

1 Syphilis self-testing to expand test uptake among men who have sex with men: a 2 theoretically informed mixed methods study in Zimbabwe

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14 Key messages:

- 15 - Syphilis self-testing is an empowering, innovative tool that can be used to expand uptake
16 of STI testing among sexual minorities in Zimbabwe.
- 16 - Facilitators and barriers for syphilis self-testing are similar to those observed for HIV self-
17 testing in Zimbabwe and other low- and middle- income countries.
- 17 - Participants reported high self-test usability and found that self-testing provided increased
18 privacy, convenience and autonomy in comparison to facility-based testing.

19 **Keywords:** syphilis, self-testing, men who have sex with men

21 ABSTRACT

22 **Objectives** - Self-testing for STIs such as HIV and syphilis may empower sexual minorities and expand
23 uptake of STI testing. While much is known about HIV self-testing (HIVST), less is known about syphilis
24 self-testing, particularly in low-income settings. The objective of this study is to determine context-specific
25 facilitators and barriers for self-testing and to assess the usability of syphilis self-testing in Zimbabwe among
26 men who have sex with men (MSM).

27 **Methods** - This mixed methods study was conducted in Harare as part of a larger syphilis self-testing trial.
28 The study included in-depth interviews (phase one) followed by usability testing and a second interview
29 (phase two). In-depth interviews were conducted with MSM and key informants prior to syphilis self-testing.

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30 The same MSM then used the syphilis self-test, quantitatively assessed its usability and participated in a
31 second in-depth interview. Phase one data was analysed using a thematic approach, guided by an adapted
32 Social Ecological Model conceptual framework. Phase two interviews were analysed using Rapid Assessment
33 Procedure qualitative methodology, and usability was assessed using a pre-established index, adapted from
34 existing HIVST evaluation scales.

35 **Results** – Twenty MSM and 10 key informants were recruited for phase one in-depth interviews and 16 of
36 these MSM participated in phase two by completing a syphilis self-test kit. Facilitating factors for self-testing
37 included the potential for increased privacy, convenience, autonomy and avoidance of social and healthcare
38 provider stigma. Barriers included the fear to test and uncertainty about linkage to care and treatment. Data
39 from the usability index suggested high usability (89.6% on a 0-100 scale) among the men who received the
40 self-test.

41 **Conclusions** - MSM in Zimbabwe were willing to use syphilis self-test kits and many of the barriers and
42 facilitators were similar to those observed for HIVST. Syphilis self-testing may increase syphilis test uptake
43 among sexual minorities in Zimbabwe and other low- and middle-income countries.

44 **Introduction**

45 In 2016, WHO estimated 19.9 million cases of syphilis worldwide, with the highest prevalence in the WHO
46 African region (1). In the same year, the Global Health Sector Strategy on Sexually Transmitted Infections
47 sets an impact goal to reduce syphilis infections by 90% globally between 2016-2030. As syphilis is often
48 asymptomatic, testing is essential to effectively interrupting transmission and innovative strategies are needed
49 to expand syphilis test uptake (2). Syphilis is more common among men who have sex with men (MSM), with
50 the WHO reporting a median seroprevalence of 6.0% in this group, estimated from 2016-2017 Global AIDS
51 Monitoring data (3). A 2020 biobehavioural survey in Zimbabwe found that 5.1% of Harare MSM had
52 positive treponemal and non-treponemal tests (4). In addition, syphilis and HIV share common sexual risk
53 behaviours and syphilis facilitates HIV transmission, making syphilis co-infection particularly prevalent in
54 HIV-infected MSM (2)(5). As PrEP becomes increasingly available in LMIC, risk behaviours may also
55 change and inadvertently facilitate STI transmission (6). As a result, the WHO strongly recommends routine
56 syphilis screening among MSM (7).

57
58 MSM face unique health care challenges because of lack of funding for MSM health, lack of testing, legal and
59 cultural barriers, and stigmatisation, particularly in low- and middle-income countries (LMIC) (8). Stigma
60 associated with same sex relationships may also extend to healthcare facilities and professionals (9). There is
61 also a considerable gap in evidence to guide MSM health programs in many LMICs (10). As a result, despite
62 WHO recommendations, MSM are frequently excluded from syphilis testing services in many LMICs (2).

63
64 One way to expand MSM syphilis test uptake is self-testing. Syphilis self-testing is an approach whereby a
65 person performs a rapid syphilis test themselves and interprets the result in private. Self-testing may overcome
66 some of the barriers associated with facility-based testing, promoting early diagnosis, interrupting disease
67 progression, and reducing syphilis transmission (11).

68
69 HIVST is recommended by the WHO to expand test uptake among stigmatised key populations (7). A
70 qualitative evidence synthesis found that HIVST empowered people and decreased test-associated stigma
71 (12). Many countries, including Zimbabwe, have policies to support HIVST as an entry point into sexual
72 health services (13). However, there is less evidence supporting syphilis self-testing, despite the known
73 importance of qualitative research in implementing novel diagnostic technologies (12). Syphilis self-testing
74 pilots have shown that it may increase testing frequency by empowering MSM and reducing the impact of
75 structural barriers, but there is no data from sub-Saharan Africa (14)(15). Additionally, in the context of the
76 COVID-19 pandemic, self-testing has become an increasingly important pathway to safely sustain testing
77 when testing facilities are closed or only partially open.

