Integrated decision support software and data feedback can improve sexual orientation recording, comprehensive sexual health testing and detection of infections among gay and bisexual men attending general practice

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ABSTRACT

Background: Gay and bisexual men are disproportionately affected by HIV and other sexually transmissible infections (STIs) yet opportunities for STI testing of this population are often missed or incomplete in general practice settings. Strategies are needed for improving the uptake and completeness of sexual health testing in this setting.

Objectives: We evaluated an intervention centred around integrated decision support software and routine data feedback to improve the collection of sexual orientation data and increase sexual health screening among gay and bisexual men attending general practice.

Methods: A study using before/after and case/comparison methods was undertaken to assess the interventions impact in seven Australian general practice clinics. The software was introduced in 2012 and used patient records to prompt clinicians to record sexual orientation and, along with pathology testing history, generated prompts when sexual health testing was overdue or incomplete. It also facilitated the routine extraction of clinical data, which was regularly reported to clinicians. We calculated summary rate ratios (SRRs) based on quarterly trends in the 12-month before and 24-month intervention periods and compared those to four comparison clinics that did not receive the intervention.

Results: Among 32,276 attending male patients, sexual orientation recording increased 19% (from 47% to 56%) during the intervention period (SRR=1.10, P<0.001). Comprehensive STI testing increased by 89% during the intervention (26-49%; SRR=1.38, P<0.001). While comprehensive testing increased slightly in comparison sites, the increase was comparatively greater in intervention sites (SRR=1.12, P<0.001). There was also an increase in detection of chlamydia and gonorrhoea after the intervention’s introduction, which was not observed in the comparison sites.

Conclusion: Integrated decision support software and data feedback were associated with modest increases in sexual orientation recording, comprehensive screening among gay and bisexual men, and the detection of STIs. Decision support software can be utilised to enhance the delivery of sexual health care in general practice.
KEYWORDS
Men who have sex with men; general practice; sexual health; software; STIs

INTRODUCTION
In most high-income settings, the prevalence of HIV and other sexually transmissible infections (STIs) is high among gay, bisexual and other men who have sex in men.[1-3] Combatting this disproportionate burden requires, among other strategies, routine and frequent sexual health testing, particularly among men whose sexual practices place them at risk of infection.[4] For this reason, clinical guidelines in countries like Australia, Canada and the USA recommend that sexually-active gay and bisexual men should receive a comprehensive sexual health screen at least once per year and more frequently as dictated by sexual risk.[5-7]

Australian guidelines during this study defined a comprehensive screen for gay and bisexual men as one that involved tests for rectal and urogenital chlamydia, rectal and pharyngeal gonorrhoea, infectious syphilis, and (among men not known to be infected), HIV.[8] The importance of comprehensive screening has been underscored by previous research, with one study finding that 60% of gonorrhoea infections and 80% of chlamydia in gay and bisexual men would be missed if rectal swabs were not collected.[9] And although approximately three quarters of gay men in Australia receive some form of sexual health testing annually, far fewer (37%) report receiving a comprehensive screen.[10]

In many countries, general practice is responsible for a large amount of sexual health testing. In Australia, just over half of gay and bisexual men report receiving sexual health testing from general practice clinics [11, 12] and the regularity with which people attend general practices makes them ideal for routine screening. Some general practitioners, however, are uncomfortable discussing issues of sexuality with patients or simply forget to raise sexual health due to a focus on the primary reason...
for presentation and other competing demands. Further, studies have found that general practitioners rarely take patients’ sexual histories or record their sexual orientation, which is vital information for guiding any approach to STI testing. Collectively, these factors may challenge the quality and completeness of sexual health care to gay and bisexual men attending general practice clinics. This contention is supported by research that found gaps in the uptake of STI testing among gay and bisexual men attending Australian general practice clinics.

