

1 **Manuscript title: Improving HIV pre-exposure prophylaxis (PrEP) adherence**  
2 **and retention in care: Recommendation development from a national PrEP**  
3 **programme.**

4  
5 Jennifer MacDonald<sup>1</sup>, Claudia S Estcourt<sup>1,2,6</sup>, Paul Flowers<sup>3</sup>, Rak Nandwani<sup>2</sup>, Jamie Frankis<sup>1</sup>,  
6 Ingrid Young<sup>4</sup>, Dan Clutterbuck<sup>5</sup>, Jenny Dalrymple<sup>1</sup>, Lisa McDaid<sup>6</sup>, Nicola Steedman<sup>7</sup>, John  
7 Saunders<sup>8</sup>

8  
9 1 Glasgow Caledonian University, Glasgow, Scotland

10 2 NHS Greater Glasgow & Clyde, Glasgow, Scotland

11 3 University of Strathclyde, Glasgow, Scotland

12 4 University of Edinburgh, Edinburgh, Scotland

13 5 NHS Lothian, Edinburgh, Scotland

14 6 Institute for Social Science Research, The University of Queensland, Brisbane, Australia

15 7 Chief Medical Officer Directorate, Scottish Government, Edinburgh

16 8 University College London, London, England

17  
18 <sup>§</sup> Corresponding author: Claudia Estcourt

19 Glasgow Caledonian University

20 Cowcaddens

21 Glasgow

22 G4 0BA

23 UK

24 Phone number: +44 141 331 8275

25 Email: [claudia.estcourt@gcu.ac.uk](mailto:claudia.estcourt@gcu.ac.uk)

26  
27 E-mail addresses of authors:

28 JM: [jennifer.macdonald@gcu.ac.uk](mailto:jennifer.macdonald@gcu.ac.uk)

29 PF: [paul.flowers@strath.ac.uk](mailto:paul.flowers@strath.ac.uk)

30 RN: [rak.nandwani@glasgow.ac.uk](mailto:rak.nandwani@glasgow.ac.uk)

31 JS: [john.saunders@ucl.ac.uk](mailto:john.saunders@ucl.ac.uk)

32 JF: [j.frankis@gcu.ac.uk](mailto:j.frankis@gcu.ac.uk)

33 IY: [ingrid.young@ed.ac.uk](mailto:ingrid.young@ed.ac.uk)

34 DC: [daniel.clutterbuck@nhslothian.scot.nhs.uk](mailto:daniel.clutterbuck@nhslothian.scot.nhs.uk)

35 JD: [jenny.dalrymple@gcu.ac.uk](mailto:jenny.dalrymple@gcu.ac.uk)

36 LM: [l.mcdaid@uq.edu.au](mailto:l.mcdaid@uq.edu.au)

37 NS: [nicola.steedman@gov.scot](mailto:nicola.steedman@gov.scot)

38 CE: [claudia.estcourt@gcu.ac.uk](mailto:claudia.estcourt@gcu.ac.uk)

39  
40 **Keywords:** Adherence; Retention in care; HIV pre-exposure prophylaxis (PrEP); Implementation  
41 study; Intervention development; Recommendations.

42  
43 **Word count:**

44 Abstract: 350/350  
45 Main text: 4993/5000

46

## 47 **Abstract**

48 **Introduction:** HIV pre-exposure prophylaxis (PrEP) is a key component of HIV combination  
49 prevention. Effective prevention needs people to adhere to PrEP during periods of risk and  
50 remain in care. However, relevant models of care are under-researched. Using data from the  
51 first two years of Scotland’s PrEP programme, we explored barriers and facilitators to PrEP  
52 adherence and retention in care and systematically developed evidence-based, theoretically-  
53 informed recommendations to enhance future adherence and retention.

54

55 **Methods:** We conducted semi-structured interviews and focus groups (09/2018-07/2019) with  
56 geographically and demographically diverse patients who were either using/declined/stopped  
57 or had been assessed as ineligible for PrEP (n=39), healthcare professionals involved in PrEP  
58 provision (n= 54), non-governmental organisation service users (n=9) and staff (n=15) across  
59 Scotland. We used thematic analysis to map key barriers and facilitators to priority areas that  
60 could enhance adherence and retention in care. Next, we used analytic tools from  
61 implementation science (Theoretical Domains Framework, Intervention Functions, Behaviour  
62 Change Technique Taxonomy, APEASE criteria) and expert opinion to systematically generate  
63 recommendations to enhance future PrEP adherence and retention in care.

64

65 **Results:** Barriers and facilitators to adherence and retention in care were diverse and multi-  
66 layered. Barriers included perceived complexity of event-based dosing, the tendency for users  
67 to stop PrEP before seeking professional support, troublesome side-effects, limited flexibility in  
68 the settings, timings, and nature of appointments for follow up, enduring PrEP-related stigma  
69 and emerging stigmas around not using PrEP. Facilitators included flexible appointment  
70 scheduling, reminders, and processes to follow up non-attenders. We generated 25 wide-  
71 ranging but specific recommendations for key stakeholders, for example, emphasising the  
72 benefits of PrEP reviews and providing appointments flexibly within individualised PrEP care;  
73 using clinic systems to remind/recall PrEP users for review; supporting PrEP conversations

74 among sexual partners; clear guidance on event-based dosing; encouraging/commitment to  
75 good PrEP citizenship; and detailed discussion on managing side-effects and care/coping  
76 planning activities.

77

78 **Conclusions:** PrEP adherence and retention in care is challenging for many people. Such  
79 challenges reduce the benefits of PrEP at individual and population levels. Our findings identify  
80 and provide solutions to where and how collaborative interventions across public health,  
81 clinical, and community practice could address these challenges.

82

83

## 84 **Introduction**

85 Oral HIV pre-exposure prophylaxis (PrEP, tenofovir disoproxil/emtricitabine) is a highly effective  
86 biomedical intervention to reduce HIV acquisition [1] and is central to elimination of HIV  
87 transmission. Global implementation of PrEP is accelerating but coverage remains patchy [2].  
88 Evidence to date suggests that adherence to PrEP and retention in care is challenging [1, 3-6]. A  
89 systematic review of PrEP trials clearly demonstrated that efficacy is associated with adherence  
90 [1]. Other studies show that up to 50% of people who initiate PrEP stop taking it within one  
91 year and cessation is associated with younger age, being a transgender women, socio-economic  
92 deprivation, lower educational attainment, and drug misuse [7-9]. Cessation of PrEP may  
93 happen because of a perceived reduction in HIV acquisition risk, which may or may not be  
94 accurate. However, it is unclear how best to identify and support individuals who stop PrEP but  
95 remain at, or return to, a risk of HIV acquisition. We need to establish how to encourage  
96 adherence to PrEP and retention in care for individuals with ongoing need, and to establish  
97 mechanisms through which users can restart PrEP as required.

98

99 Learning from large-scale PrEP implementation studies has been limited to date, particularly  
100 regarding how services have achieved greatest impact or what could be done to optimise future  
101 provision. This is a missed opportunity as real-world studies could be particularly informative  
102 more of the PrEP care cascade. To date, attempts to conceptualise the implementation of PrEP

103 have tended to be broad and descriptive, typically categorising the whole of PrEP care into four  
104 or five steps within a continuous linear ‘care cascade’ [10-13] or PrEP care pathway. No studies  
105 have used conceptualisations of the PrEP care cascade as the starting point for systematic and  
106 focussed service improvement.

