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ORIGINAL RESEARCH

Increased targeted HIV testing and reduced undiagnosed HIV infections among gay and bisexual men

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Objectives

To evaluate the impact of government HIV strategies that aimed to increase HIV testing uptake and frequency among gay and bisexual men (GBM) in New South Wales (NSW), Australia.

Design

We analysed HIV testing data from existing passive and sentinel surveillance systems between 2010 and 2018.

Methods

Six indicators were measured: (1) state-wide total HIV laboratory tests; (2) number of GBM attending publicly-funded clinics; (3) 12-monthly testing uptake; (4) annual testing frequency; (5) HIV testing with a STI diagnosis; and (6) HIV positivity. Mathematical modelling was used to estimate (7) the proportion of men with undiagnosed HIV. Indicators were stratified by Australian vs. overseas-born.

Results

Overall, 43,560 GBM attended participating clinics (22,662 Australian-born, 20,834 overseas-born) from 2010-2018. Attendees increased from 5,186 in 2010 to 16,507 in 2018. There were increasing trends ($p<0.001$ for all) in testing uptake (83.9% to 95.1%); testing with a STI diagnosis (68.7% to 94.0%); annual HIV testing frequency (1.4 to 2.7); and a decreasing trend ($p<0.01$) in HIV positivity (1.7% to 0.9%). Increases in testing were similar in Australian-born and overseas-born GBM. However, there were decreasing trends in the estimated undiagnosed HIV proportion overall (9.5% to 7.7%) and in Australian-born GBM (7.1% to 2.8%), but an increasing trend in overseas-born GBM (15.3% to 16.9%) ($p<0.001$ for all).

Keywords: gay and bisexual men, HIV infections, HIV testing, sentinel surveillance, undiagnosed HIV

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Introduction

HIV testing is a prerequisite for antiretroviral treatment (ART), which reduces morbidity and mortality [1-3] and can reduce HIV to undetectable levels, rendering the person sexually non-infectious [4-6]. Further, confirmation of HIV-negative status enables people at ongoing risk of HIV infection to access effective HIV prevention strategies such as pre-exposure prophylaxis (PrEP) [7]. The World Health Organization (WHO) recommends that HIV testing is offered at least annually for key populations, or more frequently depending on risk behaviours [8]. In Australia, guidelines in place from 2014 until late 2019 recommended annual HIV testing in sexually active gay and bisexual men (GBM), and up to four times a year in

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those at higher risk [9]. In 2014, UNAIDS announced ambitious new global targets that 90% of people living with HIV (PLHIV) should be diagnosed by 2020 [10], and subsequently released fast-track targets that 95% should be diagnosed by 2030 [11].

In New South Wales (NSW), since 2010 approximately 80% of HIV diagnoses occurred among GBM [12]. The NSW Government released a strategy in 2012 aiming for the virtual elimination of HIV transmission in NSW by 2020 [13]. This aim was reaffirmed in the 2016 NSW HIV strategy [14]. As well as enhanced prevention strategies and easier access to treatment, the two strategies emphasized increasing HIV testing in those at risk, and the strengthening of service integration and models of care to deliver HIV testing in priority settings [13,14]. The strategies also prioritized improved surveillance and research to inform the HIV prevention response.

In this context, we monitored changes in testing uptake and testing frequency as well as the proportion of GBM with undiagnosed HIV infection, during the period covered by the two HIV strategies.

Methods

Monitoring and evaluation

In 2015 a 5-year monitoring and evaluation framework was funded (the NSW HIV Prevention Partnership Project, hereafter 'the NSW Partnership Project') to evaluate the NSW HIV strategies [15]. This project included government, community, clinical, laboratory and research organizations involved in HIV prevention in NSW [15]. The NSW Partnership Project aimed to provide timely and regular feedback to policymakers and programme implementers on a series of HIV testing indicators selected to measure the uptake and impact of a range of testing initiatives implemented under the strategies, and identify any adjustments or new initiatives required.

Setting

HIV testing services in NSW are provided by a mix of clinical and community services. Sexual health services (SHSs) focus on providing free HIV and sexually transmissible infection (STI) testing for priority populations, including GBM, and are funded by the NSW government. Since 2013, peer-led, rapid HIV testing services have also offered free HIV and STI testing with a priority focus on GBM. These services are operated and managed by ACON (NSW's largest LGBTI health organization) and partnering SHSs with funding from the NSW government. Hereafter we refer to SHSs and peer-led services collectively as publicly funded HIV testing services. General practice clinics also offer HIV and STI testing as part of broader primary care services. These clinics are privately owned, with fees subsidized by Australia's universal health care scheme, Medicare, and many clinics charge a co-payment for visits. Some private GP clinics specialize in sexual health-related consultations and have high caseloads of GBM.

Initiatives to increase HIV testing uptake and frequency

We undertook a consultation process with selected HIV testing services, community organizations and NSW Health staff working in HIV prevention to document initiatives undertaken to increase HIV testing.

