered by your medical institution in Km2?

| |
|--|
| |
|--|

4. What is the total number of doctors working in your medical institution? Of those how many are specialists and how many are general practitioners?

| Practitioners | Number |
|--------------------------|--------|
| General practitioners | |
| Specialist practitioners | |

5. Is it possible for you to use a phone at your medical institution? Indicate with an X please

Yes No

Should you answer with a No, what distance must you travel to be able to use a phone?

Please write how far you need to travel in the space below.

6. Does your medical institution provide any information communication technology applications in the categories listed below?

Please indicate those that apply to your medical institution with an X.

| | | | | | | | |
|----------------|--|-----------------|--|-------------|--|-----------------|--|
| Dermatology | | ECG Diagnostics | | Radiology | | Telemedicine | |
| E-diagnosis | | E-prescription | | E-referrals | | E-health record | |
| Histopathology | | E-consultation | | Others | | | |
| | | | | | | | |

7. Please indicate in the spaces below the quantities of network/hardware and other resources at your medical institution?

| Items | Number | Items | Number |
|--|--------|--|--------|
| Laptops | | computer with a connection to digitalised X-ray apparatus | |
| Desktops | | computer with a connection to a camera with a high resolution digital image that monitors a microscope | |
| Monitors | | consultation rooms (for general practitioners) | |
| Printers | | consultation rooms (for specialists) | |
| Document scanners | | beds in wards (general wards) | |
| Photocopiers | | beds in wards (ICU) | |
| Phones(ISDN) | | beds in wards (high care) | |
| Video conference system operated from a TV | | Others (specify) | |
| Video conference system operated from a computer | | | |
| camera with a connection to a computer | | | |
| webcam with a connection to a computer | | | |

8. In general what operating systems are used on your computers? For instance Linux, Windows XP, Vista, 98 etc. please be specific about which one.

| |
|--|
| |
|--|

9. Is there an internet connection at your medical institution?

Yes No

If yes, then what type of connection is it? Please mark the appropriate one with an X

| | | | | | |
|---------|--|------|--|----------------|--|
| ADSL | | SDSL | | SHDSL | |
| Dial UP | | ISDN | | Other(specify) | |
| | | | | | |

10. Please indicate the software used for operating each task indicated below.

| Item | Software/programme |
|-----------------|--------------------|
| E-Health Record | |
| E-Prescription | |
| E-Consultation | |
| E-Referrals | |
| E-Learning | |

11. Please write down in the space provided below the names of software used to train your staff for carrying out any of the tasks indicated above.

| |
|--|
| |
|--|

12. Are there any facilities for sending and receiving emails at your medical institution?

Yes No

13. Could you please list below any information technology equipment that is not working in your medical institution and please tell us for how long it has been inoperable.

| | |
|--|--|
| | |
| | |
| | |
| | |
| | |
| | |

14. Please list below any information technology equipment that could be needed in your medical institution and if possible provide a reason why it is needed.

| Item | Why |
|------|-----|
| | |
| | |
| | |
| | |

| | |
|--|--|
| | |
|--|--|

SERVICES PROVIDED BY THE CENTRE

15. At your medical institution, how many outpatients are treated on average per day?

| Day of Week | Sat | Sun | Mon | Tues | Wed | Thurs | Fri |
|-------------|-----|-----|-----|------|-----|-------|-----|
| Minimum | | | | | | | |
| Maximum | | | | | | | |

16. Please write down below the average number of patients per ward in your medical institution and feel free to leave any other comments you feel are relevant.

| Wards | Number | Any other comments |
|--------------|--------|--------------------|
| General ward | | |
| Special ward | | |

17. Please write down below the average number of cases that come to your medical institution per week.

| Number referred per week | Typical complaints/cases |
|--------------------------|--------------------------|
| | |
| | |
| | |

| | |
|--|--|
| | |
| | |
| | |

18. Is your medical institution sometimes unable to treat patients in the way a medical professional deems appropriate? Please write in the boxes below any instances where the treatment was not possible because of:

18.1 Medical equipment/facilities.

| |
|--|
| |
|--|

18.2 Medical personal/specialists.

| |
|--|
| |
|--|

19. Please indicate with an X the frequency with which the following services are utilised.

| Resources/Items | Very Often | Often | Seldom | Never |
|--|-------------------|--------------|---------------|--------------|
| Phone calls to specialists for advice | | | | |
| Phone calls to other colleagues for advice | | | | |

| | | | | |
|---|--|--|--|--|
| | | | | |
| Referral to other hospitals/ clinics for specialist treatment | | | | |

LINKAGES to other centres

20.1 Please indicate with a cross the frequency with which you communicate with other medical institutions.

| Weekly | Monthly | Quarterly | Half- yearly | Yearly |
|-----------------|---------|-----------|--------------|--------|
| | | | | |
| Other (specify) | | | | |

20.2 Please put a cross below in the sections that indicate the types of communication used when contacting other medical institutions by your organisation.

| Letters (print) | E-letters(e-mail) | Meetings | Phone calls | Workshops |
|-----------------|-------------------|----------|-------------|-----------|
| | | | | |
| Other (specify) | | | | |

20.3. When communicating with other medical institutions, what are the topics most commonly discussed?

| |
|--|
| |
|--|

21. Of all the problems experienced in your medical institution, which ones do you believe to be the most common?

22. What types of information communication technology is needed in your medical institution? For instance: software or hardware, advice on usage or staff training.

23. How do you see the information communication technology developing in your medical institution? Please write any ideas you might have in the box below.

T HE END

THANK YOU FOR YOUR PARTICIPATION

QUESTIONNAIRE FOR DOCTORS, NURSES AND WARD ATTENDANTS

About this questionnaire

Any information received will be treated with the utmost confidentiality. The questionnaire is answered on completely voluntary basis and we appreciate very much your donated time and effort.

Purpose: The aim of this questionnaire is to work out:

- What the process and procedure is likely to be for baseline data in the use of EPR's, e-prescriptions, e-referrals and e-consultations.
- The statistics for the post-training activities carried out in the medical institution.

1.1. Please indicate using an X what your job is in your medical institution.

Doctor Nurse Ward Attendant Other

1.2 Please indicate using an X whether or not your department is conducted as a multidisciplinary clinical team?

Yes No

1.3 Please indicate using an X whether or not health records of your patients need to be shared with other healthcare professionals?

Yes No

2. Patient health record.

2.1 Please write in the box provided below, the way in which patient health records are currently created in your medical institution.

2.2 Please write in the box provided below, the system presently used in your medical institution for the maintenance of patient health records.

2.3 please indicate using an X in either of the boxes below, whether or not it is the responsibility of each individual doctor to personally look after the maintenance individual's medical records or is that the responsibility of a central authority?

Maintain each patient's record Centralised

2.4 Please write in the box below the ways in which records are kept, for instance are they written by hand, by use of a word processor or Dictaphone or Tran-scripted etc.

State the means of recording. (E.g. handwritten, Dictaphone, transcription, word processor, etc)

2.5 Please indicate using an X whose job it is to record the patient records.

Doctors Nurses Ward attendants Other (specify)

2.6. Please write below the way in which patient records or normally collected, for instance by use of a form or with minimum fields etc.

2.7. Please indicate in the box below how much time would typically be used daily for maintaining the health records of patients.

3.1 Please indicate in the box below where the usual place is for storing patient healthcare files.

3.2 Please indicate below the normal procedures for storing and retrieving patient healthcare files, for instance: how it is stored – in secure cupboards or filing-cabinets etc.

3.3 Please indicate below the pattern of arrangement for your patient health records; for instance are they stored in an alphabetical or chronological sequence or depending upon security or how many copies there are etc.

3.4 Please indicate below what staffs possess the authority to see patient records without permission; for instance doctors and nurses etc.

3.5 Please indicate below the typical time required to retrieve the records of a patient.

4. Please indicate using an X whether or not you think that the system currently used for recording patient health records is providing a good service accurately and thoroughly and then indicate in the box provided why you gave this answer. Yes No

5. Please answer with an X, whether you think that the quality and format in which patient health records are recorded is good enough for healthcare workers to share it effectively and then write down in the box below the reasons for your answer. Yes
No

6. In your opinion, does the way in which patient health records are currently stored give good value for money and do the best job possible in delivering healthcare services in allowing:

6.1 The retrieval of patient health records in the minimum/optimal amount of time?

Yes No

Please indicate why you answered yes or no

6.2 Minimising the time needed for diagnosing and treating ailments?

Yes No

Please indicate why you answered yes or no

6.3 Patient health records to be as confidential as possible?

Yes No

Please indicate you answered yes or no.

7. What are the principle ways in which the present system is limited:

7.1 The creation of patient health records?

7.2 The maintenance of patient health records?

7.3 The storage of patient health records?

7.4 The retrieval of patient health records?

Determination of e-consultation and e-prescription

8. What is the present procedure for consulting between patient and doctor?

Face-to-face Through electronic means

8.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable)

E-mail (computer) E-mail (cell phone) Telephone SMS

Other Specify

9. What system is currently used for consultations between healthcare professionals?

9.1 Within the medical institution?

Face-to-face Through electronic means

9.1.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable)

E-mail (computer) E-mail (cell phone) Intranet SMS

Telephone Other Specify

9.2 With other medical institutions?

Face-to-face E-video consultation Through electronic means

9.2.1 If that procedure is electronic means, please indicate which modalities are most frequently employed (indicate as many as applicable)

E-mail (computer) E-mail (cell phone) Internet SMS

Telephone Other Specify

10. Are there Ehealth facilities within your medical institution?

Yes No

If yes, describe in what ways it is utilised.

11. How are patients referred to the pharmacy to collect their prescriptions? For instance are they given a piece of paper or is it transferred electronically. Please write in box provided below

12. What do you see as the pluses and minuses about the way in which patients are currently referred to the pharmacy to collect their prescription in your medical institution?

| | |
|----------------------|--|
| Advantages | |
| Disadvantages | |

Determination of training opportunities

13. How frequently do you access a personal computer? Indicate with an X the appropriate answer please.

Daily Weekly Monthly Never

13.1 What tasks do you perform on your computer? Please be specific.

14. In what ways does the availability or unavailability of computers or the internet effect your work? Please specify below.

15. What is the total amount of time you spend on your computer each day? Please specify in hours below.

16. How would you rate your ability to use a computer? Indicate with an X please.

Novice Average Experienced

Have you ever been trained to use an Ehealth record system or had any experience operating one? Yes No

If you have, then what type of experience or training was it?

17. In your opinion, do you believe that you could operate an Ehealth record system without any further training?

Yes No

If you indicated yes, then which system are you referring to?

18. Is there anything that you would like to add, such as a recommendation or to comment upon something that has occurred to you?

Please, write down your thoughts below.

THE END

Many thanks for participating

Appendix B

INTERVIEW QUESTIONS FOR ADMINISTRATORS, DOCTORS, NURSES AND WARD ATTENDANTS

About this interview

All data collected from this questionnaire is guaranteed to be treated confidentially. Those completing this questionnaire do so totally voluntarily and will be appreciated immensely by the researcher.

Objectives: Determining how accepted and possibly how useful certain systems might be to medical institutions, for example: patient healthcare records, E-consultations, E-prescriptions and E-referrals.

1. How would you expect your medical institution to benefit from the installation of the following Ehealth applications?

| |
|--|
| E-patient health record systems <ul style="list-style-type: none">➤ Time for recording patient information➤ Time for retrieving patient information➤ Diagnosis and treatment time➤ Confidentiality of patient information |
| E-consultation systems |
| E-prescription systems |
| E-referral systems |
| E- training systems |

2. How do you think any of the applications above would improve efficiency in your medical institution? Please be specific about the system and your expectations.

3. Do you feel that the implementation of any of the systems you detailed above would create any problems? Be specific about the system and problem.

4. Is there any technology in your medical institution at this time that might support such an E-health application? Please be specific.

5. Would it be to your liking to be trained in the use of computers so that your job performance might be enhanced?
6. How do you feel about accessing E-health applications outside of your job? Is this something you would like to do and why?
7. Is there something else you would like to add or something you feel needs recommending or commenting upon?

THE END

Thank you all for your time, participation and valuable contribution.

Appendix C: Approval Letters

التاريخ: /
الموافق: /
الإشاري:

وزارة الصحة
مستشفى إمعيتيقة

معاً من أجل بناء ليبيا

Ref : Mr. Mansour Ahwidy .

Dear Dr . Lyn Pemberton .

Thank you for your letter dated **28.sep.2012** regarding offering Mr. ahwidy to the form at information and other cooperation in order to help him .

Leading his research into aspect of developing and health in restructure in Libya .

We are happy to say that we offered him permission to do so .

Wishing him all the success

Dr. Mohammed Wanis
Head of Medical Affairs
Muairega Hospital

ليبيا حرة

ماشتا ليبيا حرة

التاريخ 2018/2/20

الموافق: / /

الرقم الأشاري: 558



وزارة الصحة

مركز سبها الطبي

CERTIFICATION

To Whom It May Concern

Administration of Sebha Medical Center, Sebha, Libya, states that Mr. Mansour Ahwidy is applying for a certain study according to the Letter attached from the University of Brighton, United kingdom.

So, we have no any objection for supplying him information needed For his study.

This certificate is being issued upon the request of the above named Person for all legal intent and purpose it may serve him best.

Dr. Nasser Khalifa
Chief, Medical Services Office
Sebha Medical Center, Sebha, Libya



021.608832 ☎ 071.2624429 - 2621816 - 17 * 2620306 }



المجلس الوطني الانتقالي - ليبيا
وزارة الصحة
مستشفى بن سينا التعليمي سرت



November 18, 2012
الرقم الإشاري

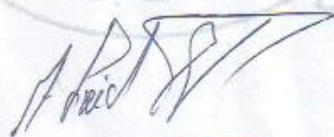
CERTIFICATION

To Whom It May Concern:

Administration of IBN SINA Teaching Hospital, Sirte, Libya, states that **Mr. Mansour Ahwidy** is applying for a certain study according to the letter attached from the University of Brighton, United Kingdom.

So, we have no any objection for supplying him with information needed for his study.

This certificate is being issued upon the request of the above named person for all legal intent and purpose it may serve him best.


Dr. Ali Younis
Chief, Medical Services Office
IBN SINA Teaching Hospital
Sirte, Libya



هاتف : 66499 / 65459 _ فاكس : 62505 الهدالة : 62500 / 62504 / 054

Appendix D: Feedback Letter

**حكومة الأنقاذ الوطني**
وزارة الصحة
مركز علاج العقم سبها 

التاريخ: 19/09/2016 2016
لاشاري: 465/2016 م

السيد / منصور أهويدي خميس أهويدي
السلام عليكم....

