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Quantifying unmet prevention needs among MSM in Europe through a multi-site bio-behavioural survey.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

Quantifying unmet prevention needs among MSM in Europe through a multi-site bio-behavioural survey.

Abstract

Introduction

The HIV epidemic represents an important public health issue in Europe particularly among men who have sex with men (MSM). Considering the pressing need for a harmonised collection of reliable and comparable data, the use of the Global AIDS Monitoring indicators (GAM) has been widely and jointly promoted as a set of crucial standardised items to be adopted for monitoring, and responding to, the epidemic.

Methods

The Sialon II study was a complex multi-centre integrated bio-behavioural cross-sectional survey implemented in 13 European cities and targeting MSM, with a concomitant collection of behavioural and biological (oral fluid or blood specimens) data. Rigorous sampling approaches for hard-to-reach population were used (Time-Location Sampling and Respondent-Driven Sampling) and GAM indicators calculated. The sampling frames were adapted to allow weighted estimation of GAM indicators.

Results

4,901 MSM were enrolled across the 13 study cities. HIV prevalence estimates ranged from a minimum of 2.4% in Stockholm to a maximum of 18.0% in Bucharest. When exploring city-level correlations between GAM indicators, preventive campaigns significantly correlated with levels of condom use and level of HIV testing among MSM.

Discussion

The Sialon II project has made a significant contribution to the monitoring and evaluation of the HIV epidemic across Europe, integrating the use of GAM indicators within a SGSS approach and in participatory collaboration with MSM communities in

13 European cities. In doing so, the study has not only had a major influence in the HIV field regarding the harmonisation of European data collection procedures and indicators via GAM country reporting but has also contributed essential knowledge to inform the development and implementation of strategic, evidence-based HIV prevention campaigns for MSM across European countries.

KEYWORDS
GAM indicators; MSM; HIV; bio-behavioural survey; HIV testing

Introduction

Background

The HIV epidemic represents an important public health issue in Europe, particularly among men who have sex with men (MSM). In more than half of all 31 European Union/European Economic Area (EU/EEA) countries the prevalence among MSM is estimated to be 5% or above (1) (2). According to the European Centre for Disease Prevention and Control (ECDC) the 2014 HIV prevalence among MSM aged 25 years or younger is approximately 2.9%, while for MSM older than 25 years, it is estimated to be 7.7% (1).

While over the last few years there has been a general increase in new HIV infections among MSM in the EU/EEA, among young MSM specifically, the increase has been particularly noticeable (3). Indeed, the number of MSM aged 20-24 years newly diagnosed with HIV almost doubled between 2004 and 2013, while in MSM aged 30-39 years old there seems to be a relative stabilisation of new cases (1). Such data suggests that to reverse these trends, there is a need for strategic, large-scale comprehensive and complementary prevention measures such as increased HIV and Sexually Transmitted Infections (STIs) testing, condom promotion, access to Pre-Exposure Prophylaxis (PrEP) and earlier treatment initiations (2).

The situation is even more problematic in many Eastern European and Central Asian countries where although the HIV epidemic among this population is often similar, the highly stigmatised environment(s) is probably less conducive to the reporting of data that would deepen the understanding of mechanisms of HIV transmission among MSM (4).

In order to target prevention strategies effectively, and to monitor their impact at local/regional and country level, a better understanding of the epidemiological patterns and identification of the most affected sub-populations, should be considered as key enabling factors in tackling the multifaceted HIV epidemic. In the European context this particularly relates to MSM and there is a clear need for a harmonised collection of reliable and comparable data on epidemiology and coverage of prevention measures in this population.

Consequently, international agencies (namely, UNAIDS, WHO and ECDC) have called for countries to use robust surveillance and monitoring systems that adopt common and standardised indicators (5). A key part of this international effort for harmonisation is the promotion and implementation of Second Generation HIV Surveillance Systems (SGSS), which collect and link biological and behavioural data (6). The Global AIDS Monitoring indicators (GAM) are part of the SGSS and comprise a set of standardised items widely and jointly promoted by the WHO and UNAIDS (7) (8).

However, despite concerted efforts by these international agencies, the implementation of such a methodological approach is patchy and requires both adoption and strengthening across countries (8). Although country reporting to the UNAIDS GAM has improved consistently over the years, to-date there remains considerable variability in response rates (8).

A recent review of the GAM reporting process has highlighted a lack of data relating to key populations. For example, in 2012, GAM data on key populations were reported in approximately only 30% of cases (9).

A standardised set of GAM indicators is crucial given their role in providing specific data and information to monitor the implementation of the Sustainable Development

Goals (SDG) and the UNAIDS 90-90-90 strategy, recently endorsed by the new European Commission Communication on *Next steps for a sustainable European future*.

The European Commission has co-funded several projects in the area of HIV/AIDS, two of which have aimed specifically to implement a joint survey across different EU/EEA countries adopting the main principles of both SGSS and the GAM approach as cornerstones of the study. The two projects are the Sialon project (10) and the more recent Sialon II project (11) (12). In particular, in the Sialon II project a total of 13 countries with very different cultural and social environments with 30 institutions including public health institutions and NGOs were involved. The meaningful participation of Lesbian-Gay-Bisexual-Trans-plus (LGBT+) communities in all participating countries has been key in designing and implementing the study.
The added value of the Sialon II project lays in the sampling approach (Time-Location Sampling and Respondent-Driven Sampling) and use of GAM indicators. The methodology adopted allowed the weighted estimation of GAM indicators, presented in this manuscript. To our knowledge, this is the first paper delivering weighted estimates for GAM indicators in a large number of European cities set within the framework of a SGSS specifically targeting MSM.

Objectives

The objectives of this paper are to: (i) present weighted estimates of the GAM indicators among MSM from 13 European cities; and (ii) discuss the usefulness of these GAM indicators in monitoring the HIV epidemic and responses across EU countries.

Methods

Detailed descriptions of study procedures and methods have been published elsewhere (11). Here we present a short overview of the main methodological aspects.

Study design

The Sialon II study was a complex multi-centre integrated bio-behavioural cross-sectional survey with a concomitant collection of behavioural data and biological data (oral fluid or blood specimens).