78

79 This study aims to understand how syphilis self-testing can create opportunities to test for MSM in Zimbabwe.
80 The purpose of this study was to determine facilitators and barriers for syphilis self-testing and to assess the
81 usability of syphilis self-testing as reported by Zimbabwean men who have sex with men (MSM).

82

83 **Methods**

84 A two-phased mixed methods study was conducted among MSM in Zimbabwe. We focused on Harare
85 because of the strong network of MSM community-based organisations in the city. The first phase was prior
86 to syphilis self-testing and the second phase was after syphilis self-testing. The formative data from both
87 phases informed a trial protocol aiming to compare syphilis self-testing to facility-based testing in MSM in
88 Zimbabwe (16).

89

90 In phase one, in-depth interviews were conducted amongst MSM and key informants, by trained and
91 experienced researchers from the Pangaea Zimbabwe Aids Trust (PZAT), between March and April 2020. We
92 recruited MSM using snowball sampling (17). Participants needed to meet the following inclusion criteria: 16
93 years or older, living in Harare, ever had anal or oral sex with another man, born biologically male, and able
94 to provide informed consent. All MSM were referral facilitators, responsible for offering community support
95 to individuals who are harder-to-reach. Key informants were healthcare professionals and were purposively
96 sampled to include providers who had experience with HIV and/or syphilis testing.

97

98 Interviews were conducted using a structured guide, lasted approximately 30 minutes and were audio-
99 recorded. The MSM interview guide was developed to explore prior syphilis- and HIV-testing experiences,
100 facilitating and deterring factors, and self-testing intervention preferences. Socio-demographic data were also
101 collected. The key informant interview guide included healthcare provider experiences with HIV and syphilis
102 testing and treatment services, including population served and challenges faced.

103

104 Interviews were translated and transcribed by PZAT researchers. Transcripts were then entered into Dedoose
105 8.3.17. The Framework Method was used to guide our analysis (18). Two codebooks were developed based
106 on an adapted Social Ecological Model to systematically analyse the data, following calculation of the
107 intercoder agreement. Ultimately our conceptual framework included an individual level, a community level
108 and a policy and environment-level (Figure 1) (19). The framework was used to organise deductive and
109 inductive themes emerging from the data, and to create separate analytic memos for MSM and key informant
110 data. The preliminary findings described in these analytic memos were used to refine the pilot trial protocol
111 (MRCZ/A/ 2533).

112

113 In phase two, the syphilis self-test distributed to MSM consisted of a Standard Q Syphilis Ab treponemal blood-
114 based rapid test (SD Biosensor), adapted for individual use and interpretation. Individual lancets and buffer

115 samples were packaged into sealed plastic pouch, together with an individual test device and an infographic,
116 created to explain step-by-step use and appropriate disposal of the kit. An instructional video was created and
117 disseminated to facilitate independent use. Tests were distributed by researchers from PZAT to the same MSM
118 who had completed in-depth interviews in phase one. It emerged that insufficient quantities of buffer were
119 provided in some test kits, impeding successful self-test completion. This was however resolved through
120 community-based distribution of additional buffer samples.

121
122 In phase two (August 2020), PZAT researchers interviewed a sample of 16 MSM who successfully completed
123 a syphilis self-test. These interviews were conducted under COVID-19 social distancing measures, as per
124 guidance provided by the Zimbabwe Ministry of Health. Only 16 MSM were interviewed in phase two, as four
125 of the initial cohort of 20 MSM were lost to follow-up. An exit interview guide was developed to qualitatively
126 assess specific facilitators and barriers for syphilis self-testing. Participants also completed a survey to establish
127 quantitative usability of the test, adapted from a HIVST usability index used in South Africa (20). Qualitative
128 data was analysed following the Rapid Assessment Procedures (RAP), a set of methodologies designed for rapid
129 assessment of health-seeking behaviour (21). A RAP matrix was developed using the exit interview guide and
130 Social Ecological Model. Data were then organised into the matrix, by paraphrasing, synthesizing and quoting
131 from participant responses in interview recordings. This allowed us to simultaneously and systematically
132 identify similarities, differences and trends in responses (22). A table illustrating the template that was used by
133 researchers to analyse participant responses regarding the syphilis self-testing kits can be found in Appendix 3.

134
135 Ethical clearance was obtained from both Zimbabwe (MRC/A/2533) and London School of Hygiene and
136 Tropical Medicine (Ref: 17848). In line with MRCZ guidance, participants were each compensated for their
137 time. Participants provided informed verbal consent before the start of all interviews. Data was anonymised at
138 the source and participants were given a unique ID.