بعد اطلاعتنا على مشروعك البحثي بعنوان (نظم السجلات الالكترونية) من قبل المركز،

عليه... نعد الصحة الالكترونية إحدى أقطاب الإدارة الالكترونية المعاصرة ومن أفضل الإنجازات
المحورية التي تعتمد عليها عملية تقديم الرعاية الصحية داخل المستشفيات وبين مختلف أنواع
المنظمات الطبية، ومع النمو الهائل في كمية و نوعية المعلومات الطبية و تنوع مصدرها يعتبر
هذا المشروع من الطرق المساعدة في تطوير النظام الإلكتروني و الحد من الأخطاء المسببة في
نقل النظام

بدا على الصلاحيات الممنوحة لهذه اللجنة العلمية و استلذاً إلى القوانين تم منحكم الترتيب من
قبل مركزنا.

شاكرين حسن تعاونكم معنا
و السلام عليكم و رحمة الله و بركاته


أعضاء اللجنة العلمية بالمركز

العنوان : مقابل مستوصف العنشية
00 218 71 263 0422

Brief Translation of the Approval Letter:

Date: 19/04/2016.

Ref: 460/2016.

Dear Mr Mansour Ahwidy Khamis AHWIDY

After reviewing your recent research project titled (The Development and Implementation of E-health Services for the Libyan NHS: Case Studies of Hospitals and Clinics in both Urban and Rural Areas) by the Scientific Research Panel.

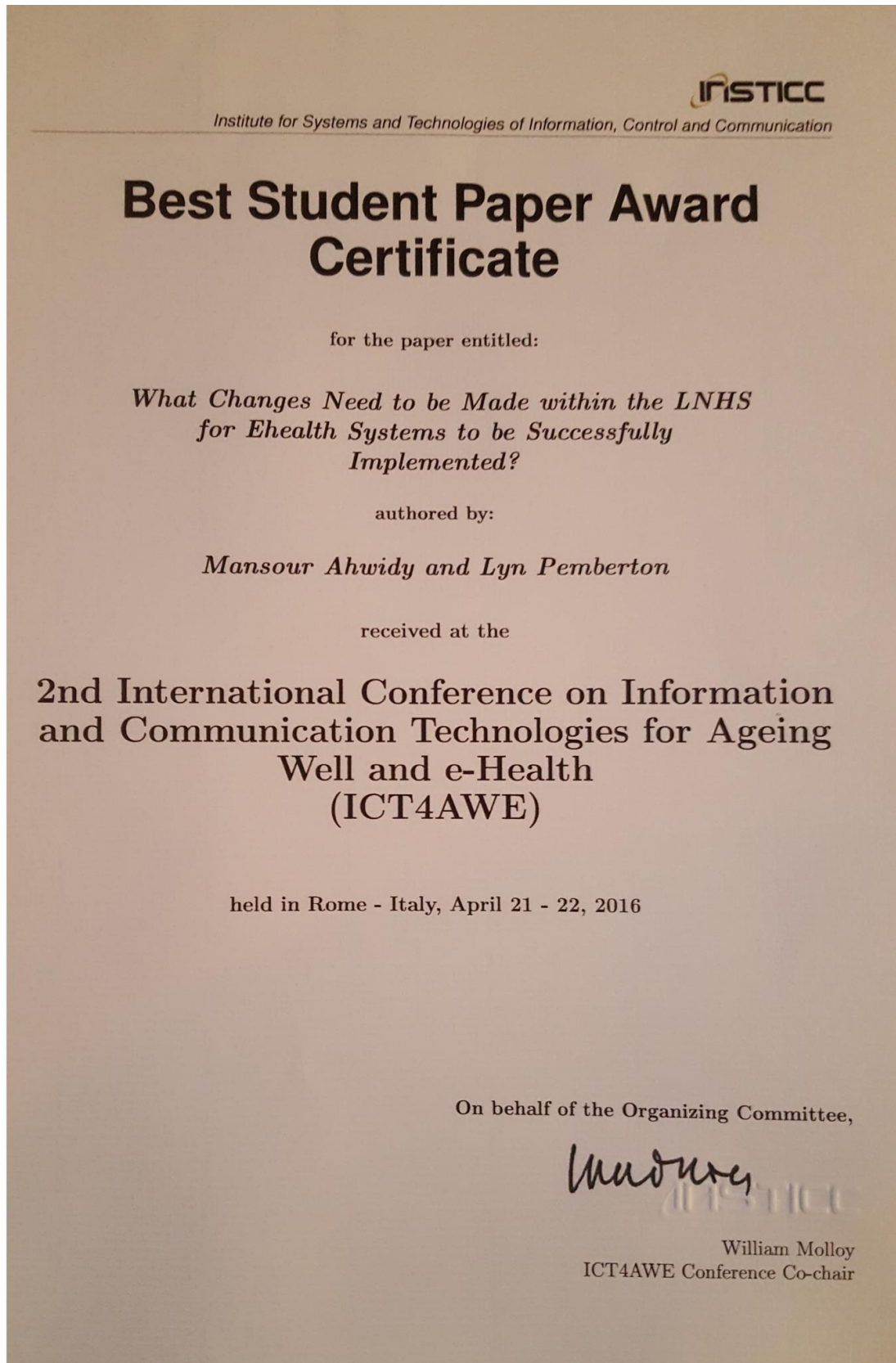
The E-health Services are considered to be of high importance in the time of E-governments, and considered to be as an important factor in delivering high standards of healthcare services within healthcare institutions and other healthcare organisations.

With the increase in healthcare demand and the enormous increase in healthcare information produced from different sources, this research project is considered to be as a way to help implementing E-health Services within the Libyan NHS.

In accordance with the authorithise given to this Scientific Research Panel your research project has been approved.

Signed and stamped by members of the Scientific Research Panel.

Appendix E: Best Student Paper Award Certificate



Official Certificate

Mansour Ahwidy

of

Brighton University, United Kingdom

attended the

ICT4AWE 2016

2nd International Conference on Information
and Communication Technologies for Ageing
Well and e-Health

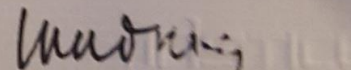
held in Rome - Italy, April 21 - 22, 2016

and presented a paper entitled:

*What Changes Need to be Made within the LNHS
for Ehealth Systems to be Successfully
Implemented?*

as a conference speaker.

On behalf of the Organizing Committee,



William Molloy
ICT4AWE Conference Co-chair

Official Certificate

Mansour Ahwidy

of

Brighton University, United Kingdom

attended the

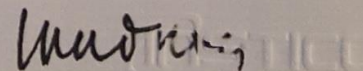
ICT4AWE 2016

**2nd International Conference on Information
and Communication Technologies for Ageing
Well and e-Health**

held in Rome - Italy, April 21 - 22, 2016

and has Chaired a Session

On behalf of the Organizing Committee,



William Molloy
ICT4AWE Conference Co-chair

Appendix F: Important Documents for Future Users of my Proposals.

| | | | | | |
|------|------|------|------|--|----|
| 70 | 804 | 874 | 2007 | مستشفى الفاتح لطب وجراحة الأطفال / بنغازي | 75 |
| 51 | 371 | 422 | 2007 | الأمراض النفسية / بنغازي | 76 |
| 69 | 585 | 654 | 2007 | مستشفى / بنغازي | 77 |
| 120 | 305 | 425 | 2007 | مركز خدمات الكلى / بنغازي | 78 |
| 36 | 302 | 338 | 2007 | مستشفى النهر الصناعي للعيون / بنغازي | 79 |
| 122 | 1118 | 1240 | 2007 | مستشفى الجلاء / بنغازي | 80 |
| 67 | 410 | 477 | 2007 | مركز الهوارى للمسلك | 81 |
| 145 | 1059 | 1204 | 2007 | مستشفى / بنغازي | 82 |
| 97 | 596 | 693 | 2007 | مستشفى بن سينا / سرت | 83 |
| 185 | 592 | 777 | 2007 | مستشفى الخمس التطيمي | 84 |
| 85 | 434 | 519 | 2007 | مستشفى مسلاته | 85 |
| 223 | 947 | 1170 | 2007 | مستشفى - سيها | 86 |
| 85 | 508 | 593 | 2007 | مستشفى اوبارى العام | 87 |
| 97 | 444 | 541 | 2007 | مستشفى مرزق العام | 88 |
| 101 | 33 | 134 | 2007 | الهيئة الليبية للإغاثة | 89 |
| 1180 | 768 | 1948 | 2007 | المركز الوطني للوقاية من الأمراض السارية والمتوطنة ومكافحتها | 90 |
| 28 | 132 | 160 | 2007 | مركز خدمات الأسنان /طرابلس | 91 |
| 13 | 98 | 111 | 2007 | مركز بنغازي للأشعة التشخيصية والعلاجية | 92 |
| 302 | 0 | 302 | 2007 | مركز زراعة الأعضاء | 93 |
| | | | -- | الإجمالي | |

| | | | | | |
|------|------|------|------|--|----|
| 33 | 134 | 167 | 2008 | مستشفى بن جواد القروي | 35 |
| 98 | 412 | 510 | 2008 | مستشفى بني وليد العام | 36 |
| 8 | 92 | 100 | 2008 | مستشفى الداوون القروي | 37 |
| 49 | 78 | 127 | 2008 | مستشفى سلوق القروي | 38 |
| 40 | 175 | 215 | 2008 | مستشفى أبي ستة لأمراض وجراحة الصدر | 39 |
| 49 | 119 | 168 | 2008 | مستشفى تازربو القروي | 40 |
| 102 | 637 | 739 | 2008 | مستشفى زيتن التعليمي | 41 |
| 69 | 219 | 288 | 2008 | مستشفى السكر والغدد الصماء/طرابلس | 42 |
| 44 | 261 | 305 | 2008 | مستشفى غدامس العام | 43 |
| 17 | 140 | 157 | 2008 | مستشفى كبابو القروي | 44 |
| 167 | 1257 | 1424 | 2008 | مستشفى الثورة المركزي التعليمي | 45 |
| 5660 | 0 | 5660 | 2008 | مركز بنغازي الطبي | 46 |
| 19 | 92 | 111 | 2008 | مجلس التخصصات الطبية | 47 |
| 84 | 369 | 453 | 2007 | مستشفى صرمان | 48 |
| 103 | 564 | 667 | 2007 | مستشفى الزهراء العام | 49 |
| 232 | 364 | 596 | 2007 | مستشفى زواره العام | 50 |
| 38 | 497 | 535 | 2007 | مستشفى الجميل العام | 51 |
| 379 | 494 | 873 | 2007 | مستشفى غريان التعليمي | 52 |
| 157 | 272 | 429 | 2007 | مستشفى مزده - العام | 53 |
| 110 | 346 | 456 | 2007 | مستشفى يفرن - العام | 54 |
| 194 | 280 | 474 | 2007 | مستشفى نالوت - المركزي | 55 |
| 57 | 533 | 590 | 2007 | مستشفى الجلاء للأطفال | 56 |
| 774 | 347 | 1121 | 2007 | مستشفى الجلاء للولادة | 57 |
| 160 | 1954 | 2114 | 2007 | مستشفى طرابلس المركزي | 58 |
| 62 | 615 | 677 | 2007 | مستشفى الرازي للأمراض النفسية | 59 |
| 99 | 1065 | 1164 | 2007 | مستشفى الحوادث أبي سليم | 60 |
| 260 | 790 | 1050 | 2007 | مستشفى الخضراء | 61 |
| 426 | 4039 | 4465 | 2007 | مركز طرابلس الطبي | 62 |
| 93 | 639 | 732 | 2007 | مستشفى علي عمر عسكر | 63 |
| 122 | 502 | 624 | 2007 | المعهد الأفريقي لعلاج الأورام / صيراته | 64 |
| 43 | 58 | 101 | 2007 | مركز مرضى الصرع/ طرابلس | 65 |
| 87 | 53 | 140 | 2007 | مستشفى السكر / مصراته | 66 |
| 165 | 99 | 264 | 2007 | مركز جراحة القلب / بنغازي | 67 |
| 182 | 127 | 309 | 2007 | مركز خدمات الكلى / طرابلس | 68 |
| 74 | 72 | 146 | 2007 | المركز الوطني لعلاج العظم / طرابلس | 69 |
| 90 | 720 | 810 | 2007 | مستشفى صيراته التعليمي | 70 |
| 425 | 613 | 1038 | 2007 | مستشفى الوحدة / درنة | 72 |
| 352 | 560 | 912 | 2007 | مستشفى أحمد المقرئف / اجدابيا | 73 |
| 119 | 242 | 361 | 2007 | مستشفى جالو العام | 74 |