Setting

The survey was implemented in 13 European cities. The decision to use either Time-Location Sampling (TLS) or Respondent-Driven Sampling (RDS) in each study site was based on preliminary formative research and organisational issues. TLS was adopted in nine cities: Brussels (Belgium), Sofia (Bulgaria), Hamburg (Germany), Warsaw (Poland), Lisbon (Portugal), Ljubljana (Slovenia), Barcelona (Spain), Stockholm (Sweden), and Brighton (UK). The setting for data collection included social and/or commercial venues and cruising settings preliminarily identified through formative research (13) and then selected randomly for data collection sampling calendars. RDS was used in four cities: Verona (Italy) Vilnius (Lithuania), Bucharest (Romania), and Bratislava (Slovakia). Regarding the latter, enrolment was based on the individuals' social network and for the data collection locally accredited health care facilities (e.g. hospital) were used. Data collection for all sites took place from April 2013 to November 2014.

Sample size

The sample size estimation was carried out based on the results from the former Sialon I project and other available studies (10). Based on assumptions of HIV prevalence in the target population of at most 15%, a precision of 5%, a significance level of 95% and a design effect of 2.0 provided a random clustered sample size calculation of 392 MSM per study site. Taking into account the possibility of invalid samples, a final target of 408 MSM per city for TLS and 400 for RDS was planned.

Participants

Enrolment was based on the following inclusion criteria: having had any kind of sex with another man during the previous year before enrolment; providing informed consent, and agreeing to donate either an oral fluid (TLS) or blood specimen (RDS). The exclusion criteria were set as follows: being younger than the legal age of consent; having already participated in the study.

Data sources/ measurement

Behavioural data

Behavioural data were collected through a pen-and-paper self-administered questionnaire. Core items were developed in line with the GAM indicators (7). To allow for sampling weight calculations, additional items were included in the questionnaires on the venues attendance (TLS) or on network size (RDS).

Biological data

Biological specimens were obtained from participants of both study arms (TLS/RDS). In cities where TLS was used, specimens were tested for HIV antibodies using

GENSCREEN HIV 1/2 version 2, BIO-RAD (Marne la Roquette, France). A total IgG antibodies ELISA test Human IgG ELISA Kit 1x96, Quantitative / Immunology Consultants Laboratory was also used for oral fluid (OF) sample testing suitability and quality control. All HIV-reactive samples were re-tested with Vironostika HIV Ag/Ab, Biomerieux (Marcy-l'Étoile, France). Samples reactive to the first ELISA HIV test, but negative to the second were classified as negative.

In cities where RDS was used, blood specimens were collected and processed for serum extraction according to the respective national guidelines for safety and quality assurance. Serum samples were tested with an HIV 4th generation ELISA/CLIA screening test. A Western Blot test was used to confirm the positive cases.

Variables

The variables used for the present analysis included the GAM indicators suggested for MSM target population (14). All proposed items included in the GAM guidelines for MSM were used in the survey questionnaire. In particular, numerators and denominators were defined as follows:

GAM	Nominator	Denominator
1.11 (prevention programme)	Number of MSM who replied "yes" to both questions related to the prevention programmes as per GAM guidelines (knowledge of HIV testing services, and condoms received in the last 12 months in the context of broad prevention campaigns – outreach service)	Total number of MSM who participated in the survey
1.12 (Condom use)	Number of MSM who reported that a condom was used the last time they had anal sex	Number of MSM who reported having had anal sex with a male partner in the last six months
1.13 (HIV testing)	Number of MSM who reported having been tested for HIV during the last 12 months and who knew their results	Number of MSM included in the sample
1.14 (HIV prevalence)	Number of MSM with a reactive HIV test (based on laboratory results)	Number of MSM tested for HIV in the context of the survey

Statistical methods

The analysis was carried out according to the GAM indicator guidelines (14). For all indicators, estimates were carried out with the following age disaggregation: <25 years old and ≥25 years old. Age was calculated on the basis of the self-reported year of birth. STATA Version 14.1 was used for all analyses (College Station, TX: StataCorp LP). To allow sampling weights calculation, a specific procedure was devised on the basis of previous publications and methodological guidelines (11) (15) (16).

For the TLS survey, individual weights were assigned as the inverse of the product of the following: (i) the probability of the participant being at the sampled venue given he was at the sampled venue type (number of visits to sampled venue / number of visits to all types of venues); (ii) the length of the sampling time (out of all Venue-Day-Time units on the particular day) and (iii) the proportion of sampled individuals during the event in relation to the estimated number of visitors during the sampling event, a modification of the method proposed by Karon and Wejnert (16).

For the RDS survey, and in line with a RDS approach (17), weighted estimates were calculated using RDS Analyst (www.hpmrg.org), a suite of R commands developed by Handcock and colleagues (2015 RDS Analyst: Software for the Analysis of Respondent-Driven, Sampling Data, Version 0.52). Gile's Sequential Sampler approach was used for calculating the sampling weights. This approach is based on the inclusion probabilities of members of the sample which are based on reported network sizes (15). This method is recommended when the sample is a significant fraction of the target population. Therefore, in order to use this method, population size estimates were carried out for each city. The calculation was based on (i) the total number of inhabitants for the city area, and; (ii) the expected percentage of MSM

(according to the consensus among the project's scientists and according to the scientific literature, given there is currently no comprehensive and precise agreement among experts on MSM population size estimations within the general population) (18) (19). All point estimates were reported with their respective sample size, lower and upper bound of the 95% Confidence Intervals (95% CI), and Estimated Design effect.

Ethics

All procedures adopted in the present study were in line with the 1964 Helsinki declaration and its amendments. Survey protocols were approved by the appropriate ethics committee in each participating city as well as by both the WHO Research Project Review Panel (RP2) and the WHO Research Ethics Review Committee (ERC). The name or any other identifier of the MSM enrolled in the study was not collected. All respondents were entitled to collect their test result at a nominated centre indicated to the participant during study enrolment. In case of a positive result, further testing, counselling, clinical follow up and ARV treatment were provided in line with the respective national guidelines.

Results

Participants

A total of 4,901 MSM were enrolled across the 13 participating cities. In TLS study sites, 3,596 participants were enrolled, while in RDS sites a total of 1,305 participants were enrolled. Participants enrolled per study city and per age group are shown in Table 1, while in Table 2 age, mean, median, Standard Deviation, minimum and maximum are shown by city. A detailed description of the sample is available in the Sialon II project report (12).

