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Sexual Health

Supplementary Material

Improving digital partner notification for sexually transmitted infections and HIV through a systematic review and application of the Behaviour Change Wheel approach

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Supplementary file S1: Deviations from the protocol

Deviations from the protocol (Available from: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=201746) are reported below:

We did not collect additional outcomes beyond barriers and facilitators to PN, as these were not widely reported in our included studies.

Supplementary file S2: Barrier and facilitator prioritisation criteria

A barrier/facilitator was taken forward to BCW analyses if it matches one of the following criteria:

1. It is stated in 2 or more papers*
2. It is evidenced 3 or more times across papers (frequency)*
3. Conflicting and corresponding beliefs are present regarding the barrier/facilitator
4. It satisfies the subjective assessment

**If a barrier and facilitator support each other, representing the same factor determining behaviour (e.g., 'notification is easy to do online as I own a smartphone' and 'notification is hard to do online as I don't own a smartphone'), both the barrier and facilitator are taken forward if their summed frequency and paper counts satisfied criterion (1) or (2).*

Subjective assessment – statement is taken forward if it satisfies (1) and (2) as well as one of (3) or (4):

1. It is forward facing and relevant to future PN
2. A possible intervention is deemed to be feasible (at first inspection)
3. An intervention would be beneficial and easy or the potential gains of an intervention are significant
4. An intervention would help reduce inequality, e.g., if the barrier/facilitator is specific to an underserved/unengaged group

Supplementary table S1: Search Terms

<p>Database Searches conducted on 03/12/2021 and 24/07/2023</p>	<p>Key Words</p>
<p>Ovid Medline</p>	<p>Telemedicine/ OR Mhealth OR m-health OR e-notification* OR ((digital or mobile) adj health) OR on?line OR internet OR app OR application OR ((cellular or mobile or smart) adj phone) OR (web based) OR (text message) OR (text messaging) OR SMS AND Sexually Transmitted Diseases/ OR (sexually transmitted disease*) OR (sexually transmissible infection*) OR (sexually transmitted infection*) OR STI* OR STD* OR HIV OR (Human immunodeficiency virus) OR Chlamydia OR gonorrh?ea OR neisseria gonorrhoeae OR syphilis OR treponema pallidum AND Contact Tracing/ OR ((Partner or contact) adj notification) OR (partner tracing) OR ((partner or contact) adj treatment) OR ((partner or contact) adj testing) OR ((partner or contact) adj screening) OR ((partner or contact) adj management) OR ((partner or contact) adj services) OR (communicable disease control) OR (exposure notification)</p>
<p>Ovid Embase</p>	<p>Telemedicine/ OR Mhealth OR m-health OR e-notification* OR ((digital or mobile) adj health) OR on?line OR internet OR app OR application OR ((cellular or mobile or smart) adj phone) OR (web based) OR (text message) OR (text messaging) OR SMS AND Sexually Transmitted Disease/ OR (sexually transmitted disease*) OR (sexually transmissible infection*) OR (sexually transmitted infection*) OR STI* OR STD* OR HIV OR (Human immunodeficiency virus) OR Chlamydia OR gonorrh?ea OR neisseria gonorrhoeae OR syphilis OR treponema pallidum AND Contact Examination/ OR ((Partner or contact) adj notification) OR (partner tracing) OR ((partner or contact) adj treatment) OR ((partner or contact) adj testing) OR ((partner or contact) adj screening) OR ((partner or contact) adj management) OR ((partner or contact) adj services) OR (communicable disease control) OR (exposure notification)</p>
<p>PsychInfo</p>	<p>Telemedicine/ OR Mhealth OR m-health OR e-notification* OR ((digital or mobile) adj health) OR on?line OR internet OR app OR application OR ((cellular or mobile or smart) adj phone) OR (web based) OR (text message)</p>

