CSIRO PUBLISHING

RESEARCH PAPER
https://doi.org/10.1071/SH22191

SEXUAL HEALTH

Informing the design of a digital intervention to support sexually transmissible infection care in general practice: a qualitative study exploring the views of clinicians

Melis Gezer[A], Barbara Hunter[B], Jane S. Hocking[A], Jo-Anne Manski-Nankervis[B] and Jane L. Goller[A,*]

For full list of author affiliations and declarations see end of paper

***Correspondence to:**
Jane L. Goller
Melbourne School of Population & Global Health, The University of Melbourne, 207 Bouverie Street, Carlton, Vic. 3053, Australia
Email: jane.goller@unimelb.edu.au

Handling Editor:
Anthony Smith

ABSTRACT

Background. Strengthening sexually transmissible infection (STI) management in general practice is prioritised in Australian STI strategy. Digital interventions incorporating clinical decision support offer a mechanism to assist general practitioners (GPs) in STI care. This study explored clinicians' views towards a proposed digital intervention for supporting STI care in Australian general practice as a first step in the tool's design. **Methods.** Semi-structured one-to-one interviews were conducted during 2021 with sexual health physicians ($n = 2$) and GPs ($n = 7$) practicing in the state of Victoria, Australia. Interviews explored views on a proposed STI digital intervention for general practice. We applied the Theoretical Domains Framework (TDF), a behaviour change framework to our analysis. This involved: (1) directed content analysis of transcripts into TDF domains; and (2) thematic analysis to identify sub-themes within relevant TDF domains. Subthemes were subsequently categorised into enablers and barriers to the use and implementation of a STI computerised clinical decision support system (CDSS). **Results.** All interviewees viewed a digital intervention for STI care favourably, expressing confidence in its potential to improve care and support management. Within the relevant TDF domains (e.g. environmental context and resources), subthemes emerged as barriers (e.g. lack of sensitivity to patient context) or enablers (e.g. clear communication and guidance) to the use and implementation of a STI CDSS in primary care. Multiple subthemes (e.g. time constraints) have the potential to be a barrier or an enabler, and is largely dependent on end-user needs being met and clinical context being appropriately addressed. **Conclusions.** A digital intervention incorporating clinical decision support was viewed favourably, indicating a possible role for such a tool in Australian general practice. Co-design with end-users and prototype evaluation with health consumers is recommended to ensure relevance and usefulness.

Keywords: Australia, chlamydia, clinical decision support, digital, electronic medical record, general practice, gonorrhoea, primary care, STI management, STIs, syphilis.

Received: 6 December 2022
Accepted: 6 June 2023
Published: 6 July 2023

Cite this:
Gezer M *et al.* (2023)
Sexual Health, **20**(5), 431–440.
doi:10.1071/SH22191

Introduction

Sexually transmissible infections (STIs) cause significant harms in Australia.[1] Rates of bacterial STIs are increasing; between 2011 and 2019, *Chlamydia trachomatis* (chlamydia) by 32% ($n = 107\,286$ cases in 2019), *Neisseria gonorrhoea* (gonorrhoea) by 188% ($n = 34\,780$ cases in 2019) and *Treponema pallidum* (syphilis) by 344% (5912 cases in 2019).[2] These STIs are often asymptomatic and may not be detected, but can cause serious complications. Chlamydia and gonorrhoea can ascend to the upper genital tract to cause pelvic inflammatory disease (PID) and tubal infertility for women[3,4] and epididymitis for men.[5] Anti-microbial-resistant gonorrhoea is of global concern as it introduces the prospect of untreatable infection.[6] Furthermore, rising heterosexual syphilis transmission between 2011 and 2020 saw a >400% increase in the number of syphilis cases among women and 58 cases of congenital syphilis.[2]

Timely diagnosis and optimal management are crucial for reducing STI transmission and their associated adverse impacts. In Australia, specialist STI care is provided in sexual

health and family planning services, but they are at capacity and not widely available outside of metropolitan areas. General practice is Australia's mainstream primary care setting. Visited by >80% of Australians at least annually,[7] it is the most accessible option for STI testing and care for most Australians. Barriers to general practitioners (GPs) routinely offering STI testing and providing optimal STI care have been identified and include knowledge/skill deficits (e.g. who to test, what tests to offer), time constraints (e.g. STI screening in addition to the patient's reason for the visit), and lack of recall systems.[8,9] Strengthening STI testing and management in general practice is prioritised in Australia's Fourth National STI strategy.[1]

Computerised clinical decision support systems (CDSSs) are gaining increasing attention in health care and may offer a mechanism to support general practice in STI care provision. Furthermore, digital infrastructure and clinical decision support is a priority for Australian primary care going forward.[10] Recent advances have seen CDSS development with algorithms that integrate and query data within the general practice electronic medical record (EMR) system to identify at-risk patients who can be targeted for intervention.[11–13] Such tools can operate both in and out of clinical consultations to provide clinicians with computer prompts for patient-specific recommended actions and links to clinical guidelines.[11–13] To date in Australia, CDSSs have largely been developed and evaluated for prescribing or chronic disease. A CDSS to support antibiotic prescribing was viewed as acceptable by Australian GPs and assisted appropriate prescribing in a simulation study.[12] A cardiovascular disease CDSS supported improvements in risk factor screening in Australian primary care; however, recommended medication prescribing did not change.[14] In the United States, CDSSs for STI care have shown some success, leading to increased chlamydia and STI screening in paediatric settings.[15,16]