107  
108 Scotland became one of the first countries worldwide to implement a national PrEP programme  
109 [14]. At the time, there were around 4600 people living with HIV attending specialist care in  
110 Scotland [15] and 228 people newly diagnosed with HIV each year, half of whom were gay,  
111 bisexual, and other men who have sex with men (GBMSM) [16]. From July 2017, PrEP and all  
112 associated monitoring were made available as part of broader HIV combination prevention and  
113 sexual health care, free at point of access almost exclusively through sexual health clinics, to  
114 those at greatest risk of HIV acquisition [17]. Prescribing followed specialist association  
115 guidance [18], but services developed their own local models of delivery, largely within existing  
116 budgets. These broadly involved: (1) identifying a patient as a PrEP candidate; (2) provision of  
117 PrEP information, baseline screening for HIV, other blood borne viruses (BBVs), sexually  
118 transmitted infections (STIs), and renal function; (3) prescribing and dispensing PrEP; and (4)  
119 regular in person reviews for HIV, BBV, and STI testing, renal monitoring, adherence support,  
120 wider sexual health promotion, and PrEP prescribing [18]. Quantitative outcomes from the  
121 Programme have been reported as part of routine surveillance [17,19,20] and within a detailed  
122 epidemiological study [21].

123  
124 We conducted an evaluation of the first two years of Scotland’s PrEP programme. Our approach  
125 divided the PrEP care cascade into three sections; awareness and access, initiation and uptake  
126 (both described elsewhere) and adherence and retention in care. Here we focussed on  
127 adherence and retention in care as a broad domain potentially in need of behaviour change  
128 interventions to enhance implementation. We defined *adherence* as taking PrEP in line with  
129 medical advice / using PrEP appropriately (critical for efficacy) and *retention in care* as  
130 attending PrEP review appointments and staying on PrEP during periods of risk.

131

132 We addressed the following research questions:

- 133 1. Within PrEP care pathways, where should we intervene (priority areas) to improve PrEP  
134 adherence and retention in care?
- 135 2. What are the barriers and facilitators to implementing the priority areas for PrEP  
136 adherence and retention in care?
- 137 3. Which evidence-based and theoretically informed recommendations could improve  
138 PrEP adherence and retention in care?

139

## 140 **Methods**

141 This study involved Stage 1: a retrospective qualitative process evaluation within a larger  
142 natural experimental design study evaluating PrEP implementation in Scotland (research  
143 questions 1 and 2), and Stage 2: development of recommendations to improve PrEP adherence  
144 and retention in care, using systematic intervention development approaches (research  
145 question 3).

146

### 147 **Data collection**

#### 148 Participants

149 We used multi-perspective purposive sampling to understand the implementation of PrEP  
150 adherence and retention in care from diverse viewpoints. In total, 117 participants took part in  
151 individual semi-structured telephone interviews (n=71) or in one of 10 group discussions (n=46)  
152 (September 2018-July 2019). The sample comprised: 39 patients; 54 healthcare professionals;  
153 nine non-governmental organisation (NGO) service users; and 15 NGO staff from across  
154 Scotland. All NGOs had an HIV prevention remit and served GBMSM, trans, and/or Black African  
155 communities. Group discussions included one type of stakeholder only.

156

157 Patients were either using PrEP (n=23, 59%) or had declined (n=5, 13%), stopped (n=6, 15%), or  
158 been assessed as ineligible (n=5, 13%) for PrEP. PrEP users included those who took PrEP daily,  
159 event-based or both ways. They ranged in age from 20-72 years with just over half (n=21, 54%)  
160 between 25-34 years. All self-identified as gay or bisexual men, the majority of whom (n=34,

161 87%) were cisgender. Almost all were of 'White British' (n=31, 80%) or 'Other White' (n=7, 18%)  
162 ethnicity. Two thirds reported a university degree as their highest level of education (n=26,  
163 67%) and the majority were in employment (n=34, 87%). The patient areas of residence  
164 reflected a mix of relative affluence and deprivation although the most (n=5, 16.7%) and least  
165 (n=3, 10%) deprived quintiles (according to Scottish Index of Multiple Deprivation (SIMD), which  
166 divides areas into five subgroups according to the extent to which an area is "deprived" [22])  
167 were under-represented and patients predominantly resided in the middle three quintiles  
168 (73%) (data missing for 9 participants). Healthcare professionals were all involved in PrEP  
169 implementation in a mix of rural (n=12, 22%), semi-rural/urban (n=8, 15%), or urban (n=34,  
170 63%) settings, largely reflecting the wider Scottish population distribution. They included  
171 specialist sexual health doctors and nurses of various grades, some with national PrEP roles,  
172 PrEP prescribing general practitioners (who prescribed PrEP where there was no sexual health  
173 service on their Scottish island), health promotion officers, a midwife, and a clinical secretary  
174 responsible for PrEP-related administration. NGO service users were all of Black African  
175 ethnicity, predominantly cis-gender women, and not using PrEP.

176

### 177 Recruitment

178 Healthcare professionals offered patients the opportunity to take part in the study during  
179 routine consultations taking place in four of the 14 regional health boards (responsible for the  
180 protection and improvement of their population's health)) providing over 90% of PrEP related  
181 care in Scotland. NGO service users who were either engaged with NGOs *and* attending sexual  
182 health clinics (classed as patients above) or only engaged with NGO services (classed as NGO  
183 service users above) were invited to participate via interactions with NGO staff. We recruited  
184 these and other NGO staff and healthcare professionals across all of Scotland's 14 regional  
185 health boards by email invitation.

186

### 187 Procedure

188 All participants provided informed verbal or written consent immediately prior to the  
189 interviews /group discussions. We collected data with the aid of a topic guide that included

190 open-ended questions designed to explore participants' experiences and perceptions of PrEP  
191 adherence and retention in care, rather than questions based on any theoretical concepts  
192 anticipated to influence implementation. Where possible within the group discussions, dialogue  
193 between participants was encouraged rather than between facilitators and participants. All  
194 participants talked from their own and others' perspectives; data were taken at face value.  
195 Patients were offered a £30 shopping voucher as reimbursement for their time.

196

197 Data collection was led by JM, with input from experienced qualitative researchers, PF, IY, and  
198 JF. JM, PF, IY, and JF reviewed and discussed early transcripts for quality assurance purposes. All  
199 interviews and group discussions were audio recorded, transcribed verbatim, anonymised, and  
200 imported into NVivo software for analysis.

201

## 202 **Data analysis**

### 203 Stage 1

204 *1. Within PrEP care pathways, where should we intervene (priority areas) to improve PrEP*  
205 *adherence and retention in care?*

206 Firstly, we used the Action, Actor, Context, Target, Time framework [23], to conceptualise the  
207 sequential actors, actions, settings, and processes that constituted PrEP adherence and  
208 retention in care. Secondly, we iteratively created a series of visualisations of the overall  
209 behavioural system of PrEP adherence and retention in care using available UK guidance on  
210 best clinical practice in PrEP provision [18] and transcripts of early interviews and group  
211 discussions. Thirdly, we comprehensively assessed the breadth and depth of data relating to  
212 the patient pathway through PrEP adherence and retention in care. Fourthly, we (PF & JM)  
213 ranked the most important areas which were considered to be amenable to change to create  
214 priority areas for intervention This stage combined the earlier findings with input from the  
215 specialist doctor team members who had real-world clinical experience of providing PrEP  
216 services in assorted settings (CSE, RN, JS). This stage ended with the identification of nine  
217 priority areas for recommendation development.