كشف بالقوى العاملة وفق الملاكات المعتمدة بالمستشفيات والمراكز التخصصية

| ت | أسم المرفق | سنة الاعتماد | الوظائف الكلية | الوظائف المشغولة | الوظائف الشاغرة |
|----|---|--------------|----------------|------------------|-----------------|
| 1 | الهيئة العامة للبيئة | 2010 | 554 | 487 | 67 |
| 2 | مستشفى الهوارى العام | 2010 | 1975 | 292 | 1683 |
| 3 | مركز المعطومات والتوثيق | 2009 | 31 | 28 | 3 |
| 4 | مركز البطنان الطبي | 2009 | 1259 | 1130 | 129 |
| 5 | مستشفى العيون / طرابلس | 2009 | 506 | 455 | 51 |
| 6 | مستشفى / المرج | 2009 | 935 | 695 | 240 |
| 7 | مستشفى ترهونة العام | 2009 | 472 | 343 | 129 |
| 8 | مستشفى امعتيقة | 2009 | 390 | 295 | 95 |
| 9 | مستشفى مصراته للدرن والأمراض الصدرية | 2009 | 140 | 111 | 29 |
| 10 | المعهد القومي لعلاج الأورام مصراته | 2009 | 186 | 141 | 45 |
| 11 | مستشفى الحروق والتجميل/طرابلس | 2009 | 417 | 361 | 56 |
| 12 | مستشفى جادو القروي | 2009 | 80 | 69 | 11 |
| 13 | مستشفى نيجي القروي | 2009 | 205 | 178 | 27 |
| 14 | مستشفى الأصابعمة القروي | 2009 | 288 | 232 | 56 |
| 15 | مستشفى الجفوب العام | 2009 | 271 | 240 | 31 |
| 16 | مستشفى العجيلات العام | 2009 | 466 | 425 | 41 |
| 17 | المركز الوطني لتشخيص وعلاج العقم/بنغازي | 2009 | 70 | 42 | 28 |
| 18 | المختبر الطبي المرجعي / طرابلس | 2009 | 178 | 112 | 66 |
| 19 | مستشفى القلب تاجوراء التخصصي | 2009 | 1144 | 1024 | 120 |
| 20 | مستشفى بنغازي للأمراض الصدرية | 2008 | 398 | 352 | 46 |
| 21 | مستشفى بدر الأسطى ميلاد | 2008 | 170 | 162 | 8 |
| 22 | مستشفى ققم القروي | 2008 | 182 | 150 | 32 |
| 23 | المجلس الوطني لتحديد المسؤولية الطبية | 2008 | 13 | 5 | 8 |
| 24 | مستشفى الحراية القروي | 2008 | 174 | 134 | 40 |
| 25 | مستشفى سوق الخميس القروي | 2008 | 91 | 71 | 20 |
| 26 | مستشفى الشهيد عطية الكاسح | 2008 | 329 | 264 | 65 |
| 27 | مستشفى براك العام | 2008 | 454 | 418 | 36 |
| 28 | مركز الأمراض السارية والمناخية / بنغازي | 2008 | 184 | 141 | 43 |
| 29 | مستشفى قمينس القروي | 2008 | 168 | 128 | 40 |
| 30 | مستشفى شحات للدرن والأمراض الصدرية | 2008 | 204 | 157 | 47 |
| 31 | مستشفى غات | 2008 | 388 | 331 | 57 |
| 32 | مستشفى مصراته المركزي | 2008 | 1149 | 881 | 268 |
| 33 | مستشفى الزاوية التطبيقي | 2008 | 1198 | 1071 | 127 |
| 34 | مستشفى عافية الجفرة/ هون | 2008 | 372 | 289 | 83 |

القوى العاملة بقطاع الصحة والبيئة بالمناطق

| رقم | المناطق | المستشفيات القروية | المعيادات | المراكز | الوحدات | المناخات | الإمداد الطبي | الإسماء |
|-----|---|-----------------------|-----------|---------|---------|----------|------------------|---------|
| 1 | المرافق الصحية بمنطقة البطنان | 156 | 132 | 801 | 747 | 51 | 39 | 15 |
| 2 | المرافق الصحية بمنطقة درنة | 462 | 299 | 1876 | 250 | -- | 63 | 37 |
| 3 | المرافق الصحية بمنطقة الجبل الأخضر | 326 | 441 | 773 | 793 | -- | 41 | 45 |
| 4 | المرافق الصحية بمنطقة المرج | 272 | -- | 1472 | 510 | -- | 28 | 13 |
| 5 | المرافق الصحية بمنطقة بنغازي | --- | 1098 | 1274 | 570 | 30 | 103 | 80 |
| 6 | المرافق الصحية بمنطقة الواحات | 116 | 143 | 1096 | 433 | -- | 35 | 15 |
| 7 | المرافق الصحية بمنطقة الكفرة (اعتماد الملاك 2009) | --- | -- | 366 | 61 | 32 | 13 | 13 |
| 8 | المرافق الصحية بمنطقة سرت | --- | 214 | 496 | 483 | -- | 31 | 45 |
| 9 | المرافق الصحية بمنطقة الجفرة | 96 | -- | 233 | 132 | -- | 11 | 10 |
| 10 | المرافق الصحية بمنطقة مرزق | 134 | 111 | 683 | 559 | 10 | 4 | 9 |
| 11 | المرافق الصحية بمنطقة سبها | 43 | 130 | 392 | 258 | 8 | 23 | 23 |
| 12 | المرافق الصحية بمنطقة غات | --- | -- | 316 | 102 | -- | -- | -- |
| 13 | المرافق الصحية بمنطقة وادي الحياة | --- | -- | 561 | 509 | -- | 7 | 7 |
| 14 | المرافق الصحية بمنطقة وادي الشاطي | 329 | -- | 1074 | 612 | -- | 13 | 14 |
| 15 | المرافق الصحية بمنطقة مصراته | 229 | 503 | 1526 | 461 | 40 | 40 | 80 |
| 16 | المرافق الصحية بمنطقة المرقب | 180 | 212 | 1796 | 1053 | 11 | 33 | 75 |
| 17 | المرافق الصحية بمنطقة طرابلس | --- | 1538 | 2346 | 715 | 9 | 122 | 200 |
| 18 | المرافق الصحية بمنطقة الجفاره | --- | -- | 1929 | 1514 | 26 | 35 | 49 |
| 19 | المرافق الصحية بمنطقة الزاوية (اعتماد الملاك 2009) | --- | 353 | 361 | 1150 | -- | 32 | 42 |
| 20 | المرافق الصحية بمنطقة النقاط الخمس | --- | 223 | 1798 | 704 | 42 | 35 | 15 |
| 21 | المرافق الصحية بمنطقة الجبل الغربي | 332 | 139 | 1169 | 1354 | -- | 36 | 30 |
| 22 | المرافق الصحية بمنطقة نلوت | --- | -- | 746 | 393 | 35 | 39 | 15 |
| | المجموع | 2675 | 5541 | 23059 | 13347 | 294 | 798 | 836 |

الإجمالي :- 46550

جدول يبين عدد المستشفيات بليبيا وعدد الأسرة

| عدد الاسره | المجموع | القروية | عامة | مركزية | تخصوية | م |
|------------|---------|---------|------|--------|--------|------------|
| 20689 | 97 | 32 | 21 | 18 | 26 | المستشفيات |

نسبة الاسرة لكل 10,000 مواطن = 38 سرير

جدول يبين عدد مرافق الرعاية الصحية الأولية

| وحدات الرعاية الصحية | | | | عيادات الاسنان المركزية | المراكز الصحية | العيادات المجمعة | فروع المركز الوطني لمكافحة الامراض |
|----------------------|-----|----|----------------|-------------------------------|-------------------|---------------------|---|
| ج | ب | ا | الحجر الصحي | | | | |
| 143 | 591 | 86 | 17 | 15 | 535 | 37 | 27 |
| 1424 | | | | | | | |

نسبة مرافق الرعاية الصحية الأساسية لكل
10,000 مواطن = 2.6 مرفق

المؤشرات الخاصة بالموارد البشرية

| المؤشر | العدد أو النسبة |
|-------------------------------------|-----------------|
| نسبة الأطباء لكل 10,000 مواطن | 20 |
| نسبة أطباء الأسنان لكل 10,000 مواطن | 6 |
| نسبة الصيادلة لكل 10,000 مواطن | 6 |
| نسبة الممرضات لكل 10,000 مواطن | 71 |

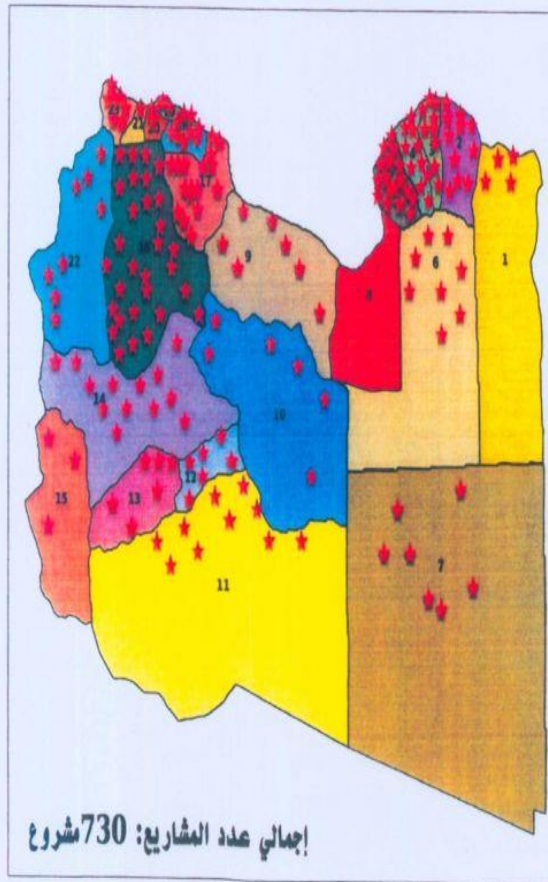
ملخص الوضع الحالي

عدد العناصر الطبية والطبية المساعدة والإدارية بالمرافق الصحية (الوطنية و غير الوطنية) - 2010

| التخصص | أطباء | أطباء أسنان | صيادلة | تمريض وقابلات | فنيين صحيين | إدارية وخدمية | المجموع |
|-----------------------------------|--------------|---------------|-------------|---------------|--------------|---------------|-----------------|
| عدد العناصر العاملة بالمستشفيات | 8280 | 124 | 503 | 16878 | 6398 | 14725 | 46908 |
| عدد العناصر العاملة بالمناطق | 3043 | 3052 | 598 | 24048 | 10242 | 19646 | 60629 |
| المجموع | 11323 | 3176 * | 1101 | 40926 | 16640 | 34371 | 107,537 |
| مجموع العاملين بقطاع الصحة | | | | | | | 129706** |

مشروعات تصنيع النسيج والخبز

تأهبة وتطور المراكز الإدارية



| عدد المشروعات | الشعبيات | الترتيب |
|---------------|----------------|---------|
| 9 | البطنان | 1 |
| 14 | حبة | 2 |
| 13 | الجبل الأخضر | 3 |
| 13 | البرج | 4 |
| 56 | بنغازي | 5 |
| 7 | الوادات | 6 |
| 9 | الكفرة | 7 |
| 6 | إجدابيا | 8 |
| 9 | سرت | 9 |
| 7 | الجفرة | 10 |
| 11 | ازرق | 11 |
| 7 | سيما | 12 |
| 7 | وادي الحياة | 13 |
| 18 | وادي الشاطئ | 14 |
| 3 | غات | 15 |
| 36 | الجبل الغربي | 16 |
| 64 | وهرانة | 17 |
| 37 | البرقب | 18 |
| 33 | طرابلس | 19 |
| 32 | الجفارة | 20 |
| 34 | الزاوية | 21 |
| 8 | نالت | 22 |
| 24 | القطا الخمس | 23 |
| 6 | مختلف الشعبيات | |

المستشفيات العاملة بليبيا حسب تصنيفها

| عدد الأسرة | المستشفيات القروية | عدد الأسرة | المستشفيات التخصصية | عدد الأسرة | المستشفيات العامة والمركزية | عدد الأسرة | المستشفيات التعليمية الكاربية | عدد الأسرة | المستشفيات التعليمية الكاربية |
|------------|--------------------|------------|----------------------------------|------------|-----------------------------|------------|-------------------------------|------------|--------------------------------|
| 60 | سوق الخميس | 1 | 100 | 1 | 435 | 1 | 317 | 1 | العيون طرابلس |
| 60 | تيجي | 2 | 400 | 2 | 120 | 2 | 282 | 2 | المركز القلب بتاجوراء |
| 60 | كبابو | 3 | 120 | 3 | 136 | 3 | 236 | 3 | مستشفى الحروق والتجميل - ط |
| 60 | الحراية | 4 | 120 | 4 | 120 | 4 | 200 | 4 | الجلاء للأطفال طرابلس |
| 60 | العينية | 5 | 170 | 5 | 120 | 5 | 480 | 5 | الجلاء للإولادة طرابلس |
| 60 | الزنتان | 6 | 150 | 6 | 201 | 6 | 219 | 6 | ابي سنة للأمراض الصدرية |
| 60 | جادو | 7 | 160 | 7 | 136 | 7 | 100 | 7 | السكر والغدد الصماء - طرابلس |
| 60 | الجويوب | 8 | 40 | 8 | 120 | 8 | 201 | 8 | مركز الكلى الزهراء |
| 60 | الثبة | 9 | 60 | 9 | 282 | 9 | 480 | 9 | ابي سليم للحواشي والعظام |
| 60 | التميمي | 10 | 100 | 10 | 136 | 10 | 480 | 10 | الجلاء للحواشي بنغازي |
| 60 | سوسة | 11 | 450 | 11 | 150 | 11 | 350 | 11 | طب وجراحة الاطفال |
| 60 | بن جواد | 12 | 1870 | المجموع | | 120 | 515 | 12 | الجمهورية للإولادةبنغازي |
| 60 | القره بولي | 13 | | | 120 | 13 | 120 | 13 | المعهد القومي للأورام - صبراتة |
| 60 | تاورغاه | 14 | | | 120 | 14 | 120 | 14 | النهر الصناعي للعيون بنغازي |
| 60 | برقن | 15 | | | 120 | 15 | 462 | 15 | الثورة بالبيضاء |
| 60 | قبينس | 16 | | | 236 | 16 | 223 | 16 | ابن سيناءبسررت |
| 60 | المقورية- توكره | 17 | | | 60 | 17 | 480 | 17 | مصراتة - المركزي |
| 60 | الايبار | 18 | | | 120 | 18 | 480 | 18 | مركز سبها الطبي |
| 60 | الداوون | 19 | | | 500 | 19 | 480 | 19 | عزيان |
| 60 | سلوق | 20 | | | 500 | 20 | 201 | 20 | طى عمر صكر/اسبيجة |
| 60 | البردي | 21 | | | 201 | 21 | 600 | 21 | الخنزاه طرابلس |
| 60 | الأسابعه | 22 | | | 282 | 22 | 480 | 22 | الزاوية |
| 60 | البريقة | 23 | | | 512 | 23 | 201 | 23 | صبراتة |
| 60 | ادري | 24 | | | 4847 | المجموع | | 480 | زايفن |
| 60 | ودان | 25 | | | | | 925 | | طرابلس المركزي |
| 60 | صو المختار | 26 | | | | | 200 | | 7 أكتوبر - بنغازي |
| 60 | الشويرف | 27 | | | | | 1438 | | مركز طرابلس الطبي |
| 60 | جريس الأحرار | 28 | | | | | 400 | | مركز بنغازي الطبي |
| 60 | تازريو | 29 | | | | | 420 | | مركز البننان الطبي |
| 60 | تراغن | 30 | | | | | 282 | | الخنس |
| 60 | القربات | 31 | | | | | 200 | | طب الغشاء والأصق- امعتوية |
| 60 | سمنو | 32 | | | | | | | |
| 60 | ام الرزم | 33 | | | | | | | |
| 60 | قصر خيار | 34 | | | | | 12052 | | المجموع |
| 60 | امساعد | 35 | | | | | | | |
| 100 | المجموع | | المجموع الكلي لعدد الأسرة 20,869 | | | | | | |