	<p>OR (text messaging) OR SMS</p> <p>AND</p> <p>Sexually Transmitted Diseases/ OR (sexually transmitted disease*) OR (sexually transmissible infection*) OR (sexually transmitted infection*) OR STI* OR STD* OR HIV OR (Human immunodeficiency virus) OR Chlamydia OR gonorrh?ea OR (neisseria gonorrhoeae) OR syphilis OR (treponema pallidum)</p> <p>AND</p> <p>((Partner or contact) adj notification) OR ((Partner or contact) adj tracing) OR ((partner or contact) adj treatment) OR ((partner or contact) adj testing) OR ((partner or contact) adj screening) OR ((partner or contact) adj management) OR ((partner or contact) adj services) OR (communicable disease control) OR (exposure notification)</p>
Scopus	<p>(TITLE-ABS-KEY (telemedicine OR mhealth OR "m-health" OR "e-notification*" OR online OR internet OR app OR application OR "text message" OR "text messaging" OR sms) OR TITLE-ABS-KEY (((digital OR mobile) W/0 health)) OR TITLE-ABS-KEY (((cellular OR mobile OR smart) W/0 phone)) AND TITLE-ABS-KEY (("sexually transmitted disease*") OR ("sexually transmissible infection*") OR ("sexually transmitted infection*") OR sti* OR std* OR hiv OR ("human immunodeficiency virus") OR chlamydia OR gonorrhea OR gonorrhoea OR ("neisseria gonorrhoeae") OR syphilis OR ("treponema pallidum")) AND TITLE-ABS-KEY (((partner OR contact) W/0 (notification OR tracing OR treatment OR testing OR screening OR management OR services))) OR TITLE-ABS-KEY (("communicable disease control") OR ("exposure notification"))) AND PUBYEAR > 2009</p>
Web of Science	<p>Telemedicine OR Mhealth OR "m-health" OR "e-notification*" OR ((digital or mobile) NEAR/0 health) OR online OR internet OR app OR application OR ((cellular or mobile or smart) NEAR/0 phone) OR ("web based") OR ("text message") OR ("text messaging") OR SMS</p> <p>AND</p> <p>("sexually transmitted disease*") OR ("sexually transmissible infection*") OR ("sexually transmitted infection*") OR STI* OR STD* OR HIV OR ("Human immunodeficiency virus") OR Chlamydia OR gonorrhea OR gonorrhoea OR "neisseria gonorrhoeae" OR syphilis OR "treponema pallidum" AND</p> <p>((partner OR contact) NEAR/0 (notification OR tracing OR treatment OR testing OR screening OR management OR services) OR ("communicable disease control") OR ("exposure notification"))</p>
CINAHL Plus	<p>Telemedicine OR Mhealth OR "m-health" OR "e-notification*" OR ((digital or mobile) N0 health) OR online OR internet OR app OR application OR</p>

	<p>((cellular or mobile or smart) N0 phone) OR ("web based") OR ("text message") OR ("text messaging") OR SMS</p> <p>AND</p> <p>("sexually transmitted disease*") OR ("sexually transmissible infection*") OR ("sexually transmitted infection*") OR STI* OR STD* OR HIV OR ("Human immunodeficiency virus") OR Chlamydia OR gonorrhoea OR gonorrhoea OR "neisseria gonorrhoeae" OR syphilis OR "treponema pallidum" AND</p> <p>((partner OR contact) N0 (notification OR tracing OR treatment OR testing OR screening OR management OR services) OR ("communicable disease control") OR ("exposure notification"))</p> <p>Update <i>The above search strategy only retrieved 3 irrelevant results (other infections/disease focus); therefore, we broke down the search to 3 main search terms:</i></p> <p>(MH "Telemedicine") AND (MH "Sexually Transmitted Diseases") AND (MH "Contact Tracing")</p>
<p>Cochrane Library (including Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Database of Systematic Reviews, Cochrane Methodology Register)</p>	<p>Telemedicine/ OR Mhealth OR "m-health" OR e-notification* OR ((digital or mobile) NEAR/0 health) OR on?line OR internet OR app OR application OR ((cellular or mobile or smart) adj phone) OR "web based" OR "text message" OR "text messaging" OR SMS</p> <p>AND</p> <p>Sexually Transmitted Diseases/ OR (sexually transmitted disease*) OR sexually transmissible infection* OR sexually transmitted infection* OR STI* OR STD* OR HIV OR "Human immunodeficiency virus" OR Chlamydia OR gonorrh?ea OR "neisseria gonorrhoeae" OR syphilis OR "treponema pallidum"</p> <p>AND</p> <p>Contact tracing/ OR ((partner OR contact) NEAR/0 (notification OR tracing OR treatment OR testing OR screening OR management OR services) ("communicable disease control") OR ("exposure notification"))</p>
<p>NHS Evidence</p>	<p>(Telemedicine OR Mhealth OR "m health" OR "e notification*" OR "digital health" OR "mobile health" OR online OR internet OR app OR application OR "cellular phone" or "mobile phone" OR "smart phone" OR "web based" OR "text message" OR "text messaging" OR SMS)</p> <p>AND</p> <p>("sexually transmitted disease*" OR "sexually transmissible infection*" OR "sexually transmitted infection*" OR STI* OR STD* OR HIV OR "Human</p>

	<p>immunodeficiency virus" OR Chlamydia OR gonorrhea OR gonorrhoea OR "neisseria gonorrhoeae" OR syphilis OR "treponema pallidum")</p> <p>AND</p> <p>("partner notification" OR "partner tracing" OR "partner treatment" OR "partner testing" OR "partner screening" OR "partner management" OR "partner services" OR "contact notification" OR "contact tracing" OR "contact treatment" OR "contact testing" OR "contact screening" OR "contact management" OR "contact services" OR "communicable disease control" OR "exposure notification")</p>
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Supplementary table S2: Mixed Methods Appraisal Tool

Qualitative Studies								
Study	Are there clear research questions?	Do the collected data allow to address the research questions?	Is the qualitative approach appropriate to answer the research question?	Are the qualitative data collection methods adequate to address the research question?	Are the findings adequately derived from the data?	Is the interpretation of results sufficiently substantiated by data?	Is there coherence between qualitative data sources, collection, analysis and interpretation?	Comments
Contesse et al. (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Hopkins et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Lessard et al. (2019)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Yan et al (2022)	Yes	Yes	Yes	Yes	Yes	No	Yes	
Quantitative Descriptive Studies								
Study	Are there clear research questions?	Do the collected data allow to address the research questions?	Is the sampling strategy relevant to address the research question?	Is the sample representative of the target population?	Are the measurements appropriate?	Is the risk of nonresponse bias low?	Is the statistical analysis appropriate to answer the research question?	Comments

Bilardi et al. (2010)	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	No demographics available. Unable to verify the legitimacy of data measured. No comparison population data to assess nonresponse. Data extracted from existing sources, less controlled than primary collection.
Carnicer-Pont et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Wang et al. (2016)	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	No demographics for people who declined participation.