218

219 2. *What are the barriers and facilitators to implementing the priority areas for PrEP adherence*  
220 *and retention in care?*

221 We (JM and PF) conducted deductive thematic analysis [24] of the qualitative data concerning  
222 barriers and facilitators for each priority area. We used the relative frequency of barriers and  
223 facilitators to manage the volume of findings and to ensure we focussed only on those that  
224 were deemed most important. This stage ended with the identification of the major barriers  
225 and facilitators for priority areas relating to adherence and retention in care.

226

## 227 Stage 2

228 3. *Which evidence-based and theoretically informed recommendations could improve PrEP*  
229 *adherence and retention in care?*

230 We treated each of the priority areas independently and analysed each one separately. Firstly,  
231 we entered the key barriers and facilitators into a matrix. Secondly, we used the Behaviour  
232 Change Wheel (BCW) approach [25], to characterise behaviour change components of PrEP  
233 care and systematically coded the key barriers and facilitators for each priority area. Thirdly, we  
234 used the Theoretical Domains Framework (TDF) [26] to theorise the key barriers and  
235 facilitators. Fourthly, we specified corresponding Intervention Functions (broad ways of  
236 intervening relevant to the theoretical domains) and used the Behaviour Change Technique  
237 (BCT) and corresponding Taxonomy (BCTT) [27] to describe, in detail and using a standardised  
238 language, potential intervention content that may be helpful to operationalise the Intervention  
239 Functions, address key barriers and facilitators, and enhance implementation. This created an  
240 initial “long-list” of recommendations. All coding and drafting of recommendations were  
241 completed by JM and double-checked for accuracy, validity, and credibility by PF. Any  
242 disagreements were discussed until consensus was reached.

243

244 Finally, clinical expert team members (CE, RN, JS) scrutinised, sense-checked, and shortlisted  
245 the long list of initial recommendations using the APEASE criteria [28]. This resulted in the  
246 introduction of some new recommendations, in addition to minor amendments to or  
247 merging/deleting of existing recommendations.



248

249 **Ethical considerations**

250 The Glasgow Caledonian University Research Ethics Committee (HLS/NCH/17/037,  
 251 HLS/NCH/17/038, HLS/NCH/17/044) and the South East Scotland National Health Service  
 252 Research Ethics Committee (18/SS/0075, R&D GN18HS368) provided ethical approval.

253

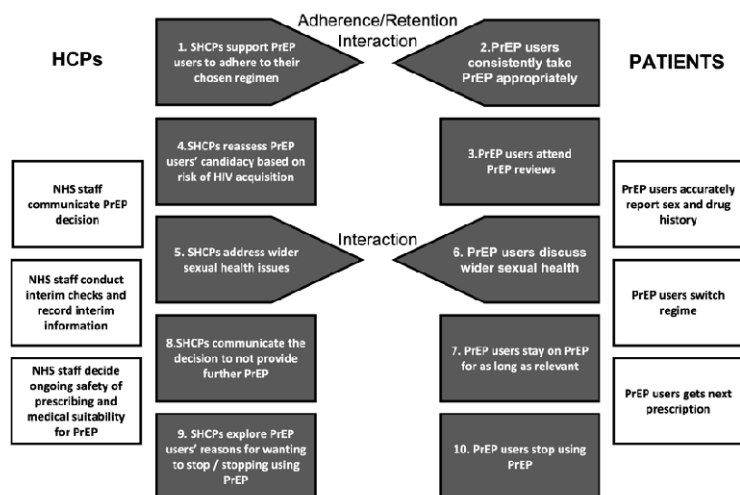
254 **Results**

255 *1. Within PrEP care pathways, where should we intervene (priority areas) to improve PrEP*  
 256 *adherence and retention in care?*

257 We identified 10 priority areas for intervention within the final visualised behavioural system  
 258 (Table 1, Figure 1 & Appendix 1) of a typical PrEP care pathway for adherence (n=2) and  
 259 retention in care (n=8). These priority areas involved two actors (PrEP providers and PrEP  
 260 users). Six were interactional (1, 4, 5, 6, 8, and 9) and concerned supporting effective PrEP use,  
 261 assessing ongoing eligibility for PrEP, discussing and addressing wider sexual health issues,  
 262 communicating the decision to not provide further PrEP, and exploring reasons for wanting to  
 263 stop/stopping PrEP. Four were more individually oriented (2, 3, 7, and 10) and concerned PrEP  
 264 users taking PrEP in line with medical advice, attending PrEP reviews, continuing to use PrEP for  
 265 as long as required, and stopping PrEP safely.

266

267 **Figure 1: A schematic of the behavioural system of adherence and retention in care**



268

269 White boxes – not selected as a priority area as not considered amenable to change

270 Black boxes – selected as a priority area

271 Arrowed Boxes – demonstrate priority areas that interact

272

273 *2. What are the barriers and facilitators to implementing the priority areas for PrEP adherence*  
 274 *and retention in care?*

275 The key barriers and facilitators relating to our priority areas, which were multi-levelled and  
 276 ranged from the macro to the micro, are shown in Table 1.

277

278 **Table 1. Key barriers and facilitators to the priority areas for PrEP adherence and retention in**  
 279 **care.**

Priority area	Key barriers	Key facilitators
<i>Adherence</i>		
1. PrEP providers support PrEP users to adhere to a chosen regimen	<ul style="list-style-type: none"> <li>• Reliance on user-reported adherence which may over-report good adherence due to a desire to please PrEP providers</li> <li>• Inability to accurately identify when first doses of event-driven PrEP will be needed precludes making practical suggestions to support correct use.</li> <li>• Complexity of and unfamiliarity with event-based dosing, including starting and stopping rules for different scenarios</li> </ul>	<ul style="list-style-type: none"> <li>• Offer practical suggestions to help users remember to take daily PrEP and the ‘after’ doses when using event-based PrEP</li> <li>• Provide clear patient information about the various ways to take PrEP with diagrams showing how to take event-based PrEP</li> </ul>
2. Users consistently take PrEP appropriately	<ul style="list-style-type: none"> <li>• Absence of or disruption to a daily or usual routine (daily users) inability to predict when sex will occur to trigger first dose for event-based users</li> <li>• Inflexible clinic appointment processes mean it is difficult to access PrEP ‘last minute’ so users can run low on or run out of PrEP</li> </ul>	<ul style="list-style-type: none"> <li>• Incorporate taking PrEP into a pre-existing daily routine (if taking PrEP once a day) or a usual routine ahead of planned sex (if using event-based PrEP)</li> <li>• Receive routine and ad-hoc adherence support from PrEP providers</li> <li>• Put in place reminders to avoid missing a dose</li> <li>• Keep PrEP handy by carrying it or</li> </ul>

