

1 Increasing Attendance at Pre-booked Sexual Health Consultations: A Systematic Review

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8

9 **Abstract**

10 *Background:* Attending a sexual health consultation is integral to the effective prevention
11 and treatment of sexually transmitted infections (STIs). However, individuals who may be
12 at risk of STIs do not always do so, leading to an increased risk of STI complications and
13 transmission of infection to others. This systematic review aimed to identify interventions
14 implemented to increase attendance at a pre-booked sexual health clinic appointment and
15 to identify behavioural theory and behaviour change techniques (BCTs) which form the
16 basis for such interventions. *Methods:* Articles were identified through a systematic search
17 of four electronic databases (Web of Science; ProQuest; Scopus; PubMed) and included if
18 they aimed to increase attendance at a pre-booked, synchronous sexual health
19 consultation. The quality of included studies was assessed independently by two
20 researchers. Findings were synthesised narratively. *Results:* Thirteen studies were included
21 from three countries; eight non-randomised before-after study designs and five
22 randomised controlled trials. Behavioural interventions increased attendance at pre-
23 booked sexual health consultations. Text messages were the most frequently used mode
24 for intervention delivery. A total of 19 BCTs were identified but only three studies

25 mentioned behavioural theory. The most frequently used BCTs in effective interventions
26 were: using credible sources, employing prompts/cues and the provision of information
27 about health consequences. However, these BCTs were also identified in interventions that
28 were not effective, meaning that optimal content and theoretical underpinning of effective
29 interventions remains unclear. *Conclusions:* Behavioural interventions can increase
30 attendance at sexual health consultations. Further research is needed to examine the
31 effectiveness of different BCT combinations.

32 Keywords: Sexual health, Sexually Transmitted Infections, HIV, Behaviour Change,
33 Intervention, Attendance, Health Services Research, Systematic Review

34

35 **Introduction**

36 When left untreated, sexually transmitted infections (STIs) can lead to poor health
37 outcomes including infertility, chronic pelvic pain and an increased risk of human
38 immunodeficiency virus (HIV) [1-2]. Access to, and attendance at sexual health clinic
39 appointments (SHCs) can provide advice on prevention as well as rapid testing and
40 treatment to reduce STI transmission and harmful sequelae. Yet, despite being preventable
41 and treatable, STIs commonly remain untested and untreated. The latest National Survey
42 of Sexual Attitudes and Lifestyles found that 75% of individuals at risk of STIs do not attend
43 SHCs [3]. Moreover, those who do identify themselves to be at risk and book a clinic
44 appointment, often still fail to attend [4]. Such non-attendance can lead to inefficient use
45 of staff time and wasted resources as well as increased waiting times for other service-
46 users [5] and poor outcomes for individuals.

47

48 Healthcare services often implement techniques that remind patients about their
49 appointment to reduce non-attendance, such as sending short message service (SMS) text
50 messages [5-6]. However, literature examining factors associated with the use of SHCs,
51 suggests that barriers and facilitators to attendance can also occur at individual and
52 interpersonal levels, such as the embarrassment of a genital examination, lack of STI
53 knowledge, and fear related to the stigma associated with STIs [7-8]. Further barriers can
54 occur in healthcare service provision and delivery, including, for example, access to SHCs,
55 healthcare provider characteristics and previous experiences or expectations of
56 discrimination [8-10]. To date, only a small number of interventions to improve attendance
57 at sexual health consultations have previously been investigated [11]. A greater
58 understanding of what kinds of interventions can be implemented and which elements
59 within these have the greatest effect on appointment attendance in the context of sexual
60 health care is essential for optimising future intervention delivery.

61 The aim of this review was to identify the range and effectiveness of interventions
62 implemented to improve attendance at pre-booked sexual health consultations. A
63 secondary aim was to identify theoretical constructs and behaviour change techniques
64 (BCTs) used within included interventions.

65

66 **Methods**

67 This review is reported in accordance with the Preferred Reporting Items for Systematic
68 Reviews and Meta-Analyses (PRISMA) statement [12]. The review protocol was registered
69 with the International Prospective Register of Systematic Reviews (PROSPERO) (*redacted*
70 *for blinding*). The development of this reviews' research questions and outcomes

71 measures were informed by an advisory group that consisted of the research team, sexual
72 healthcare professionals and sexual health service-user representatives.