Main results

GAM 1.11 (Prevention programmes) considered as condoms availability and testing site knowledge

In eight of the nine cities where TLS was implemented, more than half of respondents answered positively to both questions (see Table 3, GAM 1.11). The sole exception was Warsaw where 28.8% (95% CI: 23.3 - 34.3) of the participants had been reached by a prevention programme. Where RDS was implemented, less than half of the MSM answered yes to both the GAM questions, except for the older participants (≥25 years) in Bucharest (50.7%; 95% CI: 38.4 - 62.9) and young MSM (<25 years) in Vilnius (58.3%; 95% CI: 43.4 - 72.3).

The highest percentages of MSM reporting to be reached with an HIV prevention programme in the last 12 months were reported in Sofia and Hamburg (88.4%; 95% CI: 82.9 - 94.1 and 81.4%; 95% CI: 77.6 - 85.1 respectively). In Bratislava and Warsaw, the lowest proportions of MSM participating in the survey had been reached

by an HIV prevention programme (22.6%; 95% CI: 17.0 - 26.8 and 28.8%; 95% CI: 23.3 -34.3, respectively).

In all cities (except Brighton, Hamburg, and Lisbon), older participants (≥25 years) had been reached over the last 12 months to a higher extent compared with younger participants (<25 years), although differences between these age categories were small in most cities.

GAM 1.12 (Condom use)

Condom use according to the GAM definition, ranged from 45.2% (95% CI: 38.1 - 51.4) in Bratislava to 69.6% in Lisbon (95% CI: 64.5 – 74.3) (Table 3, GAM 1.12). With the exception of a few sites (Bratislava, Bucharest, Lisbon, Verona, and Warsaw) condom use was higher for the young MSM category (<25 years). Among older MSM (≥25 years), estimates of condom use varied between 46.7% in Bratislava (95% CI: 38.5 - 54.8) to 72.0% in Lisbon (95% CI: 65.2 - 77.9). It should be noted that for some cities, the number of participants in the younger age group was low and therefore the precision of the estimates is reduced.

GAM 1.13 (HIV testing)

The level of HIV testing as per GAM guidelines is reported in Table 3 (GAM 1.13). The highest proportions of participants (total) reporting having received an HIV test within the last 12 months and who also knew the result of that test, were reported in Brussels (68.1%; 95% CI: 56.4 - 79.8) and Barcelona (63.0%; 95% CI: 52.6 - 73.4). In Lisbon only 21.1% (95% CI: 12.5 - 29.8) of younger men reported a HIV test with the collection of the test result in the last year, which represented the lowest levels in the study. The second lowest estimate after Lisbon was found in Bratislava with

29.0% (95% CI: 19.1 - 39.0) followed respectively by Brighton 36.1% (95% CI: 22.7 - 49.6) and Bucharest 39.0 (95% CI: 21.8 - 56.2). In several cities there were large differences between age groups with regard to receiving an HIV test within the last 12 months and knowing the results. Participants from Brussels, Lisbon, and Warsaw reported differences greater than 20% for the two age groups.

GAM 1.14 (HIV prevalence)

HIV prevalence was calculated based on the oral fluid-based laboratory testing for TLS and from serum samples-based laboratory tests for RDS. As shown in Table 3 - GAM 1.14, HIV prevalence estimates varied by city: the lowest level was reported in Stockholm (2.4%; 95% CI: 1.1 - 5.2), while the highest level was found in Bucharest (18.0%; 95% CI: 9.1 - 27.0). Five cities had an HIV prevalence between 10-20% (Brussels, Barcelona, Lisbon, Brighton, Bucharest), three cities between 5-10% (Hamburg, Warsaw, Verona), and five cities below 5% (Stockholm, Vilnius, Ljubljana, Bratislava and Sofia).

City-level correlations between GAM indicators

When exploring city-level correlations between GAM indicators (graph 1) a significant correlation was found (i) between preventive programme indicator (defined as condom availability and testing site knowledge) and HIV testing (correlation coefficient 0.52, p-value=0.006) and (ii) between preventive programme indicator and condom use (correlation coefficient 0.45, p-value=0.022). Data suggest that the higher the preventive programme indicator the higher the level of condom use and testing among MSM, in both age groups.

Discussion and conclusions

Key results

HIV remains a public health priority in the EU and the data from the Sialon II study presented in this paper demonstrate the value of policy impact monitoring using common approaches and indicators across countries.

The percentage of MSM reached with prevention programmes (as measured by GAM 1.11) showed significant differences both between and within cities. Although the use of different sampling methods can partially explain some of the differences between RDS versus TLS cities, the comparison among cities surveyed with the same sampling methodology provides valid indications on MSM prevention needs. In Warsaw, the number of individuals reached with prevention programmes is generally low, particularly for younger MSM. With the exception of Brighton, Hamburg, Lisbon and Vilnius, older MSM seem to be reached more frequently compared to younger MSM. Cities surveyed using RDS present, in general, a lower number of MSM reached with prevention programmes, and with the exception of Vilnius (where a specific programme was run by an NGO before and during the data collection period), younger MSM showed the lowest level. These estimates are consistent with the literature and suggest the need for targeted prevention programmes tailored to locations and communities that can also accommodate for the needs of sub-populations, such as young MSM, MSM who are tourists, and bisexuals (22) (23).

Data focusing on the GAM 1.12 (Condom use) indicate that in the majority of the surveyed cities, condom use with any kind of partner was lower for younger men than for older men. However, the sample sizes for younger men were small for several cities and the association between age and condom use was not consistent across all

study cities. In another publication based on the same Sialon-II-dataset authors looked at condom use from another perspective, namely any anal intercourse without a condom during the previous six months and not just the last sexual encounter. In the paper, authors reported that almost half of the HIV-uninfected individuals reported condomless anal intercourse (CLAI). This was reported slightly more often by men living in Central European study cities and more frequently with steady partners compared to non-steady partners (24).

Based on the estimates of this GAM indicator there is a clear need to either increase condom use among this population or to complement prevention strategies by providing meaningful access to other similarly effective HIV prevention tools such as HIV pre-exposure prophylaxis. Indeed, despite the fact that condom and lubricant distribution is often considered a simple and somewhat naïve approach to facilitate condom use, it is commonly acknowledged in the literature that fear of disapproval and discrimination by health-care providers is likely to deter many gay men and other men who have sex with men from accessing mainstream health services (17) therefore reducing the likelihood of accessing free condom distribution, as well as low threshold HIV and STIs testing (25).