HIV indicators

Indicators to monitor HIV testing were designed and approved by an expert panel representing stakeholders from the government, HIV research, clinical, and community sectors prior to finalization for publication in

Box 1 New South Wales (NSW) HIV indicators

(1) HIV laboratory tests – the total number of HIV tests performed by NSW laboratories.
(2) GBM attendees – the number of unique gay and bisexual men (GBM) who attended publicly funded HIV testing services.
(3) Twelve-monthly HIV testing uptake – the proportion of GBM attending a testing service who had an HIV test in the 12 months prior to their visit.
(4) Annual HIV testing frequency – the average number of HIV tests per GBM at a publicly funded HIV testing service in the previous 12 months.
(5) HIV testing concurrent with a STI diagnosis ('concurrent HIV testing') – the proportion of GBM diagnosed with chlamydia, gonorrhoea and/or infectious syphilis at an HIV testing service, who received an HIV test in the window of 60 days before to 30 days after a sexually transmissible infection (STI) diagnosis.
(6) HIV positivity – the proportion of GBM tested at a publicly funded HIV testing service who had a confirmed new HIV-positive diagnosis.
(7) Proportion of HIV-positive GBM who were undiagnosed – the proportion of GBM living with HIV in NSW who were undiagnosed.

quarterly online data reports [16].Seven HIV testing indicators were identified for the project, and these are listed in Box 1. Two of the indicators were at a state-wide level (1 and 7), and the others focused on the publicly funded HIV testing services, where a large proportion of the HIV testing initiatives had occurred.

Indicators 1 and 3–6 are calculated using 6-monthly (biannual) intervals and reported as an overall annualized rate of change. Indicators 2 and 7 are calculated using annual intervals and reported as an annualized rate of change. We also stratified indicators by place of birth (Australia, overseas), as HIV notification data in NSW showed a divergence in notifications among Australian- and overseas-born GBM during the study period [12]. Indicators 2–6 excluded any previously diagnosed HIV-positive individuals. We also stratified the HIV testing frequency indicator by high risk and other risk. These categories were defined based on behavioural and clinical criteria aligning as close as possible to HIV and STI testing, and PrEP guidelines [9,17]. GBM were defined as 'high risk' for HIV if they were enrolled into a large-scale rapid PrEP uptake study [7] or reported injecting drug use; reported more than 20 sexual partners per year and inconsistent condom use; or were diagnosed with a rectal STI in the past 2 years.

Data sources

Data sources that contributed to these indicators are as follows:

- *NSW HIV testing data from laboratories:* 15 laboratories, covering ~95% of HIV notifications in NSW, that send monthly aggregated HIV test numbers to NSW Health every quarter. These data are available from 2012 [16] and were used to calculate indicator 1.
- *HIV testing data from publicly funded HIV testing services:* 25 SHSs including three peer-led community-based HIV/STI testing services, contributed de-identified data on patient visits in NSW. These data were extracted from a national clinic-based sentinel surveillance system called ACCESS (Australian Collaboration for Coordinated Enhanced Sentinel Surveillance) [18]. The software used to extract the data enables anonymous probabilistic linkage of patient records between clinics within the ACCESS network to comprehensively measure patients' testing history across participating clinics, including any linked HIV/STI tests conducted at general practices within the ACCESS network [18]. Linked STI/HIV testing data within the ACCESS NSW network (including publicly funded HIV testing services (PFSHCs) and private general practices) were used to calculate indicators 2–6. We assessed the representativeness of our sample by comparing the number of HIV tests conducted among GBM at publicly funded sexual health clinics in our dataset for 2018 to the reported state-wide total number of HIV tests conducted among GBM at PFSHCs.
- *HIV notifications data:* doctors report demographic, testing, clinical and management history of people with laboratory notified HIV infection, including CD4 count at diagnosis, HIV exposure category, country of birth and year of arrival in Australia (for people born outside Australia) to NSW Health; reporting is mandatory [19]. These data were used to calculate indicator 7 (undiagnosed proportion) using the European Centre for Disease Prevention and Control (ECDC) HIV modelling tool, as previously described [20-24].

Statistical analyses

Poisson regression was used to evaluate overall annual trends between 2010 and 2018 with the exception of indicator 1 which was analysed over 2012–2018. Calendar time was fitted as a continuous independent variable based on half-year units (H1 and H2, with the exception of indicators 2 and 7, which used full-year units) [25]. Potential changes in trend were reviewed using join-point regression with the permutation method of model optimization [25]. Outputs were calculated as annual average percentage changes (AAPC). Analyses were conducted using Stata 15.1 and Join-point Regression Program v.4.6.0.0 [26].

Ethics

Ethical approval, including waiver of consent, for the ACCESS database was granted by the human research ethics committee of Alfred Hospital in Melbourne (248/17). Inputs to modeled data calculating estimated undiagnosed HIV and state-wide HIV testing data are publicly available.

Results

Representativeness of our sample

In 2018, our dataset included details of 29 829 HIV tests among GBM conducted at publicly funded sexual health clinics. This was 82.4% of the 2018 state-wide total number of 36 195 HIV tests conducted among GBM who attended publicly funded sexual health clinics, as reported in quarterly HIV data monitoring reports [27].

Initiatives to increase HIV testing uptake and frequency, and total state-wide HIV testing

Between 2010 and 2018, a number of initiatives were undertaken in NSW to increase HIV testing among GBM

(Table S1). These initiatives included policy changes, and the development of performance indicators for the publicly funded HIV testing services included testing targets, innovations in clinic procedures, expanded testing modalities, health promotion, and workforce development. Over this time, state-wide testing increased [AAPC = 5.8%, 95% confidence interval (CI): 4.9–6.6, $P < 0.001$), with a total of 3 519 130 HIV laboratory tests conducted between 2012 and 2018 (Fig. S1).