139

140 **Results**

141 Twenty MSM and 10 key informants were recruited for in-depth interviews in phase one. In phase two, the
142 whole cohort was contacted but four MSM were lost to follow-up due to relocation or communication
143 difficulties. Sixteen MSM were therefore invited to conduct the self-test independently and were
144 subsequently interviewed. In phase one, 18 of 20 MSM had previously used HIVST (Table 1). All of these
145 MSM had at least secondary-level education and all but three self-identified as MSM. We observed the
146 following themes in qualitative data: prior STI and HIV testing experiences, both with self-testing and
147 facility-based services; usability of the syphilis self-test and how it compares to HIV self-testing; MSM-
148 specific facilitators and barriers for self-testing.

149 *Table 1 - Demographic characteristics of in-depth interview participants and exit interviews following the*
150 *syphilis self-test kit trial*

	Men who have sex with men n (%)
Phase 1 – in-depth interview	
Age	
Mean age in years (range)	24 (20-33)
Education level	
Secondary	7 (35.0)
College	6 (30.0)
University	7 (35.0)
Employment status	
Student	7 (35.0)
Formal work	7 (35.0)
Informal work	3 (15.0)
Unemployed	2 (10.0)
Other	1 (5.0)
Sexual orientation	
Gay (MSM)	17 (85.0)
Heterosexual (MSW)	2 (10.0)
Bisexual (MSM/MSW)	1 (5.0)
Self-reported disclosure of sexual identity	
Out to family, friends or doctors	19 (95.0)
Not out	1 (5.0)
History of HIV self-testing	
Yes	18 (90.0)
No	2 (10.0)
Phase 2 – syphilis self-testing exit interview	
History of syphilis facility-based testing	8 (50.0)
Conducted a syphilis self-test	16 (80.0)
Tested positive for syphilis	2 (12.5)
Self-reported disclosure of sexual identity	
In person via community-based organisation	6 (37.5)
Through messaging via WhatsApp	9 (56.25)

151

152

153 **Prior HIV and STI testing experiences**

154 In phase one, eighteen MSM had experienced HIV self-testing before using the oral HIV test. Ten participants
155 stated they used HIVST every three to six months. In addition, thirteen of the 18 HIVST-experienced MSM
156 had then attended a facility and were empowered to seek facility-based services. Key informants confirmed
157 that syphilis testing is usually reserved for pregnant women, and only three had received training on how to
158 work with MSM, suggesting MSM are largely neglected by STI services. Some providers recommended
159 syphilis testing should be mandatory for key populations.

160

161 **Syphilis self-test usability and comparison with HIVST**

162 Of the 16 participants in phase two, two (12.5%) tested positive for syphilis. Fifteen participants reported the
163 clarity of explanations provided in the infographic and video were instrumental to successful test completion.
164 Overall, MSM reported 89.6% usability for the syphilis self-test on a 0-100 scale. This is described in detail in
165 Table 2. The main challenge with the test kit, reported by 11 of the 16 participants, was the blood draw using
166 the capillary pipette. Participants nonetheless felt this particular challenge was warranted for the test to
167 function. One participant had difficulties extracting the buffer because insufficient quantities were provided.
168 Four participants had to repeat the test, as they did not provide enough blood for the test to show a result.

169

170 **Comparing syphilis self-testing to HIVST**

171 Phase two participants felt that the syphilis and HIV self-test kits had many similarities, including the
172 potential for privacy and convenience. The major challenge cited was that syphilis self-testing uses a blood
173 sample whilst most HIVST kits use oral samples. Two MSM reported a preference for HIVST compared to
174 syphilis self-testing because of this issue. However, fifteen (94%) participants felt that they trusted the syphilis
175 test result more because it was blood-based. They also preferred the syphilis self-test because of the clarity of
176 instructions compared to prior HIVST instructional material.

177

178 **Self-testing facilitators and barriers**

179 Facilitating and deterring factors for self-testing were categorised into individual, community and structural-
180 level factors (Table 3). Convenience, privacy, and autonomy were the most cited reasons why MSM preferred
181 self-testing over facility-based testing.

182

183 **Self-testing facilitators**

184 The following factors were facilitators for both HIVST and syphilis self-testing: privacy, autonomy and
185 empowerment, convenience, user-friendliness, high perceived trust in blood-based tests, avoidance of social
186 and healthcare provider stigma, monetary and time savings, and reduced contact with facility-based services
187 in the COVID-19 context. All MSM participants felt comfortable testing alone and stated they would prefer
188 doing their next test at home, in order to be the first to see their results. In comparison, three participants

189 *Table 2 - Usability index of the syphilis self-test based on a stepwise questionnaire administered in phase two*