One way to enhance health care provision is through computerised clinical decision support systems. Systems that prompt clinicians or provide them with tools to make clinical decisions have been shown in diverse fields of health to improve patient outcomes. While a few studies have shown that clinician prompts can improve rates of testing for HIV and other STIs, nearly all have been based in sexual health clinics and focused on offering sexual health testing to all patients or all members of a particular population. In general practice, patients attend frequently and for diverse reasons, so any decision support system must consider patient sexual risk and testing history.

In response to the need for enhanced sexual health care in general practice, we designed a computerised clinical decision support system that aimed to improve the recording of patient sexual orientation and promote comprehensive STI screening uptake among gay and bisexual men. The software was tailored to general practice by drawing upon information contained within electronic patient records to generate clinician prompts. This paper evaluates the clinicals impacts of this system, ‘The eTEST Project’.

MATERIALS AND METHODS

Study design

We undertook an observational study design involving (i) before-after time series analyses at sites that received the intervention, and (ii) concurrent trends in intervention and comparison clinics.
Setting

Intervention sites

Study participation was limited to seven general practice clinics with minimum annual caseloads of 50 individual gay and bisexual male patients. All practices were located in Sydney and Melbourne, the cities with the largest populations of gay and bisexual men in Australia and where approximately half of men receive sexual health care in general practice.[11, 12] Clinics were identified for recruitment through consultation with organisations representing general practice, sexual health, HIV medicine, and the health of gay and bisexual men. We also located clinics in or around neighbourhoods with high concentrations of same-sex partnered households using Australian census data [23] and by posting study advertisements in medical newsletters.

Potential sites were sent an introductory letter or email, which outlined the study and proposed an in-person meeting. Of the 19 clinics sent introductory information, 12 in-person meetings were undertaken. Nine sites were recruited to participate, although two withdrew participation because their practice computers did not meet the minimum requirements for installing and operating the software. Of the seven study sites, all were located in inner urban areas. Participating clinics employed between three and 17 general practitioners in full or part-time service. In total, 66 general practitioners participated in the intervention, of which 28 (42%) were female and 38 (58%) were male.

Comparison sites

In addition to the intervention sites, data were extracted from the patient management systems of four other general practice clinics based in urban areas (two in Sydney and two in Melbourne). The comparison sites were matched by case load and geography; with a minimum of 50 individual gay
and bisexual men annually, ranging from 73 to 3,690 men and within 10 kilometres of the intervention sites.

**Study intervention**

We designed a computerised clinical decision support system for sexual health in general practice. The software built upon an existing piece of technology used in general practice known as the *PrimaryCare Sidebar™*, which worked by querying patient databases and using those queries to generate prompts, produce assessments, or trigger patient recalls. One of the seven study sites utilised a patient management system incompatible with the study software and, therefore, participated using a modified version of the intervention that involved establishing prompts using existing built-in assessment tools.

A sexual health-specific module was added to the existing Sidebar software. The module included a custom-built sexual history tool, which facilitated the assessment and recording of sexual risk practices for gay and bisexual male patients. The tool categorised patients into three simple categories linked to testing frequency recommendations, namely ‘high risk’ (3-6 monthly testing: ≥10 sexual partners in the past six months or condomless anal sex with a casual partner), ‘medium risk’ (annual testing: any anal sex in past six months), and ‘low risk’ (test as needed: no sex in past year or in a monogamous relationship). The assessment screen also included links to online sexual health testing guidelines [25] and a partner notification resource [26].

Additionally, the sexual health module of Sidebar included a system of electronic prompts (Figure 1). These prompts were triggered by patient records and were dynamic but passive in that they appeared after a patient record was opened and faded shortly thereafter. The fading function was specifically requested by participating doctors in order to reduce unnecessary interference with consultations. Sexual health prompts were activated when:
a. Sexual orientation details were not included in a patient’s record, 
b. A risk level assessment had not been recorded for a gay or bisexual patient, and 
c. Sexual health testing for a gay or bisexual patient was due or incomplete.