12-monthly HIV testing uptake and GBM attendance at HIV testing services

The proportion of GBM who visited a publicly funded HIV testing service who had an HIV test in the previous 12 months increased over time from 83.9% to 95.1%, with a similar increase but starting from a lower base in Australian-born GBM (from 81.8% in 2010 to 94.7% in 2018) and a higher base in overseas-born GBM (from 87.0% in 2010 to 95.5% in 2018) (Fig. 1). An increasing trend over the entire study period was observed in GBM overall (AAPC = 1.3%, 95% CI: 0.9–1.6, $P < 0.001$) and in Australian-born (AAPC = 1.6%, 95% CI: 1.2–1.9, $P < 0.001$) and overseas-born GBM (AAPC = 1.1%, 95% CI: 0.2–1.9, $P = 0.0149$). These changes took place in a backdrop of increasing annual attendance of GBM (218%) at HIV testing services over 2010–2018 (AAPC = 16.5%, 95% CI: 11.5–21.6, $P < 0.001$; Fig. S2).

Annual HIV testing frequency

Among HIV-negative GBM attending the HIV testing services, the annual HIV testing frequency was 1.4 in 2010, increasing to 2.7 in 2018 (Fig. 2), with an increasing trend overall across the study period (AAPC = 7.5%, 95% CI: 6.1–9.0, $P < 0.001$). Among Australian-born and overseas-born GBM classified as high risk (Fig. 2), testing frequencies were fairly comparable, as were overall trends (AAPC = 9.0%, 95% CI: 7.3–10.9, $P < 0.001$; and AAPC = 8.7%, 95% CI: 6.4–11.0, $P < 0.001$). In Australian and overseas-born GBM classified into the 'other' risk category, increasing testing frequency was also observed overall (AAPC = 5.1%, 95% CI: 3.8–6.5, $P < 0.001$; and AAPC = 3.3%, 95% CI: 2.4–4.1, $P < 0.001$).

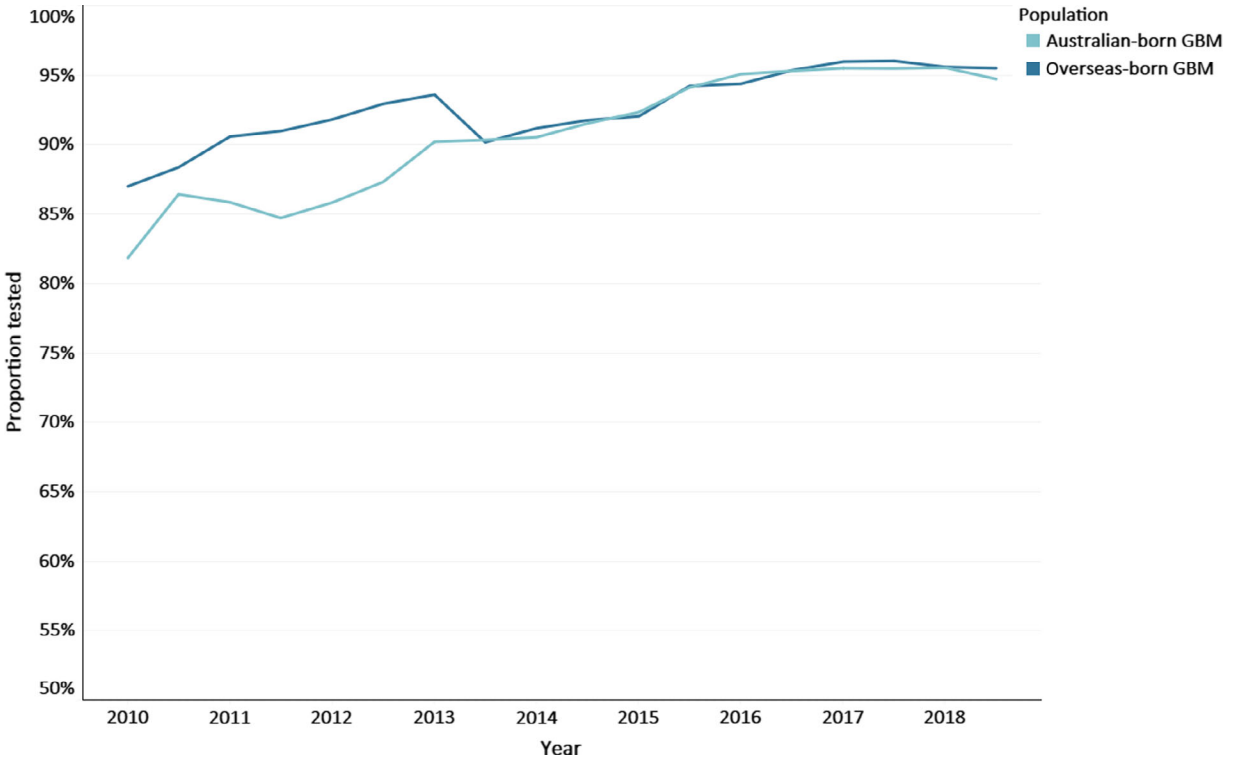

Fig. 1 Proportion of patients tested at least once for HIV in the previous year in publicly funded HIV testing services. Patients known to be HIV-positive were excluded. The testing period is retrospective; the proportion represents those who attended in the half-year period and had at least one HIV test in the previous 12 months. [Colour figure can be viewed at wileyonlinelibrary.com]