المستشفيات العاملة بإبييا حسب تصنيفها

| م.ر | المستشفيات التعليمية التدريبية | عدد الأسرة | م.ر | المستشفيات العامة والمركزية | عدد الأسرة | م.ر | المستشفيات التخصصية | عدد الأسرة | م.ر | المستشفيات القروية | عدد الأسر |
|------------|-----------------------------------|---------------|-----|--------------------------------|---------------|-----|------------------------------------|---------------|-----|-----------------------|---------------|
| 1 | المعرون طرابلس | 317 | 1 | المرج | 435 | 1 | مركز الكلى بنغازي | 100 | 1 | سوق الخميس | 60 |
| 2 | المركز القلب بتاجوراء | 282 | 2 | عطية التمشح/ الكفرة | 120 | 2 | الرازي للأمراض النفسية | 400 | 2 | تيجي | 60 |
| 3 | مستشفى الحروق والتجميل - ط | 236 | 3 | العاقية - بون | 136 | 3 | بنز الاسطى ميلاد للجدام | 120 | 3 | كابار | 60 |
| 4 | الجلاء للأطفال طرابلس | 200 | 4 | أوباري | 120 | 4 | الامراض الصدرية - مصراتة | 120 | 4 | الحراية | 60 |
| 5 | الجلاء للولادة طرابلس | 480 | 5 | بني وايد | 120 | 5 | الامراض الصدرية - شحات | 170 | 5 | العوينة | 60 |
| 6 | ابى سة للأمراض الصدرية | 219 | 6 | ترهونة | 201 | 6 | الامراض الصدرية الكوفية | 150 | 6 | الزنتان | 60 |
| 7 | السكر والغدد الصماء - طرابلس | 100 | 7 | صرمان | 136 | 7 | مركز الهوارى لراحة المسالك | 160 | 7 | جادو | 60 |
| 8 | مركز الكلى الزهراء | 201 | 8 | المعجلات | 120 | 8 | مركز الأمراض المنارية بنغازي | 40 | 8 | الجويوب | 60 |
| 9 | ابى سليم للحواث والعظام | 480 | 9 | زوارا | 282 | 9 | مركز القلب - بنغازي | 60 | 9 | القية | 60 |
| 10 | الجلاء للحواث بنغازي | 480 | 10 | غدامس | 136 | 10 | مركز علاج الأورام - مصراتة | 100 | 10 | التميمي | 60 |
| 11 | طب وجراحة الاطفال | 350 | 11 | يقرن | 150 | 11 | مستشفى الأمراض النفسية - بنغازي | 450 | 11 | سوسة | 60 |
| 12 | الجمهورية للولادةبنغازي | 515 | 12 | برك الشلبي | 120 | 12 | المجموع | 1870 | 12 | بن جواد | 60 |
| 13 | المعهد القومي للأورام - مصراتة | 120 | 13 | مرزق | 120 | 13 | | | 13 | القره بولى | 60 |
| 14 | النهر الصناعي للمعون كينغازي | 120 | 14 | الجميل | 120 | 14 | | | 14 | تاورغاه | 60 |
| 15 | الثورة بالبيضاء | 462 | 15 | مزدة | 120 | 15 | | | 15 | برقن | 60 |
| 16 | ابن ميناها/سرت | 223 | 16 | نالت | 236 | 16 | | | 16 | قنينس | 60 |
| 17 | مصراتة - المركزي | 480 | 17 | جالو | 60 | 17 | | | 17 | المعقورية- توكره | 60 |
| 18 | مركز سبها الطنبي | 480 | 18 | غات | 120 | 18 | | | 18 | الايابر | 60 |
| 19 | غريان | 480 | 19 | صلاح الدين - طرابلس | 500 | 19 | | | 19 | الداوون | 60 |
| 20 | علي عمر عسكري/سبيجة | 201 | 20 | الهوارى العام / بنغازي | 500 | 20 | | | 20 | سلوق | 60 |
| 21 | الخصراء طرابلس | 600 | 21 | مسلاطة | 201 | 21 | | | 21 | البردي | 60 |
| 22 | الزاوية | 480 | 22 | إبمحمد المقريف - إجدابيا | 282 | 22 | | | 22 | الأصابعه | 60 |
| 23 | مصراتة | 201 | 23 | الوحدة - درنة | 512 | 23 | | | 23 | البريقة | 60 |
| 24 | زاين | 480 | 24 | المجموع | 4847 | 24 | | | 24 | ادري | 60 |
| 25 | طرابلس المركزي | 925 | 25 | | | 25 | | | 25 | ودان | 60 |
| 26 | 7 أكتوبر - بنغازي | 200 | 26 | | | 26 | | | 26 | عمر المختار | 60 |
| 27 | مركز طرابلس الطبي | 1438 | 27 | | | 27 | | | 27 | الشويرف | 60 |
| 28 | مركز بنغازي الطبي | 400 | 28 | | | 28 | | | 28 | جردس الأحرار | 60 |
| 29 | مركز البنطنان الطبي | 420 | 29 | | | 29 | | | 29 | تازربو | 60 |
| 30 | الخمس | 282 | 30 | | | 30 | | | 30 | تراغن | 60 |
| 31 | طب الفضاء والأعماق- امعتيقة | 200 | 31 | | | 31 | | | 31 | القريات | 60 |
| 60 | | | 32 | | | 32 | | | 32 | سمنو | 60 |
| 60 | | | 33 | | | 33 | | | 33 | أم الرزم | 60 |
| 60 | | | 34 | | | 34 | | | 34 | قصر خيار | 60 |
| 60 | | | 35 | | | 35 | | | 35 | أمساعد | 60 |
| 100 | المجموع | | | | | | | | | المجموع | 20,869 |

• الشركة العامة لصناعة الأدوية والمستلزمات الطبية

أنشئت الشركة بقرار اللجنة المنطقه العامة رقم (26) لسنة (2003 م) الصادر بتاريخ 13/25/2003 ميلادية ، تحت إسم الشركة العامة لصناعة الأدوية والمستلزمات الطبية ويتبعها مصنع الماية للأدوية ومصنع الرابطة للمواد الأولية ، ومصنع الرابطة للتشكيلات الصيدلانية ،

• المجلس الطبي المختص بتحديد المسؤولية الطبية

أنشئ المجلس الطبي المختص بتحديد المسؤولية الطبية تنفيذا للقانون رقم { 17 } لسنة 1986 م ، بشأن المسؤولية الطبية ، بموجب قرار اللجنة الشعبية العامة (سابقاً رقم (182) لسنة 1989 م بإنشاء مجلس طبي ويختص المجلس بالنظر في القضايا المتعلقة بالأخطاء المهنية الطبية التي تحال إليه من الهيئات القضائية المختصة وغيرها من الجهات المخولة بذلك.

• مجلس التخصصات الطبية.

أنشئ مجلس التخصصات الطبية بالقرار (131) لسنة 1995 ميلادية لتوفير احتياجات المجتمع من الأطباء المتخصصين في فروع الطب بواسطة التدريب أثناء العمل ، ويجري التدريب في (11) تخصص مختلف من التخصصات الطبية .

• المركز الوطني لمكافحة الأمراض

أنشئ المركز بموجب قرار اللجنة المنطقية العامة رقم (78) لسنة 2002 م القاضي بدمج عدد من المراكز ،وهي مركز مراقبة الدرن والأمراض الصدرية ومركز مكافحة الأمراض السارية والمتوطنة والمركز الوطني للبحوث الطبية واللجنة الوطنية لمكافحة الإيدز في مركز واحد تحت إسم المركز الوطني للوقاية من الأمراض السارية والمتوطنة ومكافحتها . وقد تم تطوير المركز إلى شكله الجديد بإصدار قرار اللجنة الشعبية العامة (سابقاً) رقم ((281)) لسنة 2010 ميلادي بشأن إضافة إختصاصات للمركز وإعادة تسميته حيث أصبح المسمى الجديد ((المركز الوطني لمكافحة الأمراض وصبحت إختصاصاته شاملة لمكافحة الأمراض السارية والمتوطنة ومكافحة الأمراض غير السارية وبرامج الحماية الصحية).

• معهد تنمية القوى العاملة

ثم إنشائه بموجب قرار اللجنة الشعبية العامة(سابقاً) رقم (5) لسنة 1994 و يعتبر معهد تنمية القوى العاملة الطبية أحد أهم المؤسسات التدريبية التابعة للوزارة ، حيث يتولى مهام تدريب وتأهيل العناصر الطبية والطبية المساعدة والفنية والإدارية العاملة بمختلف المرافق العاملة بمختلف المرافق الصحية للقطاع .

• مركز المعلومات و التوثيق

انشئ المركز بتاريخ 28 / 3 / 2006 م ، وبإشراف المركز عمله بتاريخ 1 / 5 / 2006 م وقد تم تنظيم المركز بموجب قرار اللجنة الشعبية العامة (سابقاً) رقم (485) لسنة 2007 ميلادية ، ويختص بتجميع البيانات والإحصائيات الخاصة بالقطاع وإستخراج المعلومات والمؤشرات الصحية للدولة .

كشف بالجهات التابعة

• جهاز الإمداد الطبي

أنشئ جهاز الإمداد الطبي بموجب قرار اللجنة المنطقية العامة رقم (121) 2009 م، لتولي توفير الأدوية والمستلزمات والمعدات الطبية للمرافق الصحية العامة وبما يضمن تدفق مستمر لبنود الإمداد الطبي.

و يتولى الجهاز توفير إحتياجات قطاع الصحة والبيئة من الأدوية والمعدات الطبية والمستلزمات الطبية وبيان أصنافها وكمياتها وحركة تداولها والعمل على توفير رصيد دائم منها

• جهاز خدمات الإسعاف

أنشئ جهاز الإسعاف بموجب قرار اللجنة الشعبية العامة (سابقاً) رقم (398) لسنة 2009 م كأحد الأجهزة التي يشرف عليها القطاع حيث اخص الجهاز بمهام تقديم وتطوير خدمات الإسعاف البري والجوي والبحري و يبلغ عدد مكاتب الإسعاف بالمناطق (23) مكتب تشرف على تقديم خدمات الإسعاف حسب نطاق إختصاصها الجغرافي .

جدول يبين المستشفيات بليبيا حسب كل منطقة .

| ت | اسم المنطقة | المستشفيات | عدد الاسرة |
|----------|--------------|-----------------------------|------------|
| 1 | البتنان | مركز البطان الطبي | 420 |
| | | مستشفى البردي | 60 |
| | | مستشفى الجقيوب | 60 |
| | | مستشفى أمساعد | 60 |
| الإجمالي | | 600 سرير | |
| 2 | الجبل الأخضر | مستشفى الثورة | 462 |
| | | مستشفى سوسة | 60 |
| | | مستشفى شحات للمصدر | 170 |
| | | مستشفى عمر المختار | 60 |
| الإجمالي | | 752 سرير | |
| 3 | درنة | مستشفى الوحدة | 512 |
| | | مستشفى القبة | 60 |
| | | مستشفى التميمي | 60 |
| | | مستشفى أم الرزم | 60 |
| الإجمالي | | 692 سرير | |
| 4 | المرج | مستشفى المرج | 435 |
| | | مستشفى الأبيار | 60 |
| | | مستشفى العقورية - توكرة | 60 |
| | | مستشفى جردس الأحرار | 60 |
| الإجمالي | | 615 سرير | |
| 5 | اجدابيا | مستشفى الشهيد امحمد المقرنف | 282 |
| | | مستشفى البريقة | 60 |
| الإجمالي | | 342 سرير | |
| 6 | الواحات | مستشفى جالو | 60 |
| الإجمالي | | 60 سرير | |
| 7 | الكفرة | مستشفى الكفرة | 120 |
| | | مستشفى تازربو | 60 |
| الإجمالي | | 180 سرير | |
| 8 | سرت | مستشفى بن سينا | 223 |
| | | مستشفى بن جواد | 60 |
| الإجمالي | | 283 سرير | |
| 9 | الجفرة | مستشفى العافية | 136 |
| | | مستشفى الودان | 60 |
| الإجمالي | | 196 سرير | |

تحليل الوظائف المعتمدة لدواوين المناطق بقطاع الصحة

| م | اسم الجهة | تاريخ الاعتماد | الوظائف المعتمدة | المشغولة | الشاغرة |
|----------------------|--------------------------|----------------|------------------|-------------|-------------|
| 1 | ديوان الوزارة | 2008 | 419 | 288 | 131 |
| 2 | ديوان منطقة البطنان | 2007 | 214 | 157 | 57 |
| 3 | ديوان منطقة درنة | 2007 | 214 | 200 | 14 |
| 4 | ديوان منطقة الجبل الأخضر | 2007 | 214 | 136 | 78 |
| 5 | ديوان منطقة المرج | 2007 | 194 | 140 | 54 |
| 6 | ديوان منطقة بنغازي | 2007 | 279 | 217 | 62 |
| 7 | ديوان منطقة الكفرة | 2007 | 161 | 132 | 29 |
| 8 | ديوان منطقة سرت | 2007 | 188 | 114 | 74 |
| 9 | ديوان منطقة الجفرة | 2007 | 147 | 83 | 64 |
| 10 | ديوان منطقة مرزق | 2007 | 161 | 104 | 57 |
| 11 | ديوان منطقة سبها | 2007 | 214 | 133 | 81 |
| 12 | ديوان منطقة وادي الشاطئ | 2007 | 161 | 94 | 67 |
| 13 | ديوان منطقة مصراته | 2007 | 214 | 129 | 85 |
| 14 | ديوان منطقة المرقب | 2007 | 214 | 136 | 78 |
| 15 | ديوان منطقة طرابلس | 2007 | 279 | 191 | 88 |
| 16 | ديوان منطقة الجفارة | 2007 | 214 | 155 | 59 |
| 17 | ديوان منطقة الزاوية | 2007 | 214 | 155 | 59 |
| 18 | ديوان منطقة النقاط الخمس | 2007 | 196 | 131 | 65 |
| 19 | ديوان منطقة الجبل الغربي | 2007 | 214 | 149 | 65 |
| 20 | ديوان منطقة نالوت | 2007 | 214 | 160 | 54 |
| 21 | ديوان منطقة غات | 2007 | 161 | 62 | 99 |
| 22 | ديوان منطقة الواحات | 2007 | 214 | 182 | 32 |
| 23 | ديوان منطقة وادي الحياة | 2007 | 161 | 148 | 13 |
| المجموع الكلي | | | 4861 | 3396 | 1465 |