Prompts for HIV and STI testing were triggered on the basis of pathology records in the patient management system, which were automatically downloaded from servicing laboratories. Prompts for testing were also generated depending on assessed risk, with clinicians prompted six months after previous testing for patients assessed as ‘high risk’ and 12 months for ‘medium risk’ patients.

Following a six-month pilot at one clinic, staggered implementation of the software occurred between April and August 2012 and operated in each clinic for a minimum of 24 months. An overview of the prompt system and risk assessment dialogue is provided as a video in the accompanying multimedia appendix.

**Figure 1.** General practice software sexual health module electronic prompt dialogues

<table>
<thead>
<tr>
<th>Prompt 1: Sexual orientation not recorded</th>
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</thead>
<tbody>
<tr>
<td><strong>Prompt 2: Sexual risk assessment due</strong></td>
</tr>
<tr>
<td><strong>Prompt 3: Sexual health testing due or incomplete</strong></td>
</tr>
</tbody>
</table>

Beyond the user-facing component, the intervention software also facilitated routine extraction of de-identified data from male patients attending each service. These data were used to evaluate the software but also included as part of the intervention itself. Specifically, clinics were provided biannual reports on testing trends, test positivity and sexual orientation recording at their service. These reports were routinely presented at clinic meetings to allow doctors a chance to discuss the data, ask questions, and share feedback on the software itself. Individually, clinicians also received
tailored emails that focused on different indicators specific to their patients and with comparisons within and between clinics. In these ways, clinical data were used like a model of quality improvement.

Variables

The intervention’s impact was assessed along a clinical pathway of three outcome variables: sexual orientation recording, sexual health testing uptake, and comprehensive screening. Figure 2 provides an overview of this pathway with variables calculated as follows: (i) sexual orientation recording was calculated as the proportion of attending male patients for whom sexual orientation details were collected, (ii) sexual health testing uptake was calculated as the proportion of patients for whom sexual orientation was recorded as gay or bisexual who had any HIV or STI test, and (iii) comprehensive screening was calculated as the proportion of men who received a sexual health screen and had tests for chlamydia (rectal, urogenital), gonorrhoea (rectal, pharyngeal), syphilis and, among men not known to be infected, HIV. We also assessed changes to the detection of HIV and other STIs, which was determined using positive pathology or, for infectious syphilis, by reviewing historical test results and the interpretative comments provided by labs. In situations where infectious syphilis could not be determined (i.e., insufficient information) the result was excluded.

Data sources

We collected patient data using a data extraction component of the intervention software. De-identified, line-listed patient data were extracted for the 12-month pre- and 24-month intervention periods. For male patients aged 14 years and older, we extracted the following details per patient visit: unique identifier, age, home postcode, Indigenous status, sexual orientation, HIV status, visit date, visit reason, provider, and HIV/STI testing conducted. Because the results of pathology were downloaded into patient management systems as free text, they could not be extracted directly from
participating clinics. Thus, parallel HIV and STI pathology results for all male patients were extracted from the laboratories that serviced participating sites.

Data for comparison sites were extracted from an existing sentinel surveillance network for blood borne viruses and STIs. 'ACCESS' routinely extracts de-identified patient data from a range of clinical sites across Australia and provided the comparison data for sites not participating in the study intervention. Details on this project have been published previously.[26]

Analysis

Evaluation indicators were calculated quarterly. Because of the staggered entry point, the study observation period for intervention sites was organised into 12 study quarters: the before period (quarters 1-4) and the intervention period (quarters 5-12). Changes in sexual orientation recording, test uptake and comprehensive screening were assessed by calculating quarterly trends in the proportions before and during the intervention and then calculating the summary rate ratios (SRR). SRRs were also used to compare the mean number of infections diagnosed quarterly in the before period with the mean number diagnosed quarterly during the intervention period and, for all indicators, to compare changes between the intervention and comparison sites. Sexual orientation was retrospectively applied to facilitate comparisons over time so that if a patient was identified at one point as gay or bisexual that was applied across the study period. Because recorded sexual orientation was low among men attending clinics in the comparison group, to facilitate comparisons of testing we used any history of a rectal swab to identify gay and bisexual male patients, which has been previously shown to be an effective proximal marker for this population (see [27]). Stata version 14 was used for all analyses.[28]

Ethical review
Ethical review of this study’s conduct was provided by the University of New South Wales Human Research Ethics Committee (HC10310).