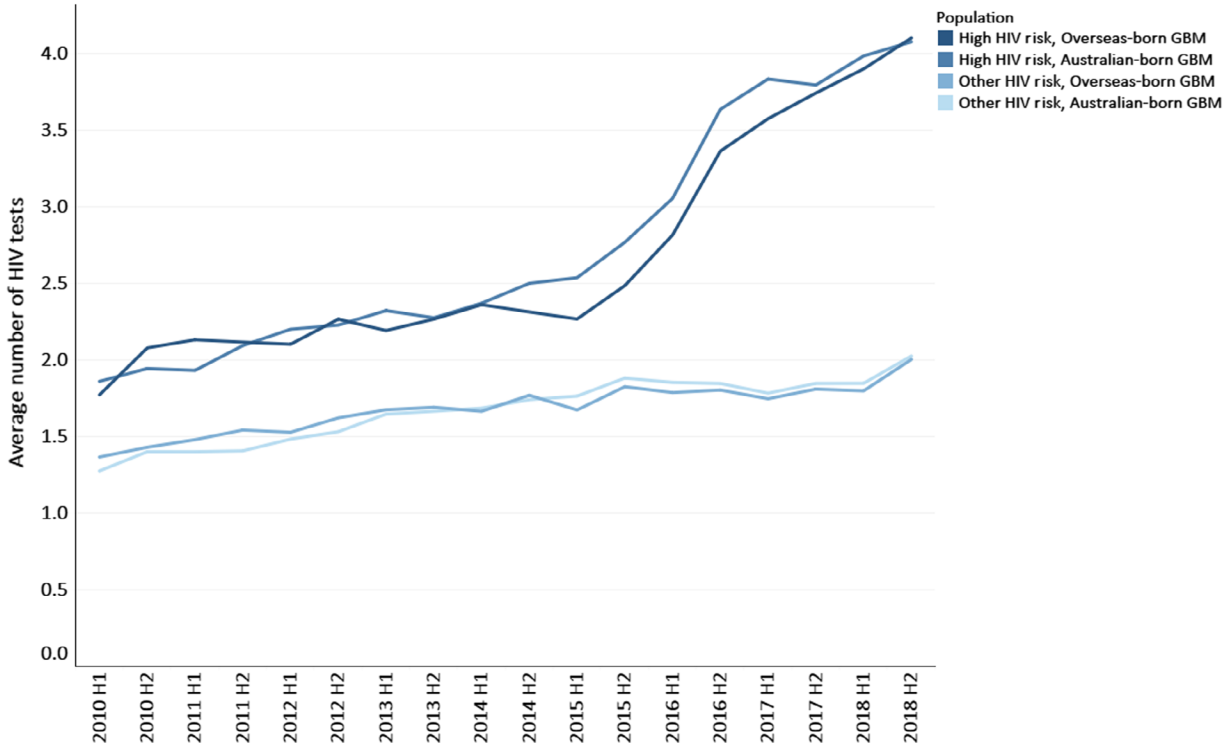

Fig. 2 Average number of HIV tests among gay and bisexual men (GBM) attending publicly funded HIV testing services, by risk. Average is calculated over the retrospective 12-month period. Patients known to be HIV-positive were excluded. GBM were defined as high risk if they were on pre-exposure prophylaxis (PrEP); reported injecting drug use; reported more than 20 partners/year and inconsistent condom use; or reported history of a rectal sexually transmissible infection in the past 2 years. H1 (January 1–June 30), H2 (July 1–December 31).

HIV testing occurring concurrently with an STI diagnosis

There were a total of 14 733 GBM diagnosed with an STI, with 68.7% concurrently tested for HIV in 2010 increasing to 94.0% in 2018, with similar increases in Australian-born (66.7–93.6%) and overseas-born GBM (72.2–94.4%) (Fig. 3). Increasing trends in concurrent HIV testing in GBM were detected over the entire study period (AAPC = 2.8%, 95% CI: 1.6–4.0, $P < 0.001$) and similar trends were also observed when stratified by Australian- and overseas-born GBM (AAPC = 2.6%, 95% CI: 1.8–3.5, $P < 0.001$ and AAPC = 2.7, 95% CI: 1.5–4.0, $P < 0.001$, respectively).

HIV positivity

There were a total of 162 207 HIV unique tests conducted at HIV testing services over the study period. A total of 886 positive tests (45.5% of the total) were in Australian-born GBM and 1051 (54.0%) were in overseas-born GBM. Overall, HIV positivity declined from 1.7% in 2010 to 0.9% in 2018 (1.2% to 0.7% in Australian and 2.4% to 1.2% in overseas-born GBM respectively (Fig. 4). A declining trend was observed among all GBM (AAPC = –6.4%, 95% CI: –10.7 to –1.8, $P = 0.0065$) and in overseas-born GBM (AAPC = –7.6%, 95% CI: –9.8 to –5.2, $P < 0.001$) and there was a non-significant declining trend in Australian-born GBM (AAPC = –6.5%, 95% CI: –13.3–0.9, $P = 0.0833$).

Estimated proportion of HIV-positive GBM who were undiagnosed

There were an estimated 8429 GBM who were living with HIV in NSW by the end of 2018, of whom 645 had undiagnosed infections. Of these, 24% (152, range: 108–220) were Australian-born and 76% (493, range: 349–532) were overseas-born GBM. The proportion of HIV-positive GBM who were undiagnosed declined by 18.9%, from 9.5% in 2010 to 7.7% in 2018 (AAPC: –2.6%, 95% CI: –2.8% to –2.5%, $P < 0.001$). Among Australian-born HIV-positive GBM, a declining trend was observed in the estimated undiagnosed proportion, from 7.1% to 2.8% (AAPC = –11.1%, 95% CI: –12.0 to –10.3, $P < 0.001$) and the estimated time from infection to diagnosis fell from 2.0 to 1.6 years (AAPC = –2.5%,