Mixed Methods Studies

Study	Are there clear research questions? Can also be interpreted as objectives.	Do the collected data allow to address the research questions?	Is there an adequate rationale for using a mixed methods design to address the research question?	Are the different components of the study effectively integrated to answer the research question?	Are the outputs of the integration of qualitative and quantitative components adequately interpreted?	Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?	Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?	Comments
Kutner et al. (2021)	Unclear	Unclear	Yes	Yes	Yes	Not applicable (no divergence)	Yes	

Supplementary table S3: Using the behaviour change to generate recommendations to improve the use of digital PN interventions

Simple barrier statement	Simple facilitator statement	TDF domain(s)	Intervention functions	BCTs	Recommendations (BCTs) [recommendation number]
Reported from traditional & digital PN					
The index patient does not feel a responsibility to notify partner(s)	The index patient believes they have a social responsibility to notify their partners	Social/professional role and identity	Education, Persuasion	<p>Information about health consequences (5.1)</p> <p>Saliency of consequences (5.2)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Anticipated regret (5.5)</p> <p>Credible source (9.1)</p>	<p>Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [4]</p> <p>Educate the index patient that, if not notified, their sex partner(s) might not know they have an STI until they have developed more serious, and potentially longer-term, symptoms which could have been avoided with earlier testing and treatment. (5.1, 5.3, 5.5) [5]</p> <p>Inform patients that delayed testing and treatment of their sex partners could lead to long-term, serious health consequences, e.g., infertility or reinfection of the index patient. Present this message via a doctor/NHS staff, such as in a talking heads video, or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [3]</p>

					Emphasise that notification benefits the health and wellbeing of those within the index patient's community, possibly through peer-led online stories or videos. (5.1, 5.3) [32]
The index patient is not concerned about their sexual partner(s) and their health (1)	The index patient worries about the health impacts of STIs	Beliefs about Consequences	Education, Persuasion	<p>Information about health consequences (5.1)</p> <p>Saliency of consequences (5.2)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Anticipated regret (5.5)</p> <p>Credible source (9.1)</p>	<p>Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [4]</p> <p>Educate the index patient that, if not notified, their sex partner(s) might not know they have an STI until they have developed more serious, and potentially longer-term, symptoms which could have been avoided with earlier testing and treatment. (5.1, 5.3, 5.5) [5]</p> <p>Inform patients that delayed testing and treatment of their sex partners could lead to long-term, serious health consequences, e.g., infertility or reinfection of the index patient. Present this message via a doctor/NHS staff, such as in a talking heads video, or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [3]</p>

The index patient has concerns about the competence and skills of any third parties involved in the PN process (3)		Beliefs about Consequences	Persuasion	Information about social and environmental consequences (5.3)	Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]
The index patient is not concerned about their sexual partner(s) and their health	The index patient has concerns for their partner(s) and their well-being	Beliefs about Consequences Emotion	Education, Persuasion	Information about health consequences (5.1) Information about social and environmental consequences (5.3) Information about others' approval (6.3)	Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17] Emphasise the caring aspect of notification to the index patient by explaining that notifying a partner early and encouraging them to seek testing and treatment can help protect them from longer-term health consequences. (5.1, 5.3) [19] Use language that indicates a helping/caring role for the index patient (e.g., in calls to action - “Help your partner get tested” as opposed to “Complete partner notification details”). This may also focus on how notification benefits the health and wellbeing of a community. (5.3) [26]