Marcus et al (2017) in modelling the relationship between UAI and HIV disclosure with the same study dataset, found that among those respondents being aware of being HIV positive, condom use with steady partners was higher than among HIV negative men. However, condom use with non-steady partners was also lower. Men unaware of being infected with HIV reported the lowest condom use with non-steady partners (26) (24).

A significant number of MSM are potentially not aware of their HIV status. It is estimated that in western and central Europe a relevant number of people at risk are

not getting tested or at least experience difficulties in being tested for HIV and STIs (2). Based on surveillance data, ECDC estimates that a number of European countries may have a significant proportion of late HIV diagnoses (2). The testing behaviour as measured by the GAM 1.13 however, depicts a very different situation among the surveyed cities. In Barcelona, Hamburg, Sofia, Stockholm, and Verona, approximately half of the participants (all ages) reported having received an HIV test within the last twelve months and knew the result of that test. In Brighton, Brussels, and Warsaw more than half of older participants reported a known HIV test result within the last 12 months while among younger participants, it was significantly below that level. In Lisbon only one in five of younger men reported a known HIV test result in the last year which represented the lowest levels in the study. Considering the period in which data were collected there might be a possible effect attributable to the low level of resources available during the financial crisis period which could explain these results. The situation may now be better following economic improvement in many countries with additional resources being made available.

In several cities there were large differences between the two age groups with regards to receiving an HIV test within the last 12 months and knowing the results. Participants from Brighton, Brussels, Lisbon, and Warsaw all reported differences of greater than 20% for the two age groups and considering that the time span limits to the last 12 months the differences cannot be attributed to the age effect where older individuals had more time to be tested. Older participants are tested more recently and to a higher extent than younger participants in the majority of the cases. This clearly indicates that increasing access to culturally sensitive HIV counselling and testing and to antiretroviral therapy for MSM found to have HIV is an urgent health priority

particularly for younger generations. The current levels of HIV testing are insufficient to link gay men and other MSM to care within a short period after acquiring HIV infection. Testing frequencies often remain insufficient to effectively reduce the period of infectiousness of people who newly acquire HIV.

Alternative approaches such as the use of Point of Care Tests (PoCTs) for HIV and STIs in low threshold community testing and LGBT venue-based testing, home collection testing, and HIV self-testing may represent effective approaches to increase diagnosis and linkage to care.

The problem of late diagnosis reflects a lack of access to and uptake of HIV testing and counselling services in many countries (27). A late diagnosis also means that a person has remained unaware of their HIV status for an indeterminate length of time, thus increasing the risk of transmitting the virus. The most recent surveillance data show that, despite significant efforts dedicated to the prevention and control of HIV, not only has the rate of new HIV diagnoses not substantially declined in the EU/EEA but it has increased substantially over the last decade in the European Region.

Although HIV prevalence as an epidemic indicator is not a good parameter of the infection spread dynamic, for some cities it can be helpful to provide an indirect picture of the epidemic history and patterns. HIV prevalence estimates (GAM 1.14), as measured by testing biological specimens (and not self-reported serological status), highlight critical levels of HIV infections across Europe among MSM communities despite valuable and concerted public health efforts (14).

Brussels, Barcelona, Lisbon, Brighton, Bucharest present a global HIV prevalence in the range 10-20%. The HIV prevalence estimate for Bucharest is probably less reliable and interpretable compared to the other cities for two main reasons: the existence of an ostensible MSM sub-sample of injecting drug-users within the city

sample, and the fact that the target number of MSM to be recruited was not reached (less than 50% of the estimated target sample). An “intermediate” level of HIV prevalence characterised a further four cities (Hamburg, Warsaw, Verona, Sofia) where it ranges from 5 to 10% of the samples, and then Stockholm, Vilnius, Ljubljana, Bratislava where the prevalence results were below 5%. Other smaller studies carried out in some of these cities (with different or similar sampling methods) produced similar results (10) (28).

When exploring city-level correlations between GAM indicators, data confirm that preventive campaigns correlates significantly with both the level of condom use and the level of HIV testing among MSM. This might call for additional efforts in implementing preventative actions. Despite numerous interventions targeting the behaviour, knowledge and attitudes of MSM, an increase of STIs and HIV diagnoses have been recently observed. Outbreaks of syphilis, lymphogranuloma venereum (LGV), hepatitis C viral infection (HCV) and other STI have been reported in multiple European cities. This might suggest the possibility of a persistent sexual risky behaviour and extensive sexual networking (27) but also an effect of the active offer of HIV and STI’s testing that took place over the years.

In some cities however, a much higher treatment coverage and thus a higher percentage of HIV-positive MSM who had undetectable viral load was attained in Western European cities (Brussels, Hamburg, Brighton and Verona) – this indicates that when the service provision is proactive and the treatment widely available, the link between testing and treating can effectively influence the HIV epidemic.

Generalisability and Limitations

To our knowledge, this is the first paper presenting weighted estimates produced as a result of a standardised collection of GAM indicators for MSM in a large number of European cities adopting a common SGSS approach. The use of this approach (SGSS and GAM Indicators) and the active participation of key LGBT community stakeholders within all aspects of the project's design and implementation, represent an asset that provide data potentially usable by both public health authorities and NGOs in each partner country. The use of TLS and RDS methodologies within the context of a bio-behavioural survey using a participatory approach allowed the study team to reach otherwise hidden and different sub-groups of MSM, usually difficult to access through surveillance studies and arguably particularly exposed to risk of infections. However, even though TLS and RDS represent the current state-of-the-art approaches in bio-behavioural surveys targeting hard-to-reach populations such as MSM, there are nonetheless some limitations that should be carefully considered when interpreting these results.

Firstly, data can only be generalised to the particular MSM attending the gay venues in each study site (in the case of TLS survey) and only to those MSM socially linked to the gay community for each specific site (in case of the RDS survey). Despite the superiority of these sampling methods compared to convenience sampling, it has been shown in other studies that these two sampling methods can result in different sample characteristics, and the differences may persist even after applying weighting corrections (29).

Secondly, the generalisability of the findings may also be limited by contextual factors not measured in this survey (e.g. legislation, social norms) and an ecological fallacy cannot be excluded.