كشف بالملاكات المعتمدة للمستشفيات والمراكز التخصصية لسنة 2012

| ت | اسم المرفق | سنة الاعتماد | رقم القرار | الوظائف الكلية | الوظائف المشغولة | الوظائف الشاغرة |
|----|-------------------------------------|--------------|------------|----------------|------------------|-----------------|
| 1 | مستشفى سوق الخميس القروي | 2012 | 60 | 285 | 96 | 189 |
| 2 | مستشفى الداوون القروي | 2012 | 130 | 280 | 92 | 188 |
| 3 | مستشفى الحراية القروي | 2012 | 131 | 215 | 122 | 93 |
| 4 | مستشفى السابع من أكتوبر | 2012 | 129 | 1015 | 750 | 265 |
| 5 | مستشفى البريقة القروي | 2012 | 128 | 445 | 173 | 272 |
| 6 | المختبر الطبي المرجعي | 2012 | 122 | 240 | 134 | 106 |
| 7 | مستشفى أبي سنة للأمراض الصدرية | 2012 | 123 | 330 | 183 | 147 |
| 8 | المركز المتخصص لعلاج السكر / مصراته | 2012 | 124 | 220 | 114 | 106 |
| 9 | مستشفى علي عمر عسكر/اسبغحه | 2012 | 127 | 1780 | 1295 | 485 |
| | وحدة علاج الصرع | 2012 | 126 | 110 | 67 | 43 |
| 10 | مجلس التخصصات الطبية | 2012 | 139 | 120 | 99 | 21 |
| 11 | مستشفى صرمان العام | 2012 | 146 | 770 | 354 | 416 |

كشفة بيين المراكز الوظيفية للمرافق الصحية

المحالة لوزارة العمل للإعانة

| ت | الجهة | العدد الفعلي للوظائف | | |
|-----|---|----------------------|------------|-------------|
| | | مشغولة | شاغرة | الإجمالي |
| 1. | مستشفى ترهونة | 396 | 355 | 751 |
| 2. | مستشفى توكة القروي | 128 | 165 | 293 |
| 3. | مستشفى تازربو القروي | 172 | 70 | 242 |
| 4. | مستشفى عمر المختار القروي | 193 | 73 | 266 |
| 5. | مستشفى مصراثة للدرن | 284 | 240 | 524 |
| 6. | مركز تشخيص وعلاج العقم | 36 | 63 | 99 |
| 7. | مستشفى القبة القروي | 226 | 33 | 259 |
| 8. | مستشفى سوسة القروي | 188 | 133 | 321 |
| 9. | مستشفى مزدة | 262 | 271 | 533 |
| 10. | مستشفى برفن | 240 | 108 | 348 |
| 11. | مستشفى غدامس | 252 | 316 | 568 |
| 12. | مركز البطان الطبي | 2029 | 168 | 2197 |
| 13. | مستشفى الكوفية للصدرية | 403 | 110 | 513 |
| 14. | مستشفى الجلاء للولادة وامراض النساء | 955 | 383 | 1338 |
| 15. | مستشفى بن جواد القروي | 164 | 130 | 294 |
| 16. | مستشفى براك العام | 545 | 102 | 647 |
| 17. | البرنامج الوطني لزراعة القرنية | 5 | 7 | 12 |
| 18. | مستشفى الثورة البيضاء | 1495 | 368 | 1863 |
| 19. | مستشفى شحات لعلاج الدرن | 191 | 236 | 427 |
| 20. | مستشفى زيتن التعليمي | 708 | 1221 | 1929 |
| 21. | مستشفى الهواري العام | 856 | 1343 | 2199 |
| 22. | مستشفى الشهيد عطية الكاسح الكفرة | 274 | 209 | 483 |
| 23. | مستشفى توجي القروي | 232 | 196 | 428 |
| 24. | مستشفى النفسية بنغازي | 481 | 469 | 950 |
| 25. | مستشفى إدري القروي | 325 | 120 | 445 |
| 26. | مستشفى مسلاتة المركزي | 446 | 460 | 906 |
| 27. | مستشفى التميمي القروي | 164 | 136 | 300 |
| 28. | قطاع الصحة باطن الجبل الغربي ديوان المنطقة | 377 11 | 891 203 | 1268 214 |
| 29. | مستشفى الخمس التعليمي | 718 | 1053 | 1771 |
| 30. | مركز خدمات الأسنان - طرابلس | 183 | 162 | 345 |
| 31. | مستشفى سلوق القروي | 138 | 248 | 386 |
| 32. | الصحة المرج | 7758 | 3059 | 4699 |
| 33. | مستشفى الأبيار | 203 | 257 | 460 |
| 34. | مستشفى الكلى | 463 | 191 | 654 |

اعداد / قسم التنظيم الإداري والمراكز

| ت | اسم المنطقة | المستشفيات | عدد الأسرة |
|------------------------|---------------|-------------------------------|------------|
| 19 | النقاط الخمس | مستشفى زوارة (مغلق للصيانة) | 282 |
| | | مستشفى العجيلات | 120 |
| | | مستشفى الجميل | 120 |
| | | مستشفى صبراتة | 201 |
| | | معهد الأورام صبراتة | 120 |
| الإجمالي | | 843 سرير | |
| 20 | الجبيل الغربي | مستشفى غريان | 480 |
| | | مستشفى يفرن | 150 |
| | | مستشفى مزدة | 120 |
| | | مستشفى الاصابهه | 60 |
| | | مستشفى العوينة | 60 |
| | | مستشفى الزنتان | 60 |
| | | مستشفى جادو | 60 |
| | | مستشفى القريرات | 60 |
| | | مستشفى الشويرف | 60 |
| الإجمالي | | 1110 سرير | |
| 21 | طرابلس | العيون | 317 |
| | | الحروق | 236 |
| | | الجلاء للأطفال | 200 |
| | | الجلاء للولادة | 480 |
| | | ابي سة للأمراض الصدرية | 219 |
| | | السكر والغدد الصماء | 100 |
| | | الحوادث ابي سليم | 480 |
| | | م. الخضراء | 600 |
| | | صلاح الدين (مغلق) | 500 |
| | | طرابلس المركزي | 925 |
| | | مستشفى معتيقة | 200 |
| | | مستشفى الرازي للأمراض النفسية | 400 |
| | | مستشفى بئر الأسطي ميلاد | 120 |
| | | مركز طرابلس الطبي | 1438 |
| مستشفى تاجوراء التخصصي | 282 | | |
| الإجمالي | | 6497 سرير | |

| ت | اسم المنطقة | المستشفيات | عدد الأسرة |
|----|-------------|--------------------------|------------|
| 10 | وادي الشاطئ | مستشفى برك | 120 |
| | | مستشفى برقن | 60 |
| | | مستشفى أنرى | 60 |
| | الإجمالي | 240 سرير | |
| 11 | سبها | مركز سبها الطبي | 480 |
| | | مستشفى سمنو | 60 |
| | الإجمالي | 540 سرير | |
| 12 | وادي الحياة | مستشفى اويارى | 120 |
| | | الإجمالي | 120 سرير |
| 13 | مرزق | مستشفى مرزق | 120 |
| | | مستشفى تراغن | 60 |
| | | الإجمالي | 180 سرير |
| 14 | غات | مستشفى غات | 120 |
| | | الإجمالي | 120 سرير |
| 15 | مصراتة | مستشفى مصراتة | 480 |
| | | الأمراض الصدرية | 120 |
| | | مستشفى زيتن | 480 |
| | | مستشفى بني وليد | 120 |
| | | مركز علاج الأورام مصراتة | 100 |
| | | مستشفى تاورغاء | 60 |
| | | الإجمالي | 1360 سرير |
| 16 | المعرب | مستشفى الخمس | 282 |
| | | مستشفى ترهونة | 201 |
| | | مستشفى مسلاته | 201 |
| | | مستشفى الداوون | 60 |
| | | مستشفى القره بولى | 60 |
| | | مستشفى سوق الخميس | 60 |
| | | مستشفى قصر خيار | 60 |
| | | الإجمالي | 924 سرير |
| 17 | الجفارة | مستشفى الزهراء | 201 |
| | | مستشفى على عمر عسكر | 201 |
| | الإجمالي | 402 سرير | |
| 18 | الزاوية | مستشفى الزاوية | 480 |
| | | مستشفى صرمان | 136 |
| | الإجمالي | 616 سرير | |

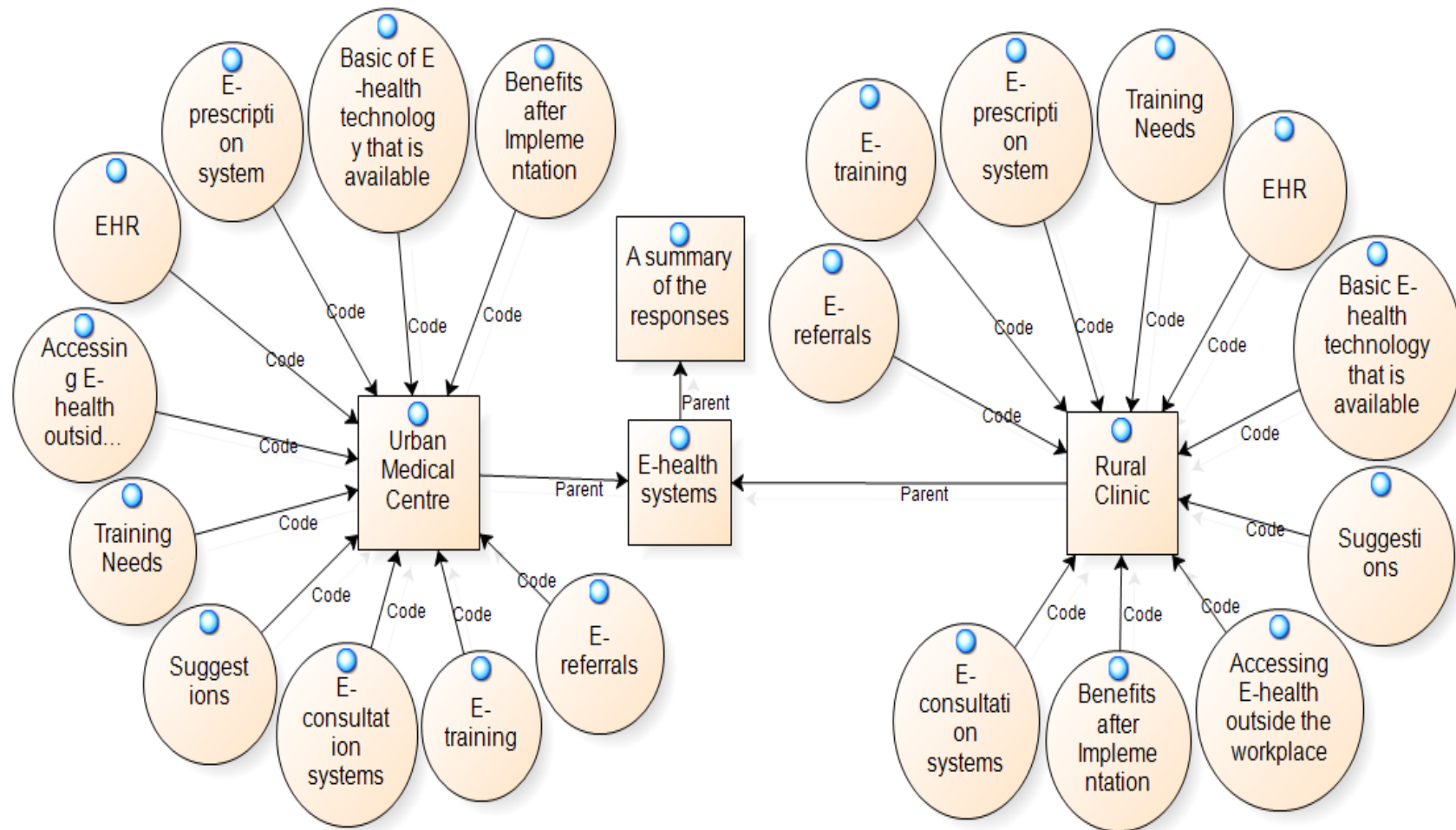
Appendix G: Responses of Interviews Coding

- Example: Reading through the transcript carefully while making notes.

استخدام وحدة المعلومات والاتصالات بالنقل الإلكتروني، استراتيجيات
وتقنيات المشاركة الفعالة أصبح أمرا لا بد منه في مستشفيات
الليبية بما فيها من تطبيقات طبية وصحية ويمكن مفهوم
الصحة الإلكترونية هي خدمة المريض بالدرجة الأولى وتسهيل العمل
العمل بين الطاقم الطبي في مختلف الأقسام وهذا من لرعاية المرضى
ودعمهم .
وعليه فإن الفوائد المرجوة لتطبيق خدمات الصحة الإلكترونية في
مستشفيات ليبيا كثيرة بصورة مباشرة أو غير مباشرة :-
ومنها فوائد كمية وهي الفوائد المحسوسة والمحسوبة لسجلات
الطبية للصحة الإلكترونية المبنية على البراهين
وفوائد الكيفية والتي لا يمكن حسابها بشكل مباشر مثل رفع كفاءة و
جودة الخدمات الصحية والتقليل من الأخطاء الطبية وسرعة الاستجابة
وسرعة الحصول على المعلومات والمشاركة في الوصول والاستفادة من
المعلومات كإتاحة خدمات المنشورات والمعلومات الطبية والخدمات
المركزة على المعرفه
الفوائد الاستراتيجية بما فيها جمع المعلومات والمعطيات والاستفادة
منها لرصد الوبائيات ونظم المعلومات الجغرافية وتعدد الاحتياجات
للمدى البعيد .