<p>The index patient has concerns about their partner(s)' reactions</p>	<p>The index patient is not concerned about their partners' reactions to PN</p> <p>The index can see examples of notification on-line and this encourages notification</p>	<p>Beliefs about Consequences</p>	<p>Education, Persuasion</p>	<p>Social support (practical) (3.2)</p> <p>Social support (emotional) (3.3)</p> <p>Instruction on how to perform behaviour (4.1)</p> <p>Information about health consequences (5.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Anticipated regret (5.5)</p> <p>Demonstration</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>Emphasise the caring aspect of notification to the index patient by explaining that notifying a partner early and encouraging them to seek testing and treatment can help protect them from longer-term health consequences. (5.1, 5.3) [19]</p> <p>Share or signpost positive but realistic written or video stories from people who have received a notification and subsequently tested, possibly digitally. (5.3, 6.3) [31]</p> <p>Use language that indicates a helping/caring role for the index patient (e.g., in calls to action - "Help your partner get tested" as opposed to "Complete partner notification details"). This may also focus on how notification benefits the health and wellbeing of a community. (5.3) [26]</p> <p>Provide or clearly signpost emotional and practical support for index patients that do not feel safe or secure notifying, perhaps due to a belief about the</p>
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			<p>of a behaviour (6.1)</p> <p>Information about others' approval (6.3)</p> <p>Credible source (9.1)</p>	<p>partner(s)' response, such as feared violence or abuse. This support may explore notification options, but would not force notification and should prioritise the safety of the patient. (3.2, 3.3) [9]</p> <p>Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17]</p> <p>When presenting information in favour of notification, employ branding or information that demonstrates the credibility of the notification source (e.g., using a domain name associated with a trusted institution). (9.1) [1]</p> <p>Consider including alternatives for linking to further care alongside links in texts, which are often seen as a sign of a scam. E.g., provide brief instructions on how to proceed to find information/testing without clicking on the link (e.g., "Search online for PNWebsiteName to view options for arranging testing and treatment or click on the link below"). (9.1) [2]</p>
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<p>The index patient has feelings of embarrassment or shame</p>	<p>The index patient believes the PN modality (digital/non-face-to-face) offers some protection from embarrassment, shame and stigma</p>	<p>Emotions</p>	<p>Persuasion, Modelling, Enablement</p>	<p>Social support (unspecified) (3.1)</p> <p>Social support (emotional) (3.3)</p> <p>Instruction on how to perform behaviour (4.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Demonstration of the behaviour (6.1)</p> <p>Social comparison (6.2)</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>Emphasise that many people test positive for STIs each year and subsequent partner notification is a routine part of STI care and treatment. Figures may be given to increase the salience of the message that many people notify their partners every day. Examples may include messaging such as "Every year ~1/2 million people in the UK test positive for an STI and partner notification is a normal part of the treatment process". (6.2) [16]</p> <p>Model the notification process in a positive light, e.g., in a video or animation of people engaging with PN or by sharing 'true stories' from the perspective of someone who has engaged in PN. Those depicted should represent the diversity of the index patients (e.g. regarding sexuality) and be tailored to the index patient where possible. (6.1) [18]</p> <p>Share or signpost positive but realistic written or video stories from people who have received a notification and subsequently tested, possibly</p>
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			<p>Information about others' approval (6.3)</p> <p>Reduce negative emotions (11.2)</p> <p>Restructuring the physical environment (12.1)</p> <p>Adding objects to the environment (12.5)</p>	<p>digitally. (5.3, 6.3) [31]</p> <p>Signpost appropriate emotional support resources which reduce emotional barriers to conducting PN (e.g., reducing anxiety). These may be online, over-the-phone or in-person services. Resources should remain accessible after notification is conducted. (3.3, 11.2, 12.5) [13]</p> <p>Avoid potentially stigmatising language, including that which can be read as signifying blame, or that suggests the direction of infection transmission. For example, avoid implying an active role of the index patient in transmitting the infection - "People you've recently had sex with are also at risk of having [the STI]" instead of "You may have transmitted the infection to your sex partners". (12.1) [27]</p> <p>Signpost existing credible resources that provide peer support or stories of peers who have received a diagnosis and notified partners or been notified by one. Those depicted should represent the diversity of the index patients (e.g. regarding sexuality) and be tailored to the index patient where possible. (3.1, 6.2) [12]</p>
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<p>The index patient has poor knowledge about STI symptoms or the asymptomatic nature of many STIs</p>		<p>Knowledge</p>	<p>Education</p>	<p>Information about health consequences (5.1) Saliency of consequences (5.2) Credible source (9.1)</p>	<p>Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [4]</p>
<p>The index patient lacks overall knowledge about PN – what it is and what it does</p>		<p>Knowledge</p>	<p>Education</p>	<p>Instruction on how to perform behaviour (4.1) Information about health consequences (5.1) Saliency of consequences (5.2) Demonstration of the behaviour (6.1)</p>	<p>Provide instruction on how to notify partners (including for multiple partners), which may be aided by a video/gif demonstration of the process emphasising the simplicity. (4.1, 6.1) [6] Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [4]</p>

				Credible source (9.1)	
The index patient believes their sexual partner(s) can deduce who notified them	The index patient believes there are safeguards in place to guarantee the authenticity of any results through digital PN	Beliefs about Consequences	Education, Persuasion	<p>Instruction on how to perform behaviour (4.1)</p> <p>Information about health consequences (5.1)</p> <p>Information about social and environmental consequences (5.3)</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>In a suitable section, such as FAQs or when discussing anonymity, explain to the index patient that the system is secure, but sometimes sex partners may still work out the source of an anonymous notification. This may be the case, for example, if the sex partner has recently only had sex with the index patient. Make sure discussions about the limits of anonymity are counterbalanced with information about the positive health consequences of notifying and include</p>

				Information about others' approval (6.3)	<p>messaging about the positive social consequences of notification (e.g., demonstration of caring). (5.1, 5.3) [11]</p> <p>Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17]</p>
The index patient believes PN is seen as a private matter and does not want third parties (such as health care professionals) involved in the PN process	The index patient knows that third parties such as health care professionals are not involved in the digital notification process	Social/professional role and identity	Education	<p>Instruction on how to perform behaviour (4.1)</p> <p>Information about social and environmental consequences (5.3)</p>	Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]