73

74 ***Eligibility criteria***

75 Studies were eligible for inclusion if they: aimed to increase appointment attendance at a
76 pre-booked, sexual health consultation during which service-users and healthcare
77 providers were able to interact synchronously (e.g. face-to-face, telephone, video-call);
78 interventions were delivered through any mode (synchronously or asynchronously); used
79 a community sample of individuals ≥ 13 years of age; included an outcome measure for
80 attendance of any real-time sexual health consultation (including reduction in missed
81 appointments); and any study design comprising an intervention evaluation (including
82 randomised controlled trials (RCTs), non-randomised control groups, single-arm designs,
83 retrospective or prospective cohort studies).

84

85 Studies were excluded if published before 2000 or not fully available in English. Also
86 excluded were studies conducted in non-WEIRD (western, educated, industrialised, rich,
87 democratic) countries. This was because heterogeneity in access to healthcare and
88 populations was considered to reduce meaningful conclusions that could be drawn from
89 the data.

90

91 ***Information sources and search strategy***

92 Four databases (Web of Science; ProQuest; PubMed, and Scopus) were systematically
93 searched from 1st January 2000 to 1st September 2021. Additional studies were identified
94 through reference chaining and citation checking via Google Scholar. The search strategy

95 was developed in line with the Population (community sample) Intervention (set of
96 behaviour change techniques) Comparator (any) Outcome (attendance) Study design (any)
97 PICOS framework [13]. Boolean operators were used to adapt the search for each database
98 and searches were limited to those available in English (see Supplementary File 1).

99

100 ***Study selection and data extraction***

101 One reviewer (RC) screened titles and abstracts and three reviewers independently
102 screened the full text of potentially relevant articles (RC, GH and CF). Data were extracted
103 from the included articles on key study characteristics, including year of publication,
104 country, study design and setting, recruitment information, sample demographics and
105 intervention characteristics, including use of theory, mode of delivery and BCTs. Data on
106 the use of theory, mode of delivery and BCTs were independently coded by the review
107 team (RC, GH and CF). Discrepancies were resolved through discussion.

108

109 Use of theory

110 The Theory Coding Scheme [14] was used to assess the extent to which theory had been
111 applied within the intervention design. This 19-item checklist contains statements that are
112 coded “yes”, “no” or “don’t know” based on the explicit description of theory within the
113 article. Items 1-11 were used to assess whether theory had been mentioned in the study,
114 whether theory had been used to select participants or tailor intervention techniques, and
115 whether theoretical constructs/predictors were explicitly linked to intervention
116 techniques.

117

118 Mode of Delivery

119 Adapting an approach outlined by Webb and Sheeran [15], the intervention's mode of
120 delivery was subdivided and presented as two aspects: (i) intervention format (e.g. text
121 message) and (ii) intervention facilitator (e.g. digital).

122

123 Behaviour change components

124 Intervention content was coded for BCTs using the Behaviour Change Taxonomy (v1) [16].
125 This taxonomy contains 93 BCTs, clustered into 16 groups: Goals and Planning, Feedback
126 and Monitoring, Social Support, Shaping Knowledge, Natural Consequences, Comparison
127 of Behaviour, Associations, Repetition and Substitution, Comparison of Outcomes, Reward
128 and Threat, Regulation, Antecedents, Identify, Scheduled Consequences, Self-Belief, and
129 Covert Learning. BCTs were only reported as being used in an intervention when explicitly
130 described in the paper.

131

132 ***Critical Appraisal of Included Studies***

133 The Mixed Methods Appraisal Tool (MMAT) [17] was used to assess methodological quality
134 of retrieved studies independently by three researchers (RC, GH, CF). An overall quality
135 score was calculated after responding "yes", "no" or "can't tell" to five questions relevant
136 to the study design. Discrepancies were resolved through discussion.