RESULTS

During the three-year observation period, a total of 32,276 individual male patients aged 14 years and older attended intervention clinics with a range of 1,905 to 8,711 patients per clinic. The median age at baseline was 46 years (interquartile range: 36-56), the majority of patients were HIV negative (74%) and, reflecting the exclusively urban nature of participating sites, most patients (97%) lived in major cities. Only 53% of patients had Indigenous status included in their record with 0.6% recorded as being of Aboriginal or Torres Strait Islander background. Similar demographics were reported in comparison sites, including a median baseline age of 46 years (interquartile range: 36-56), 75% HIV negative patients, 92% living in urban areas, and 0.9% of Aboriginal or Torres Strait Islander background.

Sexual orientation

Figure 2 outlines the clinical pathway we used to evaluate this intervention, comparing the first quarter of the pre-study period (Q1) with the last quarter of the intervention period (Q12). In the first quarter, 44% of attending male patients had details about their sexual orientation recorded, which remained stable across the pre-study period (44% in Q4). During the intervention period, however, the proportion of male patients with sexual orientation details increased from 47% in Q5 to 56% in Q12 ($P<0.001$) with a summary rate ratio of the average trend between the before and intervention periods of 1.10 (95% confidence interval [CI]: 1.04-1.11, $P<0.001$). In intervention sites, increases in recording of sexual orientation were observed across age groups, with the lowest baseline proportion but the greatest change in patients less than 30 years old, increasing by 71% during the intervention period from 17% recorded in Q5 to 29% in Q12 ($P<0.001$).
Table 1 provides an overview of the summary rate ratios of sexual orientation recording between the before and intervention periods; unfortunately, differences in how data were extracted between intervention and comparison sites meant that it was not possible to compare changes in sexual orientation recording over time. On the whole, however, sexual orientation was rarely recorded among men attending comparison sites, with only 5% of men having this detail included in their record.

**Figure 2.** Clinical pathway for assessing intervention impact between the pre- and intervention periods

### Sexual health screening uptake

As detailed in Figure 2, sexual orientation recording was only the first step in our clinical pathway. Among men recorded as gay or bisexual, we also assessed the proportion who in a quarter had any test for HIV or other STIs. In Q1, 51% of attending gay and bisexual men received some form of sexual health screening, which was stable during the pre-intervention period (51% in Q4) and also during the intervention period (51% in Q5 to 56% in Q12, $P=0.9$). There did not appear to be a difference in sexual health testing uptake between the pre- and intervention periods (SRR=0.97, 95%CI: 0.94-1.00, $P=0.2$) nor was a change observed in comparison sites (SRR=1.00, 95%CI: 0.97-1.02, $P=0.9$).
Comprehensive sexual health screening

Among men who received sexual health screening, only 26% in Q1 went on to receive the full complement of tests recommended by guidelines. This proportion remained stable during the pre-intervention period (27% in Q4, \( P=0.5 \)) but increased during the intervention period (26% in Q5 to 49% in Q12), representing an 88% relative increase in comprehensive screening \( (P<0.001) \). The summary rate ratio comparing the quarterly before and intervention trends of comprehensive testing was 1.37 \((95\% CI: 1.28-1.43, P<0.001)\). Table 1 provides an overview of the comparative increases in comprehensive sexual health testing among gay and bisexual men both by HIV status and age. During the intervention period, comprehensive screening doubled among patients aged 50 and older \((19\% \text{ in Q5 to 38}\% \text{ in Q12, } P<0.001)\) and also doubled among patients living with HIV \((18\% \text{ to } 36\%, P<0.001)\).