To date, there is no CDSS for STIs care provision in Australian general practice and no research within this context to inform the development of one. In this study we aimed to: (1) understand clinicians' views on how health professionals would use a proposed STI CDSS; and (2) identify barriers and enablers to the use and implementation of a STI CDSS in primary care. Through determining end-user viewpoints, the results of this study will be used to inform the design and development of a suitable STI module for an existing CDSS that we have developed for chronic disease in general practice.[13]

Methods

We undertook a qualitative study involving one-to-one semi-structured interviews to explore the perspectives of GPs and sexual health physicians (SHPs) working in the state of Victoria, Australia, on a proposed CDSS for STI care in general practice, including potential barriers and enablers to its use and implementation. Our approach was informed by the Theoretical Domains Framework (TDF), an integrative behaviour change framework, proposed by Michie *et al.* in 2005[17] and revised by Cane *et al.* in 2012.[18] The TDF comprises 14 domains created from 84 theoretical constructs that may explain health-related behaviour change and provides an empirical method for assessing implementation problems[18] and key behaviours important for intervention implementation. It has been successfully used as a framework to facilitate identifying barriers and enablers in implementation research.[19–21] In this study, the TDF was used to understand aspects of health professional behaviour related to using a theoretical CDSS and providing STI care, and to identify potential barriers and enablers that may influence intervention development and use, to facilitate broader implementation. It further provides a theoretical scaffold for addressing such determinants if and when such a CDSS is developed and implemented.

We drew on our existing CDSS, called Future Health Today (FHT),[13] to explore how a CDSS for STI care might look and operate. In brief, FHT is a software with embedded algorithms that query data in the EMR to automatically identify patients meeting specific criteria who can be targeted for care. Triggered by these algorithms, FHT's two main components are: (1) the dashboard, used outside of consultations to create lists of patients who can be proactively targeted for care (e.g. recall); and (2) the point-of-care, which integrates evidence-based clinical decision support, guidelines, and recommendations for management to guide care during consultations. First developed for chronic disease, FHT was co-designed with general practice staff and health consumers to ensure it was acceptable, met clinical needs and fitted into general practice workflow.[13] Specifically exploring the usefulness and appropriateness of FHT for sexual health care is important given the unique sensitivity and likely nuances of the subject area compared to chronic conditions like cardiovascular disease.

Participants and recruitment

GPs ($n = 7$) were recruited as potential end-users of a STI CDSS and SHPs ($n = 2$) as experts in the field. Purposive sampling was used. GPs and SHPs were invited to participate through study advertisement posters that were communicated by email and online posts via professional and research networks including primary health networks, the Royal Australian College of General Practitioners, the Centre for Excellence in Rural Sexual Health Care, a private Facebook group 'GPs Down Under', and the research team's relationships with general practice and sexual health clinics. Advertisement posters directed interested individuals to contact researchers who then provided a plain language statement describing the project and participant involvement. Participants gave verbal consent immediately prior to beginning the interview. A low number of participants responded, influenced greatly by

pandemic-related pressures and priorities. Although the research did not seek to achieve data saturation, the commonality in responses from the nine participants indicated that data saturation was achieved.

Data collection

Interviews were conducted online via Zoom or telephone due to coronavirus disease 2019 (COVID-19) pandemic restrictions (from July to September 2021) and audio-recorded digitally. Questions focused on STIs (chlamydia, gonorrhoea, and syphilis), namely current practices and challenges in providing care, as well as the possible design, use and usefulness of a CDSS for STI care. To facilitate responses to questions about a CDSS, interviewees were provided with a description of FHT, including the dashboard and point-of-care components, and interviewees on Zoom were also shown photos of the FHT interface.

Analysis

Interviews were transcribed verbatim and uploaded for analysis in NVivo ver. 12 software (QSR international). Analysis commenced with data familiarisation by one author (MG), which involved reading and re-reading transcripts, noting preliminary observations and discussion with authors (JG, BH). Next, a two-step approach was employed involving: (1) directed content analysis guided by TDF domains; and (2) inductive thematic analysis. This approach is commonly utilised in qualitative studies using the TDF.[20,22]

Our directed content analysis involved initial coding by MG of transcripts and categorisation into relevant TDF domains[18] and discussion with authors (JG, BH) to reach consensus for uncertainties to which domain a code belonged. The most relevant TDF domains to a STI CDSS were then determined using criteria of: (1) comparatively high incidence of beliefs; (2) presence of differing beliefs; and (3) evidence that beliefs may impact behaviour.[23] Domains were subsequently defined (Table 1). Next, our inductive thematic analysis involved developing subthemes within the relevant TDF domains through recursive review against our codes and reflection of the data. These subthemes were later categorised into barriers and enablers. Example quotes are provided followed by clinician type (SHP, GP)-ID number, gender (Female: F, Male: M) and approximate years in current clinical role.

Approval for the study was obtained from the University of Melbourne Human Research Ethics Committee (ID: LNR 4B).

Results

A total of nine participants (SHPs = 2, GPs = 7) were interviewed (eight on Zoom, one by telephone) with interview duration ranging from 23 to 42 min. All practiced in a metropolitan setting, and most were female (67%). In regard to current practices in providing STI care, GPs described many challenges including following-up positive cases, raising sexual health matters, offering testing in non-sexual health consultations, and keeping abreast of guidelines. GPs emphasised challenges and knowledge gaps in providing syphilis care, including diagnosing, interpreting serology, and providing treatment, which were largely related to the complexity of syphilis pathophysiology and seeing infrequent syphilis cases.