Thirdly, an additional source of bias limiting generalisability relates to the self-reported behavioural data. This is of course an issue common to all surveys covering the self-reporting of sensitive information. However, the anonymity of the data collected and the self-administration of the questionnaire with the careful design of the questionnaire developed and validated in all cities with the involvement of the LGBT community, may well have reduced any social desirability effect (30). It is also worth noting that no difficulties or limitations were reported by either respondents or data collectors, with regards to the use of the GAM indicators in both TLS or RDS in terms of interpretation and utility of the items and related indicators.

Fourthly, the percentage of participants who reported ever having injected drugs varied from 1.2% in Bratislava and 2.9% in Sofia to 9.5% in Brussels, and 19.3% in Bucharest. In the case of Bucharest, estimates might be difficult to be generalised due to this sub-population of IDU-MSM and to the fact that the target sample was not reached.

Fifthly, the precision of the estimates which, in some cases, is not optimal, particularly for the group of younger MSM, due to relatively small sample sizes (<50) and potential sampling biases for some cities.

Finally, an isolated limitation to the validity of the survey relates to Sofia (Bulgaria) where, due to an incorrect translation in the items questionnaire related to GAM 1.13, the indicator could not be estimated.

Conclusions

The Sialon II project and the data gathered through its implementation represent a collaborative and scientifically robust contribution to the monitoring and evaluation of the HIV epidemic across Europe, integrating the use of GAM indicators within a

SGSS approach with active community involvement. The data collected provide new evidence for appropriate planning of HIV prevention campaigns among MSM, clearly responding to the urgent need of concerted use of common indicators, with a particular focus on most at risk populations such as MSM (9). The project has actively contributed to (i) common procedures piloting (including most-advanced sampling methods, standards research algorithms, advanced laboratory diagnostics); (ii) harmonised data collection, involving experts from different institutions and with different backgrounds; and (iii) GAM country reporting, with specific reference to MSM.

References

1. **ECDC.** *ECDC SPECIAL REPORT. Thematic report: Men who have sex with men. Monitoring implementation of the Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia: 2014 progress report.* Stockholm : ECDC, 2015.

2. **ECDC .** *HIV and men who have sex with men. Monitoring implementation of the Dublin Declaration on Partnership to Fight HIV/AIDS in Europe and Central Asia: 2017 progress report.* Stockholm : European Centre for Disease Prevention and Control, 2017.

3. *Trends in HIV surveillance data in the EU/EEA, 2005 to 2014: new HIV diagnoses still increasing in men who have sex with men.* **Pharris, A., Quinten, C., Tavoschi, L., Spiteri G, Amato-Gauci AJ and Network, ECDC HIV/AIDS Surveillance.** s.l. : Euro Surveill, 2015, Vols. 2015;20(47). doi: 10.2807/1560-7917.ES.2015.20.47.30071.

4. **UNAIDS.** *Aids Update 2016.* Geneva : UNAIDS, 2016.

5. **UNAIDS-WHO.** *UNAIDS, World Health Organization and Joint United Nations Programme on HIV/AIDS. Initiating Second Generation HIV Surveillance Systems: Practical Guidelines.* Geneva : World Health Organization, 2002.

6. **UNAIDS, World Health Organization and Joint United Nations Programme on HIV/AIDS.** *Initiating Second Generation HIV Surveillance Systems: Practical Guidelines.* Geneva : World Health Organization, 2002.

7. **UNAIDS.** *Global AIDS Monitoring 2018. Indicators for monitoring the 2016 United Nations Political Declaration on Ending AIDS.* Geneva, Switzerland : UNAIDS, 2017.

8. *Global AIDS Reporting-2001 to 2015: Lessons for Monitoring the Sustainable Development Goals.* **Alfvén, T., Erkkola, T., Ghys, P.D., Padayachy, J., Warner-Smith, M., Rugg, D., de Lay, P.** s.l. : AIDS Behav, 2017, Vols. 2017 Jul;21(Suppl 1):5-14. doi: 10.1007/s10461-016-1662-9.

9. *Global Trends of Monitoring and Data Collection on the HIV Response among Key Populations Since the 2001 UN Declaration of Commitment on HIV/AIDS.* **Gall, J., Sabin, K., Frescura, L., Sabin, M.L., Erkkola, T., Toskin, I.** s.l. : AIDS Behav, 2017, Vols. Jul;21(Suppl1):34-43. doi: 10.1007/s10461-016-1618-0. PubMed PMID: 27896550.

10. *HIV bio-behavioural survey among men who have sex with men in Barcelona, Bratislava, Bucharest, Ljubljana, Prague and Verona, 2008-2009.* **Mirandola, M., Folch, C., Krampac, I., Nita I, Stanekova D, Stehlikova D, Toskin I, Gios L, Foschia JP, Breveglieri M, Furegato M, Castellani E, Bonavina MG, the SIALON network.** s.l. : Euro Surveill, 2009, Vol. 14(48):pii=19427.

11. *Bio-behavioural HIV and STI surveillance among men who have sex with men in Europe: the Sialon II protocols.* **Gios, L., Mirandola, M., Toskin, I., Marcus, U., et al,.** s.l. : BMC Public Health, 2016, Vol. 2016 Mar 2;16(1):212.

12. **Mirandola, M., Gios, L., Sherriff, N., Toskin, I., Marcus, U., Schink, S., Suligoi, B., Folch, C., Rosińska, M. (Editors).** *The Sialon II Project. Report on a Bio-behavioural Survey among MSM in13 European cities.* s.l. : ISBN 978-88-98768-55-4 Cierre Grafica, 2016.

13. **The Sialon II Network.** *Prevention Manual and Training. Formative Research Report. Prevention Training Manual. Deliverable of the SIALON II project (D7).* 2012.

14. **UNAIDS, Joint United Nations Programme on HIV/AIDS.** *Global AIDS response progress reporting 2014: construction of core indicators for monitoring the 2011 UN political declaration on HIV/AIDS.* Geneva : Joint United Nations Programme on HIV/AIDS (UNAIDS), WHO Library Cataloguing-in-Publication Data, 2014. ISBN 978 92 4 150.

15. *Improved inference for respondent-driven sampling data with application to HIV prevalence estimation.* **Gile, K.J.** s.l. : Journal of the American Statistical Association, 2011, Vols. 2011;106(493):135–146.