Priority area	Key barriers	Key facilitators
		storing it in convenient places
<i>Retention in care</i>		
3. PrEP users attend PrEP reviews	<ul style="list-style-type: none"> <li>Limited options for where, when, and how to access PrEP reviews</li> <li>Absence of appointment scheduling, reminder, follow-up and/or other targeted intervention processes</li> <li>Do not require a new PrEP prescription as using event-based PrEP or have stopped PrEP in the interim period</li> </ul>	<ul style="list-style-type: none"> <li>Flexibility in where, when, and how to access PrEP reviews</li> <li>Appointment scheduling, reminder, follow-up and/or other targeted intervention processes are in place</li> <li>Value the regular sexual health screening and other health tests and discussions that take place within PrEP reviews</li> <li>Explicit messaging about the requirement for PrEP reviews at the outset</li> </ul>
4. PrEP providers reassess PrEP users' candidacy based on risk of HIV acquisition	<ul style="list-style-type: none"> <li>Overlook this aspect of PrEP reviews due to familiarity and routinisation of giving out PrEP and assumptions around ongoing need</li> </ul>	<ul style="list-style-type: none"> <li>Supporting documents and the IT system prompt this task</li> </ul>
5. PrEP providers address wider sexual health issues	<ul style="list-style-type: none"> <li>Time constraints of PrEP review appointments</li> </ul>	<ul style="list-style-type: none"> <li>Generous and/or flexible appointment times for PrEP reviews</li> <li>Build trusting relationships and familiarity with PrEP users through continuity of care</li> <li>Trained to deliver brief behaviour change interventions or have the option to signpost PrEP users and/or make direct referrals to other specialist services for appropriate support</li> </ul>
6. PrEP users discuss wider sexual health issues	<ul style="list-style-type: none"> <li>PrEP reviews feel rushed and are typically only focused on PrEP</li> </ul>	<ul style="list-style-type: none"> <li>Build a trusting relationship and familiarity with PrEP providers through continuity of care</li> </ul>
7. PrEP users stay on PrEP for as long as relevant	<ul style="list-style-type: none"> <li>Experience or are concerned about side-effects</li> </ul>	<ul style="list-style-type: none"> <li>Positive health, emotional, and social consequences of PrEP</li> </ul>

Priority area	Key barriers	Key facilitators
	<ul style="list-style-type: none"> <li>Sexual partner(s) is suspicious of PrEP use as they associate it with promiscuity and infidelity</li> <li>Acquire recurrent sexually transmitted infections while on PrEP</li> </ul>	
8. PrEP providers communicate the decision to not provide further PrEP	<ul style="list-style-type: none"> <li>Inadequate discussion with PrEP users about the risk-benefit of PrEP at the outset owing to a lack of knowledge, skills, and experience by the HCP</li> </ul>	<ul style="list-style-type: none"> <li>Mention at the start that need for PrEP may change over time and that ongoing eligibility [11] will be assessed and is required to keep issuing PrEP</li> </ul>
9. PrEP providers explore PrEP users' reasons for wanting to stop/stopping using PrEP	<ul style="list-style-type: none"> <li>PrEP users tend not to discuss their thoughts about stopping PrEP / decision to stop PrEP before stopping</li> </ul>	<ul style="list-style-type: none"> <li>There are follow-up and/or other targeted intervention processes in place</li> </ul>
10. PrEP users stop using PrEP	<ul style="list-style-type: none"> <li>Social acceptability of PrEP and emerging stigmas around <i>not</i> using PrEP</li> </ul>	<ul style="list-style-type: none"> <li>Change in self-perceived HIV risk</li> </ul>

280

281 *3. Which evidence-based and theoretically informed recommendations could improve PrEP*  
 282 *adherence and retention in care?*

283 We generated an initial 51 recommendations to address the priority areas identified (see  
 284 Appendix 2 for the full evidence table of key barriers and facilitators to priority areas, TDF  
 285 domains, Intervention Functions, BCTs, and initial recommendations) which we reduced to 25  
 286 final recommendations after applying the APEASE criteria (Table 2).

287

288 No recommendations for priority area four (PrEP providers reassess PrEP users' candidacy for  
 289 PrEP based on risk of HIV acquisition) were retained because it is a required element of care.

290 **Table 2. Final evidence-based and theoretically informed recommendations to improve PrEP adherence and retention in care** †

Priority area	Recommendations
<i>PrEP adherence</i>	
1. PrEP providers support PrEP users to adhere to their chosen regimen	<p>i. PrEP services should give PrEP providers and NGO staff a list of practical tips for taking PrEP to share with PrEP users.</p> <p>ii. PrEP services should use a joined-up, multi-method approach to improve PrEP providers' understanding of event-based dosing to assist them during consultations.</p>
2. PrEP users consistently take PrEP as per their chosen regimen	<p>i. PrEP services should create checklists/proformas, based on formal protocols, to prompt PrEP providers to cover adherence-related issues during PrEP initiation and reviews.</p> <p>ii. PrEP providers should emphasise the importance of adherence to minimise the risks of acquiring HIV and developing antiretroviral resistance and provide verbal, written, and visual instructions regarding medication dosing schedule, starting, stopping, and missed doses.</p> <p>iii. PrEP providers should consider offering PrEP users an explicit exercise in goal setting, coping planning (plans to deal with anticipated barriers to achieving these goals), and review of goals to support adherence to their chosen PrEP regimen.</p> <p>iv. PrEP providers and NGO staff should support PrEP users to navigate services and online information for appropriate expert support.</p> <p>v. PrEP users should consider a range of strategies, including those outlined in priority area 1, to ensure effective use of PrEP and share those they find beneficial with potential and other PrEP users.</p>
<i>Retention in care</i>	
3. PrEP users attend PrEP reviews	<p>i. PrEP service planners should consider offering reviews in a range of settings (not solely sexual health clinics).</p> <p>ii. PrEP services should ensure individualised PrEP care is provided flexibly to meet diverse needs.</p> <p>iii. PrEP services should use existing or introduce new clinic processes, such as an automated text message (SMS) system (with opt-out option), to remind and follow-up PrEP users about PrEP reviews and to try and reengage non-attenders.</p> <p>iv. PrEP services should consider their patient cohort alongside the available evidence to identify characteristics of</p>

Priority area	Recommendations
	<p>people likely to miss appointments or not re-attend for PrEP reviews and develop tailored interventions to be delivered at PrEP initiation to improve retention in care.</p> <p>v.PrEP providers and NGO staff should encourage optimal PrEP use by emphasising the health and emotional benefits of PrEP reviews, such as regular HIV and STI testing, renal monitoring and review of ‘how things are going’, and the importance of discussing stopping PrEP with a PrEP provider.</p> <p>vi.PrEP users should commit to engaging with regular PrEP reviews, even if they do not require a new PrEP prescription when the next review is due.</p>
<p>4. PrEP providers address wider sexual health issues</p> <p>AND</p> <p>5. PrEP users discuss wider sexual health issues</p>	<p>i.PrEP services should ensure flexible provision of individualised PrEP care that meets diverse needs.</p> <p>ii.PrEP services and NGOs should enhance and maintain good connections across HIV prevention and care and other specialist services, to facilitate easy reciprocal referrals.</p> <p>iii.PrEP providers and NGO staff should support PrEP users to navigate services and online information for appropriate expert support.</p>
<p>6. PrEP users stay on PrEP for as long as it’s relevant</p>	<p>i.PrEP services should provide PrEP providers and NGO staff with a list of management strategies for common side effects that they can share with PrEP users.</p> <p>ii.PrEP providers should spend an adequate proportion of PrEP discussions educating PrEP users about possible side-effects and their typically transient nature and reassure against concerns about longer-term issues and create a personalised PrEP care plan, including information on switching regimens.</p> <p>iii.PrEP providers and NGO staff should consider sexual partners’ reactions, views, and perceptions when exploring and probing PrEP users’ motivations for wanting to stop or having stopped using PrEP, be cognisant of sexual partner influences on PrEP users’ decisions to remain on PrEP, and use their professional judgement to encourage and support PrEP users to have wholistic conversations with their sexual partner(s) about the meaning of PrEP and boundaries of the relationship(s).</p>