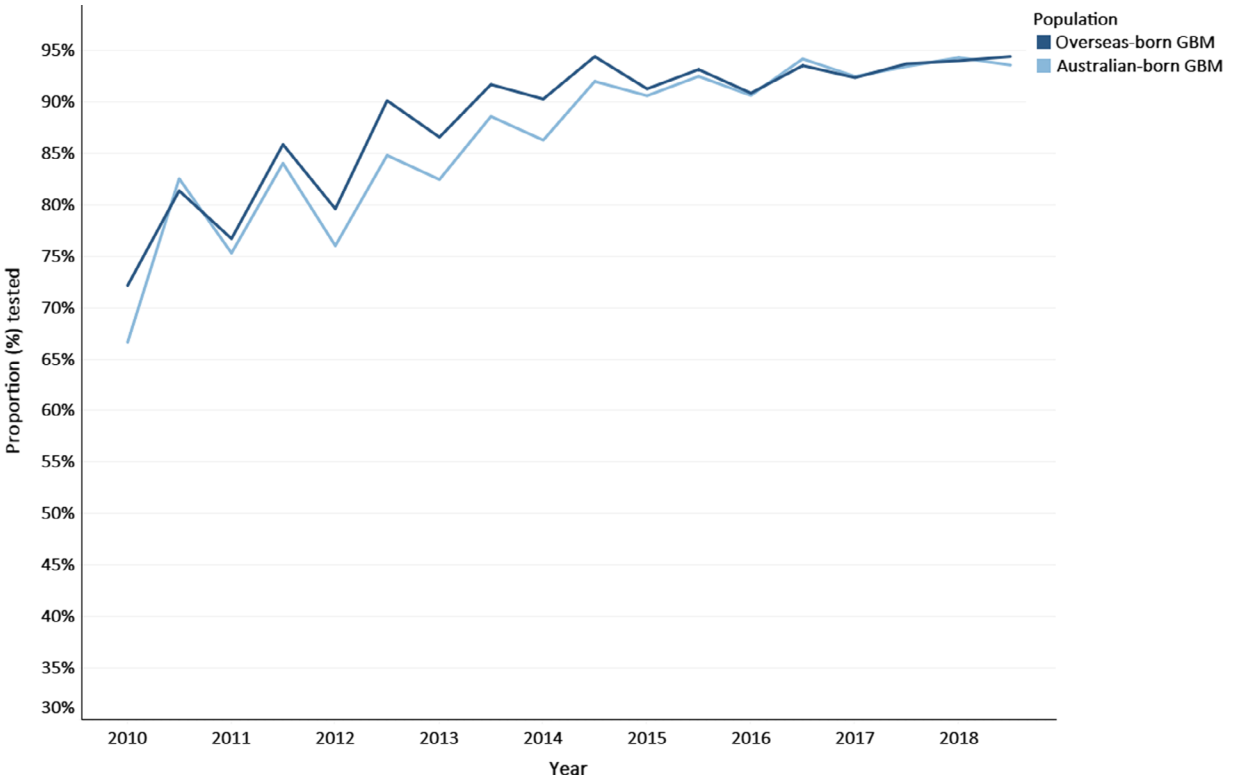

Fig. 3 Proportion of patients attending a publicly funded HIV testing services who were diagnosed with a sexually transmissible infection (STI) who received an HIV test in conjunction with that STI diagnosis, by place of birth. Patients known to be HIV-positive were excluded. The following were included: Any diagnosis of chlamydia, gonorrhoea and/or infectious syphilis; any HIV test conducted at least 60 days before or at most 30 days after a diagnosis was received. [Colour figure can be viewed at wileyonlinelibrary.com]

95% CI: –2.6 to –2.4, $P < 0.001$) (Figs 5, S3). However, in overseas-born HIV-positive GBM an increasing trend was seen in the estimated undiagnosed proportion (from 15.3% to 16.9%, AAPC = 1.2%, 95% CI: 1.2–1.3, $P < 0.001$), and time from infection to diagnosis of 2.6 to 2.9 years (AAPC = 1.8%, 95% CI: 1.8–1.8, $P < 0.001$) (Figs 5, S3).

Discussion

Over the 9-year study period, including the release of two NSW HIV strategies, there were steady increases in HIV testing among GBM attending publicly funded HIV testing services. HIV testing was optimized among these men, with the 12-monthly HIV testing uptake reaching 95% in 2018, and targeted HIV testing in GBM diagnosed with an STI reaching 94% by 2018. HIV testing frequency in high-risk GBM also increased, from an average of 1.8 to 4.1 tests/year between 2010 and 2018, in accordance with clinical guidelines which recommended testing up to four times per year for high-risk men [9]. Further, the total number of HIV-negative GBM attending publicly funded HIV testing services increased three-fold from 5186 GBM in 2010 to 16 507 GBM in 2018, with a total of 39 464 GBM tested over 9 years, demonstrating the successful mobilization of multiple stakeholders, including community organizations and clinical services, to increase testing, and increased demand for testing among GBM. Concurrently, over the study period, there was a 19% decline in the estimated undiagnosed HIV proportion among GBM living with HIV, from 9.5% to 7.7%.