137

138 ***Data synthesis and analysis***

139 Meta-analysis was not possible due to heterogeneity in the intervention modes of delivery,
140 outcome measures and participants. Instead, a narrative approach was used to synthesise
141 intervention characteristics and outcomes, theoretical application, mode of delivery and
142 BCTs. Data were presented in a tabular format. Interventions were considered effective if

143 the SHC attendance outcome was reported to have significantly increased ($p<0.05$) in the
144 intervention group and, where available, was significantly greater than control group. To
145 ensure that the reported effectiveness of intervention components only reflected active
146 elements in the intervention group, components present in both the control group and
147 intervention group were not coded.

148

149 **Results**

150 The systematic search of the databases identified 615 articles, with 13 additional articles
151 identified through reference checking. Of these, 13 articles met the inclusion criteria (see
152 Figure 1). Of the 13 included articles, eight used non-randomised before-after study
153 designs [18-25] and five used randomised controlled trials [26-30]. Five studies were
154 conducted in Australia, five in America and three in the United Kingdom. All interventions
155 were delivered within a clinical setting and one included community engagement [18]. The
156 studies reported a variety of outcome measures for attendance at SHC consultations:
157 attendance at clinic appointments ($n=6$) [18,23-24, 28-30], return visits to clinic ($n=1$) [18],
158 retesting rates ($n=7$) [19-20,21-22,25-27]. The follow up period for measuring participants'
159 attendance ranged from 1 month [29-30] to 12 months [28;24-25]. Further details about
160 intervention characteristics can be found in Supplementary File 2.

161

162 Quality Assessment

163 Methodological quality was identified as moderate in 10 studies with three rated as low-
164 quality [20,27,30] (see Table 1). Within the included studies, intervention fidelity was often
165 unclear [19,21,24-25] and four interventions were reported not to have been delivered as
166 intended because SMS messages were not delivered to all participants [20,22,26-29].

167 Furthermore, not all studies reported whether analysis controlled for confounders
168 [18,20,22,24] and there were doubts about the representativeness of some populations
169 studied [20,27-28]. Rutland [30] was reported as a conference paper. Consequently, the
170 information provided about the study is very limited and, therefore, increases the risk of
171 bias.

172

173 Intervention Effectiveness

174 *Appointment attendance and return visits*

175 Eligible studies included four interventions that aimed to support patients' attendance at
176 HIV care appointments. Following a 6-month bidirectional texting intervention, Rana [23]
177 reported participants' appointment adherence was an average of 79.1% of scheduled
178 appointments, with 47% of participants achieving 100% attendance at their scheduled
179 appointments. However, as no pre-intervention attendance data was reported, it is not
180 known if the intervention significantly increased attendance. Tanner [24] found that a
181 combination of personalised messages sent through social media, SMS and mobile
182 applications significantly decreased participants missed appointments from 68.4% in the
183 12-months before the intervention to 53.3% during the 12-month intervention ($p < 0.04$).
184 Ingersoll [28] also found that personalised bidirectional SMS messages improved missed
185 appointments from 26.9% to 9% compared to 31% to 28% in the control group.
186 Nevertheless, the findings were not significant ($p = 0.12$). Another study by Norton [29] did
187 not find the use of an SMS reminder and reminder phone call to significantly improve
188 attendance rates compared to a control group who also received a reminder phone call
189 ($p = 0.42$).

190

191 Two further studies explored intervention effectiveness on attendance in sexual health
192 clinics. Biggs [18] reported a significant increase in the number of Aboriginal people
193 attending sexual health consultations following a peer-based, incentive-driven
194 intervention (n=313) in comparison to a historical control group (n=83, $p<0.01$). However,
195 despite this increase, there was no significant difference in the number of return visits in
196 the 12-month period following the first appointment (n=169 (intervention group) vs n=51
197 (historical control group); $p<0.31$). Rutland [30] found an SMS notification with a health
198 promotional message increased reattendance rates by 15.2% ($p=0.032$) compared to 8.2%
199 with an SMS notification without a health promotional message ($p=0.36$) and 4.5% in the
200 control group.