Priority area	Recommendations
	<p>iv.PrEP providers and NGO staff should support PrEP users to navigate services and online information for appropriate expert support.</p> <p>v.PrEP information and communications should include specific content on PrEP use within the context of relationships to address PrEP stigma, enable supportive and well-informed discussions among sexual partners, and prevent discontinuation of PrEP where there is an ongoing identified need.</p> <p>vi.PrEP information and communications should include education on the positive health impacts of PrEP, as well as the wider social and emotional benefits and value of PrEP, for communities and individuals.</p>
7. PrEP providers communicate the decision to not provide further PrEP	i.PrEP services should use multi-methods to develop PrEP providers’ knowledge of and skills in explaining instances when stopping PrEP may be in a PrEP user’s best interests.
8. PrEP providers explore PrEP users’ reasons for wanting to stop / stopping using PrEP	i.PrEP services should assess monitoring and evaluation data to identify ‘did not attends’ and those overdue a PrEP review and attempt to make contact to discuss decisions to stop using PrEP and reengage them with PrEP care, as appropriate.
9. PrEP users stop using PrEP	i.PrEP and wider sexual health resources and communications should inform of all options for HIV prevention, emphasise the importance of choices, and explain the ‘seasons of risk’ concept to address emerging stigmas around <i>not</i> using PrEP.

291 † Note: Please see Appendix 2 for a fuller version of Table 2 which includes practical suggestions generated by research participants to assist  
 292 implementation.

## 293 **Discussion**

### 294 **Main findings**

295 We identified nine priority areas in the PrEP care cascade which could be optimised to improve  
296 adherence and retention in care. PrEP users, health care professionals and NGO staff and  
297 clients identified multiple barriers and facilitators to effective engagement with these priority  
298 areas. Using robust methodology with tools from implementation science, we derived 25  
299 specific recommendations to enhance future PrEP implementation. Recommendations range  
300 from those at the “micro-level” within interactions between health care professionals and PrEP  
301 users, which broadly encompassed tailoring PrEP care to the individual, to higher level  
302 suggestions for collaboration across agencies and provision of a PrEP in a variety of different  
303 settings to meet diverse needs.

304

### 305 **Strengths and weaknesses**

306 This large study involved a wide range of clinical and non-clinical stakeholders with varied  
307 perspectives and priorities, within a national PrEP programme. We focussed on adherence to  
308 PrEP and retention in care which can be problematic steps within the PrEP care cascade at  
309 which there are known to be inequity in outcomes for key vulnerable populations [6]. Our  
310 innovative approach draws directly on staff and patient perspectives and uses the cumulative  
311 knowledge embodied within theories of implementation [29] and contributes to  
312 implementation science through the shared language and depiction of core concepts (i.e.,  
313 intervention functions and behaviour change techniques).

314

315 We acknowledge that data were generated from a single country in which PrEP provision was  
316 provided free of charge within sexual health clinics. However, many of the recommendations,  
317 such as those which relate to tailoring PrEP support to the individual, flexible appointments and  
318 information are likely to be applicable in most settings in which PrEP is provided, even when  
319 PrEP is funded by the individual. In contrast, recommendations which specifically relate to  
320 sexual health clinic-based PrEP delivery, may lack wider applicability. We conducted the study  
321 in first two years of the PrEP programme and so findings reflect early stage implementation.



322 Some barriers and facilitators may change as the programme matures, for example as users and  
323 providers become more familiar with event-based dosing. The participants using PrEP were  
324 largely representative of people on PrEP in Scotland at the time and, despite our efforts,  
325 women, trans and gender diverse people are relatively underrepresented. This lack of sample  
326 diversity means that the experience and perspectives of health care professionals may largely  
327 only relate to providing PrEP care to cisgender gay, bisexual and other men who have sex with  
328 men.

329

### 330 **Findings in context of other studies**

331 Our findings build on those from several other studies which have highlighted various barriers  
332 to PrEP adherence and retention in care and our findings are in keeping with many of these  
333 [4,30-31], which provides legitimacy to our findings. Furthermore, our recommendations are  
334 broadly aligned with elements of recommendations from other authors and public health  
335 agencies, (for example, co-production of materials [32] and support in navigating health  
336 systems, e.g., Prepster [33]). Similarly, embedding PrEP delivery within combination prevention  
337 together with a focus on broader sexual wellbeing was successful in maintaining young men  
338 who have sex with men of colour on PrEP in a small feasibility pilot [34]. It is also a model of  
339 care recommended within PrEP guidelines [12,35] and is in keeping with several of our  
340 recommendations. The use of text reminders to attend healthcare appointments and adhere to  
341 medication has been successfully used in many health areas, including for PrEP, supporting our  
342 recommendation to use automated text reminders [36,37]. Some promising interventions have  
343 not been deployed in Scotland hence do not have recommendations for example, the use of  
344 peer navigators to assist people to engage with PrEP which was found useful for some [38]. To  
345 our knowledge, none of the previously published guidance has used the rigorous approach to  
346 generating recommendations that we took [39,40] or provided such a comprehensive list of  
347 recommendations focussed on this stage of the PrEP care cascade.

348

349 There are examples of effective interventions to improve medication adherence for other  
350 disease areas including for people living with HIV taking antiretroviral medication and other

351 conditions requiring long term drug therapy [41-43]. Although these relate to people already  
352 diagnosed with a chronic condition which requires long term medication rather than people  
353 trying to avoid an infection, there are similarities with our findings. Adaptation of these existing  
354 interventions could be useful to improve PrEP adherence and retention in care [44] and vice  
355 versa. However, a Cochrane review of improving adherence to and continuation of hormonal  
356 contraception, which might better approximate PrEP as it relates to prevention rather than  
357 treatment, provided less overlap in findings. For example, intensive counselling and reminders  
358 may result in only a slight increase in continuation of hormonal contraception although the  
359 effect varied by contraception method [45]. However, to date, interventional studies based on  
360 published recommendations, and designed to overcome barriers to improve PrEP adherence  
361 and retention specifically, are lacking and robust evaluation of the impact of these approaches  
362 is scarce.

363

#### 364 **Implications for policy and practice**

365 Many of our recommendations highlight the importance of supporting the individual and  
366 understanding their concerns and priorities, together with tailored advice and activities to  
367 enhance their understanding of PrEP with discussion of specific strategies to help with ensuring  
368 that PrEP is taken appropriately and safely at times of risk, through adherence to suitable  
369 dosing regimen(s). All of these are in keeping with a person-centred approach to care.  
370 However, we acknowledge that these activities take time within consultations and services may  
371 lack adequate resources to fully provide this as they are currently organised. Within the UK  
372 context, sexual health service delivery has changed significantly during the SAR-CoV2 pandemic  
373 with face-to-face appointments being reserved for people who are symptomatic and or have  
374 more complex needs. PrEP services have largely shifted to telephone models [46]. The  
375 opportunity to deliver some of our recommendations may be more challenging should services  
376 continue with more remote and light-touch models of care but are no less important. However,  
377 this could be an opportunity to commission services through community-based organisations,  
378 such as the use of peer navigators. Although the future provision of long-acting PrEP  
379 formulations could reduce adherence demands in some respects, there will still be a need for

380 regular monitoring and adherence support. Detailed recommendations to enhance adherence  
381 such as these may be even more needed.

382

383 Across PrEP services more broadly, health care professionals and NGO staff may benefit from  
384 training to improve their skills and could usefully learn from each other. NGO staff could play a  
385 key role in cultural competency training as well as helping to extend the reach of PrEP to key  
386 populations that could benefit, thereby helping to reduce inequalities in provision. In settings  
387 where generic medication is available, the costs of providing this support may outstrip drug  
388 costs and would need to be appropriately funded in the health care and NGO setting.