16. *Statistical Methods for the Analysis of Time–Location Sampling Data.* **Karon, J. M., & Wejnert, C.** s.l. : Journal of Urban Health: Bulletin of the New York Academy of Medicine, 2012, Vols. 89(3), 565–586. http://doi.org/10.1007/s11524-012-9676-8.

17. *Respondent driven sampling: a new approach to study hidden populations.* **Heckathorn, D.D.** s.l. : Soc Probl, 1997, Vols. 1997;44:174–9.

18. *Estimating the Population Size of Men Who Have Sex with Men in the United States to Obtain HIV and Syphilis Rates.* **Purcell, D. W., Johnson, C. H., Lansky, A., Prejean, J., Stein, R., Denning, P., … Crepaz, N.** s.l. : The Open AIDS Journal, 2012, Vols. 6, 98–107. http://doi.org/10.2174/1874613601206010098.

19. *Estimating the size of the MSM populations for 38 EU countries by calculating the survey-surveillance discrepancies (SSD) between self-reported new HIV diagnoses from EMIS and surveillance-reported HIV diagnoses among MSM in 2009.* **Marcus, U., Hickson, F., Weatherburn, P., & Schmidt, A. J.** s.l. : BMC Public Health, 2013, Vols. 13, 919. http://doi.org/10.1186/1471-2458-13-919.

20. *Conceptualization and measurement of homosexuality in sex surveys: a critical review.* **Michaels, S., Lhomond, B.** s.l. : Cad Saude Publica, 2006, Vols. 2006 Jul;22(7):1365-74. Epub 2006 Jun 14. Review. PubMed PMID: 16791337.

21. **European Commission.** *Action Plan on HIV/AIDS in the EU and neighbouring countries: 2014-2016.* Brussels : European Commission, 2014.

22. *Socio-demographic factors predicting HIV test seeking behaviour among MSM in 6 EU cities.* **Mirandola, M., Gios, L., Davis, R.J., Furegato, M., Breveglieri, M., Folch, C., Stanekova, D., Nita, I., Stehlíková, D.** s.l. : European Journal of Public Health, 2016, Vol. doi:10.1093/eurpub/ckw144.

23. *Socio-demographic Characteristics, Sexual and Test-Seeking Behaviours Amongst Men Who have Sex with Both Men and Women: Results from a Bio-behavioural Survey in 13 European Cities.* **Mirandola, M., Gios L, Sherriff N, Pachankis J, Toskin I, Ferrer L, Dias S, Velicko I, Staneková D, Caplinskas S, Naseva E, Niedźwiedzka-Stadnik M, et al.** s.l. : AIDS Behav, 2017, Vols. 2017 Jun 22. doi: 10.1007/s10461-017-1831-5.

24. *Behavioural and demographic correlates of undiagnosed HIV infection in a MSM sample recruited in 13 European cities.* **Marcus U, Nöstlinger C, Rosińska M, Sherriff N, Gios L, Dias SF, Gama AF, Toskin I, Alexiev I, Naseva E, Schink SB, Mirandola M and Network, Sialon II.** s.l. : BMC Infect Dis, 2018, Vols. 2018 Aug 6;18(1):368, doi: 10.1186/s12879-018-3249-8.

25. *The Geography of Sexual Orientation: Structural Stigma and Sexual Attraction, Behavior, and Identity Among Men Who Have Sex with Men Across 38 European Countries.* **Pachankis JE, Hatzenbuehler ML, Mirandola M, Weatherburn P, Berg RC, Marcus U, Schmidt AJ.** s.l. : Arch Sex Behav, 2016, Vol. Sep 12.

26. *HIV serostatus knowledge and serostatus disclosure with the most recent anal intercourse partner in a European MSM sample recruited in 13 cities: results from the Sialon-II study.* **Marcus, U., Schink, S. B., Sherriff, N., Jones, A.-M., Gios, L.,**

Folch, C., et al. s.l. : BMC Infectious Diseases, 2017, Vols. 17, 730. http://doi.org/10.1186/s12879-017-2814-x.

27. **ECDC.** *STI and HIV prevention in men who have sex with men in Europe.* Stockholm : European Centre for Disease Prevention and Control, 2013.

28. *Undiagnosed HIV infection in a population of MSM from six European cities: results from the Sialon project.* **Ferrer L, Furegato M, Foschia JP, Folch C, González V, Ramarli D, Casabona J, Mirandola M.** s.l. : Eur J Public Health, 2015, Vols. 2015 Jun;25(3):494-500. doi: 10.1093/eurpub/cku139. Epub 2014 Aug 26. PubMed PMID:25161202.

29. *An empirical comparison of respondent-driven sampling, time location sampling, and snowball sampling for behavioral surveillance in men who have sex with men, Fortaleza, Brazil.* **Kendall, C., Kerr, L.R., Gondim, R.C., Werneck GL, Macena RH, Pontes MK, Johnston LG, Sabin K, McFarland W.** s.l. : AIDS Behav, 2008, Vols. 2008 Jul;12(4 Suppl):S97-104. doi: 10.1007/s10461-008-9390-4. Epub 2008 Apr 4. PubMed PMID: 18389357.

30. *Measuring bias in self-reported data.* **Rosenman, R., Tennekoon, V., & Hill, L. G.** s.l. : International Journal of Behavioural & Healthcare Research, 2011, Vols. 2(4), 320–332. http://doi.org/10.1504/IJBHR.2011.043414.