Ten subthemes regarding the use and implementation of a CDSS for STIs emerged across the six TDF domains (detailed in Table 1) and a range of enablers and barriers to implementation of a STI CDSS were identified. The TDF domains 'Beliefs about consequences', 'Knowledge', and 'Skills' captured enablers to a CDSS for STI care and the TDF domains 'Optimism', 'Environmental context and resources', and 'Memory, attention and decision processes' captured a mix of

Table 1. Definitions of the relevant Theoretical Domains Framework domains in context.

TDF domain	TDF domain definition[A]	Definition in context
Optimism	The confidence that things will happen for the best or that desired goals will be attained	The belief that using a CDSS will result in improved provision of STI care
Beliefs about consequences	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Belief of health professionals about the value of implementing and using a CDSS for STI care
Environmental context and resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviours	Any aspect of the general practice environment that may impact CDSS implementation and usefulness; features and resources that need to be integrated into a CDSS to encourage the intended use of tool and the development of skills and abilities
Memory, attention and decision processes	The ability to retain information, focus selectively on aspects of the environment, and choose between two or more alternatives	The ability of a clinician to make decisions around STI care; the role of a CDSS in supporting clinical decisions
Knowledge	An awareness of the existence of something	An awareness of best practice STI care
Skills	An ability or proficiency acquired through practice	An ability to provide best practice STI care

[A]Definitions taken directly from Cane *et al.*[18]

enablers and barriers. The emergent subthemes are grouped as enablers or barriers under their relevant TDF domain and are described below with example quotes in Table 2.

Enablers

TDF domain: Beliefs about consequences

CDSS benefiting some areas of STI care more than others. Although most participants (GPs and SHPs) considered that all aspects of management and care for the three STIs of focus (chlamydia, gonorrhoea, syphilis) could benefit overall from a CDSS, areas of care that were viewed to have the greatest potential benefits included screening and follow up. Participants also felt that the management of more complex STIs (e.g. syphilis) and STI-complications (e.g. PID) would particularly benefit from clinical decision support.

TDF domain: Knowledge and skills

CDSS facilitating improvements in STI-related knowledge and skills. Most participants considered that a CDSS could potentially contribute to incremental and incidental improvements in STI knowledge and skills. Such improvements were perceived as possible via continuous engagement with a tool that provided clear and actionable pop-ups and integrated appropriate resources. Specific areas viewed as likely benefiting included case management guidance, result interpretation (particularly syphilis), and testing (e.g. what STI to test for and samples). Challenges in keeping abreast of sexual health guidelines were highlighted and a CDSS was viewed as a tool that may facilitate this. Potential of a CDSS to specifically facilitate education around syphilis was discussed, with all participants emphasising that GPs require education and support in this area.

TDF domain: Optimism

Confidence in a CDSS facilitating improved STI care. Drawing on the FHT description, GP participants considered a CDSS could potentially facilitate improvements in STI care, with some enthusiastic about the idea. Most GP and SHP participants considered a CDSS could help address described challenges in STI care, although viewed this as contingent on many factors. In terms of FHT components and STI care, most participants conceptually preferred the point-of-care feature through recommendations and linked guidelines.

TDF domain: Environmental context and resources

Time constraints. Time constraints in general practice was an important contextual factor, viewed as conducive and non-conducive to a STI CDSS. Some GPs considered the time pressured environment could promote adoption if the CDSS streamlined and automated aspects of care. Consideration of time constraints was viewed as a priority for CDSS design that could influence adoption and usefulness.

Usability and flexibility. These were viewed as important factors to promote implementation and adoption. Usability was discussed in terms of the tool supporting the clinician's role efficiently, and a simple design to promote engagement. Many highlighted the need for minimal clicks, actionable prompts (i.e. something clinicians can do within the consultation) and specific linkages. Flexibility was discussed in terms of being able to customise the tool (e.g. pop-ups, integrating preferred resources) and as a factor that would promote user engagement and improve effectiveness.

Integrated resources. A range of resources for clinicians and patients to integrate into a CDSS were suggested (Table 3). Linkage to reputable resources was deemed essential, with Australian STI Management[24] and Melbourne Sexual Health Centre[25] guidelines most frequently suggested.

Clear communication and guidance. Simple information and practical prompts were viewed as essential for user engagement. Some expressed concern the tool would be less appealing if excessive information was provided. Several GPs suggested it would be useful if the tool identified positive pathology results and automatically provided simple, patient-specific management recommendations to mitigate the need for specialist sexual health assistance.

TDF domain: Memory, attention and decision processes

Reminders and recommendations. These features, including point-of-care pop-ups, were viewed as useful to support; for example, (1) opportunistic screening by prompting GPs to think about offering testing to at-risk individuals; or (2) follow up by identifying past positive tests and highlighting patients who require re-testing. Clinicians identified EMR data that could be used to trigger reminders, including age, previous STIs, contraception use, pregnancy, substance abuse, sexual orientation and cervical screening. Clinicians also discussed that recommendations could facilitate clinical decision- making, particularly for more complex care (e.g. syphilis, PID).