201

202 Retesting rates

203 Seven studies assessed intervention effectiveness for increasing attendance to repeat STI
204 testing, including two studies that used SMS reminders in a sample of men who have sex
205 with men (MSM). Bourne [19] found the use of an SMS reminder for repeat STI screening
206 significantly increased retesting in MSM (64% attendance) compared to the comparison
207 group without an SMS reminder (30% attendance – OR 4.4 [95% CI 3.5 to 5.5], $P<0.01$) and
208 the pre-SMS group (31% attendance – OR 3.1 [95% CI 2.5 to 3.8], $P<0.01$). Similarly, Zou
209 [25] found the number of men who returned to the clinic to be significantly higher among
210 men who had three-monthly (89.5% attendance, $p<0.01$) or six-monthly (87.7%
211 attendance, $p<0.01$) SMS and/or email reminders compared to a concurrent control group
212 (70.8% attendance).

213

214 Four further studies used SMS reminders in men and women. Downing [26] found both
215 SMS reminders (22.7% attendance) and SMS reminders plus financial incentives (29.17%
216 attendance) to increase retesting rates compared to a control group (0% attendance;
217 $p < 0.04$ and $p < 0.04$ respectively). Guy [21] reported retesting to be significantly higher in
218 the SMS reminder group compared with the pre-SMS group (30% vs 21%; $p < 0.04$). Those
219 in the SMS group were more likely to return than the pre-SMS group (OR 1.57 [95% CI 1.01
220 to 2.46]). However, SMS reminders did not significantly increase retesting when compared
221 with a concurrent non-SMS group (30% vs 25%; $p < 0.30$). Nyatsanza [22] found that sending
222 a personalised SMS reminder significantly increased re-attendance rates for testing (56%
223 [95% CI 50-62%]) when compared to a non-personalised SMS group (33% (95% CI 28-39%);
224 $p < 0.01$). However, Burton [20] did not find SMS reminders affected re-attendance rates
225 when compared to a historical control group. Burton [20] hypothesised that tailored or
226 bidirectional SMS messages might have been more effective.

227

228 Malotte [27] examined the effects of a variety of interventions including financial
229 incentives, motivational counselling and a phone call reminder on re-attendance for repeat
230 testing. Their findings suggested that reminder phone calls were most effective to increase
231 client return visits (OR 18.1 [95% CI, 1.7-193.5]). Malotte [27] recommended combining
232 motivational counselling and phone call reminders to maximise re-attendance.

233

234 Use of Theory

235 Theory was mentioned in three included studies (see Table 2) [24,27,28]. Ingersoll [28]
236 reported that the Information, Motivation and Behavior Skills (IMB) Model of Adherence
237 [31] and Social Action Theory [32] were the theoretical foundations for the intervention.

238 However, how the theories were used to inform the development and application of the
239 intervention were not reported.

240

241 Tanner [24] reported that intervention content was informed by Social Cognitive Theory
242 [33] and Theory of Empowerment [34]. Examples of SMS messages sent to participants
243 were provided, with the messages explicitly linked to constructs from Social Cognitive
244 Theory (e.g. information, outcome-expectancies, self-efficacy, direct experience, vicarious
245 learning, persuasion/ social support, incentives) and Empowerment Theory (e.g. critical
246 consciousness, action).

247

248 Malotte [27] described motivational interviewing as commonly related to cognitive-
249 behaviour theories, such as Social Cognitive Theory [33] and Theory of Reasoned Action
250 [35]. However, the article did not report whether cognitive-behaviour theories were used
251 to inform the motivational counselling used, which theories were used, or the extent of
252 their use.

253

254 Mode of Delivery

255 Seven modes of intervention format were reported (see Table 3). The most used was SMS
256 (n=11), for which implementation varied in content and frequency (see Table 4). Other
257 interventions utilised individual, face-to-face sessions (n=2), telephone calls (n=1), email
258 contact (n=1), social media (n=1), app-based messaging (n=1) and letters (n=1). A total of
259 10 interventions used only one intervention format, while the remaining three used a
260 combination of two or more formats.

261

262 Reflecting the intervention formats, digital facilitation was commonly reported (n=11),
263 with nine interventions facilitated via automated messaging, and three using bidirectional
264 messaging [23-24]. One intervention sent reminder letters [27]. The following
265 professionals facilitated in one intervention each: Aboriginal sexual health worker, SHC
266 staff, interventionist, and a cyber-health educator.