Usability Checklist	YES n	NO n	Usability index (%) [‡]
<i>Did you find it easy to read/use the information sheet?</i>	16	0	100
<i>Did you find it easy to watch/use the instructional video?</i>	16	0	100
<i>Was it difficult for you to remove the kit components from the pack?</i>	1	15	93.8
<i>Did you verify that the silica gel pouch was yellow, to confirm their test was valid for use?</i>	16	0	100
<i>Did you remove the yellow shield from the lancet?</i>	16	0	100
<i>Did you have difficulty lancing (pricking) their finger using the blue lancet?</i>	1	15	93.8
<i>Did you have difficulty forming a blood droplet?</i>	5	11	68.8
<i>Were you able to pick up a blood drop up to the black line of the capillary pipette?</i>	5	11	31.2
<i>Were you able to open the green buffer bottle?</i>	16	0	100
<i>Were you able to use the pink pipette to pick up the buffer?</i>	15	1	93.8
<i>Did you drop three drops into the test device well?</i>	15	1	93.8
<i>Was a control line present on the test device?</i>	12	4	75.0
<i>Did you trust the self-test result?</i>	15	1	93.8
<i>Did you quit the process at any point?</i>	0	16	100
<i>Did you continue the process despite a missed or incorrect step?</i>	0	16	100
Total Usability Index			89.6%

190

[‡] The usability index (UI) was calculated based on the method used in the HIVST paper from which the index itself was extracted. The original UI is based on WHO literature on Diagnostic Assessment for submission to prequalification. Like in the HIVST study, we tracked all successful steps, in order to quantify a usability index, expressed as a percentage (20)

191 stated that facility-based testing did not provide adequate levels of privacy. MSM liked that they could
192 conduct their test without the involvement of a healthcare provider and the convenience of it.

193

194 MSM highlighted that the lengthy waiting periods for in-facility testing are an important deterring factor. A
195 rapid self-test could contribute to speeding up diagnosis, reducing treatment delay and more efficiently
196 interrupting syphilis transmission. Seven participants in fact mentioned that HIV self-testing empowered them
197 to test more frequently and take control of their sexual health. All phase two participants stated that the blood
198 draw increased their trust in the syphilis self-test. Two MSM noted the blood draw for syphilis facility-based
199 testing is more painful than the self-test, due to the nature of the self-testing lancets provided, and thus would
200 opt for the self-test. Participants explained that they preferred the pressure-activated lancets provided in the
201 study self-test kits, in comparison to the twist-top universal lancets used in-facility.

202

203 Participants liked that they were able to avoid being identified at a facility and stigmatized by members of
204 their own community. Additionally, several MSM observed that self-testing prevented hostility from
205 providers or other society members, therefore decreasing test-associated stigma. Key informants in phase one
206 explained they valued self-testing because of the potential to reduce contact with clients, especially in the
207 context of the COVID-19 pandemic.

208

209 **Barriers to self-testing**

210 Themes related to barriers included the following: the challenge of self-sampling blood, reluctance to test due
211 to poor awareness, stigma at community-level following at-home testing, indefinite linkage to care and
212 treatment availability. Twelve participants experienced difficulty with the blood draw that they attributed to
213 inexperience. One participant was concerned about the bio-hazard potential with test-kit material disposal.
214 Some MSM mentioned that self-test uptake is jeopardised among the wider community of MSM by poor
215 awareness and the perception that they do not have STIs. MSM also expressed concerns over the fact they
216 could be profiled or stigmatised within their own community following at-home self-testing. Participants
217 reported that they would seek confirmatory testing if trusted information was provided on where to go and
218 what to expect in-facility. These are legitimate concerns that align with phase one qualitative data, which
219 showed that provider discrimination and treatment shortages exist at structural level. Multiple key informants
220 also reported frequent unavailability of the facility-based syphilis tests required for confirmatory testing, as
221 these are reserved for antenatal care.

222 *Table 3. Summary of facilitating and deterring factors influencing MSM testing decision, including quotes from phase one in-depth interviews*
223