Tables and Figures

Table 1. Enrolment method and age group by city

City	Recruitment type	Age (GAM disaggregation) <25	25+	*TOT*
BARCELONA	TLS	42	360	*402*
BRIGHTON	TLS	67	344	*411*
BRUSSELS	TLS	50	341	*391*
HAMBURG	TLS	39	368	*407*
LISBON	TLS	35	373	*408*
LUBLJANA	TLS	121	273	*394*
SOFIA	TLS	115	296	*411*
STOCKHOLM	TLS	77	289	*366*
WARSAW	TLS	92	314	*406*
BRATISLAVA	RDS	118	282	*400*
BUCHAREST	RDS	47	134	*181*
VERONA	RDS	104	293	*397*
VILNIUS	RDS	83	239	*322*

Cities presented with white background: TLS survey
Cities presented with grey background: RDS survey

Table 2. Age mean, median, SD, Min-Max, by city

City	Mean	Median	SD	Min	Max
BARCELONA	37.2	35.5	1.88	19	79
BRIGHTON	35.1	32	2.5	18	74
BRUSSELS	34.9	33	1.07	18	68
HAMBURG	38.0	36	1.18	18	79
LISBON	37.9	36	1.19	19	76
LUBLJANA	30.5	29	0.87	18	73
SOFIA	29.6	29.5	0.3	18	58
STOCKHOLM	31.7	28	1.17	18	81
WARSAW	28.8	28	0.93	18	71
BRATISLAVA	30.3	29	8.18	18	62
BUCHAREST	30.8	31	7.33	19	58
VERONA	31.9	29	10.37	18	70
VILNIUS	30.7	28	9.03	19	59

Cities presented with white background: TLS survey
Cities presented with grey background: RDS survey

Table 3. GAM indicators (weighted estimates) among MSM, 95% confidence intervals, design effect and number of participants, by city and age group

City	Age group <25					Age group 25+					Total				
	Sample Size	Point estimate	95% Lower Bound	95% Upper Bound	Estimated Design effect	Sample Size	Point estimate	95% Lower Bound	95% Upper Bound	Estimated Design effect	Sample Size	Point estimate	95% Lower Bound	95% Upper Bound	Estimated Design effect
GAM 1.11 (Prevention programmes)															
BARCELONA	40	**59.0**	39.2	78.8	1.7	352	**74.9**	70.7	79.2	0.9	392	**72.7**	68.4	77.0	0.9
BRIGHTON	63	**64.0**	43.8	84.1	2.8	328	**54.5**	39.8	69.2	7.5	391	**56.3**	45.3	67.2	4.9
BRUSSELS	47	**49.1**	18.0	80.2	4.6	324	**64.4**	55.1	73.7	3.2	371	**62.1**	51.9	72.3	4.2
HAMBURG	37	**84.3**	69.8	98.7	1.5	357	**81.0**	76.6	85.4	1.2	394	**81.4**	77.6	85.1	1.0
LISBON	35	**79.9**	63.9	95.9	1.4	364	**64.4**	51.2	77.6	7.2	399	**66.0**	52.7	79.3	8.2
LJUBLJANA	119	**48.6**	38.8	58.3	1.2	265	**50.9**	44.4	57.4	1.1	384	**50.4**	44.4	56.4	1.4
SOFIA	112	**84.7**	79.7	89.7	0.6	291	**89.7**	81.9	97.6	5.1	403	**88.4**	82.9	94.1	3.2
STOCKHOLM	61	**72.7**	51.6	93.7	3.5	245	**78.0**	70.1	85.9	2.3	306	**76.6**	66.8	86.3	4.2
WARSAW	91	**25.5**	13.0	38.0	1.9	311	**30.2**	22.5	37.9	2.3	402	**28.8**	23.3	34.3	1.5
BRATISLAVA	115	**19.2**	10.0	27.5	2.0	276	**24.0**	17.0	29.5	2.1	391	**22.6**	17.0	26.8	1.9
BUCHAREST	46	**27.4**	12.6	42.4	1.4	122	**50.7**	38.4	62.9	2.0	170	**45.9**	36.1	55.7	1.7
VERONA	99	**27.7**	15.5	39.5	2.2	275	**39.1**	30.6	47.7	2.7	375	**35.9**	28.9	43.0	2.5
VILNIUS	82	**58.3**	43.4	72.3	2.2	236	**30.1**	22.0	35.6	1.6	318	**37.5**	30.1	42.8	1.7

GAM 1.12 (Condom use)

BARCELONA	36	**84.6**	70.5	92.7	1.05	267	**65.7**	56.5	73.9	2.26	303	**68.7**	59.1	77.0	2.95
BRIGHTON	46	**56.8**	34.9	76.3	1.88	222	**51.7**	40.9	62.4	2.81	268	**52.4**	41.3	63.4	3.48
BRUSSELS	39	**83.7**	67.3	92.8	0.95	253	**57.6**	44.5	69.8	4.51	292	**60.7**	47.7	72.3	4.97
HAMBURG	29	**74.9**	44.0	91.9	2.90	252	**49.1**	38.8	59.6	2.80	281	**52.5**	42.6	62.1	2.84
LISBON	30	**53.1**	28.5	76.3	2.65	294	**72.0**	65.2	77.9	1.45	324	**69.6**	64.5	74.3	0.95
LJUBLJANA	91	**57.6**	35.8	76.8	3.35	204	**47.1**	37.7	56.6	2.13	295	**49.5**	42.6	56.5	1.50
SOFIA	114	**80.0**	71.7	86.2	0.85	278	**59.3**	54.5	64.0	0.72	392	**64.7**	60.6	68.5	0.70
STOCKHOLM	38	**62.6**	44.2	78.0	1.71	160	**56.9**	43.9	69.0	2.47	198	**58.4**	47.0	69.0	2.61
WARSAW	67	**51.4**	37.3	65.3	1.70	215	**57.0**	47.9	65.7	1.70	282	**55.4**	48.2	62.4	1.50
BRATISLAVA	88	**41.7**	27.2	53.1	1.96	202	**46.7**	38.5	54.8	1.74	290	**45.2**	38.1	51.4	1.67
BUCHAREST	31	**34.6**	11.8	56.9	1.84	85	**62.3**	47.8	76.8	2.00	116	**56.6**	43.7	69.5	2.06
VERONA	87	**55.7**	39.5	71.1	2.62	235	**63.9**	55.2	73.9	2.70	324	**61.6**	53.9	70.1	2.70
VILNIUS	67	**59.6**	45.2	74.3	1.77	177	**55.3**	46.0	65.5	2.02	244	**56.6**	48.9	65.0	1.91

GAM 1.13 (HIV testing)