389

### 390 **Conclusions**

391 The potential for PrEP to have a major impact on HIV transmission relies on people adhering to  
392 it and remaining in active follow up as appropriate to their needs. These recommendations  
393 could directly enhance the quality of PrEP care at an individual patient level and inform  
394 development of interventions to improve adherence and retention in care at programme-level.  
395 More work is needed with people from a wide range of groups who could benefit from PrEP  
396 (women, trans and non-binary communities, people who inject drugs, migrant communities.) to  
397 ensure that recommendations and interventions are appropriate to all key groups and to avoid  
398 inadvertently widening existing health inequalities. Future work should include robust  
399 evaluation of implemented recommendations.

400

401

402 **Competing interests**

403 The investigators named have no financial interests that impact on their responsibilities  
404 towards the scientific value or potential publishing activities associated with the study.  
405 However, the team has other interests within the field including various roles relating to HIV  
406 and sexual health within Government (Steedman, Estcourt, Nandwani, Clutterbuck), policy  
407 generation (Steedman, Nandwani, Estcourt, Saunders, Young, Flowers, HIV Scotland), practice  
408 (Steedman, Estcourt, Nandwani, Clutterbuck, Saunders) and advocacy (Young, HIV Scotland). PF  
409 reports research grants from National Institute of Health Research UK, Chief Scientist Office of  
410 Scotland. CSE, RN, JF, JM, JS, IY, DC, NS, LM & JD report no competing interests.

411

412 **Authors' contributions**

413 All authors contributed to the conception and design of the studies, interpretation of findings,  
414 revision of the manuscript and approved the final version. Specific additional contributions are  
415 as follows and marked where appropriate in the manuscript: CSE was principal investigator and  
416 involved in all stages of the research and wrote the initial draft of the manuscript. JM led the  
417 study day to day and undertook all research activities including data collection and analysis  
418 under the supervision of PF and CSE. JS, RN, DC, NS and CSE provided expert clinical  
419 interpretation. IY and JF contributed to data collection and analysis. JD and JF led the ethical  
420 approval application.

421

422 **Author information** [Optional]

423 Claudia Estcourt is monitoring and research lead for Scotland's national PrEP Programme and is  
424 part of Scotland's HIV transmission elimination oversight group. She was Programme Steering  
425 Committee Chair for England's Impact Trial. She is co-author of BHIVA/BASHH guidelines on the  
426 use of HIV pre-exposure prophylaxis (PrEP), 2022 and led European Centre for Disease  
427 Prevention and control (ECDC) HIV Pre-Exposure Prophylaxis in the EU/EEA and the UK:  
428 implementation, standards and monitoring, technical guidance, 2021.

429 Rak Nandwani chaired the Scotland PrEP Short Life Working Group in 2016. He currently chairs  
430 the HIV transmission elimination oversight group which will submit proposals to Scottish  
431 Government in 2022. He is also a non-executive director of the Board of Public Health Scotland.  
432 Ingrid Young was on the Scotland PrEP Short Life Working group in 2016, was a co-author of the  
433 2018 and forthcoming (2022) BHIVA-BASHH guidelines on the use of Pre-exposure prophylaxis  
434 (PrEP).  
435 Nicola Steedman was on the Scotland PrEP Short Life Working Group in 2016 (as Senior Medical  
436 Officer for Scottish Government). She co-Chaired the Scottish National PrEP Monitoring and  
437 Research Group (with Professor Estcourt) and is currently Deputy Chief Medical Officer for  
438 Scottish Government with a remit which includes Sexual Health and Bloodborne Viruses.

439

#### 440 **Acknowledgements:**

441 We are very grateful to the users, patients and staff of sexual health services in all 14 Health  
442 Boards, Drs Ruth Holman, Dan Clutterbuck, Maggie Gurney, Nil Banerjee, Pauline McGough,  
443 Daniela Brawley, Kirsty Abu-Rajab, Hame Lata, Anne McLellan, Alison Currie, Sharon Cameron,  
444 Hilary MacPherson, Janice Irvine, Graham Leslie, Ciara Cunningham, Maggie Watts. We thank  
445 staff and users of HIV Scotland; Waverley Care (SX Project and African Health Project); THT  
446 Scotland; Hwupenyu Health and Wellbeing; and Scottish Trans Alliance. We thank Nathan  
447 Sparling and Jacqueline Gray for their contributions to the research process.

448

#### 449 **Funding:**

450 This work was funded through Scottish Chief Scientist Office grant reference HIPS/17/47  
451 'Optimising services for people at highest risk of HIV: Developing best practice in delivering HIV  
452 pre-exposure prophylaxis (PrEP) through evaluation of early implementation across Scotland'.  
453 The grant ran from June 2018 to October 2020. During this study, LMCD was funded by the UK  
454 Medical Research Council and Chief Scientist Office of the Scottish Government Health and  
455 Social Care Directorates at the MRC/CSO Social & Public Health Sciences Unit, University of  
456 Glasgow (MC\_UU\_12017/11, SPHSU11; MC\_UU\_00022/3, SPHSU18).

457

458 **Additional files** [Optional]

459 Appendix 1: Full evidence tables of key barriers and facilitators to the priority areas, TDF  
460 domains, Intervention Functions, BCTs, and original recommendations.

461

462 **List of abbreviations** [Optional]

463 APEASE       Affordability, Practicability, Effectiveness and cost-effectiveness, Acceptability,  
464               Side-effects and safety, Equity

465 BBV           Blood borne viruses

466 BCT           Behaviour Change Technique

467 BCTT          Behaviour Change Technique Taxonomy

468 BCW          Behaviour Change Wheel

469 GBMSM       Gay, bisexual, and other men who have sex with men

470 HIV          Human immunodeficiency virus

471 PrEP         Pre-exposure prophylaxis

472 STI          Sexually transmitted infection

473 TDF          Theoretical Domains Framework

474

475 **References**

476

- 477 1. Chou R, Evans C, Hoverman A, Sun S, Dana T, Bougatsos C, et al. Preexposure  
478 Prophylaxis for the Prevention of HIV Infection: Evidence Report and Systematic Review  
479 for the US Preventive Services Task Force. *JAMA*. 2019 Jun 11;321(22):2214–2230.  
480 doi:10.1001/jama.2019.2591.
- 481 2. World Health Organisation. Global data shows increasing PrEP use and widespread  
482 adoption of WHO PrEP recommendations [Internet]. 16 March 2021 [cited 17 January  
483 2022]. Available from: [https://www.who.int/news-room/feature-stories/detail/global-  
484 data-shows-increasing-prep-use-and-widespread-adoption-of-who-prep-  
485 recommendations](https://www.who.int/news-room/feature-stories/detail/global-data-shows-increasing-prep-use-and-widespread-adoption-of-who-prep-recommendations)