267

268 BCTS

269 A total of 19 BCTs were identified in the included interventions (see Table 5). The number
270 of BCTs used ranged from zero – 14 (mean: 3.2). The most observed BCTs across the 18
271 intervention groups were *credible source* (n=12) and *prompts/cues* (n=10). The following
272 BCTs were only observed once across intervention groups: *social support (practical)*, *social*
273 *reward*, *self-incentive*, *reduce negative emotions*, *restructuring the physical environment*,
274 *restructuring the social environment*, *focus on past success*, and *vicarious consequences*.
275 Although Nyatsanza [22] described use of both *prompts/cues* and *credible source* in the
276 intervention group and Norton [29] described *prompts/cues* in the intervention group,
277 these BCTs were also reported in the control group and thus, they were not coded.

278

279 Within the ten intervention groups found to have a significant increase in attendance
280 behaviours, the number of BCTs reported ranged from zero to 14 (mean: 4). The most
281 frequently used BCTs described in effective interventions were: *credible source* (n=8),
282 *prompts/cues* (n=8), and *information about health consequences* (n=5). The following BCTs
283 were solely used in interventions found to increase attendance at SHCs: *social support*
284 *(practical)*, *instruction on how to perform behaviour*, *social reward*, *self-incentive*, *reduce*

285 *negative emotions, restructuring the physical environment, restructuring the social*
286 *environment, focus on past success, and vicarious consequences.*

287

288 Eight intervention groups did not report a significant increase in attendance behaviours.

289 The use of BCTs within these intervention groups ranged from zero to seven (mean: 2.3).

290 The most commonly coded BCTs amongst intervention groups that did not report an

291 increase in attendance were: *credible source* (n=4), *prompts/cues* (n=4), *problem solving*

292 (n=2) and social support (unspecified) (n=2).

293

294 **Discussion**

295 This review identified 13 interventions designed to increase attendance at pre-booked SHC

296 appointments. Findings suggest that behavioural interventions can be effective at

297 supporting appointment attendance in the context of sexual health. Across all included

298 interventions, only one study explicitly linked theoretical constructs to the BCTs

299 implemented. A total of 19 BCTs were identified within 18 intervention groups, of which

300 the most common were: *information about health consequences*, use

301 of *prompts/cues*, and information provided by a *credible source*. There were seven

302 different modes of intervention delivery and six different intervention sources. SMS was

303 the most frequently employed mode of delivery, with a digital (automatic) facilitator.

304

305 Consistent with literature relating to other healthcare settings [36], the present review

306 indicates that mobile health (mHealth) interventions have the potential to increase

307 attendance rates at SHC appointments [11]. This review strongly suggests however, that

308 the content of the mHealth intervention is as important as the mode of delivery. Previous

309 research suggests that appointment reminders may be more effective when combined
310 with additional behaviour change strategies such as providing sexual health information,
311 access to advice from healthcare professionals, and social and psychosocial support that
312 can address knowledge deficits, low motivation and behaviour change [37]. This review
313 also supports previous calls to tailor appointment reminder systems to a specific service or
314 sub-population [38]. For example, appointment reminders could be combined with
315 additional messages tailored to specific subgroups of patients, such as MSM (e.g. messages
316 that target service-users perceived risk of STDs in MSM [25], health consequences of
317 missing HIV appointments [24]) and culturally appropriate messaging (e.g. messages that
318 address attendance concerns specific to stigma within a local community [18]).
319 Nevertheless, for the additional messages to be effective, acceptable and engaging it may
320 be essential to co-develop such messages with service-users. Future research also needs
321 to assess the cost-effectiveness of more complex mHealth interventions that provide a
322 variety of content compared with simpler approaches, such as SMS appointment
323 reminders. Furthermore, consideration should be given to patient communication and
324 technology preferences due to the sensitivity of sexual health and service-user privacy
325 concerns [39]. Thus, it may be beneficial to explore the effectiveness of mHealth
326 interventions compared to alternative modes of delivery.