<p>The index patient has concerns about the privacy of their STI status</p>		<p>Beliefs about Consequences</p>	<p>Education, Persuasion</p>	<p>Instruction on how to perform behaviour (4.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Social comparison (6.2)</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]</p> <p>Emphasise that many people test positive for STIs each year and subsequent partner notification is a routine part of STI care and treatment. Figures may be given to increase the salience of the message that many people notify their partners every day. Examples may include messaging such as "Every year ~1/2 million people in the UK test positive for an STI and partner notification is a normal part of the treatment process". (6.2) [16]</p>
<p>The index patient believes their sexual partner(s) can deduce who notified them</p>		<p>Beliefs about Consequences</p>	<p>Education, Persuasion</p>	<p>Instruction on how to perform behaviour (4.1)</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an</p>

			<p>Information about health consequences (5.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Information about others' approval (6.3)</p>	<p>interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>In a suitable section, such as FAQs or when discussing anonymity, explain to the index patient that the system is secure, but sometimes sex partners may still work out the source of an anonymous notification. This may be the case, for example, if the sex partner has recently only had sex with the index patient. Make sure discussions about the limits of anonymity are counterbalanced with information about the positive health consequences of notifying and include messaging about the positive social consequences of notification (e.g., demonstration of caring). (5.1, 5.3) [11]</p> <p>Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17]</p>
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<p>There are practical problems contacting partners (e.g., the index patient does not know their partner's contact details or has too many partners to contact)</p>	<p>Digital PN interventions are simple and easy to use</p>	<p>Environmental context and resources</p>	<p>Environmental restructuring, Enablement</p>	<p>Social support (practical) (3.2)</p> <p>Instruction on how to perform the behaviour (4.1)</p> <p>Demonstration of the behaviour (6.1)</p> <p>Adding objects to the environment (12.5)</p>	<p>Provide instruction on how to notify partners (including for multiple partners), which may be aided by a video/gif demonstration of the process emphasising the simplicity. (4.1, 6.1) [6]</p> <p>Provide access to practical support if the index patient is struggling with notification through the system, e.g., via FAQs or a helpline. This may be due to digital literacy or because of some difficulty or complexity in their specific situation, for example limited contact details. (3.2) [29]</p> <p>Provide notification methods/interfaces that make it easy and efficient to notify multiple sex partners.. (12.5) [22]</p> <p>When developing PN systems that notify multiple partners, give the index patient the option to make choices about the notification method or content for each sex partner individually, where such choices are available in the system. (12.5) [21]</p> <p>Explore options of integrating a PN system within dating/hook-up apps that therefore does not require external contact details. This may also support access to health information or support from a healthcare professional through the app. (12.5) [23]</p>
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<p>The index patient has concerns about the competence and skills of any third parties involved in the PN process</p>		<p>Beliefs about Consequences</p>	<p>Education</p>	<p>Information about social and environmental consequences (5.3)</p>	<p>Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]</p> <p>In the case of notification via a healthcare professional (HCP) or community-based organisation (CBO), highlight that the HCP/CBO can provide guidance and signposting for the sex partner regarding consequent testing/treatment and answer health-related questions. (5.3) [30]</p>
<p>The index patient struggles to find the time to notify partner(s)</p>		<p>Environmental context and resources</p>	<p>Environmental restructuring</p>	<p>Demonstration of the behaviour (6.1)</p> <p>Prompts/cues (7.1)</p> <p>Restructuring the physical environment (12.1)</p> <p>Adding objects to the environment (12.5)</p>	<p>When designing how the index patient interacts with the digital system, prioritise ease and simplicity. Include additional content only where it is needed, for example, after clicking on "How does notification work?" or "Is this anonymous?", or in a FAQs section. Ease and simplicity could then be emphasized/demonstrated, for example via a short animation/GIF. (6.1, 12.1) [24]</p> <p>Provide a pre-set/generic editable notification message that index patients can use to save time or share with sex partners in combination with face-to-face notification. (12.5) [25]</p> <p>Automate prompts to complete PN if the index patient has engaged with the system but not completed this step. The sensitive nature of prompts should be considered and they should be delivered</p>

					discretely and within a limited period of time after test results are received. Additionally, it is important to make it clear how the index patient's contact details will be used when they are provided, in compliance with GDPR. (7.1, 12.5) [20]
Digital/non-face-to-face modes of PN are perceived to be insensitive, cold and cowardly	The index patient believes that digital PN is better than no PN at all (6) (e.g., when face-to-face or phone are not possible).	Social influences	Enablement, Modelling	<p>Social support (practical) (3.2)</p> <p>Social support (emotional) (3.3)</p> <p>Instruction on how to perform the behaviour (4.1)</p> <p>Information about social and environmental consequences</p>	<p>Provide or clearly signpost emotional and practical support for index patients that do not feel safe or secure notifying, perhaps due to a belief about the partner(s)' response, such as feared violence or abuse. This support may explore notification options, but would not force notification and should prioritise the safety of the patient. (3.2, 3.3) [9]</p> <p>Provide or signpost credible guidance and video demonstrations on how to inform sex partners face-to-face/over the phone where the index patient feels this is the appropriate method of notification. (4.1, 6.1) [10]</p> <p>Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]</p>