- 486 3. Russ S, Zhang C, Liu Y. Pre-Exposure Prophylaxis Care Continuum, Barriers, and  
487 Facilitators among Black Men Who Have Sex with Men in the United States: A  
488 Systematic Review and Meta-Analysis. *AIDS Behav.* 2021 Jul;25(7):2278-2288.  
489 doi: [10.1007/s10461-020-03156-x](https://doi.org/10.1007/s10461-020-03156-x).
- 490 4. Edeza A, Santamaria EK, Valente PK, Gomez A, Ogunbajo A, Biello K. Experienced  
491 barriers to adherence to pre-exposure prophylaxis for HIV prevention among MSM: a  
492 systematic review and meta-ethnography of qualitative studies. *AIDS Care.* 2021  
493 Jun;33(6):697-705. doi:[10.1080/09540121.2020.1778628](https://doi.org/10.1080/09540121.2020.1778628).
- 494 5. Dang M, Scheim AI, Teti M, Quinn KG, Zarwell M, Petroll AE, et al. Barriers and  
495 Facilitators to HIV Pre-Exposure Prophylaxis Uptake, Adherence, and  
496 Persistence Among Transgender Populations in the United States: A Systematic  
497 Review. *AIDS Patient Care STDS.* 2022 Jun;36(6):236-248. doi:  
498 [10.1089/apc.2021.0236](https://doi.org/10.1089/apc.2021.0236).
- 499 6. Zhang J, Li C, Xu J, Hu Z, Rutstein SE, Tucker JD, et al. Discontinuation, suboptimal  
500 adherence, and reinitiation of oral HIV pre-exposure prophylaxis: a global systematic  
501 review and meta-analysis. *Lancet.* 2022 Apr;9(4):E254-E268.  
502 doi:[https://doi.org/10.1016/S2352-3018\(22\)00030-3](https://doi.org/10.1016/S2352-3018(22)00030-3).
- 503 7. Spinelli MA, Scott HM, Vittinghoff E, Liu AY, Gonzalez R, Morehead-Gee A, et al.  
504 Missed Visits Associated With Future Preexposure Prophylaxis (PrEP)  
505 Discontinuation Among PrEP Users in a Municipal Primary Care Health Network.  
506 *Open Forum Infect Dis.* 2019 Feb 26;6(4):ofz101. doi: [10.1093/ofid/ofz101](https://doi.org/10.1093/ofid/ofz101).
- 507 8. Krakower D, Maloney KM, Powell VE, Levine K, Grasso C, Melbourne K, et al.  
508 Patterns and clinical consequences of discontinuing HIV preexposure prophylaxis  
509 during primary care. *J Int AIDS Soc.* 2019 Feb;22(2):e25250. doi:  
510 [10.1002/jia2.25250](https://doi.org/10.1002/jia2.25250).
- 511 9. Rao DW, Carr J, Naismith K, Hood JE, Hughes JP, Morris M, et al. Monitoring HIV  
512 Preexposure Prophylaxis Use Among Men Who Have Sex With Men in

- 513 Washington State: Findings From an Internet-Based Survey. *Sex Transm Dis.*  
514 2019 Apr;46(4):221-228. doi: 10.1097/OLQ.0000000000000965.
- 515 10. Chan PA, Glynn TR, Oldenburg CE, Montgomery MC, Robinette AE, Almonte A, et al.  
516 Implementation of preexposure prophylaxis for human immunodeficiency virus  
517 prevention among men who have sex with men at a New England sexually transmitted  
518 diseases clinic. *Sex Transm Dis.* 2016 Nov 1;43(11):717-23.  
519 doi:10.1097/OLQ.0000000000000514.
- 520 11. Parsons JT, Rendina HJ, Lassiter JM, Whitfield TH, Starks TJ, Grov C. Uptake of HIV pre-  
521 exposure prophylaxis (PrEP) in a national cohort of gay and bisexual men in the United  
522 States: the motivational PrEP cascade. *J Acquir Immune Defic Syndr.* 2017 Mar  
523 1;74(3):285-292. Doi:10.1097/QAI.0000000000001251.
- 524 12. Pathela P, Jamison K, Blank S, Daskalakis D, Hedberg T, Borges C. The HIV Pre-exposure  
525 Prophylaxis (PrEP) Cascade at NYC Sexual Health Clinics: Navigation Is the Key to Uptake.  
526 *J Acquir Immune Defic Syndr.* 2020 Apr 1;83(4):357-364. doi:  
527 10.1097/QAI.0000000000002274.
- 528 13. Zhang C, McMahon J, Fiscella K, Przybyla A, LeBlanc N, et al. HIV Pre-Exposure Prophylaxis  
529 Implementation Cascade Among Health Care Professionals in the United States: Implications  
530 from a Systematic Review and Meta-Analysis. *AIDS Pat. Care and STDs.* 2019 Dec 1;33(12):507-  
531 527.. doi: <https://doi.org/10.1089/apc.2019.0119>.
- 532 14. Nandwani R. Pre-exposure prophylaxis is approved in Scotland. *Lancet.* 2017 Jun  
533 1;4(6):E238-E239. doi:[https://doi.org/10.1016/S2352-3018\(17\)30078-4](https://doi.org/10.1016/S2352-3018(17)30078-4).
- 534 15. Health Protection Scotland. HIV infection in Scotland: Quaterly report to 31 December  
535 2017. 2018 [cited 17 January 2022]. Available from:  
536 [https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2425/documents/1\\_hiv-](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2425/documents/1_hiv-infection-quarterly-dec-2017.pdf)  
537 [infection-quarterly-dec-2017.pdf](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2425/documents/1_hiv-infection-quarterly-dec-2017.pdf)
- 538 16. Health Protection Scotland. HIV diagnosis in Scotland: summary report to 31 December  
539 2018. 2019 [cited 17 January 2022]. Available from:  
540 [https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2760/documents/1\\_hiv-](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2760/documents/1_hiv-diagnoses-in-scotland-summary-to-31-dec-2018.pdf)  
541 [diagnoses-in-scotland-summary-to-31-dec-2018.pdf](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2760/documents/1_hiv-diagnoses-in-scotland-summary-to-31-dec-2018.pdf)



- 542 17. Health Protection Scotland. Implementation of HIV PrEP in Scotland: First Year Report.  
543 2019 Feb 26 [cited 17 January 2022]. Available from: [https://www.hps.scot.nhs.uk/web-](https://www.hps.scot.nhs.uk/web-resources-container/implementation-of-hiv-prep-in-scotland-first-year-report/)  
544 [resources-container/implementation-of-hiv-prep-in-scotland-first-year-report/](https://www.hps.scot.nhs.uk/web-resources-container/implementation-of-hiv-prep-in-scotland-first-year-report/)
- 545 18. BHIVA/BASHH. BHIVA/BASHH guidelines on the use of HIV pre-exposure prophylaxis  
546 (PrEP) 2018. 2018 [cited 17 January 2022]. Available from:  
547 <https://www.bhiva.org/file/5b729cd592060/2018-PrEP-Guidelines.pdf>
- 548 19. Health Protection Scotland. Implementation of HIV PrEP in Scotland: Second Year  
549 Report. 2019 Dec 17 [cited 17 January 2022]. Available from:  
550 [https://hpspubsrepo.blob.core.windows.net/hps-](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2914/documents/2_2019-12-17-HIV-PrEP-Implementation-Report.pdf)  
551 [website/nss/2914/documents/2\\_2019-12-17-HIV-PrEP-Implementation-Report.pdf](https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2914/documents/2_2019-12-17-HIV-PrEP-Implementation-Report.pdf)
- 552 20. Public Health Scotland. HIV in Scotland: update to 31 December 2019. 2020 Jun 23  
553 [cited 17 January 2022]. Available from:  
554 [https://publichealthscotland.scot/media/3313/1\\_hiv-in-scotland-2019-annual-report-](https://publichealthscotland.scot/media/3313/1_hiv-in-scotland-2019-annual-report-summary.pdf)  
555 [summary.pdf](https://publichealthscotland.scot/media/3313/1_hiv-in-scotland-2019-annual-report-summary.pdf)
- 556 21. Estcourt C, Alan Y, Nandwani R, Goldberg D, Cullen B, Steedman N, et al. Population-  
557 level effectiveness of a national HIV preexposure prophylaxis programme in MSM. *AIDS*.  
558 2021 Mar 15;35(4):665-673. Doi:10.1097/QAD.0000000000002790.
- 559 22. Scottish Government. Scottish Index of Multiple Deprivation 2020: introduction. 2020  
560 Jan 28 [cited 17 January 2022]. Available from:  
561 <https://www.gov.scot/publications/scottish-index-multiple-deprivation-2020/>
- 562 23. Presseau J, McCleary N, Lorencatto F, Patey AM, Grimshaw JM, Francis JJ. Action, actor,  
563 context, target, time (AACTT): A framework for specifying behaviour. *Implement Sci*.  
564 2019 Dec 5;14(1):102. doi: 10.1186/s13012-019-0951-x.
- 565 24. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*.  
566 2006;3(2):77-101. <http://eprints.uwe.ac.uk/11735> [accessed 12/03/22].
- 567 25. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for  
568 characterising and designing behaviour change interventions. *Implement Sci*. 2011 Apr  
569 23;6:42. doi:<https://doi.org/10.1186/1748-5908-6-42>.