Barriers

TDF domain: Optimism

Confidence in a CDSS facilitating improved STI care. Although GPs and SHPs were positive about the concept of a CDSS for STI care, they also reflected on the sensitive nature of it, with some unsure about appropriateness of the dashboard (e.g. proactive recall for STI screening). One GP was uncertain about a CDSS for STI care, expressing concern it could detract from patients during consultations, although they stated that younger clinicians may be more likely to use such a tool.

Table 2. Subthemes, enablers and barriers identified within the six TDF domains and sample quotes.

TDF domain	Subtheme	Enabler/ Barrier	Sample quotes
Beliefs about consequences	CDSS benefiting some areas of STI care more than others	Enabler	I think testing and re-testing would benefit the most from it. (GP1-F-4) More complicated things, such as PID, might be good when clinical decision making around diagnosis, [it] would be really helpful particularly for things like PID and things like syphilis . . . less so for things you just test for and treat. (SHP1-F-20)
Knowledge and skills[A]	CDSS facilitating improvements in STI-related knowledge and skills	Enabler	Sometimes people have come in having pathology forms written out for STIs with the wrong sample to be collected and things like that – so there is still education that needs to be done in terms of just what to collect. So I think as part of like a tool . . . just the swabs, what to collect... It would make it a lot easier. (GP2-F-4) I think if there are any updates that are happening – particularly with changes to medication and management – it would be good to have, if it's possible, to have a computerised tool that – a good pop-up to have would be a significant change of management. (GP2-F-4) Syphilis and helping GPs manage syphilis is really difficult and I think that could be really useful in that as it would educate the GPs as well, and they're crying out for education on syphilis. (SHP1-F-20) It would be helpful to have some more guidance, maybe around syphilis I think for GPs – specifically for GPs. (GP6-M-1.5)
Optimism	Confidence in a CDSS facilitating improved STI care	Enabler	Yeah, I think it would work but it would depend on a lot of factors. (SHP1-F-20) It could certainly benefit from it. (GP3-F-33) I think I would probably prefer the point-of-care . . . . (GP1-F-4)
		Barrier	You'd just have to be really careful because that's the problem with those computerised ones. If you sent out a text to say your kidney check is due, or we'd like to do one – you know, that's not terribly offensive. But if you accidentally sent that to the wrong – you know, to someone where it's not appropriate – you'd just have to be a little bit careful. (GP7-F-27) I think it's going to be very tricky to be mass texting everyone who has been to the clinic once to say you should have an STI test . . . I'd be surprised if my own general practice sent me a text saying, 'you're due for your STI test. (GP1-F-4) Look I don't know. But I doubt I'd use it. I guess I wonder whether it makes you – you're then going back to a computer rather than focusing on the patient.' (GP4-F-38)
Environmental context and resources	Time constraints in general practice	Enabler	GPs time is limited – anything that streamlines things will be beneficial. (GP3-F-33) You don't need to look through all the patient's previous record or need to search the guidelines – if there's a red flag sign that's easier to act on it. Rather than fishing for the information, so that'll save some time. (GP5-M-1.5)
		Barrier	A lot of GPs are pretty time pressured. Any extra steps are probably going to mean it's a barrier. (GP6-M-1.5)
	Usability and flexibility	Enabler	The less clicks the better – so I would just want to go straight to that page rather than just linking to the homepage, like I could have typed that into Google myself. Be very specific in the linkage – that would be super helpful! (GP1-F-4) It would have to be really quick...can't be too many clicks for the GP to get to what they want. (SHP2-M-8) Maybe for me the fact sheet is really important but for someone else it's not important – so having the ability to go into settings and say I just want fact sheet and STI guidelines link . . . I think that's good. It would be less attractive if it was no settings, no customisation. (GP6-M-1.5)
	Integrated resources	Enabler	Linking into those trusted resources as its going to be a new thing for people . . . linked to those trusted resources that we will always use will probably help as well. (GP1-F-4)
	Clear communication and guidance	Enabler	If there are really practical guidance around that, not just a link to a 200-page document that they're not going to read, but a one pager or a two pager that really summarises what a GP needs to know about that STI would be probably most useful. (SHP2-M-8) Make it easy to deal with, not too much information on the screen. (GP3-F-33) Read the results that come up and once it's marked to say this is the recommended treatment and then have the link to the guideline as to what needs to be done. (GP2-F-4) Whether someone has a positive chlamydia [test result], [on the computerised tool if] there is drug name – so you don't need to search, that might be easier giving the treatment option straight away. (GP5-M-1.5)

(*Continued on next page*)

Table 2. (*Continued*).