- السجلات الطبية يمكن ان تقدم خدمة التطبيق بعد بعد
حيث تغير دور المريض ، فلم يعد يتلقى الخدمة الطبية
بشكل سلبي واصبح يتفاعل معها ويعاود ان يكون
له دور مع الطبيب في اقرار العلاج الافضل
في خدمات الاستشارة الطبية الإلكترونية التي تمكن

- **A summary of the Responses Model**

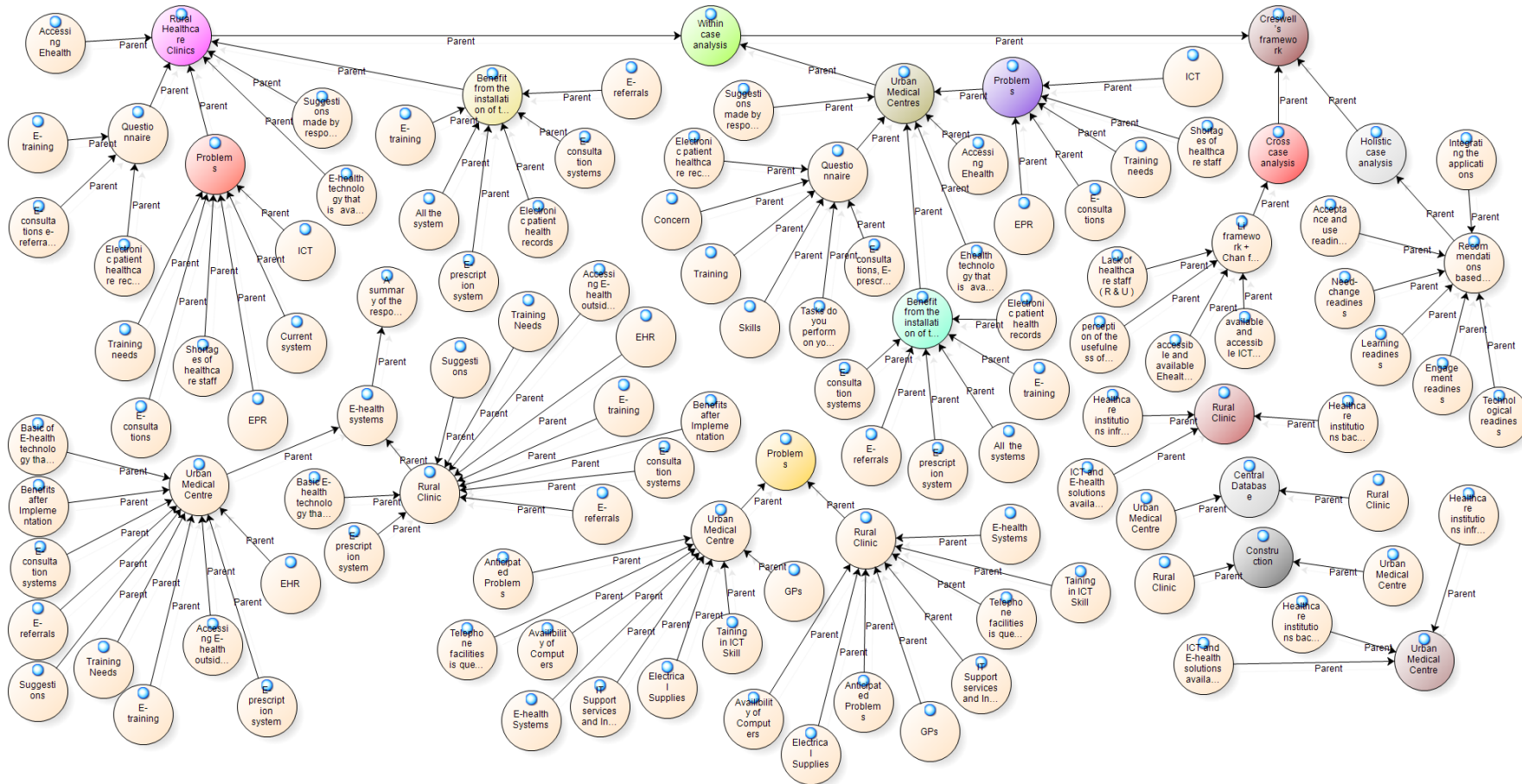


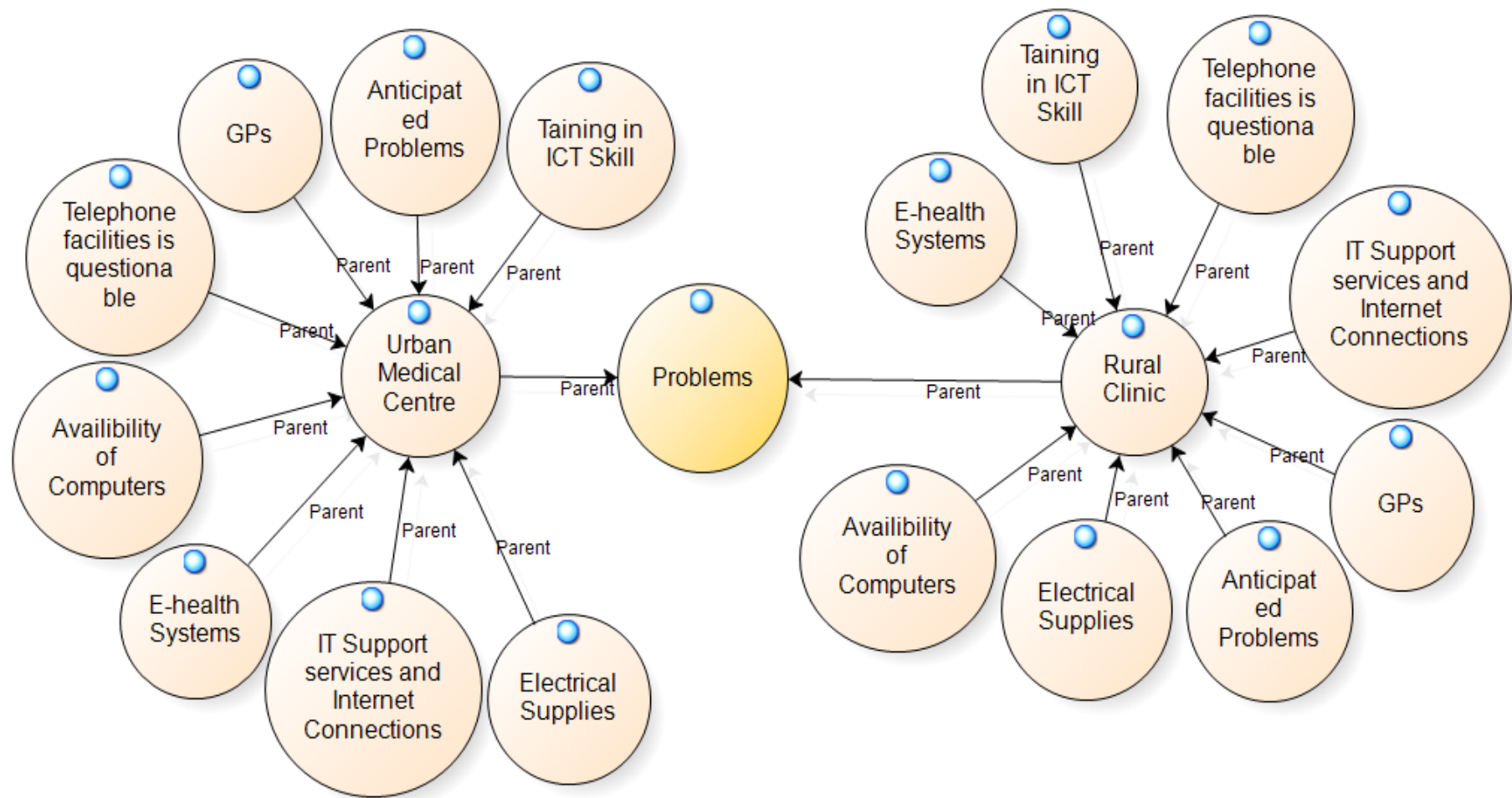
Nodes compared by number of items coded

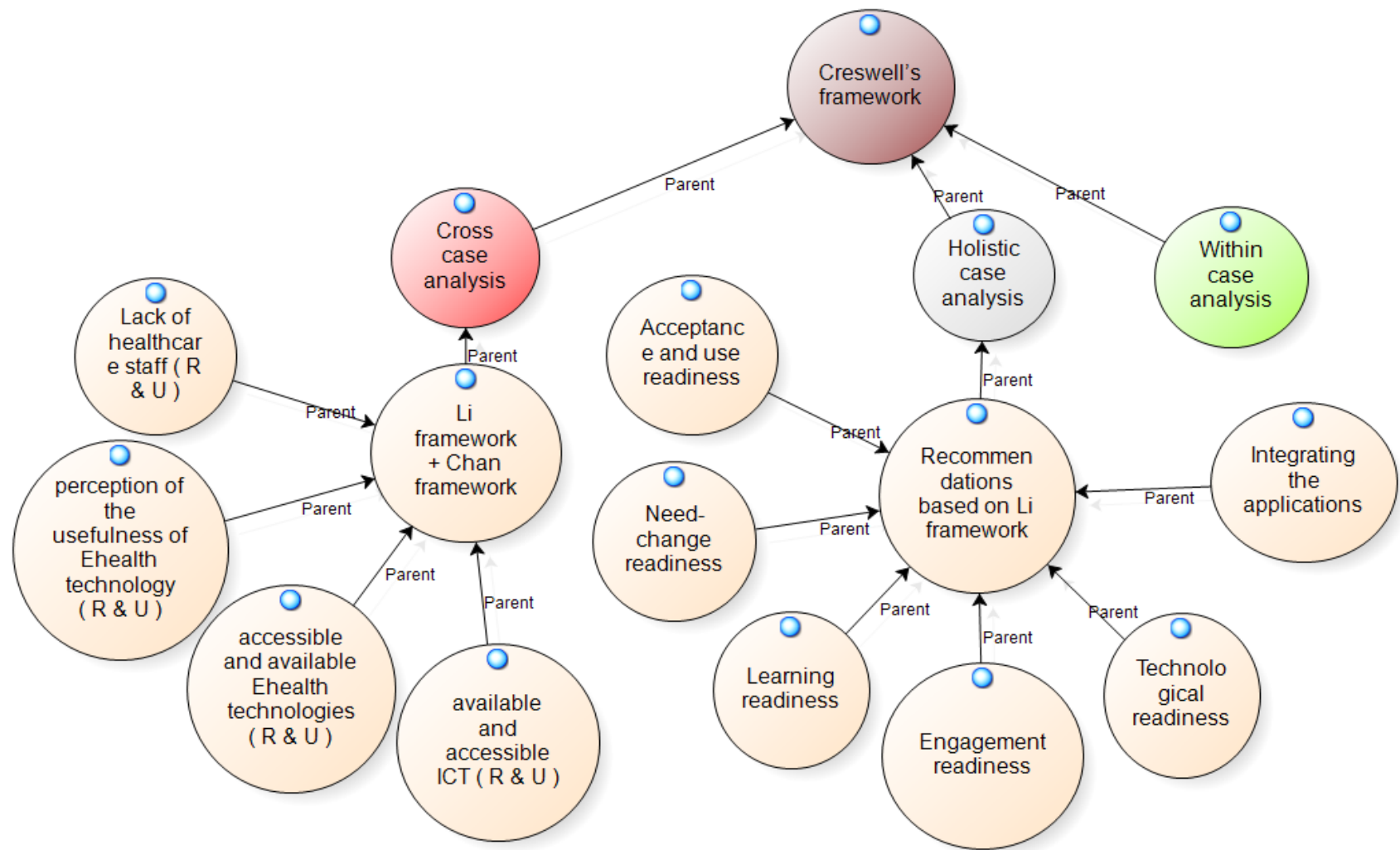
| Creswell's framework | | | | | | Problems | | | | A summary of the re | | Urban Medical | Rural Clinic | | |
|-------------------------|--|---------------------|-------------------------|----------|--|----------------|--|----------|--|---------------------|------------------|------------------|--------------|-----------------|------------|
| within case analysis | | | | | | Cross case | | | | Rural Clinic | Urban Medical Ce | E-health systems | Health | Health | Healthcare |
| urban hospitals clinics | | | Rural hospitals clinics | | | Li framew | | | | Availability | Training in | Availability | Training | Urban Medical C | |
| questionnaire | | benefit from the in | | Problems | | benefit from t | | Problems | | Sugge | | perceptio | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | all of the sy | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | current | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | EP | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Tra | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | ICT | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Sho | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Access | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | questionnaire | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-health | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-health | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | ava | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Lada | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Anticipated | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | IT Support | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | GPs | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-health | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | GPs | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Telep | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | IT Support | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Ant | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Elev | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Telepho | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Rural Clinic | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-tr | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-d | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-p | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | E-r | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Rural | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Urban | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Construction | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Central Data | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Rural | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Urban | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Rural | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Urban | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Ben | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | EH | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Act | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Sur | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Ba | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Ba | | | |
| Electronic p | | training | | E-consi | | Electronic | | E-pres | | Training need: | | Tra | | | |