327

328 The identification of BCTs within interventions highlights the importance of using *credible*
329 *sources* to provide information, implementing appointment *prompts/cues*, and providing
330 relevant *information about health consequences* to increase SHC appointment attendance.
331 However, *credible sources* and appointment *prompts/cues* were also identified in
332 ineffective interventions and it is possible that the BCT taxonomy does not capture

333 differences within their application or content which may alter their effectiveness [40].
334 Alternatively, the *credible sources* and appointment *prompts/cues* may have interacted
335 with additional BCTs used within the interventions. As theory and literature suggests that
336 appointment attendance should be understood in terms of both practical
337 (e.g. *prompts/cues*) and perceptual barriers (e.g. *information about health consequences*)
338 [41, 8-10], it is essential for interventions to combine BCTs that address both of these
339 elements. Combining strategies in this way was recommended by Malotte [27], who
340 suggested using a telephone reminder alongside motivational interviewing to increase
341 return visits. However, the effectiveness of combining BCTs could not be reliably tested
342 within this review due to the small number of relevant studies, and this should be a priority
343 for future research.

344

345 Behavioural science literature further suggests interventions based on theory or guided by
346 theoretical constructs are more effective at changing health behaviours [42]. The use of
347 theory can help explain and predict specific behaviours in different contexts, populations
348 and settings, highlighting which causal pathways should be targeted within interventions
349 [43]. However, despite recommendations for complex interventions to be theoretically
350 underpinned [44], only one of the 13 included interventions explicitly reported the
351 application and implementation of theory [24], whilst another two referenced the
352 intervention as being theory-based without providing details [27-28]. Consequently, it is
353 not possible to identify specific theoretical constructs that might mediate attendance to
354 SHCs. Nevertheless, the review does highlight the importance of utilising and explicitly
355 reporting theory in future evaluation of interventions that may, or may not, lead to
356 increased SHC attendance to help enhance understanding of the causal pathways.

357

358 Strengths and Limitations

359 This review used a robust and systematic methodology which limited bias in the
360 identification and selection of relevant studies. Three researchers independently extracted
361 data from included studies, coded for theory and BCTs and assessed quality which adds
362 further rigour. While the review updates an earlier systematic review on interventions to
363 increase testing and clinic re-attendance in SHCs [11], it further provides new knowledge
364 on behavioural theory, mode of delivery and behaviour change components in existing SHC
365 interventions, contributing to a deeper and more nuanced understanding for developing
366 future interventions.

367

368 Nevertheless, the review has limitations. Variation between included studies (e.g. research
369 designs, outcome measures, participant demographics) rendered it impossible to perform
370 more complex meta-analyses. Secondly, some studies were unclear as to whether all
371 appointments were pre-booked or whether the interventions motivated attendance to
372 walk-in clinics. Furthermore, the inclusion of a conference paper provided limited
373 information [30]. Such studies were included in order to continue building knowledge
374 within this limited field. Thirdly, reporting of intervention development and intervention
375 characteristics, such as the theoretical underpinning and application of BCTs, was limited.
376 Interventions may have used additional theories and BCTs which were not reported.
377 However, this is recognised as a common issue in systematic reviews that report the use
378 of theory and BCTs [11, 45]. Future interventions should report theoretical application and
379 use standardised measures for BCTs to support the development of a robust evidence-
380 base.

381

382 Conclusion

383 This review provides new knowledge about the types of interventions implemented to
384 improve appointment attendance at SHCs, including the effectiveness of specific
385 intervention components. Findings indicate that SHC appointment attendance can be
386 increased when both practical and perceptual barriers are targeted through the inclusion
387 of BCTs such as providing information from credible sources, using appointment reminders
388 and giving information about the consequences. This provides a focus for future research
389 to assess combining BCTs to improve clinic attendance rates. mHealth interventions may
390 offer an effective approach for delivering theoretically informed interventions to a wide
391 population but cost-effectiveness analysis is also needed before widespread
392 implementation.

393

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396 Data Availability Statement: The data that support this study will be shared upon
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552 Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)
553 flow diagram of the systematic search and selection of articles.
554
555

556 Table 1: Mixed Methods Appraisal Tool for included studies in the systematic review

557

558 Green ticked boxes: Yes. Orange blank boxes: Can't tell. Red cross: No.

559 0-2, low. 3-4, moderate. 5 high.