TDF domain	Subtheme	Enabler/ Barrier	Sample quotes
	Lack of sensitivity to patient context	Barrier	You'd have to input quite personal data . . . in our system we ask about number of partners, condom usage, sexuality, gender – and I'm not quite sure whether GPs ask about all of that information routinely and whether they would be comfortable to ask their patients that information. I think you would need that sort of information to make it a useful tool. (SHP1-F-20) That's dependent on the demographics of what is being recorded at the reception end when they first sign in which could be a limitation . . . I'm not sure if there's something to identify sexual orientation or sexual history, so that probably needs to be put in first before anything like that could be generated. (GP2-F-4) In my general practice, I know most of my patients . . . so that kind of makes it easy for me because I kind of know where they are at. (GP7-F-27) It is a bit hard to drag them back and say, 'Oh you might need an STD check' in a 19-year-old who may not even be sexually active. (GP7-F-27)
Memory, attention and decision processes	Reminders and recommendations	Enabler	I think if someone has had a STI in a specified time – and something came up to remind me like 'Mary had an STI 6-months ago maybe consider re-discussing' . . . that would be particularly helpful. (GP1-F-4) For things like PID – all those young girls that come in with abdominal pain – a clinical tool around what you do with those people and how you make the diagnosis, assess it and treat them I think would be really good and would be helpful. (SHP1-F-20)
		Barrier	I like the idea of cherry-picking information and then prompting, but . . . if the GP hasn't put in the correct information in the correct way then it doesn't work. (GP7-F-27)
	Pop-up fatigue and intrusiveness	Barrier	The idea of pop-up fatigue – where I wonder if this box is constantly coming up for every 20-year-old I see . . . I might just end up clicking or exiting it. (GP6-M-1.5) A lot of times you are just shutting boxes quickly to do what you want to do because somebody is sitting there waiting for you. I'm just saying with pop up boxes, there are so many boxes that pop up at us. (GP3-F-33) I also think it depends on the placement – I think the bottom right-hand corner if it's not obstructing anything is fine but if it's a big box that takes up a lot of space it's just like another thing to close so that would be annoying. (GP2-F-4)

[A]Domains of 'knowledge' and 'skills' were combined as the emergent theme pertained to both domains.

Table 3. Suggestions for resources to be integrated into a CDSS for STI care.

Area of care	Type of resource	How suggested resources should work within the CDSS
Testing	• Links to testing guidelines • Pop-up recommendations	• Priority groups for testing • STIs to test for
Management	• Pop-up recommendations • Flow charts • Links to guidelines • Where to go for specialist support	• Flow charts for interpreting syphilis serology and clinical decisions for management • Pop-up recommendations for positive results that indicate what management is required or where to go for management guidance • Links to Australian STI Management Guidelines[24] • Links to the Melbourne Sexual Health Centre for STI resources for health professionals[25] • Contact details and links to specialist support (e.g. Melbourne Sexual Health Centre phone number) • Display relevant guidelines within the CDSS
Patient information	• Partner notification websites • Let Them Know • Printable STI factsheets	• Links to partner notification websites (e.g. 'Let Them Know')[26] • Clear fact sheets for chlamydia, gonorrhoea and syphilis that open quickly and are printable

TDF domain: Environmental context and resources

Time constraints. As stated above, consideration of the time-pressured general practice environment was viewed as an important consideration. Some GPs expressed concerns a CDSS may result in additional tasks in already time-limited consultations.

Lack of sensitivity to patient context. This was identified by many, including concerns about specificity and appropriateness of the CDSS's clinical guidance. GPs and SHPs described that clinical decisions for sexual health care rely on personal contextual information (e.g. sexual orientation, sexual history); however, such information is generally entered as free-text in general practice EMRs due to lack of

specific fields. GPs discussed familiarity with their patients and that they may be privy to contextual information not captured in EMRs but required for accurate clinical decisions. One GP expressed concern that unnecessary investigations could be prompted by limited data, such as recall prompts based on only age.

Clear communication and guidance. Some GPs expressed concern a CDSS for STI care would be less appealing if excessive information was provided.

TDF domain: Memory, attention and decision processes

Reminders and recommendations. One concern regarding prompts was their dependence on accurate information being inputted into EMRs and that inaccurate information could compromise the tool's functionality.

Pop-up fatigue and intrusiveness. This was a concern expressed by several GPs and largely related to frequency and relevance. For example, if pop-ups for opportunistic testing occurred constantly for a specific age group (e.g. <29 years) or during each consultation with a patient, this may lead to irritation and messages being dismissed. GPs also discussed that numerous pop-ups exist in general practice and are often ignored due to perceived intrusiveness on the consultation. Specific on-screen location and size of pop-ups were viewed as critical considerations to minimise intrusion.

Discussion

To our knowledge this is the first study exploring clinician views on a CDSS to support STI care in Australian general practice. As such, our findings provide important considerations for developing such a tool. We found that GPs and SHPs viewed the concept of a CDSS for STI care favourably, suggesting a possible role in Australian general practice. Interviewees were optimistic about a digital tool's potential to improve STI care processes, address some challenges in providing STI care, and facilitate STI education. For such a tool to be appropriate and useful, it must meet end-user needs, align with clinical context, and integrate key resources, such as testing and treatment guidelines. Insight was provided into envisaged uses of such a tool. More complex conditions (e.g. syphilis) were seen as areas a digital tool may most benefit.

Our study drew on the features of FHT, specifically the dashboard and point-of-care components, to explore views on the use and usefulness of a CDSS for STI care. Our sample of clinicians considered they would be less likely to use the dashboard than the point-of-care function and attributed this to concerns around accuracy of recall processes and the risk of recall notifications being misinterpreted or otherwise negatively impacting patients. Co-design is essential when considering these concerns. One possible solution that could promote patient autonomy could be an approach used in an Australian sexual health clinic whereby men who have sex with men (MSM) patients could opt-in for automated computer-generated reminders for STI screening.[27] FHT's point-of-care component was viewed positively for STI care for which preferences included targeted and actionable pop-ups that were also modifiable (e.g. frequency, type), direct links to appropriate resources to guide clinical actions (e.g. clinical guidelines); and information presented unobtrusively to align with workflow. These desirable components are already available within FHT, suggesting that co-design for an STI module should focus on the displayed recommendations, integrated resources and underlying algorithms.