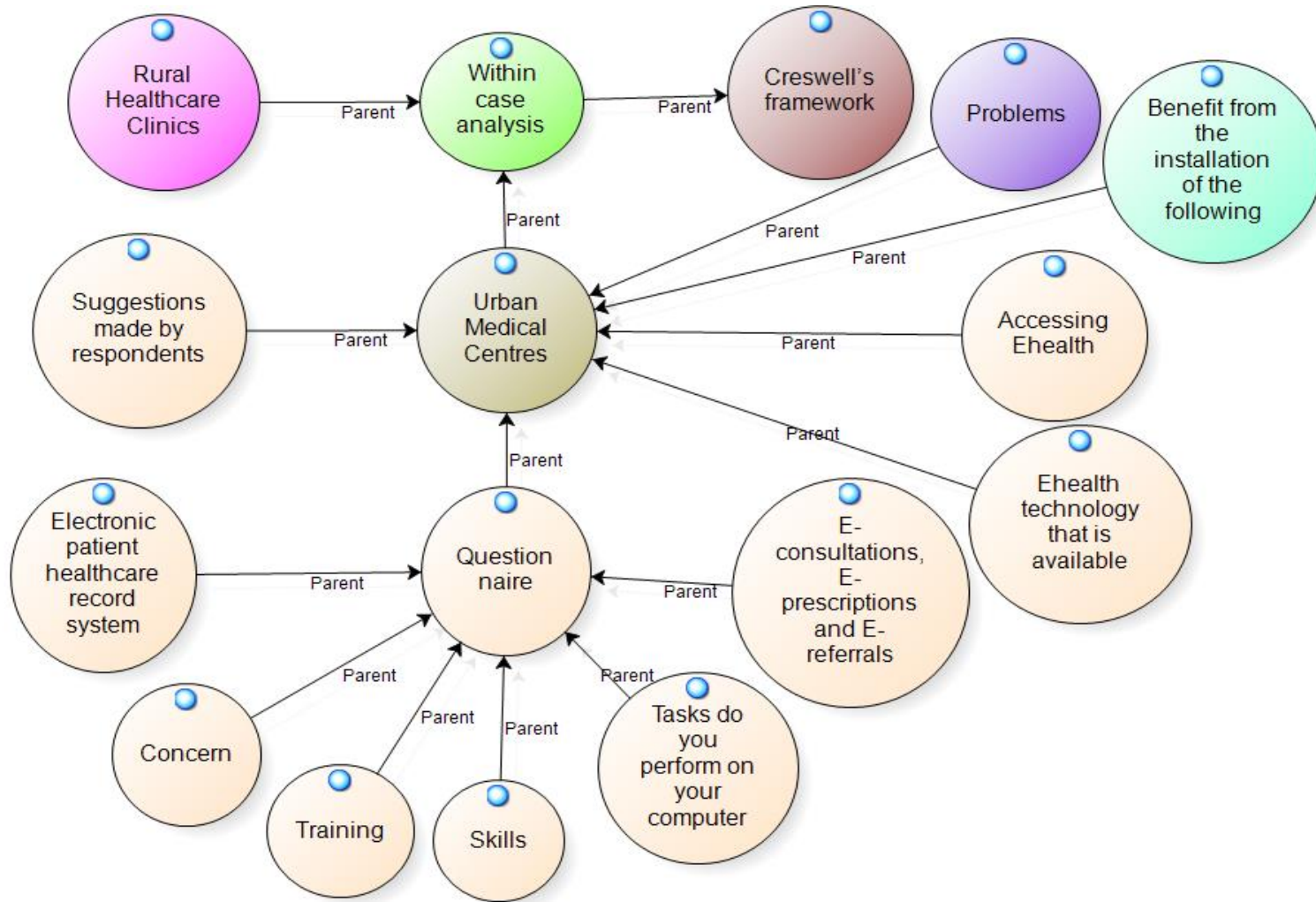
- **Relationship between Codes**

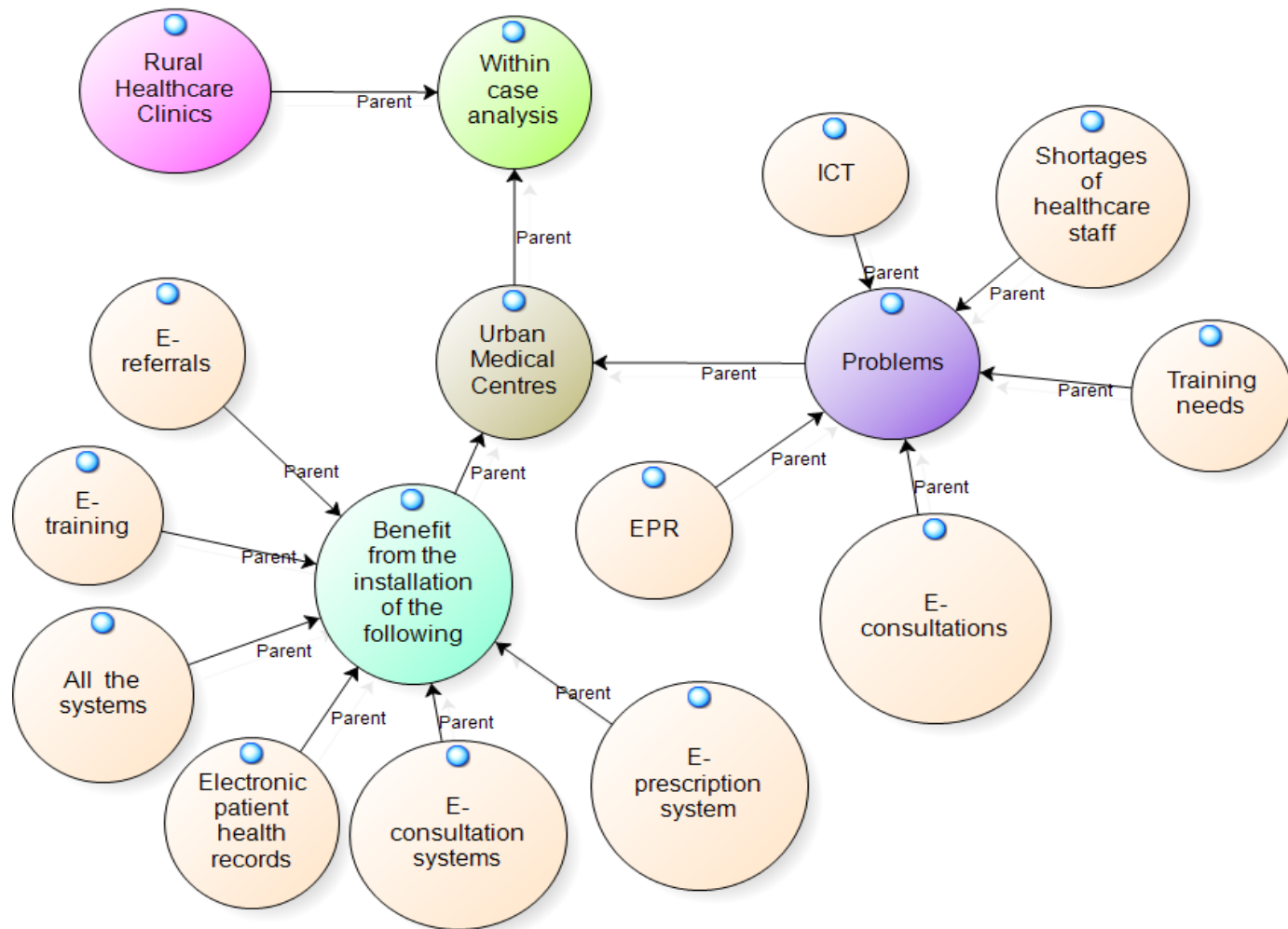
The next pages (439-445) contain a breakdown of the Relationship between Codes to make them more readable.