Category of design	Methodological quality criteria	Biggs et al (2016)[18]	Bourne et al (2011)[19]	Burton et al (2014)[20]	Downing et al (2013)[26]	Guy et al (2013)[21]	Ingersoll (2015) [28]	Malotte et al (2004)[27]	Norton (2014)[29]	Nyatsanza et al (2016)[22]	Rana et al (2016)[23]	Rutland (2012) [30]	Tanner et al (2018)[24]	Zou et al (2013)[23]
2. Quantitative randomized controlled trials	2.1. Is randomization appropriately performed?				✓		✓	✓	✓			□		
	2.2. Are the groups comparable at baseline?				✓		✗	□	✓			□		
	2.3. Are there complete outcome data?				✓		✓	□	✓			□		
	2.4. Are outcome assessors blinded to the intervention provided?				✗		✓	□	✓			□		
	2.5 Did the participants adhere to the assigned intervention?				✗		✗	□	✗			□		
3. Quantitative non-randomized	3.1. Are the participants representative of the target population?	✓	✓	□		✓				✓			✓	✓
	3.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	✓	✓	✓		✓				✓			✓	✓
	3.3. Are there complete outcome data?	✓	✓	✓		✓				✓			✓	✓
	3.4. Are the confounders accounted for in the design and analysis?	□	✓	□		✓				□			□	✗

	3.5. During the study period, is the intervention administered (or exposure occurred) as intended?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>				<input checked="" type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
5. Mixed methods	5.1. Is there an adequate rationale for using a mixed methods design to address the research question?										<input checked="" type="checkbox"/>			
	5.2. Are the different components of the study effectively integrated to answer the research question?										<input checked="" type="checkbox"/>			
	5.3. Are the outputs of the integration of qualitative and quantitative components adequately interpreted?										<input checked="" type="checkbox"/>			
	5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?										<input checked="" type="checkbox"/>			
	5.5. Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?										<input checked="" type="checkbox"/>			
	MMAT score	4	4	2	3	4	3	1	4	3	3	0	3	3

561 Table 2: Summary of intervention's use of theory and theoretical base

562

563 * significant increase in attendance in intervention group

564 ** significant increase in attendance in some intervention groups within the study

Item No.	Item	Ingersoll et al (2015) [28]	Malotte et al (2016)** [27]	Tanner et al (2018)* [24]
1	<i>Theory/model of behaviour mentioned</i>	Information, Motivation and Behavior Skills (IMB) Model of Adherence [31]; Social Action Theory (SAT) [32]	Social-Cognitive Theory [33]; the Theory of Reasoned Action [35]	Social-Cognitive Theory [33]; Empowerment theory [34]
2	<i>Targeted construct mentioned as predictor of behaviour</i>	No	No	Yes
3	<i>Intervention based on single theory</i>	No	Don't know	No
4	<i>Theory/ predictors used to select recipients for the intervention</i>	No	No	Don't know
5	<i>Theory/ predictors used to select/develop intervention techniques</i>	Don't know	Don't know	Yes: Social-Cognitive Theory; Empowerment theory
6	<i>Theory/ predictors used to tailor intervention techniques to recipients</i>	Don't know	Don't know	No
7	<i>All intervention techniques are explicitly linked to at least one theory-relevant construct/ predictor</i>	No	No	No
8	<i>At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/ predictor</i>	No	No	Yes: Information, outcome-expectancies, self-efficacy, direct experience, vicarious learning, persuasion/ social support, incentives (Social-Cognitive Theory); critical consciousness, action (Empowerment Theory)

9	<i>Group of techniques are linked to a group of constructs/ predictors</i>	Don't know	Don't know	No
10	<i>All theory-relevant constructs/predictors are explicitly linked to at least one intervention technique</i>	No	No	No
11	<i>At least one, but not all, of the theory relevant constructs/predictors are explicitly linked to at least one intervention technique</i>	No	No	Yes

566 Table 3: Summary of intervention's modes of delivery

567

568 * significant increase in attendance in intervention group

569 ** significant increase in attendance in some intervention groups within the study