				(5.3) Demonstration of the behaviour (6.1)	
The index patient believes that digital/non-face-to-face modes of PN are inappropriate for close/established relationships	The index patient believes digital/non-face-to-face modes of PN are appropriate for casual/one-off relationships	Social influences	Enablement, Environmental restructuring	Instruction on how to perform the behaviour (4.1) Information about social and environmental consequences (5.3) Adding objects to the environment (12.5)	Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8] When developing PN systems that notify multiple partners, give the index patient the option to make choices about the notification method or content for each sex partner individually, where such choices are available in the system. (12.5) [21] Provide a pre-set/generic editable notification message that index patients can use to save time or share with sex partners in combination with face-to-

					face notification. (12.5) [25]
The index patient struggles to see how digital PN could effectively link their sexual partner(s) into future sexual healthcare	The index patient can see how PN can link their partners into further sexual healthcare	Beliefs about consequences	Persuasion	Information about social and environmental consequences (5.3)	Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]

<p>The index patient believes the PN modality (digital/non-face-to-face) offers some protection from embarrassment, shame and stigma</p>	<p>Beliefs about Consequences</p>	<p>Education, Modelling, Persuasion</p>	<p>Instruction on how to perform the behaviour (4.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Demonstration of the behaviour (6.1)</p> <p>Social comparison (6.2)</p> <p>Information about others' approval (6.3)</p>	<p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method. (4.1, 5.3) [8]</p> <p>Emphasise that many people test positive for STIs each year and subsequent partner notification is a routine part of STI care and treatment. Figures may be given to increase the salience of the message that many people notify their partners every day. Examples may include messaging such as "Every year ~1/2 million people in the UK test positive for an STI and partner notification is a normal part of the treatment process". (6.2) [16]</p> <p>Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17]</p> <p>Model the notification process in a positive light, e.g., in a video or animation of people engaging with PN or by sharing 'true stories' from the perspective of someone who has engaged in PN. Those depicted should represent the diversity of the index patients (e.g. regarding sexuality) and be tailored to the index</p>
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				patient where possible. (6.1) [18]
The index is patient protected from partner violence	Beliefs about Consequences	Education	<p>Social support (practical) (3.2)</p> <p>Social support (emotional) (3.3)</p> <p>Instruction on how to perform the behaviour (4.1)</p> <p>Information</p>	<p>Provide or clearly signpost emotional and practical support for index patients that do not feel safe or secure notifying, perhaps due to a belief about the partner(s)' response, such as feared violence or abuse. This support may explore notification options, but would not force notification and should prioritise the safety of the patient. (3.2, 3.3) [9]</p> <p>Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards</p>

			about social and environmental consequences (5.3)	their preferred method. (4.1, 5.3) [8]
The index patient believes that PN is the 'right thing to do'	Social influences Social Professional role and identity	Persuasion	<p>Information about health consequences (5.1)</p> <p>Information about social and environmental consequences (5.3)</p> <p>Social comparison (6.2)</p> <p>Information about others' approval (6.3)</p>	<p>Emphasise that many people test positive for STIs each year and subsequent partner notification is a routine part of STI care and treatment. Figures may be given to increase the salience of the message that many people notify their partners every day. Examples may include messaging such as "Every year ~1/2 million people in the UK test positive for an STI and partner notification is a normal part of the treatment process". (6.2) [16]</p> <p>Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told. (5.3, 6.3) [17]</p> <p>Emphasise that notification benefits the health and wellbeing of those within the index patient's community, possibly through peer-led online stories or videos. (5.1, 5.3) [32]</p>

Reported from digital PN interventions only					
The index patient has concerns about the perceived authenticity of digital PN	The index patient believes their privacy/anonymity is safeguarded within a digital PN intervention	Beliefs about Consequences	Persuasion	Credible source (9.1)	<p>When presenting information in favour of notification, employ branding or information that demonstrates the credibility of the notification source (e.g., using a domain name associated with a trusted institution). (9.1) [1]</p> <p>Consider including alternatives for linking to further care alongside links in texts, which are often seen as a sign of a scam. E.g., provide brief instructions on how to proceed to find information/testing without clicking on the link (e.g., "Search online for PNWebsiteName to view options for arranging testing and treatment or click on the link below"). (9.1) [2]</p>
The index patient struggles to see how digital PN could effectively link their sexual	The index patient can see how PN can link their partners into further sexual healthcare	Environmental context and resources	Environmental restructuring	Adding objects to the environment (12.5)	<p>Provide a pre-set/generic editable notification message that index patients can use to save time or share with sex partners in combination with face-to-face notification. (12.5) [25]</p> <p>Signpost appropriate emotional support resources</p>