Interviewees emphasised their preferred areas of care and content for a STI CDSS including how it is presented and engaged with. Prompts for testing to detect new infections and for timely re-testing for re-infection were identified as areas that may benefit due to current gaps in STI detection and re-testing.[28] Syphilis care was viewed as an area that may benefit due to it being infrequently cared for by some GPs, and PID as an area a CDSS might support decision-making. GP and SHP interviewees suggested many resources that covered testing, infection management, patient information and emphasised the need to incorporate trusted sources. A 2021 Australian study found that trust and confidence in the content influenced GPs' intention to engage with a CDSS for antibiotic management.[29] Co-design is imperative to ensure integrated resources reflect end-user needs and expert input, as positive user attitudes are important facilitators of CDSS adoption.[30,31]

Key attributes emphasised for a successful CDSS design included simplicity (e.g. guidance that is quick and easy-to-follow, and actionable), useability (e.g. alignment with clinical processes), flexibility (e.g. potential to customise resources and prompts), and consideration of time constraints. These attributes are largely consistent with preferred features of other CDSSs. Useability is an important facilitator of CDSS engagement.[32] Simplicity for design of a proposed colorectal cancer CDSS was viewed positively, whereas complexity was viewed as a barrier to adoption.[33] Our interviewees viewed the notion of an inflexible CDSS negatively, which may reflect preferences for clinical autonomy. Time to use a CDSS was viewed as a hindrance if it created extra work or an enabler if it streamlined care. This dichotomy was highlighted in a systematic review of medication-related CDSSs in which time constraints were also perceived as a barrier or facilitator to adoption.[34]

The patient context was an important consideration. A CDSS's potential insensitivity to contextual factors necessary for STI-related clinical decision-making was perceived as a possible barrier to use. For example, general practice EMRs may not contain necessary data (e.g. sexual orientation, number of sexual partners) in an extractable form that can be incorporated into CDSS algorithms. As such, a CDSS may

be limited in available data to query to guide care, with a risk of imprecise prompts that may compromise both clinicians' trust in the tool and delivery of optimal care.

Pop-ups were viewed positively and negatively. On the positive side, they were seen as a mechanism to communicate knowledge, guide clinical behaviours, and an avenue that could facilitate improvements in knowledge and skills via engagement with recommendations and integrated resources. Suggestions for their use included re-testing reminders, identifying high-risk patients for testing, and recommending clinical decisions and management. Concerns included that pop-up relevance depends on correct data in the EMR and that they can be excessive or perceived as unimportant, leading to pop-up fatigue.[35]

Our findings show that the concept of a CDSS for STI care was viewed favourably and provides a valuable starting point for intervention design. Whether the preferred features as described can translate into care improvements is unknown. Despite considerable enthusiasm for the potential of CDSSs, two recent systematic reviews have shown variable impact on outcomes. A meta-analysis investigating provider uptake among 55 studies found that only one-third of clinicians used the CDSS and that quality of patient data underlying the CDSS was positively associated with uptake.[36] Another meta-analysis (122 studies involving over 1 million patients and 10 000 clinicians) found that CDSSs increased the proportion of patients receiving desired care by 5.8%.[37] To hypothesise the potential impact of a STI CDSS, we translate this proportion to a quantifiable gap in STI care. Australian guidelines recommend a chlamydia retest around 3 months after treatment to check for reinfection; however, retesting rates are around 25%.[38] A 5.8% increase would only increase retesting rates to around 26.5%. The potential harms of undiagnosed infections or sub-optimal care are key considerations for any CDSS for STI care. In view of increased heterosexual and congenital syphilis, and updated guidelines to include syphilis in routine STI testing, clinical decision support to prompt syphilis testing could be a key area of focus and potential benefit. Consideration will also need to be given to other factors such as development and availability of resources and education for GPs to access the necessary support for additional infections diagnosed and requiring management.

Use of the TDF in this study facilitated us to identify key considerations for developing a CDSS for STI care. Our findings have informed the subsequent co-design and technical work to develop a prototype tool that provides prompts for syphilis testing that we will soon pilot in general practice. Our understanding of the barriers and enablers to implementation and adoption will draw directly on this analysis, whereby each TDF domain can be mapped to the COM-B framework (e.g. 'Knowledge' maps onto 'Capability'; 'Environmental context and resources' maps onto 'Opportunity'; 'Beliefs about consequences' maps onto 'Motivation'), and subsequently to the Behaviour Change Wheel to facilitate understanding of the actions to support behaviour change in regards to the implementation and use of CDSSs for sexual health care.[18]

A strength of this study includes interviewing both SHPs and GPs, allowing exploration of expert and end-user views into STI care and the general practice environment. As noted earlier, our analysis was guided by the TDF, providing a theory-based approach to understanding behaviour change components that can inform intervention development. Furthermore, the TDF is complementary to frameworks for assessing intervention implementation and behaviour change. The main limitation is our small sample size and our sample being limited to metropolitan clinicians despite efforts to recruit from rural and regional areas. However, our findings were very consistent across all those interviewed. As we only interviewed GPs as end-users, our results cannot be generalised to other potential end-users of a STI CDSS, such as practice nurses. Despite this, our findings provide valuable baseline information as a first step in STI CDSS design. The co-design process will involve ongoing engagement and input from a wider range of end-users to capture a greater breadth of views. It is also acknowledged that as participants were asked to reflect on a hypothetical tool, responses are seen as views on a concept. It is possible such views may change once participants see or engage with a STI CDSS in practice.