- 570 26. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use  
571 in behaviour change and implementation research. *Implement Sci.* 2012 Aug 24;7:37.  
572 doi: <https://doi.org/10.1186/1748-5908-7-37>.
- 573 27. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The  
574 behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques:  
575 Building an international consensus for the reporting of behavior change interventions.  
576 *Ann Behav Med*, 2013 Aug;46(1):81–95. doi:10.1007/s12160-013-9486-6.
- 577 28. Michie S, Atkins L, West R. *The Behaviour Change Wheel: A Guide to Designing*  
578 *Interventions*. London: Silverback Publishing; 2014.
- 579 29. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the  
580 Theoretical Domains Framework of behaviour change to investigate implementation  
581 problems. *Implement Sci.* 2017 Jun 21;12(1):77. doi: 10.1186/s13012-017-0605-9.
- 582 30. Sidebottom D, Ekström AM, Strömdahl S. A systematic review of adherence to oral pre-  
583 exposure prophylaxis for HIV – how can we improve uptake and adherence?. *BMC Infect*  
584 *Dis.* 2018 Nov 16;18:581. doi: [10.1186/s12879-018-3463-4](https://doi.org/10.1186/s12879-018-3463-4)
- 585 31. Pleuhs B, Quinn KG, Walsh JL, Petroll AE, John SA. Health Care Provider Barriers to HIV  
586 Pre-exposure Prophylaxis in the United States: A Systematic Review. *AIDS Patient Care*  
587 *STDs.* 2020 Mar 16;34(3):111-123. doi:<http://doi.org/10.1089/apc.2019.0189>.
- 588 32. I-Base UK. UK guide to PrEP. 2022 Feb [cited 27 July 2022]. Available from: [https://i-](https://ibase.info/guides/wp-content/uploads/2022/02/PrEP-leaflet-Feb-2022.pdf)  
589 [base.info/guides/wp-content/uploads/2022/02/PrEP-leaflet-Feb-2022.pdf](https://ibase.info/guides/wp-content/uploads/2022/02/PrEP-leaflet-Feb-2022.pdf) -
- 590 33. prepster.info [Internet]. Prepster. c2022 [cited 17 January 2022]. Available from:  
591 <https://prepster.info>
- 592 34. Daughtridge GW, Conyngham SC, Ramirez N, Koenig HC. I Am Men's Health: generating  
593 adherence to HIV pre-exposure prophylaxis (PrEP) in young men of color who have sex  
594 with men. *J Int Assoc Provid AIDS Care.* 2015 Mar 1;14(2):103–7.  
595 doi:<https://doi.org/10.1177/2325957414555230>
- 596 35. AUS AIDS

- 597 36. Schwebel FJ, Larimer ME. Using text message reminders in health care services: A  
598 narrative literature review. *Internet Interv.* 2018 Jun 21;13:82-104.  
599 doi:10.1016/j.invent.2018.06.002.
- 600 37. Siegler AJ, Steehler K, Sales JM, Krakower D. A Review of HIV Pre-exposure Prophylaxis  
601 Streamlining Strategies. *Curr HIV/AIDS Rep.* 2020 Sept 13;17:643–653.  
602 doi:<https://doi.org/10.1007/s11904-020-00528-9>
- 603 38. Pinto RM, Berringer KR, Melendez R, Mmeje O. Improving PrEP implementation through  
604 multilevel interventions: a synthesis of the literature. *AIDS Behav.* 2018 Jun  
605 5;22(11):3681-3691. doi:10.1007/s10461-018-2184-4.
- 606 39. Silapaswan A, Krakower D, Mayer KH. Pre-Exposure Prophylaxis: A Narrative Review of  
607 Provider Behavior and Interventions to Increase PrEP Implementation in Primary Care. *J*  
608 *Gen Intern Med.* 2017 Feb 1;32(2):192–198. doi: 10.1007/s11606-016-3899-4
- 609 40. World Health Organisation. PrEP implementation tool for pre-exposure prophylaxis  
610 (PrEP) of HIV infection [Internet]. c2022 [cited 17 January 2022]. Available from:  
611 <https://www.who.int/tools/prep-implementation-tool>
- 612 41. Simoni JM, Pearson CR, Pantalone DW, Marks G, Crepaz N. Efficacy of interventions in  
613 improving highly active antiretroviral therapy adherence and HIV-1 RNA viral load. A  
614 meta-analytic review of randomized controlled trials. *J Acquir Immune Defic Syndr.* 2006  
615 Dc 1;43(0 1): S23–S35. doi:10.1097/01.qai.0000248342.05438.52.
- 616 42. Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing  
617 medication adherence. *Cochrane Database Syst Rev.* 2008 Apr 16;(2):CD000011.  
618 doi:10.1002/14651858.CD000011.pub3.
- 619 43. Viswanathan M, Golin CE, Jones CD, Ashok M, Blalock SJ, Wines, RCM, et al.  
620 Interventions to improve adherence to self-administered medications for chronic  
621 diseases in the United States: a systematic review. *Ann Intern Med.* 2012 Dec  
622 4;157(11);785-795. doi: 10.7326/0003-4819-157-11-201212040-00538.
- 623 44. Marcus J, Buisker T, Horvath T, Amico K, Fuchs J, Buchbinder S, et al. Potential  
624 Interventions to Support Adherence to HIV Preexposure Prophylaxis (PrEP): A

- 625            Systematic Review. HIV Med. 2014 Aug;15(7):385-395.  
626            doi:<https://doi.org/10.1111/hiv.12132>
- 627            45. Mack N, Crawford TJ, Guise JM, Chen M, Grey TW, Feldblum PJ, et al. Strategies to  
628            improve adherence and continuation of shorter-term hormonal methods of  
629            contraception. Cochrane Database Syst Rev. 2019 Apr; 4: CD004317.  
630            doi:10.1002/14651858.CD004317.pub5.
- 631            46. Henderson L, Gibbs J, Quinn J, Ramasami S, Estcourt CS. Maintaining access to HIV Pre  
632            Exposure Prophylaxis in a pandemic: A service evaluation of a telephone-based model of  
633            PrEP provision. Int J STD AIDS. 2022 Apr 23;33(7):718-721. doi:  
634            <https://doi.org/10.1177/09564624211068766>