Tests for HIV and syphilis were, by far, the most common component of testing events among gay and bisexual patients. Prior to the intervention, 84% of testing events included syphilis and HIV, which increased to 89% for syphilis during the intervention period \((P<0.001)\) but remained stable for HIV \((P=0.1)\). The overall proportions of tests involving chlamydia and gonorrhoea were much lower in the before period: 19% of testing events included rectal swabs for chlamydia and gonorrhoea, which increased to 34% during the intervention \((P<0.001)\), while urine testing for chlamydia increased from 22% to 37% \((P<0.001)\). Pharyngeal swabs for gonorrhoea also increased, from 17% before to 34% during the intervention \((P<0.001)\).

In the four comparison sites, comprehensive screening uptake was lower overall than in the intervention sites but increased over time (Figure 3). During the two-year period that the intervention was active in other sites, comprehensive screening for HIV and STIs increased from 19% to 24% among gay and bisexual men \((P<0.001)\). Compared with the prior 12 months, the summary
rate ratio for these sites was 1.18 (95%CI: 1.11-1.26, P<0.001). Overall, although comprehensive screening for HIV and STIs increased across both intervention and comparison sites, the increase and the difference between periods was greater for sites that received the intervention than for those who did not (SRR=1.12, 95%CI: 0.10-1.14, P<0.001).

**Figure 3.** Comprehensive screening uptake among gay and bisexual men attending intervention and comparison sites

Detection of HIV and other STIs

Finally, we explored changes in the detection of HIV and STIs between study and comparison sites. While there was a 46% increase in the detection of rectal chlamydia during the intervention from a mean of 40.0 infections per quarter in the pre-period to 58.5 per quarter of the intervention (SRR=1.28, 95%CI: 1.07-1.53, P=0.007), there was a non-significant increase of 27% in comparison sites (SRR=1.17, 95%CI: 0.99-1.37, P=0.06). Similarly, while detection of urogenital chlamydia in clinics with the intervention was 44% higher during the intervention period than before (26.5 to 28.0 average per quarter, SRR=1.26, 95%CI: 1.01-1.57, P=0.04) there was no similar increase among comparison clinics (43.5 to 40.3 average per quarter, SRR=0.85, 95%CI: 0.71-1.02, P=0.09).

For gonorrhoea, detection of rectal infections increased 45% from a mean of 25.4 to 35.0 per quarter during the intervention (SRR=1.27, 95%CI: 1.01-1.61, P=0.04) but was stable among comparison sites.
Pharyngeal diagnoses of gonorrhoea were the one infection to increase between both study and comparison sites, rising from 23.8 to 46.0 per quarter in intervention sites (SRR=1.69, 95%CI: 1.35-2.11, P<0.001) and from 9.0 to 20.0 in comparison sites (SRR=2.04, 95%CI: 1.42-2.94, P<0.001). In the intervention sites there were no differences in diagnoses of infectious syphilis during the intervention (42.8 to 51.0, SRR=1.05, 95%CI: 0.88-1.26, P=0.6) or in HIV (13.5 to 13.0, SRR=0.75, 95%CI: 0.52-1.05, P=0.09), which was the same for comparison sites.
Table 1. Average annual trends and summary rate ratios in the quarterly proportions of male patients who had: (i) sexual orientation recorded, (ii) any HIV or STI test, and (iii) a comprehensive sexual health screen* in the pre- and intervention periods.