SEM level	Facilitators	Quotes	Barriers	Quotes
	Privacy	<i>But sometimes you need privacy because not everyone is reliable enough to keep your information with and we are humans (on HIVST, 23yo MSM)</i>	Blood sample required	<i>I was afraid of being pricked (MSM020, on HIVST)</i>
	Autonomy and self-empowerment	<i>One, I do the thing on my own when I'm willing to do it. Two, it produces the results that I will see on my own" (on HIVST, MSM age unspecified)</i>	Reluctance to test and poor awareness surrounding syphilis	<i>At first, I was scared of being positive but my cousin encouraged me to go for HIV tests and told me that if I become positive that will not be the end of life' (on HIVST, 20yo MSM)</i>
	User-friendly testing and innovation	<i>It's because it's an improvement. Things will be better than [facility-based syphilis testing] where you go there and they take the blood (on syphilis self-testing, 27yo MSM)</i>		<i>I wouldn't [consider taking a syphilis self-test] because in my mind I have already told myself that I do not have STIs, maybe I would encourage others instead. (on syphilis self-testing, 23yo MSM)</i>
	High perceived trust in blood-based tests	<i>I feel the blood based one gives a more accurate result. (on HIVST, 21yo MSM)</i>		
INDIVIDUAL				
	Avoidance of social stigma	<i>The MSM community is small [...] mostly they will spread rumours that you don't have to date this person because he has syphilis (on syphilis self-testing, 30yo MSM)</i>	Stigma at community level over testing within peer groups	<i>You would be afraid because the people you live with, if they find out that you are self-testing for HIV, they'll be like "what pushes you?", which means you're practicing something" (on HIVST, 23yo MSM)</i>
	High perceived importance of syphilis and peer pressure to test	<i>I have a boyfriend of mine who said he has syphilis, so he was treated for syphilis. So I need to see if I also have it (on syphilis self-testing, 24yo MSM)</i>		
COMMUNITY				
	Convenience and improved access	<i>No, I was just motivated with the channel of self-testing because sometimes you won't be having any access (on HIVST, 27yo MSM)</i>	Indefinite linkage to care and treatment availability	<i>We give them kits, but some of them don't come back. [...] they end up knowing your phone number they will end up not answering. So that is the challenge with the self-test (key informant, Kuwadzana Polyclinic)</i>
	Avoidance of hostility, stigma, and discrimination from healthcare providers	<i>You know sometimes you need to go through a whole lot of protocol to get the test kit and that's what I wouldn't want (MSM005)</i> <i>I would not want to go the clinic because some nurses have got an attitude towards people like us because some of them are homophobic. (MSM003,</i>		<i>Benzathine... rarely. Sometimes it's out of stock and if you refer patients to go and buy outside at pharmacies, that's where there is a challenge (key informant, Hatcliffe clinic)</i>
	Time savings	<i>I actually did it [...] without having to go anywhere or consult anyone, so yah, in terms of time, in terms of cost it was cost effective." (on HIVST, 25yo MSM)</i>		
	Monetary savings			
	Avoidance of health risk for providers	<i>We do not have safety clothes to protect us when we are doing HIV tests [...] and we will be putting our lives in danger especially in this period of COVID-19 (key informant, Malbereign clinic)</i>		
STRUCTURAL				

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224 Discussion

225 Our study expands on the limited literature on syphilis self-testing, includes qualitative and quantitative data,
226 and follows MSM prior to and after self-testing. We found that syphilis self-testing was feasible and highly
227 acceptable among MSM in Zimbabwe. The high usability index (89.6%) suggests that syphilis self-testing
228 would be acceptable in this subgroup of MSM. Overall, 12.5% of phase two MSM tested positive for syphilis,
229 a high proportion considering the relatively small number of participants. Participants reported self-testing
230 was a convenient method that provided increased privacy, autonomy and diminished vulnerability in
231 comparison to facility-based testing. The testing challenges associated with the amount of test buffer were
232 transient and were improved by increasing the quantity of buffer provided.

233
234 Study findings are consistent with HIV self-testing data in Zimbabwe, as well as syphilis self-testing data
235 from China (23) and the Netherlands (15). Our qualitative data suggested that many of the same facilitators
236 and barriers for syphilis self-testing exist for HIV self-testing. Self-testing is a private and convenient method
237 that is preferred over facility-base testing, especially for higher risk individuals. This is reflected in the large
238 body of evidence that exists for HIV self-testing, which is now well established in Zimbabwe (24). We found
239 that syphilis self-testing was the first ever syphilis test for half of our study participants. This is consistent
240 with data from China suggesting that syphilis self-testing may increase test uptake among MSM (23). Recent
241 data from HIVSTAR in Malawi, Zambia and Zimbabwe also show that HIVST also encourages first-time
242 HIV testing (25).

243
244 Our qualitative data suggest that syphilis self-testing can empower MSM to test when, where, and with whom
245 they wish. This is consistent with a global HIVST qualitative literature showing how self-testing gives agency
246 to those who test (12)(26). Existing research also shows self-testing can improve testing frequency (27,28).
247 Providing autonomy, control and creating a culture of testing among vulnerable MSM could potentially help
248 to build trust in the local health system, which is relatively low according to recent evidence (9).

249
250 One barrier to syphilis self-testing was the uncertainty of linking to confirmatory testing and treatment within
251 health facilities. Key informants noted that Zimbabwe hospitals have variable access to non-treponemal tests
252 and stock-outs of penicillin occur. While similar concerns existed for HIVST, linkage to care rates have been
253 excellent (26). Poor linkage to syphilis care would impact the capacity for testing to translate into public
254 health benefits for syphilis control. Embedding syphilis self-testing within the HIVST systems could be a way
255 to enhance linkage to care. HIVST has been part of the Zimbabwe National HIV/AIDS Strategic Plan since
256 2016. The recent large scale HIVSTAR implementation study used community-based distributors, accounting
257 for over 75% of test kit distribution, through Population Services International branches, achieving 50.3%
258 community-level coverage (25). A number of studies in China show successful integration of HIV and
259 syphilis testing services (11).