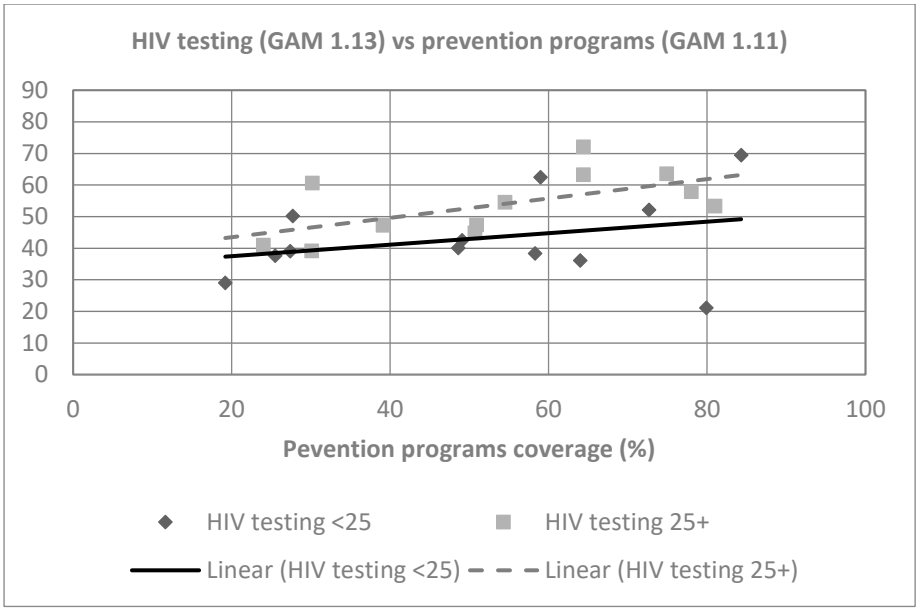
BARCELONA	41	**62.5**	53.2	71.8	0.4	345	**63.6**	53.1	74.0	3.9	386	**63.0**	52.6	73.4	4.7
BRIGHTON	63	**36.1**	22.7	49.6	1.2	313	**54.6**	43.9	65.3	3.3	376	**47.3**	43.3	51.3	0.6
BRUSSELS	50	**42.5**	18.6	66.4	2.9	317	**72.1**	59.8	84.4	5.7	367	**68.1**	56.4	79.8	6.0
HAMBURG	37	**69.5**	53.0	86.0	1.1	350	**53.3**	41.1	65.6	5.1	387	**53.6**	43.4	63.7	4.2
LISBON	34	**21.1**	12.5	29.8	0.4	360	**63.3**	56.0	70.6	2.0	394	**60.9**	53.4	68.4	2.4
LJUBLJANA	117	**40.1**	23.5	56.6	3.4	256	**47.4**	41.9	53.0	0.8	373	**46.4**	40.5	52.3	1.4
SOFIA *															
STOCKHOLM	62	**52.1**	39.0	65.2	1.1	229	**57.9**	47.1	68.6	2.6	291	**56.3**	45.6	66.9	3.5
WARSAW	91	**37.6**	27.2	48.1	1.0	301	**60.6**	48.6	72.6	4.5	392	**54.0**	45.7	62.2	2.8
BRATISLAVA	112	**29.0**	19.1	39.0	1.9	228	**41.0**	31.8	48.8	2.2	340	**37.2**	30.4	43.0	1.9
BUCHAREST	47	**39.0**	21.8	56.2	1.6	122	**44.8**	32.5	57.1	2.0	171	**43.3**	33.1	53.5	1.9
VERONA	99	**50.2**	36.3	64.0	2.3	233	**47.3**	36.1	57.1	3.1	335	**47.7**	38.6	56.1	3.2
VILNIUS	81	**38.3**	24.8	50.5	1.8	192	**39.1**	29.0	47.6	2.1	273	**38.8**	31.2	45.0	1.7

** results from Sofia for GAM 1.13 are missing due to incorrect translation*

GAM 1.14 (HIV prevalence)

BARCELONA	42	**0.8**	0.1	6.6	0.5	358	**16.4**	12.4	21.5	1.2	400	**14.2**	10.1	19.5	1.2
BRIGHTON	65	**2.9**	0.5	15.5	1.5	337	**20.7**	15.7	26.8	1.4	402	**17.6**	13.8	22.3	0.9
BRUSSELS	49	**0.5**	0.1	4.3	0.3	330	**14.4**	8.6	23.0	3.1	379	**12.3**	7.6	19.4	4.9
HAMBURG	37	**1.9**	0.3	9.9	0.6	353	**8.1**	4.1	15.4	3.3	390	**7.5**	3.9	13.8	3.6
LISBON	33	**1.2**	0.1	9.2	0.5	338	**18.9**	14.2	24.8	1.4	371	**17.1**	12.4	23.0	2.6
LJUBLJANA	107	**1.4**	0.2	11.1	1.1	240	**5.3**	2.2	12.2	2.6	347	**4.4**	2.1	8.9	1.8
SOFIA	99	**0.1**	0.0	16.1	0.1	262	**3.9**	1.0	14.0	4.1	361	**3.0**	0.9	9.1	0.8
STOCKHOLM	73	**0.0**	0.0	0.0	-	283	**3.4**	1.5	7.4	1.3	356	**2.4**	1.1	5.2	2.2
WARSAW	92	**1.6**	0.7	3.7	0.3	313	**9.7**	5.7	15.9	1.9	405	**7.2**	4.3	11.9	2.0
BRATISLAVA	118	**2.1**	0.0	4.7	1.5	282	**5.3**	1.8	8.4	2.2	400	**4.3**	2.2	6.2	1.4
BUCHAREST	47	**11.6**	2.1	21.0	1.1	134	**18.5**	8.4	28.7	2.4	183	**18.0**	9.1	27.0	2.6
VERONA	104	**3.8**	0.0	9.6	3.0	293	**12.2**	3.8	20.8	5.6	400	**9.6**	4.5	14.9	3.5
VILNIUS	83	**0.0**	0.0	0.0	-	239	**4.6**	0.4	9.2	3.3	322	**3.4**	0.0	6.9	3.6

Cities presented with white background: TLS survey
Cities presented with grey background: RDS survey
Estimated Design effect: The design effect is a correction factor used to adjust required sample size for cluster sampling.
GAM 1.11 reference items: (i) Do you know where you can go if you wish to receive an HIV test? (ii) In the last twelve months, have you been given condoms?
GAM 1.12 reference items: -
GAM 1.13 reference items: (i) Have you been tested for HIV in the last 12 months?; (ii) If yes: I don't want to know the results, but did you receive the results of that test?
GAM 1.14 reference items: -


HIV testing (GAM 1.13) vs prevention programs (GAM 1.11)
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
Pevention programs coverage (%)
HIV testing <25
HIV testing 25+
Linear (HIV testing <25)
Linear (HIV testing 25+)