Conclusion

In this qualitative study, we found that the concept of a STI CDSS based on the FHT software was viewed favourably by our sample of GPs and SHPs, indicating a potential role for such a tool in Australian primary care. Although such a tool might support improvements in STI care processes, this can only occur if end-users' needs are met and barriers are addressed. A STI CDSS should be considerate of the time-pressured environment, the patient context, and include appropriate resources and pop-ups that reflect end-users' clinical needs and workflow. During 2022, we commenced work on developing a prototype in FHT that provides prompts for syphilis testing, with this study providing an important first step in the tool's design.

References

1 Australian Department of Health. Fourth national sexually transmissible infections strategy 2018–2022. Canberra: Australian Department of Health, Commonwealth of Australia; 2018.
2 Kirby Institute. HIV, viral hepatitis and sexually transmissible infections in Australia: annual surveillance report 2021. Sydney: UNSW Sydney, NSW; 2021.
3 Price MJ, Ades AE, Soldan K, Welton NJ, Macleod J, Simms I, *et al.* The natural history of *Chlamydia trachomatis* infection in women: a multi-parameter evidence synthesis. *Health Technol Assess* 2016; 20(22): 1–250. doi:10.3310/hta20220
4 Goller JL, Fairley CK, De Livera AM, Chen MY, Bradshaw CS, Chow EP, *et al.* Trends in diagnosis of pelvic inflammatory disease in an Australian sexual health clinic, 2002–16: before and after clinical