partner(s) into future sexual healthcare					<p>which reduce emotional barriers to conducting PN (e.g., reducing anxiety). These may be online, over-the-phone or in-person services. Resources should remain accessible after notification is conducted. (12.5) [14]</p> <p>When links to online information or services are used, ensure there are also non-digital links to care, such as phone numbers to call or address for local healthcare settings. (12.5) [15]</p>
There are practical problems contacting partners (e.g., the index patient does not know their partner's contact details or has too many partners to contact)	The index patient believes Digital PN interventions makes it practically easier to contact partners (e.g., if they are travelling or not answering their phone)	Environmental context and resources	Environmental restructuring, Enablement	<p>Social support (practical) (3.2)</p> <p>Instruction on how to perform the behaviour (4.1)</p> <p>Demonstration of the behaviour (6.1)</p> <p>Adding objects to the environment (12.5)</p>	<p>Provide instruction on how to notify partners (including for multiple partners), which may be aided by a video/gif demonstration of the process emphasising the simplicity. (4.1, 6.1) [6]</p> <p>Provide access to practical support if the index patient is struggling with notification through the system, e.g., via FAQs or a helpline. This may be due to digital literacy or because of some difficulty or complexity in their specific situation, for example limited contact details. (3.2) [29]</p> <p>Provide notification methods/interfaces that make it easy and efficient to notify multiple sex partners.. (12.5) [22]</p> <p>When developing PN systems that notify multiple partners, give the index patient the option to make choices about the notification method or content for each sex partner individually, where such choices are</p>

					available in the system. (12.5) [21] Explore options of integrating a PN system within dating/hook-up apps that therefore does not require external contact details. This may also support access to health information or support from a healthcare professional through the app. (12.5) [23]
	The index patient has been coached to use digital methods of PN and has gained digital notification skills	Skills Beliefs about capabilities	Training, Modelling	Instruction on how to perform the behaviour (4.1) Demonstration of the behaviour (6.1)	Provide or signpost credible guidance and video demonstrations on how to inform sex partners face-to-face/over the phone where the index patient feels this is the appropriate method of notification. (4.1, 6.1) [10]
The index patient believes PN is seen as a private matter and does not want third parties (such as health care professionals) involved in the PN process	The index patient knows that third parties such as health care professionals are not involved in the digital notification process	Beliefs about consequences	Persuasion	Information about social and environmental consequences (5.3)	Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed. (5.3) [7]

	<p>The index patient believes Digital PN interventions makes it practically easier to contact partners (e.g., if they are travelling or not answering their phone)</p>	<p>Environmental context and resources</p>	<p>Environmental restructuring</p>	<p>Demonstration of the behaviour (6.1)</p> <p>Restructuring the physical environment (12.1)</p> <p>Adding objects to the environment (12.5)</p>	<p>When designing how the index patient interacts with the digital system, prioritise ease and simplicity. Include additional content only where it is needed, for example, after clicking on "How does notification work?" or "Is this anonymous?", or in a FAQs section. Ease and simplicity could then be emphasized/demonstrated, for example via a short animation/GIF. (6.1, 12.1) [24]</p> <p>Provide a pre-set/generic editable notification message that index patients can use to save time or share with sex partners in combination with face-to-face notification. (12.5) [25]</p> <p>Align language (and user experiences) with common digital norms such that interactions with the system are familiar and digital literacy requirements reduced. For example, after submitting a form, the index patient may expect a submission confirmation to appear on the screen or via email. If this doesn't occur they may assume the form did not submit. (12.1) [28]</p>
<p>The index patient does not feel a responsibility to notify partner(s)</p>	<p>The index patient believes they have a social responsibility to notify their partners</p>	<p>Social/professional role and identity</p>	<p>Education/Persuasion</p>	<p>information about health consequences (5.1)</p> <p>Salience of consequences (5.2)</p>	<p>Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [4]</p> <p>Educate the index patient that, if not notified, their</p>

The index can share their own, and see others' examples, of notification on-line	Social influence		<p>Information about social and environmental consequences (5.3)</p> <p>Anticipated regret (5.5)</p> <p>Credible source (9.1)</p>	<p>sex partner(s) might not know they have an STI until they have developed more serious, and potentially longer-term, symptoms which could have been avoided with earlier testing and treatment. (5.1, 5.3, 5.5) [5]</p> <p>Inform patients that delayed testing and treatment of their sex partners could lead to long-term, serious health consequences, e.g., infertility or reinfection of the index patient. Present this message via a doctor/NHS staff, such as in a talking heads video, or in combination with reference to a reputable (healthcare) organisation, for example through branding. (5.1, 5.2, 9.1) [3]</p> <p>Emphasise that notification benefits the health and wellbeing of those within the index patient's community, possibly through peer-led online stories or videos. (5.1, 5.3) [32]</p>
		Environmental restructuring	<p>6.1 Demonstration of the behaviour</p> <p>6.2 Social comparison</p>	<p>Emphasise that notification benefits the health and wellbeing of those within the index patient's community, possibly through peer-led online stories or videos.[32]</p>

Supplementary table S4: Unique recommendations generated from the BCW analysis of the synthesised and selected barriers and facilitators to using digital PN interventions

ID	Recommendation	BCTs	Recommendation theme	Count
1	When presenting information in favour of notification, employ branding or information that demonstrates the credibility of the notification source (e.g., using a domain name associated with a trusted institution).	9.1	STI education	2
2	Consider including alternatives for linking to further care alongside links in texts, which are often seen as a sign of a scam. E.g., provide brief instructions on how to proceed to find information/testing without clicking on the link (e.g., "Search online for PNWebsiteName to view options for arranging testing and treatment or click on the link below").	9.1	Integrations and convenience	2