The increases in the uptake of HIV testing and HIV testing frequency occurred during a period where a range of initiatives were undertaken in NSW to make HIV testing more accessible, acceptable and efficient. These initiatives included the provision of alternative testing settings, outside traditional clinical environments, and the implementation of key performance indicators for increased HIV testing at SHSs. Local health service managers were accountable for meeting these targets. Capacity at existing services was increased by the expansion of express clinics, enabling clinics to see more clients during clinic sessions. New testing modalities (rapid tests and

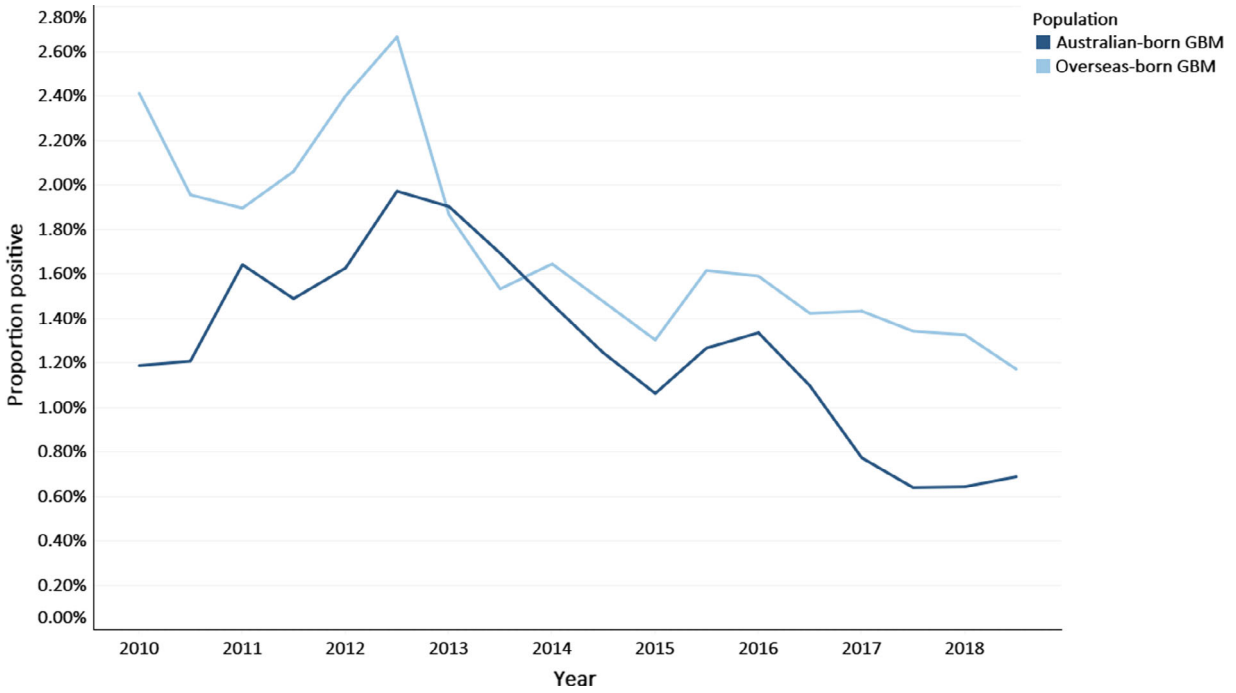

Fig. 4 Proportion of gay and bisexual men (GBM) attending publicly funded HIV testing services tested for HIV with a positive result (HIV positivity) by 6-month period during 2010–2018. Patients known to be HIV-positive were excluded. HIV positivity is calculated as the proportion of individuals tested in a retrospective year (discounting repeat tests among individuals) with an HIV diagnosis or confirmed pathology (positive p24 antigen or western blot test). [Colour figure can be viewed at wileyonlinelibrary.com]

dried blood spot postal test kits) were introduced and new peer-led community-based rapid HIV testing services were developed in partnership with SHSs. Mobile phone text (SMS) reminders for re-testing were expanded across testing services, and there were ongoing health promotion activities to create demand. Many of these initiatives, e.g. SMS appointment reminders, the introduction of rapid HIV testing at sexual health clinics and peer-led rapid HIV testing services, followed an iterative data-driven process where feasibility, impact and acceptability were determined in pilot projects prior to large-scale expansion [28-31]. A large-scale PrEP access programme targeted largely at high-risk GBM was introduced in NSW in 2016, with men on PrEP receiving quarterly HIV and STI testing [32]. Regular HIV testing and concurrent HIV and STI testing among GBM enrolled in this study would have significantly contributed to the increases in HIV testing frequency and HIV testing in conjunction with an STI diagnosis that we observed from 2016. During the course of our study we modified reporting of HIV testing frequency among high-risk GBM to stratify them according to PrEP status. Increases in HIV testing frequency were observed among high-risk GBM who commenced PrEP, but not among high-risk GBM who were not on PrEP [12]. A recent Australian national study of self-reported HIV testing frequency among GBM made a similar finding [33].

The estimated proportion of GBM with undiagnosed HIV infections (9.5%) was below the 10% target for 2020 outlined by UNAIDS at the beginning of the study period and declined by 19% (to 7.7%) in 2018. The 61% decline in the estimated proportion of Australian-born GBM with undiagnosed HIV (to 2.8%) in 2018, below the UNAIDS fast-track target of 5% by 2030 [11], is among the lowest levels reported to date in GBM globally [34]. These changes, along with the reduction in the estimated time from infection to diagnosis in Australian-born GBM (from 2.0 years in 2010 to 1.6 years in 2018) suggest that the testing initiatives undertaken were well targeted and may have contributed to reductions in HIV notifications. Undiagnosed HIV infections were estimated to contribute to 59% of new infections each year in Australia in 2015, due to increases in sexual risk behaviour, and the larger proportion of undiagnosed GBM in the acute phase of infection, who are more likely to have high viral loads associated with seroconversion [24]. It is likely that improvements in ART initiation among people diagnosed with HIV and PrEP scale-up among high-risk GBM also contributed to lower HIV notifications [7,21].