audit feedback. *Sex Health* 2019; 16(3): 247–53. doi:10.1071/SH18119
5 Trojian TH, Lishnak TS, Heiman D. Epididymitis and orchitis: an overview. *Am Fam Physician* 2009; 79(7): 583–7.
6 Tapsall J, World Health Organization. Antimicrobial resistance in *Neisseria gonorrhoeae*. World Health Organization; 2001.
7 Young J, Eley D, Fahey P, Patterson E, Hegney D. Enabling research in general practice: increasing functionality of electronic medical records. *Aust Fam Physician* 2010; 39(7): 506–9.
8 Yeung A, Temple-Smith M, Spark S, Guy R, Fairley CK, Law M, *et al.* Improving chlamydia knowledge should lead to increased chlamydia testing among Australian general practitioners: a cross-sectional study of chlamydia testing uptake in general practice. *BMC Infect Dis* 2014; 14(1): 584. doi:10.1186/s12879-014-0584-2
9 Hocking JS, Parker RM, Pavlin N, Fairley CK, Gunn JM. What needs to change to increase chlamydia screening in general practice in Australia? The views of general practitioners. *BMC Public Health* 2008; 8: 425. doi:10.1186/1471-2458-8-425
10 Australian Government. Future focused primary health care: Australia's Primary Health Care 10 Year Plan 2022–2032. Canberra: Department of Health; 2022. Available at https://www.health.gov.au/resources/publications/australias-primary-health-care-10-year-plan-2022-2032
11 Chiang J, Furler J, Boyle D, Clark M, Manski-Nankervis J-A. Electronic clinical decision support tool for the evaluation of cardiovascular risk in general practice: a pilot study. *Aust Fam Physician* 2017; 46(10): 764–8.
12 Manski-Nankervis J-A, Biezen R, Thursky K, Boyle D, Clark M, Lo S, *et al.* Developing a clinical decision support tool for appropriate antibiotic prescribing in Australian general practice: a simulation study. *Med Decis Making* 2020; 40(4): 428–37. doi:10.1177/0272989X20926136
13 Hunter B, Biezen R, Alexander K, Lumsden N, Hallinan C, Wood A, *et al.* Future health today: codesign of an electronic chronic disease quality improvement tool for use in general practice using a service design approach. *BMJ Open* 2020; 10: e040228. doi:10.1136/bmjopen-2020-040228
14 Patel B, Peiris D, Usherwood T, Li Q, Harris M, Panaretto K, *et al.* Impact of sustained use of a multifaceted computerized quality improvement intervention for cardiovascular disease management in Australian primary health care. *J Am Heart Assoc* 2017; 6(10): e007093. doi:10.1161/JAHA.117.007093
15 Goyal MK, Fein JA, Badolato GM, Shea JA, Trent ME, Teach SJ, *et al.* A computerized sexual health survey improves testing for sexually transmitted infection in a pediatric emergency department. *J Pediatr* 2017; 183: 147–52.e1. doi:10.1016/j.jpeds.2016.12.045
16 Karas D, Sondike S, Fitzgibbon J, Redding M, Brown M. Using a clinical decision support tool to increase chlamydia screening across a large primary care pediatric network. *Clin Pediatr* 2018; 57(14): 1638–41. doi:10.1177/0009922818803397
17 Michie S, Johnston M, Abraham C, Lawton R, Parker D, Walker A, *et al.* Making psychological theory useful for implementing evidence based practice: a consensus approach. *Qual Saf Health Care* 2005; 14: 26–33. doi:10.1136/qshc.2004.011155
18 Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci* 2012; 7: 37. doi:10.1186/1748-5908-7-37
19 French S, Green S, O'Connor D, McKenzie J, Francis J, Michie S, *et al.* Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implement Sci* 2012; 7(1): 38. doi:10.1186/1748-5908-7-38
20 Kirk JW, Sivertsen DM, Petersen J, Nilsen P, Petersen HV. Barriers and facilitators for implementing a new screening tool in an emergency department: a qualitative study applying the Theoretical Domains Framework. *J Clin Nurs* 2016; 25(19-20): 2786–97. doi:10.1111/jocn.13275
21 Mazza D, Chapman A, Michie S. Barriers to the implementation of preconception care guidelines as perceived by general practitioners: a qualitative study. *BMC Health Serv Res* 2013; 13(1): 36. doi:10.1186/1472-6963-13-36
22 Mosavianpour M, Sarmast HH, Kissoon N, Collet J-P. Theoretical domains framework to assess barriers to change for planning health care quality interventions: a systematic literature review. *J Multidiscip Healthc* 2016; 9: 303–10. doi:10.2147/JMDH.S107796
23 Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, *et al.* A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implement Sci* 2017; 12(1): 77. doi:10.1186/s13012-017-0605-9
24 Australasian Society for HIV Viral Hepatitis and Sexual Health Medicine (ASHM). Australian STI management guidelines, for use in primary care. ASHM; 2021. Available at https://sti.guidelines.org.au/
25 Melbourne Sexual Health Centre. Health professionals. 2022. Available at https://www.mshc.org.au/health-professionals
26 Melbourne Sexual Health Centre. Let them know. Melbourne Sexual Health Centre. 2022. Available at https://letthemknow.org.au/
27 Zou H, Fairley CK, Guy R, Bilardi J, Bradshaw CS, Garland SM, *et al.* Automated, computer generated reminders and increased detection of gonorrhoea, chlamydia and syphilis in men who have sex with men. *PLoS ONE* 2013; 8(4): e61972. doi:10.1371/journal.pone.0061972
28 Gray RT, Callander D, Hocking JS, McGregor S, McManus H, Dyda A, *et al.* Population-level diagnosis and care cascade for chlamydia in Australia. *Sex Transm Infect* 2020; 96(2): 131–6. doi:10.1136/sextrans-2018-053801
29 Laka M, Milazzo A, Merlin T. Factors that impact the adoption of Clinical Decision Support Systems (CDSS) for antibiotic management. *Int J Environ Res Public Health* 2021; 18(4): 1901. doi:10.3390/ijerph18041901
30 Hor CP, O'Donnell JM, Murphy AW, O'Brien T, Kropmans TJB. General practitioners' attitudes and preparedness towards Clinical Decision Support in e-Prescribing (CDS-eP) adoption in the West of Ireland: a cross sectional study. *BMC Med Inform Decis Mak* 2010; 10(1): 2. doi:10.1186/1472-6947-10-2
31 Wright M-O, Knobloch MJ, Pecher CA, Mejicano GC, Hall MC. Clinical decision support systems use in Wisconsin. *WMJ* 2007; 106(3): 126–9.
32 Ford E, Edelman N, Somers L, Shrewsbury D, Lopez Levy M, van Marwijk H, *et al.* Barriers and facilitators to the adoption of electronic clinical decision support systems: a qualitative interview study with UK general practitioners. *BMC Med Inform Decis Mak* 2021; 21(1): 193. doi:10.1186/s12911-021-01557-z
33 Harrison JD, Masya L, Butow P, Solomon M, Young J, Salkeld G, *et al.* Implementing patient decision support tools: moving beyond academia? *Patient Educ Couns* 2009; 76(1): 120–5. doi:10.1016/j.pec.2008.12.013
34 Westerbeek L, Ploegmakers KJ, de Bruijn G-J, Linn AJ, van Weert JC, Daams JG, *et al.* Barriers and facilitators influencing medication-related CDSS acceptance according to clinicians: a systematic review. *Int J Med Inf* 2021; 152: 104506. doi:10.1016/j.ijmedinf.2021.104506
35 Khalifa M, Zabani I. Improving utilization of clinical decision support systems by reducing alert fatigue: strategies and recommendations. 14th Conference on International Conference on Informatics, Management, and Technology in Healthcare; 2016.
36 Kouri A, Yamada J, Lam Shin Cheung J, Van de Velde S, Gupta S. Do providers use computerized clinical decision support systems? A systematic review and meta-regression of clinical decision support uptake. *Implement Sci* 2022; 17(1): 21. doi:10.1186/s13012-022-01199-3
37 Kwan JL, Lo L, Ferguson J, Goldberg H, Diaz-Martinez JP, Tomlinson G, *et al.* Computerised clinical decision support systems and absolute improvements in care: meta-analysis of controlled clinical trials. *BMJ* 2020; 370: m3216. doi:10.1136/bmj.m3216
38 Bowring A, Gouillou M, Guy R, Kong F, Hocking J, Pirotta M, *et al.* Missed opportunities – low levels of chlamydia retesting at Australian general practices, 2008–2009. *Sex Transm Infect* 2012; 88(5): 330–34. doi:10.1136/sextrans-2011-050422

Data availability. Data for this analysis are not publicly available.

Conflicts of interest. Jane Hocking is an Editor of *Sexual Health,* but was blinded from the peer review process for this paper. All other authors declare no conflicts of interest.

Declaration of funding. This research did not receive any specific funding.

Acknowledgements. We wish to thank our key informants for participating in an interview and for their valuable contribution to improving understanding of the potential role and attributes of a clinical decision support system for STI care.

Author affiliations
[A]Melbourne School of Population & Global Health, The University of Melbourne, Carlton, Vic., Australia.
[B]Department of General Practice, The University of Melbourne, Melbourne, Vic., Australia.