260

261 This study has a number of limitations. Firstly, as a mixed methods study, qualitative results should be
262 interpreted as only an indication of the preferences of the men interviewed. The MSM participants all had at
263 least secondary-level education, were educated about STIs and able to access community-based services. They
264 may therefore be early adopters within the MSM population, more likely to take up health innovations due to
265 heightened awareness and contact with MSM community organisations (29). Most of the interviewees had
266 tried HIVST, which could have also made them familiar with the self-testing method and thus more likely to
267 accept syphilis self-testing. The perspectives of this subset of MSM may be different to those of other,
268 potentially more marginalised MSM in Zimbabwe. For example, subsets of low literacy MSM have had
269 problems implementing HIVST and this may also be the case for syphilis self-testing (30).

270

271 This study has implications for research and policy. It has revealed that more research is needed on how we
272 can integrate syphilis self-testing into established networks of HIV self-testing services to facilitate
273 implementation. Syphilis self-testing cannot effectively contribute to interrupting syphilis transmission if
274 facility-based confirmatory testing and treatment is not made accessible to MSM. Clinical trials are needed to
275 assess the effectiveness and risks of syphilis self-testing in practice. From a policy perspective, many of the
276 existing HIVST policies could be expanded to cover syphilis self-testing. Further policy development will
277 help national leadership to embrace syphilis self-testing as a tool for expanding syphilis testing. Improving
278 testing among key populations can reduce the bridging of syphilis into the general population, likely having an
279 impact on the overall prevalence of syphilis, with the potential of reducing mother-to-child transmission.

280

281 In conclusion, the findings from this study suggest that syphilis self-testing may decrease user perceived test-
282 associated stigma and empower MSM in an area where same sex relations are condemned. As PrEP is
283 expanded in Zimbabwe and other LMIC settings, leading to a possible shift in sexual risk behaviours, syphilis
284 prevalence may increase. Innovative tools such as syphilis self-testing are needed to expand syphilis test
285 uptake, especially for marginalised populations of MSM.

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292

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299

300 **No competing interests declared**

301

302 **Patient consent for publication** Not required

303

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306 informed consent.

307

308 **Provenance and peer review :** Not commissioned; awaiting external peer review.

309

310 **Data availability statement – Data are available upon reasonable request :** All individual patient data
311 collected that underlie the results reported in this article will be available (text, tables, figures and appendices).
312 Analytic codebooks and consent forms are also available upon request. This data will be available
313 immediately following publication to researchers who provide a methodologically sound proposal. Proposals
314 should be directed to clarisse.sri-pathmanathan@kcl.ac.uk. To gain access, data requestors will need to sign a
315 data access agreement.

316

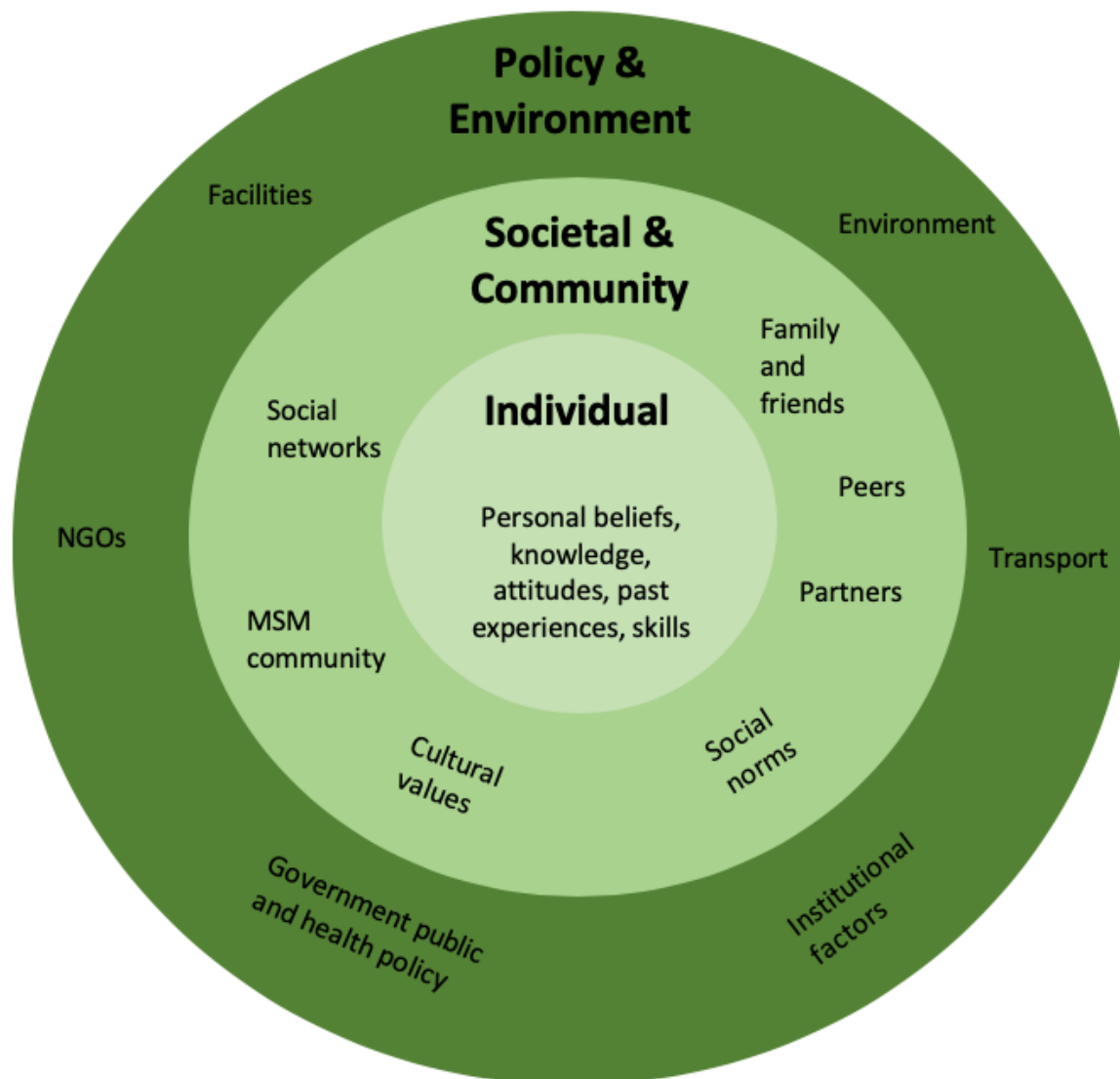
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319 References