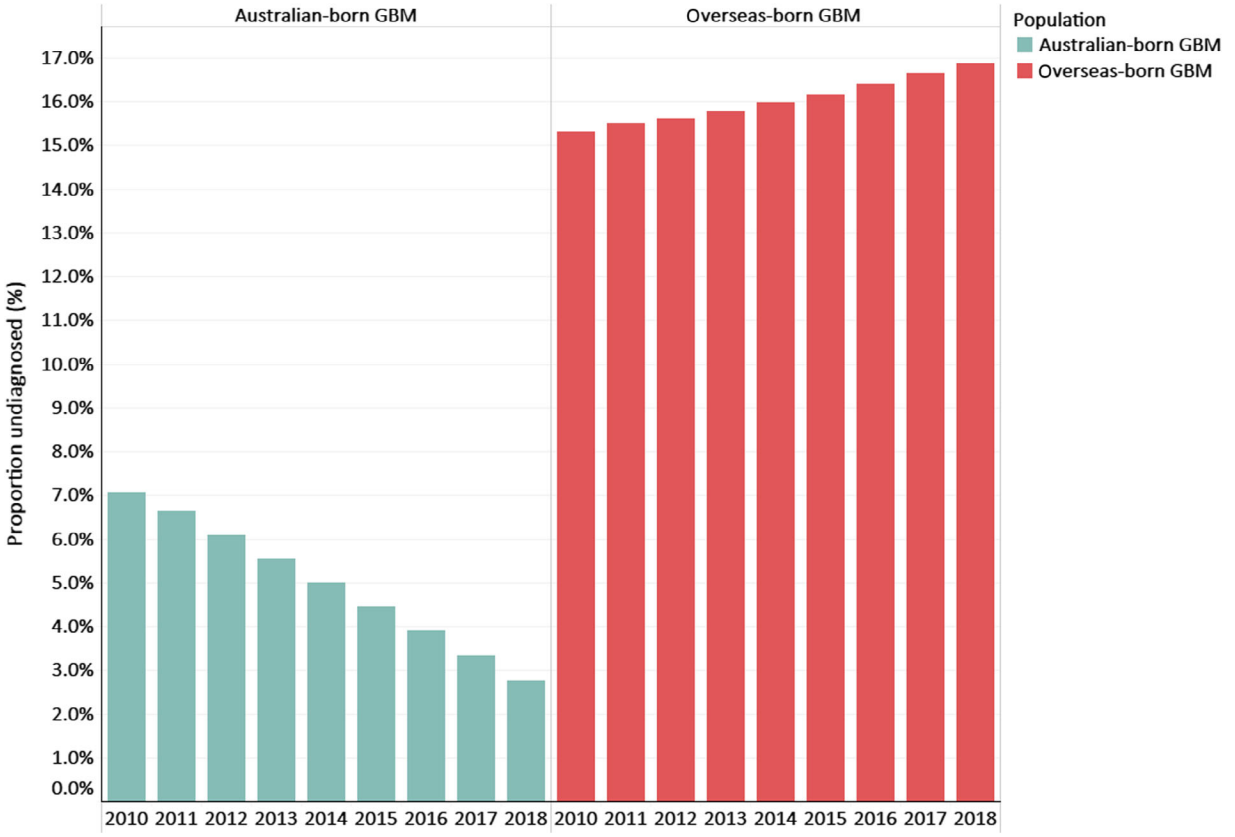

Fig. 5 Proportion of gay and bisexual men (GBM) with undiagnosed HIV infection, by place of birth. [Colour figure can be viewed at wileyonlinelibrary.com]

These overall encouraging trends in testing in GBM were tempered by some concerning trends in overseas-born GBM, who accounted for over three-quarters of all undiagnosed HIV infections in GBM living with HIV in 2018, and among whom the proportion undiagnosed (16.9%) was six times higher than among Australian-born men. Moreover, in overseas-born GBM, the time from infection to diagnosis increased by 15%, from 2.6 years in 2010 to 2.9 years in 2018. These findings are consistent with a divergence between new HIV notifications among Australian-born and overseas-born reported in NSW and Australia [12,23]. More detailed analysis of 2018 NSW HIV notification data shows that an increasing proportion of GBM newly diagnosed with HIV are from Asia, increasing from 18.5% in 2014 to 29.2% in 2018, and that 44.6% of all overseas-born GBM diagnosed were likely to have acquired their infection overseas [12]. Explanations for these epidemiological shifts include greater migration of Asian GBM to Australia [35], including a substantial increase in overseas-born students arriving in NSW, increasing the population size of men with undiagnosed HIV relative to those men living with HIV who know their status. Between 2011 and 2016 the proportion of the NSW population that was born overseas increased from 28.3% to 30.1%, and the country of origin of the largest group of migrants was China [36]. Temporary residents in Australia are not eligible for government-subsidized PrEP, so PrEP uptake may be lower among recently arrived overseas-born GBM than among Australian-born GBM. Also, it is possible there has been an increase in HIV transmissions among overseas-born GBM in NSW, due to higher-risk sexual networks, lower health literacy and lack of awareness about risk, and barriers to accessing prevention services due to concerns about confidentiality [37].

Despite the increasing proportion of undiagnosed HIV infections in overseas-born GBM, our data from sexual health clinics showed that testing at the HIV testing services has increased in overseas-born GBM to the same extent as Australian-born GBM. This suggests that once

linked to care, overseas-born MSM do access HIV testing at high rates. These findings suggest that overseas-born men should be linked with HIV testing services soon after arrival into Australia. In response to these emerging data, community-based organizations in NSW introduced culturally appropriate, targeted social marketing campaigns in specific Asian languages in 2019 to raise awareness about HIV testing and prevention [38]. Additionally, Mandarin language HIV testing clinics were established in late 2018 within the existing peer-led community-based services, staffed by Mandarin-speaking peers and nurses [39].