<table>
<thead>
<tr>
<th></th>
<th>Before period</th>
<th>Intervention period</th>
<th>Before vs intervention period</th>
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<tr>
<td></td>
<td>Average annual trend</td>
<td>95% CI</td>
<td>p-trend</td>
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<tr>
<td><strong>Sexual orientation</strong></td>
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<tr>
<td>Overall (intervention)</td>
<td>1.00</td>
<td>0.99-1.03</td>
<td>0.3</td>
</tr>
<tr>
<td>Age (intervention)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 years</td>
<td>1.03</td>
<td>0.97-1.10</td>
<td>0.314</td>
</tr>
<tr>
<td>30-49 years</td>
<td>1.02</td>
<td>0.99-1.04</td>
<td>0.050</td>
</tr>
<tr>
<td>&gt;50 years</td>
<td>1.00</td>
<td>0.98-1.04</td>
<td>0.396</td>
</tr>
<tr>
<td>HIV status (intervention)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HIV positive</td>
<td>1.00</td>
<td>0.98-1.04</td>
<td>0.541</td>
</tr>
<tr>
<td>HIV negative</td>
<td>1.01</td>
<td>0.99-1.03</td>
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</tr>
<tr>
<td><strong>Any sexual health testing</strong></td>
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<td></td>
</tr>
<tr>
<td>Overall (intervention)</td>
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<td>0.97-1.03</td>
<td>0.834</td>
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<td>Overall (comparison)</td>
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<td>0.00-0.05</td>
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<tr>
<td><strong>Comprehensive screening</strong></td>
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<td>Overall (intervention)</td>
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<td>0.96-1.07</td>
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<td>1.03-1.14</td>
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<td>&lt;30 years</td>
<td>1.09</td>
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<tr>
<td>&gt;50 years</td>
<td>0.98</td>
<td>0.89-1.08</td>
<td>0.7</td>
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<tr>
<td>HIV status (intervention)</td>
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<td>HIV positive</td>
<td>1.06</td>
<td>0.97-1.14</td>
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<tr>
<td>HIV negative</td>
<td>0.99</td>
<td>0.93-1.05</td>
<td>0.7</td>
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Tests for chlamydia (rectal, urogenital), gonorrhoea (rectal, pharyngeal), syphilis and, among men not know to be infected, HIV
DISCUSSION

The findings of this study suggest that integrated decision support software in general practice can improve sexual health care for gay and bisexual men. The implementation of software that facilitated routine feedback and prompted general practitioners to collect details on patient sexuality and offer comprehensive sexual health screening was associated with increased recording of sexual orientation among male patients and, among gay and bisexual men, increases in comprehensive sexual health testing in line with clinical guidelines. The observed increases in testing led to increased detection of infections with chlamydia and gonorrhoea.

It is worth noting that testing for STIs increased across general practice settings that did and did not receive the intervention. Australia's epidemiology of these infections has documented rising rates for years [2] and the governments of New South Wales and Victoria – the states in which this study took place – have both implemented numerous strategies aimed at increasing sexual health testing. Nevertheless, the intervention appears to have contributed to higher rates of testing and diagnoses than would have otherwise taken place, suggesting a cumulative effective with other initiatives. Although promising, the observed increases were moderate, with the intervention demanding consistent energy to produce data reports and ensure that the software remained operational. Future analyses of integrated decision support software and quality improvement reports should consider the balance between costs and gains.

In spite of the increases in sexual orientation recording among male patients, at the end of the intervention period this variable remained unrecorded for the majority of men. Given the value of knowing sexual orientation for providing care beyond just sexual health,[29] additional effort may be required to encourage the collection of this variable among clinicians in general practice. It is possible, however, that for some patients these details were recorded somewhere other than the 'official' location in their file, which would not have been captured by our analysis.
The intervention appears to have encouraged greater completeness of testing among those engaged in sexual health care. The prompts, however, did not impact on the overall uptake among gay and bisexual men, demonstrated by the stable proportion of men who received any form of sexual health testing. While testing may not have been required for some of the men who received no sexual health screening (i.e., sexually inactive men, men who received sexual health care elsewhere), it would seem that the software was useful for capitalising on existing testing opportunities but not necessarily for creating new ones. Different strategies to improve the overall offer of testing may be warranted, particularly among those not already engaged in sexual health care at a clinic.