- 320 1. Rowley J, Hoorn S Vander, Korenromp E, et al. Chlamydia, gonorrhoea, trichomoniasis and syphilis: Global
321 prevalence and incidence estimates, 2016. *Bull World Health Organ.* 2019;97(8):548–62.
- 322 2. World Health Organization. Global Health Sector Strategy on Sexually Transmitted Infections 2016–2021.
323 WHO/RHR/1609. 2016;Sexual Hea:64.
- 324 3. WHO. Report on global sexually transmitted infection surveillance, 2018. World Health Organization. 2018.
325 6-7 p.
- 326 4. ICAP at Columbia University. HIV and STI Biobehavioral Survey among Men Who Have Sex with Men,
327 Transgender Women, and Genderqueer Individuals in Zimbabwe - Final Report. 2020 (August).
- 328 5. Katz DA, Dombrowski JC, Bell TR, et al. HIV Incidence Among Men Who Have Sex With Men After
329 Diagnosis With Sexually Transmitted Infections. *Sex Transm Dis.* 2016 Apr;43(4):249–54.
- 330 6. Ong JJ, Baggaley RC, Wi TE, et al. Global Epidemiologic Characteristics of Sexually Transmitted Infections
331 Among Individuals Using Preexposure Prophylaxis for the Prevention of HIV Infection: A Systematic
332 Review and Meta-analysis. *JAMA Netw Open [Internet].* 2019 Dec 11;2(12):e1917134–e1917134. Available
333 from: <https://doi.org/10.1001/jamanetworkopen.2019.17134>
- 334 7. World Health Organization. Consolidated guidelines on HIV prevention, diagnosis, treatment and care for
335 key populations. *WHO Guidel [Internet].* 2014;(July):184.
- 336 8. Bien-Gund CH, Zhao P, Cao B, et al. Providing competent, comprehensive and inclusive sexual health
337 services for men who have sex with men in low- and middle-income countries: a scoping review. *Sex Health*
338 *[Internet].* 2019;16(4):320–31. Available from: <https://doi.org/10.1071/SH18191>
- 339 9. Tsang EY-H, Qiao S, Wilkinson JS, et al. Multilayered Stigma and Vulnerabilities for HIV Infection and
340 Transmission: A Qualitative Study on Male Sex Workers in Zimbabwe. *Am J Mens Health [Internet].*
341 2019;13(1):1557988318823883–1557988318823883.
- 342 10. Rebe K, Hoosen N, McIntyre JA. Strategies to improve access for MSM in low-income and middle-income
343 countries. *Curr Opin HIV AIDS.* 2019 Sep;14(5):387–92.
- 344 11. Ong JJ, Fu H, Smith MK, et al. Expanding syphilis testing: a scoping review of syphilis testing interventions
345 among key populations. *Expert Rev Anti Infect Ther [Internet].* 2018 May 4;16(5):423–32. Available from:
346 <https://doi.org/10.1080/14787210.2018.1463846>
- 347 12. Qin Y, Han L, Babbitt A, et al. Experiences using and organizing HIV self-testing. *AIDS [Internet].* 2018 Jan
348 28;32(3):371–81.
- 349 13. Ministry of Child and Healthcare. Operational and Service Delivery Manual for the Prevention, Care and
350 Treatment of HIV in Zimbabwe. AIDS TB Program. 2017;116.
- 351 14. Tucker JD, Bu J, Brown LB, et al. Accelerating worldwide syphilis screening through rapid testing: a
352 systematic review. *Lancet Infect Dis.* 2010 Jun;10(6):381–6.
- 353 15. Bil JP, Prins M, Stolte IG, et al. Usage of purchased self-tests for HIV and sexually transmitted infections in
354 Amsterdam, the Netherlands: results of population-based and serial cross-sectional studies among the general
355 population and sexual risk groups. *BMJ Open [Internet].* 2017 Sep 21;7(9):e016609–e016609. Available
356 from: <https://pubmed.ncbi.nlm.nih.gov/28939577>
- 357 16. ClinicalTrials.gov. Syphilis Self-testing to Expand Test Uptake Among Men Who Have Sex With Men (SST)
358 *[Internet].* 2020. p. Identifier: NCT04480749. Available from:
359 <https://clinicaltrials.gov/ct2/show/NCT04480749>
- 360 17. Goodman LA. Comment: On Respondent-Driven Sampling and Snowball Sampling in Hard-to-Reach
361 Populations and Snowball Sampling Not in Hard-to-Reach Populations. *Sociol Methodol [Internet].* 2011
362 Aug 1;41(1):347–53. Available from: <https://doi.org/10.1111/j.1467-9531.2011.01242.x>
- 363 18. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in
364 multi-disciplinary health research. *BMC Med Res Methodol [Internet].* 2013;13(1):117. Available from:
365 <https://doi.org/10.1186/1471-2288-13-117>
- 366 19. McLeroy KR, Bibeau D, Steckler A, et al. An Ecological Perspective on Health Promotion Programs. *Health*
367 *Educ Q.* 1988 Dec;15(4):351–77.
- 368 20. Majam M, Mazzola L, Rhagnath N, et al. Usability assessment of seven HIV self-test devices conducted with
369 lay-users in Johannesburg, South Africa. *PLoS One [Internet].* 2020 Jan 14;15(1):e0227198. Available from:
370 <https://doi.org/10.1371/journal.pone.0227198>