570 SMS, short message service

	Intervention format	Intervention facilitator
Biggs et al (2016)* [18]	Individual, face-to-face sessions	Aboriginal sexual health worker and peers
Bourne et al (2011)* [19]	SMS	Digital (automated message)
Burton et al (2014) [20]	SMS	Digital (automated message)
Downing et al (2013)* [26]	SMS	Digital (automated message)
Guy et al (2013) [21]	SMS	Digital (automated message)
Ingersoll et al (2015) [28]	SMS	Digital (automated message & bidirectional)
Malotte et al (2004)** [27]	Individual, face-to-face sessions and/or phone calls/ letter	Sexual health clinic staff and/or printed material
Norton et al (2014) [29]	SMS	Digital (automated message)
Nyatsanza et al (2016)* [22]	SMS	Digital (automated message)
Rana et al (2016) [23]	SMS	Digital (bidirectional messaging: Interventionist (BA-level trained research assistant))
Rutland et al (2012) [30]*	SMS	Digital (automated message)
Tanner et al (2018)* [24]	SMS, social media and/or app-based messaging	Digital (bidirectional messaging: Cyberhealth educator)
Zou et al (2013)* [25]	SMS and/or email	Digital (automated message)

571

572 Table 4: SMS message reminder content and delivery

573

574 * significant increase in attendance in intervention group

575 SMS, short message service

	SMS content	Frequency of SMS delivery
Bourne et al (2011)* [19]	'You are due for your next screening. Please call SSHC on 93827440 to make an appointment.'	On average 4 months after baseline test.
Burton et al (2014) [20]	'It is time for you to have a routine test. Walk-in during opening hours or ring xxxxxx for an appointment. Do not text back. From CMH'	6 weeks after initial appointment (range of 2-12 weeks).
Downing et al (2013)* [26]	Group 2: '3 mths r up, drop in 4 a checkup or call 40506205 for an appointment' Group 3: '3 mths r up, drop in 4 a check-up or call 40506205 for an appointment & get \$10'	Group 2 & 3: 10-12 weeks after treatment
Guy et al (2013) [21]	'You are due for a repeat test. Please call SSHC on 93827440 to make an appointment.'	3 months after initial infection on a pre-established convenient date for patient.
Norton et al (2014) [29]	'Reminder: you have a doctor's appointment tomorrow'	One message sent the night before appointment
Nyatsanza et al (2016)* [22]	'Hi (Patient Forename) It's time for a routine test. Walk-in, call xxxxxx or email xxxxxxxx for appt'	Usually 6 weeks after initial episode.
Rana et al (2016) [23]	Self-selected or participant created e.g. 'You're worth it – remember your clinic appointment'; 'don't forget about your doctor's appointment... love, Godzilla'	Once weekly sent 3 weeks, 2 weeks and 1 week before scheduled clinic appointment, and once daily 2 days and 1 day before clinic appointment.
Tanner et al (2018)* [24]	Tailored appointment reminders from existing guide messages e.g. 'Sometimes people miss their appointments and then are less healthy. I don't want u to be one of them!'; 'After your appt do treat urself (<i>something that the cyberhealth educator knows that the participant values/wants and is reasonable and within reach</i>)'	Not reported.

Zou et al (2013)* [25]	'Your next check-up is now due. Phone for an appointment or walk in.'	Every 3/ 6/ 12 months based on patient preference.
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576

Group 9: Comparison of outcomes	9.1 Credible source	■	■	■	■	■	■		■	■	■	■						■	■
Group 10: Reward and threat	10.1 Material incentive	■				■			■										
	10.4 Social reward																	■	
	10.7 Self-incentive																	■	
Group 11: Regulation	11.2 Reduce negative emotions																	■	
Group 12: Antecedents	12.1 Restructuring the physical environment																	■	
	12.2 Restructuring the social environment																	■	
Group 13: Identity	13.2 Framing/reframing									■		■							
Group 15: Self- belief	15.3 Focus on past success																	■	
Group 16: Covert learning	16.3 Vicarious consequences																	■	
Total BCTs used		4	2	2	2	3	2	1	2	8	2	7	0	0	3	1	2	14	3