There are a few potential limitations to consider when interpreting our findings. First, our data on the state-wide number of laboratory tests were not specific to GBM. Second, HIV testing data from ACCESS did not separately analyse HIV testing conducted by GBM visiting GPs in NSW, as HIV testing initiatives in the strategies focused largely on publicly funded HIV testing services, where 55.7% of gay men report attending for HIV testing [40]. Third, in grouping all overseas-born men together, without distinguishing time since arrival to Australia and region of birth, we recognize that we may mask nuances at subpopulation levels. Fourth, given the observational design, it is possible that changes may have occurred without the initiatives taking place, or may be due to unmeasured factors. We think this is very unlikely as we have comprehensively captured all the major HIV testing initiatives being undertaken in NSW. Additionally, we included men who enrolled in a large NSW PrEP access study among men who we defined as high risk. While GBM who take PrEP as prescribed have very high levels of protection against HIV infection [41,42], we included these men in the high-risk category as this group was clinically determined as being at high risk of HIV infection. An analysis of Australian national cross-sectional data collected among GBM found that self-reported annual HIV testing frequency among high-risk men who were not taking PrEP did not increase between 2013 and 2018 [43]. However, our analysis covered a longer period and found that annual HIV testing frequency among GBM did increase before uptake of PrEP among GBM in 2016 [32]. Unfortunately, the aggregate nature of our data collection and analysis, and an ethics restriction that prevents us from reporting data relating to single clinics meant that we were unable to assess the impact of specific initiatives or changes at individual clinics; however, we have referred to studies that did evaluate the impact of some of the specific testing initiatives. Finally, the PrEP study protocol required men to have monitoring visits which included HIV and STI testing. As the PrEP study commenced recruitment in March 2016, testing among men in the study would have contributed to increased HIV testing frequency and HIV testing in conjunction with an STI diagnosis.

Conclusion

In conclusion, since 2015, HIV prevention, monitoring and evaluation data have been used to inform the development and targeting of initiatives to increase HIV testing in priority populations in NSW. These data were used to monitor two state-wide HIV strategies and inform the ongoing implementation of targeted HIV testing initiatives. There were considerable increases in HIV testing in GBM and, in parallel, decreases in the proportion of undiagnosed HIV infections among GBM. Among GBM, higher rates of undiagnosed infections among overseas-born men compared with Australian-born men suggest a need for greater health promotion and novel initiatives targeting this group. NSW has begun to implement strategies to address this emerging priority.

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Conflict of interest: The authors have no competing interests to declare.

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Author contributions

RG, AEG, PGP and PK conceptualized the study and data analysis plan. PGP collated and analysed data and contributed to the drafting and re-drafting of manuscript. PK, CP and DC collected data on HIV testing initiatives through the NSW HIV Prevention Partnership Project, and PK contributed to the drafting and re-drafting of the manuscript. CP collected additional data on HIV testing initiatives in NSW. HM advised on and carried out the statistical analysis. PGP, PK, TD, DC, CS, VK, KJ, and VJB developed HIV testing indicators through the NSW HIV Prevention Partnership Project. RTG ran the ECDC model. JA assisted with collation of ACCESS data. PR provided input on HIV testing initiatives undertaken at sexual health clinics. TD, CS, VK, KJ, BRB, VJB and all other authors read, commented on and approved the final manuscript.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Fig. S1 Total biannual number of HIV tests in NSW laboratories.

Fig. S2 Number of individual HIV-negative GBM attending publicly funded HIV testing services per year over study period by place of birth.

Fig. S3 Time to diagnosis (years) stratified by Australian-born and overseas-born GBM.

Table S1 HIV testing initiatives in New South Wales during 2010–2018.

Appendix 1

The investigators in the NSW HIV Prevention Partnership Project Study are Professor Andrew Grulich, Dr Christine Selvey, Professor Rebecca Guy, Associate Professor Garrett Prestage, Associate Professor Iryna Zablotska, Ms Jo Holden, Mr Tim Duck, Mr Craig Cooper, Ms Karen Price, Professor Martin Holt, Professor John de Wit, Professor John Kaldor, Professor Anthony Kelleher and Professor David Wilson. The late Mr Alan Brotherton, the late Professor David A Cooper and the late Adjunct Associate Professor Levinia Crooks were also investigators on the grant. The project steering committee included these investigators, Mr Bill Whittaker, Mr Phillip Keen, Dr Denton Callander, Mr Daniel Madeddu, Dr Heather-Marie Schmidt, Ms Barbara Telfer, Ms Karen Price, Dr Mark Boyd, Mr Craig Cooper, Dr Benjamin R Bavinton, Mr Scott McGill, Dr Prital Patel, Ms Cherie Power, Dr Angie Pinto, Dr Steven Nigro, Ms Tina Gordon and Mr Lance Feeney. The members of the HIV Testing Working Group of the NSW HIV Prevention Partnership Project were Professor Rebecca Guy, Mr Tim Duck, Ms Cherie Power, Professor Andrew Grulich, Mr Phillip Keen, Dr Denton Callander, Dr Vickie Knight, Ms Vicki Bowden, Mr Craig Cooper, Mr Philip Cunningham, Associate Professor Limin Mao, Dr Prital Patel, Mr Karl Johnson, Professor John de Wit, Mr James Gray, Mr Matthew O'Dwyer, Dr Heather-Marie Scmidt and Mr Brent Clifton.