- 371 21. Prentice AM. RAP: Rapid Assessment Procedures, Qualitative Methodologies for Planning and Evaluation of
372 Health Related Programmes: edited by Nevin S Scrimshaw and Gary R Gleason. 1992. International
373 Nutrition Foundation for Developing Cou. *Am J Clin Nutr* [Internet]. 1994 Jan 1;59(1):135–6. Available
374 from: <https://doi.org/10.1093/ajcn/59.1.135>
- 375 22. Averill JB. Matrix Analysis as a Complementary Analytic Strategy in Qualitative Inquiry. *Qual Health Res*
376 [Internet]. 2002 Jul 1;12(6):855–66. Available from: <https://doi.org/10.1177/104973230201200611>
- 377 23. Wang C, Cheng W, Li C, et al. Syphilis Self-testing: A Nationwide Pragmatic Study Among Men Who Have
378 Sex With Men in China. *Clin Infect Dis* [Internet]. 2019 Jul 1;70(10):2178–86. Available from:
379 <https://doi.org/10.1093/cid/ciz603>
- 380 24. Mavedzenge SN, Sibanda E, Mavengere Y, et al. Acceptability , feasibility , and preference for HIV self-
381 testing in Zimbabwe. 2016;94104.
- 382 25. Hatzold K, Gudukeya S, Mutseta MN, et al. HIV self-testing: breaking the barriers to uptake of testing
383 among men and adolescents in sub-Saharan Africa, experiences from STAR demonstration projects in
384 Malawi, Zambia and Zimbabwe. *J Int AIDS Soc*. 2019;22(S1):43–52.
- 385 26. Njau B, Covin C, Lisasi E, et al. A systematic review of qualitative evidence on factors enabling and
386 deterring uptake of HIV self-testing in Africa. *BMC Public Health* [Internet]. 2019 Oct 15;19(1):1289.
387 Available from: <https://pubmed.ncbi.nlm.nih.gov/31615461>
- 388 27. Liu F, Qin Y, Meng S, et al. HIV self-testing among men who have sex with men in China: a qualitative
389 implementation research study. *J Virus Erad* [Internet]. 2019;5(4):220–4. Available from:
390 <http://www.sciencedirect.com/science/article/pii/S2055664020300340>
- 391 28. Young SD, Daniels J, Chiu CJ, et al. Acceptability of using electronic vending machines to deliver oral rapid
392 HIV self-testing kits: a qualitative study. *PLoS One* [Internet]. 2014 Jul 30;9(7):e103790–e103790. Available
393 from: <https://pubmed.ncbi.nlm.nih.gov/25076208>
- 394 29. Rogers EM, Marshall LR. *Diffusion of Innovations*, 5th Edition [Internet]. Free Press; 2003. (Social science /
395 The Free Press). Available from: <https://books.google.co.uk/books?id=4wW5AAAIAAJ>
- 396 30. P. I, M. K, M. N, et al. Providing user support for HIV self-testing beyond instructions-for-use in Malawi.
397 *Top Antivir Med*. 2017;
398
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Figure 1: An adapted social-ecological framework of factors influencing test uptake and acceptability of a syphilis self-testing intervention among MSM (19).