While the intervention increased comprehensive screening, this was largely due to more samples being collected for chlamydia and gonorrhoea, it had a lesser impact on testing for syphilis and no impact on HIV testing. This finding echoes earlier work assessing the effects of health promotion, which was associated with increased testing for chlamydia and gonorrhoea but not syphilis or HIV. [30] It may be that some doctors are unaware of all the different samples required to effectively test for chlamydia and gonorrhoea, with our findings echoing earlier work that found anal and throat swabs are among the most-commonly missed [10]. It is also possible that patients are more likely to request a test for HIV than other STIs. Thus, the intervention's impact in this domain highlights its usefulness for capitalising on clinical encounters.

The observed increases in sexual orientation recording and comprehensive screening were gradual, due likely to the time it took for clinicians to become familiar with the software. Further, the time required to properly calibrate the software to each clinic’s technical infrastructure may also have hampered its usefulness in the intervention’s earlier days. These factors underscore the need for careful attention and routine follow-up to ensure that newly designed systems are functioning as expected.
It is possible that the changes in sexual orientation recording and comprehensive screening were due to some factor unrelated to this study’s intervention, but the potential influence of external forces is likely limited by the staggered intervention entry points across services, the fact that no significant trends identified in the before period and the use of comparison sites. Further, we are unaware of any new clinical activities that occurred before or during the intervention period. It is also worth noting that study recruitment specifically targeted clinics perceived as providing care to gay and bisexual men. As such, it is not possible to generalise these findings to other clinic or patient types. Additional research is required to evaluate if this style of decision support software could similarly influence the delivery of sexual health care among other groups of patients.

CONCLUSIONS
This study provides evidence that computerised clinical decision support systems can be effectively utilised in general practice to moderately improve sexual health clinical practice among gay and bisexual men. Further, as detecting these infections reduces the likelihood of onward transmission to sexual partners, these systems may have a part to play in reducing community prevalence of HIV and STIs.

ACKNOWLEDGEMENTS
Funding for this project was provided by the New South Wales Ministry of Health and UNSW Sydney. The authors acknowledge the following people and organisations for their support and guidance: Anna Roberts (ASHM), Craig Cooper (Positive Life NSW), Geoff Honnor (ACON), Sonny Williams (Positive Life NSW), Marianne Gale (NSW Ministry of Health), Vijay Ramanathan (Royal Australian College of General Practitioners), and Liza Doyle, Larissa Lewis and Fraser Drummond (Kirby Institute, UNSW Australia). The authors also acknowledge the developers and managers of the PrimaryCare Sidebar™ sexual health module, in particular Christine Chidgey, Paul Matthews, and Monica
Schlesinger (PEN Computer Systems). Data from pathology laboratories was extracted with the help of the following people: Lisa Crawford (Douglas Hanly Moir), Stella Pendle and Adrian Yap (Australian Clinical Labs), Lisa Katon and Joymarie Armstrong (SydPath Central Laboratory), Rob Warren (VIDRL), and Gareth Halbert (Laverty Pathology). And finally, the authors acknowledge the tremendous contribution practice managers and nursing staff at participating clinics, namely Shakira Watts, Esme Sinnott, Jo Toomey, Marie Stoal, Marion Solomon, Elisha Smith, Claire Johnson, Erin McDonald, Alastair Colgrave, Lucy Kalangi, Cheryl Walker, Danielle Collins, and Simon Powell. For the provision of additional data, the authors also acknowledge additional ACCESS investigators who are not authors on this paper (Carol El-Hayek and Margaret Hellard).

CONFLICTS OF INTEREST

None to declare.
MULTIMEDIA APPENDIX

Appendix 1. Video guide of sexual health prompts and risk assessment dialogue introduced in general practice clinics via the PrimaryCare Sidebar™
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