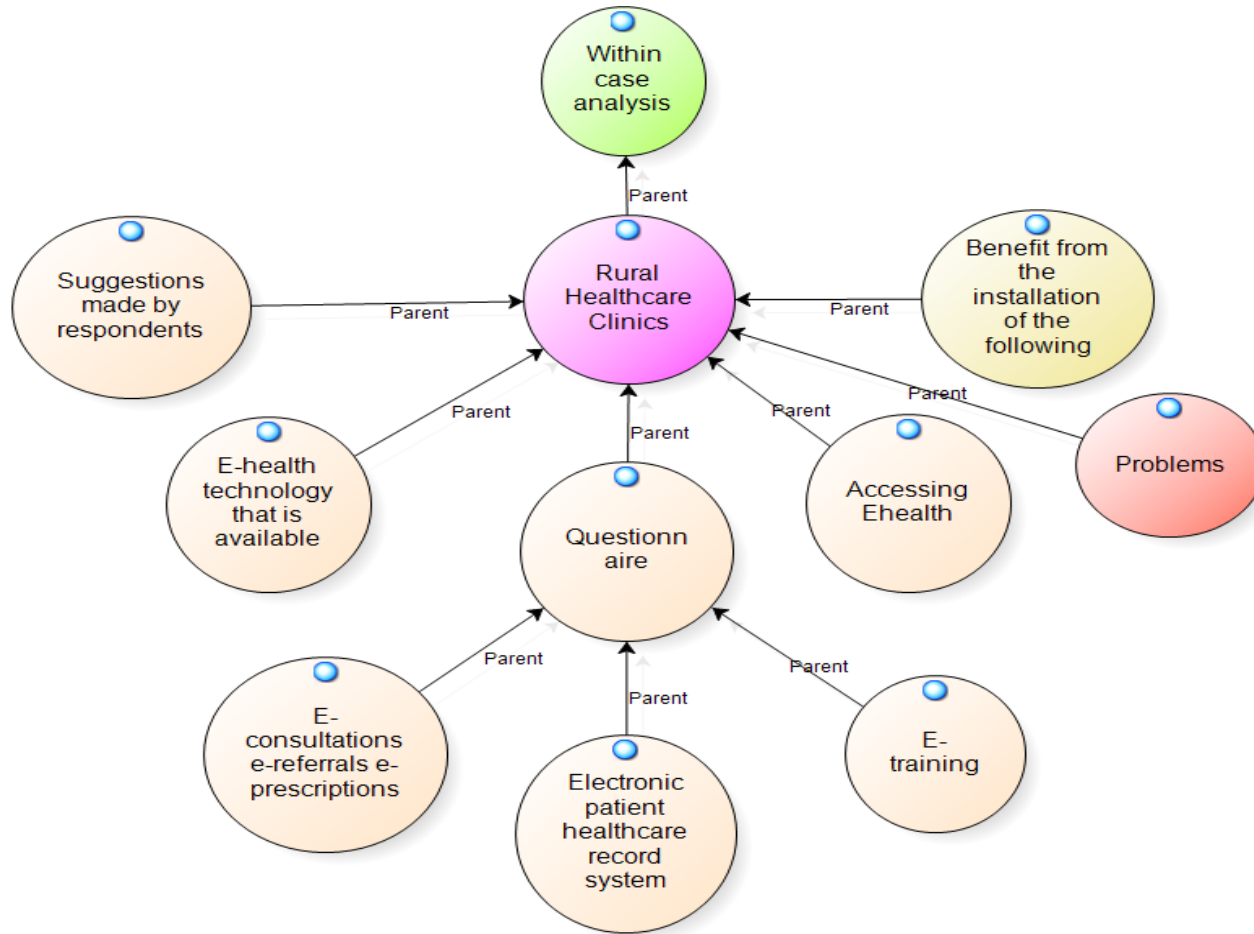


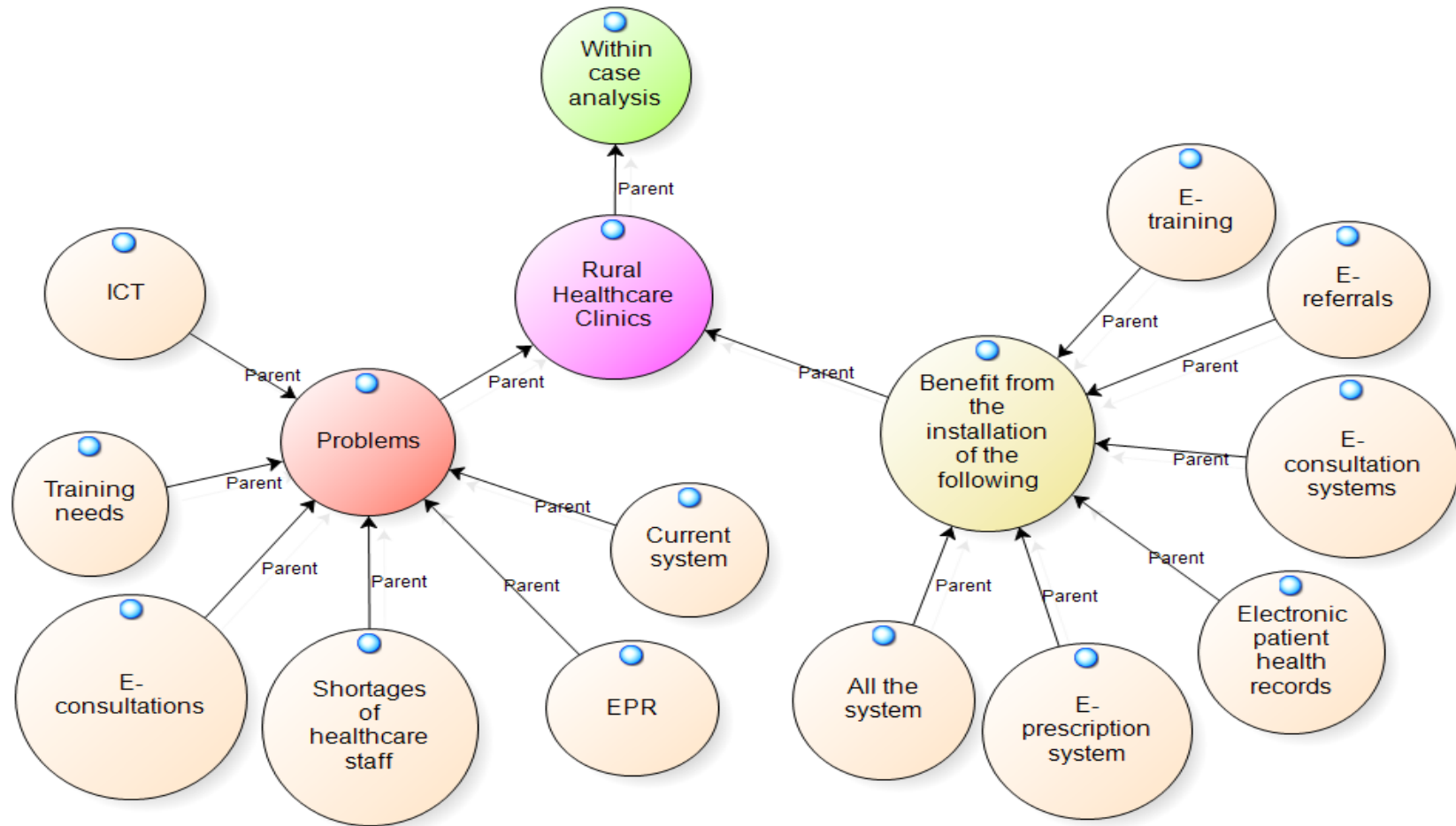


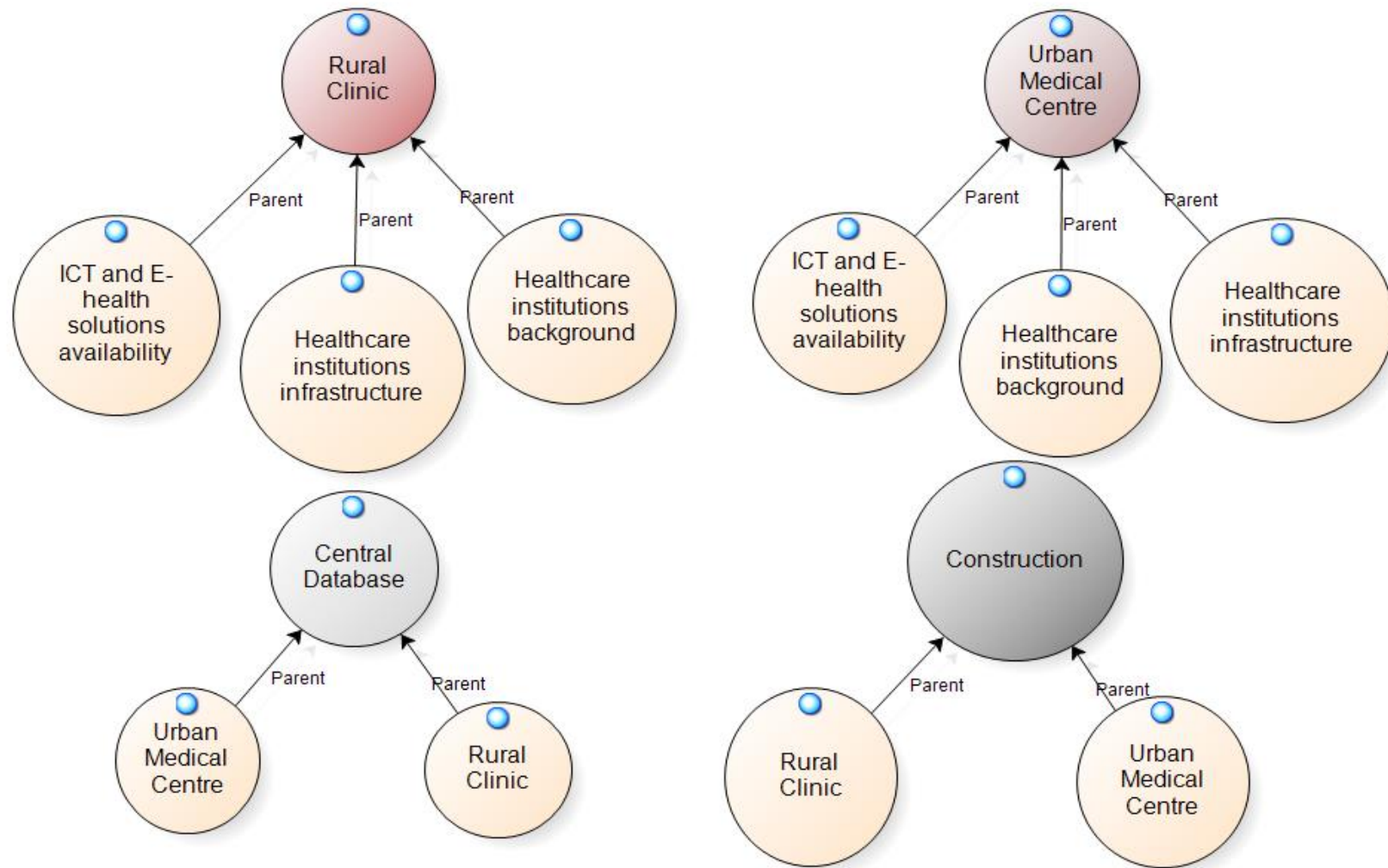












- **Codes**

| Codes | Sources | References |
|--|----------------|-------------------|
| A summary of the responses | 0 | 0 |
| E-health systems | 0 | 0 |
| Rural Clinic | 0 | 0 |
| Accessing E-health outside the workplace | 1 | 3 |
| Basic E-health technology that is available | 1 | 3 |
| Benefits after Implementation | 2 | 18 |
| E-consultation systems | 2 | 5 |
| HER | 2 | 11 |
| E-prescription system | 2 | 7 |
| E-referrals | 2 | 6 |
| E-training | 3 | 8 |
| Suggestions | 1 | 3 |
| Training Needs | 1 | 3 |
| Urban Medical Centre | 3 | 88 |
| Accessing E-health outside the workplace | 1 | 3 |
| Basic E-health technology that is available | 1 | 4 |
| Benefits after Implementation | 2 | 21 |
| E-consultation systems | 2 | 4 |
| HER | 3 | 15 |
| E-prescription system | 3 | 12 |
| E-referrals | 2 | 6 |
| E-training | 3 | 8 |
| Suggestions | 2 | 9 |
| Training Needs | 2 | 6 |
| Central Database | 0 | 0 |
| Rural Clinic | 5 | 6 |
| Urban Medical Centre | 5 | 6 |
| Construction | 0 | 0 |
| Rural Clinic | 5 | 6 |
| Urban Medical Centre | 5 | 5 |
| Creswell's framework | 0 | 0 |
| Cross case analysis | 0 | 0 |
| Li framework + Chan framework | 0 | 0 |
| accessible and available Ehealth technologies (R & U) | 1 | 3 |
| available and accessible ICT (R & U) | 2 | 8 |
| Lack of healthcare staff (R & U) | 2 | 7 |
| perception of the usefulness of Ehealth technology (R & U) | 19 | 19 |
| Holistic case analysis | 0 | 0 |
| Recommendations based on Li framework | 0 | 0 |
| Acceptance and use readiness | 0 | 0 |
| Engagement readiness | 0 | 0 |

| | | |
|--|----|----|
| Integrating the applications | 0 | 0 |
| Learning readiness | 0 | 0 |
| Need-change readiness | 0 | 0 |
| Technological readiness | 0 | 0 |
| within case analysis | 0 | 0 |
| Rural hospitals clinics | 0 | 0 |
| Accessing Ehealth | 4 | 4 |
| benefit from the installation of the following | 0 | 0 |
| all of the system | 9 | 16 |
| E-consultation systems | 4 | 6 |
| Electronic patient health records | 5 | 14 |
| E-prescription system | 4 | 8 |
| E-referrals | 4 | 9 |
| E-training | 2 | 4 |
| Ehealth technology that is available | 3 | 4 |
| Problems | 1 | 1 |
| current system | 5 | 8 |
| E-consultations | 1 | 1 |
| EPR | 3 | 3 |
| ICT | 4 | 11 |
| Shortages of healthcare staff | 2 | 4 |
| Training needs | 3 | 3 |
| Questionnaire | 0 | 0 |
| E-consultations e-referrals e-prescriptions | 6 | 13 |
| Electronic patient healthcare record system | 4 | 9 |
| E-training | 6 | 10 |
| Suggestions made by respondents | 7 | 14 |
| urban hospitals clinics | 0 | 0 |
| Accessing Ehealth | 1 | 3 |
| benefit from the installation of the following | 1 | 1 |
| all of the system | 5 | 6 |
| E-consultation systems | 6 | 13 |
| Electronic patient health records | 10 | 21 |
| E-prescription system | 7 | 14 |
| E-referrals | 6 | 13 |
| E-training | 2 | 4 |
| Ehealth technology that is available | 4 | 12 |
| Problems | 6 | 18 |
| E-consultations | 2 | 2 |
| EPR | 1 | 6 |
| ICT | 2 | 6 |
| Shortages of healthcare staff | 3 | 4 |
| Training needs | 12 | 16 |
| Questionnaire | 0 | 0 |

| | | |
|--|----|----|
| Concern | 3 | 3 |
| E-consultations, E-prescriptions and E-referrals | 10 | 14 |
| Electronic patient healthcare record system | 26 | 35 |
| Skills | 9 | 10 |
| tasks do you perform on your computer | 2 | 2 |
| Training | 11 | 11 |
| Suggestions made by respondents | 1 | 7 |
| Problems | 0 | 0 |
| Rural Clinic | 0 | 0 |
| Anticipated Problems | 2 | 9 |
| Availability of Computers | 7 | 17 |
| E-health Systems | 6 | 14 |
| Electrical Supplies | 5 | 5 |
| GPs | 4 | 7 |
| IT Support services and Internet Connections | 5 | 7 |
| Training in ICT Skill | 7 | 13 |
| Telephone facilities is questionable | 4 | 4 |
| Urban Medical Centre | 0 | 0 |
| Anticipated Problems | 2 | 8 |
| Availability of Computers | 7 | 14 |
| E-health Systems | 5 | 13 |
| Electrical Supplies | 2 | 3 |
| GPs | 6 | 10 |
| IT Support services and Internet Connections | 6 | 9 |
| Training in ICT Skill | 7 | 16 |
| Telephone facilities is questionable | 2 | 2 |
| Rural Clinic | 0 | 0 |
| Healthcare institutions background | 5 | 19 |
| Healthcare institutions infrastructure | 5 | 16 |
| ICT and E-health solutions availability | 5 | 39 |
| Urban Medical Centre | 1 | 1 |
| Healthcare institutions background | 5 | 25 |
| Healthcare institutions infrastructure | 6 | 15 |
| ICT and E-health solutions availability | 5 | 26 |

| Codes | Number of coding references | Number of items coded |
|---|------------------------------------|------------------------------|
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\Accessing E-health outside the workplace | 3 | 1 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\Basic E-health technology that is available | 3 | 1 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\Benefits after Implementation | 18 | 2 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\E-consultation systems | 5 | 2 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\EHR | 11 | 2 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\E-prescription system | 7 | 2 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\E-referrals | 6 | 2 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\E-training | 8 | 3 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\Suggestions | 3 | 1 |
| Nodes\\A summary of the responses\E-health systems\Rural Clinic\Training Needs | 3 | 1 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\Accessing E-health outside the workplace | 3 | 1 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\Basic E-health technology that is available | 4 | 1 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\Benefits after Implementation | 21 | 2 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\E-consultation systems | 4 | 2 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\EHR | 15 | 3 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\E-prescription system | 12 | 3 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\E-referrals | 6 | 2 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\E-training | 8 | 3 |
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\Suggestions | 9 | 2 |

| | | |
|---|----|----|
| Nodes\\A summary of the responses\E-health systems\Urban Medical Centre\Training Needs | 6 | 2 |
| Nodes\\Central Database\Rural Clinic | 6 | 5 |
| Nodes\\Central Database\Urban Medical Centre | 6 | 5 |
| Nodes\\Construction\Rural Clinic | 6 | 5 |
| Nodes\\Construction\Urban Medical Centre | 5 | 5 |
| Nodes\\Creswell's framework\Cross case analysis\Li framework + Chan framework\accessible and available Ehealth technologies (R & U) | 3 | 1 |
| Nodes\\Creswell's framework\Cross case analysis\Li framework + Chan framework\available and accessible ICT (R & U) | 8 | 2 |
| Nodes\\Creswell's framework\Cross case analysis\Li framework + Chan framework\Lack of healthcare staff (R & U) | 7 | 2 |
| Nodes\\Creswell's framework\Cross case analysis\Li framework + Chan framework\perception of the usefulness of Ehealth technology (R & U) | 19 | 19 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Accessing Ehealth | 4 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\all of the system | 16 | 9 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\E-consultation systems | 6 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\Electronic patient health records | 14 | 5 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\E-prescription system | 8 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\E-referrals | 9 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\benefit from the installation of the following\E-training | 4 | 2 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Ehealth technology that is available | 4 | 3 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems | 1 | 1 |

| | | |
|---|----|----|
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\current system | 8 | 5 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\E-consultations | 1 | 1 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\EPR | 3 | 3 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\ICT | 11 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\Shortages of healthcare staff | 4 | 2 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Problems\Training needs | 3 | 3 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\questionnaire\E-consultations e-referrals e-prescriptions | 13 | 6 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\questionnaire\Electronic patient healthcare record system | 9 | 4 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\questionnaire\E-training | 10 | 6 |
| Nodes\\Creswell's framework\within case analysis\Rural hospitals clinics\Suggestions made by respondents | 14 | 7 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Accessing Ehealth | 3 | 1 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following | 1 | 1 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\all of the system | 6 | 5 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\E-consultation systems | 13 | 6 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\Electronic patient health records | 21 | 10 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\E-prescription | 14 | 7 |

| | | |
|---|----|----|
| system | | |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\E-referrals | 13 | 6 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\benefit from the installation of the following\E-training | 4 | 2 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Ehealth technology that is available | 12 | 4 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems | 18 | 6 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems\E-consultations | 2 | 2 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems\EPR | 6 | 1 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems\ICT | 6 | 2 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems\Shortages of healthcare staff | 4 | 3 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Problems\Training needs | 16 | 12 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\concern | 3 | 3 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\E-consultations, E-prescriptions and E-referrals | 14 | 10 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\Electronic patient healthcare record system | 35 | 26 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\skills | 10 | 9 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\tasks do you perform on your computer | 2 | 2 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\questionnaire\training | 11 | 11 |
| Nodes\\Creswell's framework\within case analysis\urban hospitals clinics\Suggestions made by respondents | 7 | 1 |
| Nodes\\Problems\Rural Clinic\Anticipated | 9 | 2 |

| | | |
|---|----|---|
| Problems | | |
| Nodes\\Problems\Rural Clinic\Availability of Computers | 17 | 7 |
| Nodes\\Problems\Rural Clinic\E-health Systems | 14 | 6 |
| Nodes\\Problems\Rural Clinic\Electrical Supplies | 5 | 5 |
| Nodes\\Problems\Rural Clinic\GPs | 7 | 4 |
| Nodes\\Problems\Rural Clinic\IT Support services and Internet Connections | 7 | 5 |
| Nodes\\Problems\Rural Clinic\Training in ICT Skill | 13 | 7 |
| Nodes\\Problems\Rural Clinic\Telephone facilities is questionable | 4 | 4 |
| Nodes\\Problems\Urban Medical Centre\Anticipated Problems | 8 | 2 |
| Nodes\\Problems\Urban Medical Centre\Availability of Computers | 14 | 7 |
| Nodes\\Problems\Urban Medical Centre\E-health Systems | 13 | 5 |
| Nodes\\Problems\Urban Medical Centre\Electrical Supplies | 3 | 2 |
| Nodes\\Problems\Urban Medical Centre\GPs | 10 | 6 |
| Nodes\\Problems\Urban Medical Centre\IT Support services and Internet Connections | 9 | 6 |
| Nodes\\Problems\Urban Medical Centre\training in ICT Skill | 16 | 7 |
| Nodes\\Problems\Urban Medical Centre\Telephone facilities is questionable | 2 | 2 |
| Nodes\\Rural Clinic\Healthcare institutions background | 19 | 5 |
| Nodes\\Rural Clinic\Healthcare institutions infrastructure | 16 | 5 |
| Nodes\\Rural Clinic\ICT and E-health solutions availability | 39 | 5 |
| Nodes\\Urban Medical Centre | 1 | 1 |
| Nodes\\Urban Medical Centre\Healthcare institutions background | 25 | 5 |
| Nodes\\Urban Medical Centre\Healthcare institutions infrastructure | 15 | 6 |
| Nodes\\Urban Medical Centre\ICT and E-health solutions availability | 26 | 5 |