3	Inform patients that delayed testing and treatment of their sex partners could lead to long-term, serious health consequences, e.g., infertility or reinfection of the index patient. Present this message via a doctor/NHS staff, such as in a talking heads video, or in combination with reference to a reputable (healthcare) organisation, for example through branding.	5.1, 5.2, 9.1	STI education	2
4	Inform index patients that they play a key role in preventing transmission and that this is difficult without PN as STIs are often present without causing noticeable symptoms. Communicate this message via a doctor/NHS staff or in combination with reference to a reputable (healthcare) organisation, for example through branding.	5.1, 9.1	STI education	4
5	Educate the index patient that, if not notified, their sex partner(s) might not know they have an STI until they have developed more serious, and potentially longer-term, symptoms which could have been avoided with earlier testing and treatment.	5.1, 5.3, 5.5	STI education	2

6	Provide instruction on how to notify partners (including for multiple partners), which may be aided by a video/gif demonstration of the process emphasising the simplicity.	4.1, 6.1	Empowering and supporting the patient	2
7	Describe or demonstrate to the index patient how notification via a third party (e.g., a health advisor) or digital method would take place from the sex partner perspective, such that the nature and sensitivity of the notification can be conveyed.	5.3	Empowering and supporting the patient	4
8	Clearly present the options for different notification methods that leave the index patient in control of what they share and how, highlighting the differences between each method (considering emotional, privacy, anonymity and safety factors, including the speed of notification). For example, this could be a comparison table/visual or an interactive decision tool guiding the patient towards their preferred method.	4.1, 5.3	Empowering and supporting the patient	8

9	Provide or clearly signpost emotional and practical support for index patients that do not feel safe or secure notifying, perhaps due to a belief about the partner(s)' response, such as feared violence or abuse. This support may explore notification options, but would not force notification and should prioritise the safety of the patient.	3.2, 3.3	Empowering and supporting the patient	3
10	Provide or signpost credible guidance and video demonstrations on how to inform sex partners face-to-face/over the phone where the index patient feels this is the appropriate method of notification.	4.1, 6.1	Empowering and supporting the patient	2
11	In a suitable section, such as FAQs or when discussing anonymity, explain to the index patient that the system is secure, but sometimes sex partners may still work out the source of an anonymous notification. This may be the case, for example, if the sex partner has recently only had sex with the index patient. Make sure discussions about the limits of anonymity are counterbalanced with information	5.1, 5.3		1

about the positive health consequences of notifying and include messaging about the positive social consequences of notification (e.g., demonstration of caring).

12 Signpost existing credible resources that provide peer support or stories of peers who have received a diagnosis and notified partners or been notified by one. Those depicted should represent the diversity of the index patients (e.g. regarding sexuality) and be tailored to the index patient where possible.

3.1, 6.2

Normalising PN as an act of caring

1

13 Signpost appropriate emotional support resources which reduce emotional barriers to conducting PN (e.g., reducing anxiety). These may be online, over-the-phone or in-person services. Resources should remain accessible after notification is conducted.

3.3, 11.2, 12.5

Empowering and supporting the patient

1

14	Provide or signpost clear and easy-to-access health information in both the digital PN system and in the sex partner notification information. For example, this may include information about health consequences, how to get treatment, or STI window periods.	5.1, 12.5	Empowering and supporting the patient	1
15	When links to online information or services are used, ensure there are also non-digital links to care, such as phone numbers to call or address for local healthcare settings.	12.5		1
16	Emphasise that many people test positive for STIs each year and subsequent partner notification is a routine part of STI care and treatment. Figures may be given to increase the salience of the message that many people notify their partners every day. Examples may include messaging such as "Every year ~1/2 million people in the UK test positive for an STI and partner notification is a normal part of the treatment process."	6.2	Normalising PN as an act of caring	4

17	Explain to index patients that letting their sex partners know that they are at risk of having an STI can be hard to do, but in the long run partners are generally very grateful to have been told.	5.3, 6.3	Normalising PN as an act of caring	5
18	Model the notification process in a positive light, e.g., in a video or animation of people engaging with PN or by sharing 'true stories' from the perspective of someone who has engaged in PN. Those depicted should represent the diversity of the index patients (e.g. regarding sexuality) and be tailored to the index patient where possible.	6.1	Normalising PN as an act of caring	2
19	Emphasise the caring aspect of notification to the index patient by explaining that notifying a partner early and encouraging them to seek testing and treatment can help protect them from longer-term health consequences.	5.1, 5.3	Normalising PN as an act of caring	2
20	Automate prompts to complete PN if the index patient has engaged with the system but not completed this step. The sensitive nature of prompts should be considered and they should be delivered discretely and within a limited period of time	7.1, 12.5	Empowering and supporting the patient	1

after test results are received. Additionally, it is important to make it clear how the index patient's contact details will be used when they are provided, in compliance with GDPR.

	When developing PN systems that notify multiple partners, give the index patient the option to make choices about the notification method or content for each sex partner individually, where such choices are available in the system.	12.5		2
21	Provide notification methods/interfaces that make it easy and efficient to notify multiple sex partners.	12.5	Integrations and convenience	1
22	Explore options of integrating a PN system within dating/hook-up apps that therefore does not require external contact details. This may also support access to health information or support from a healthcare professional through the app.	12.5	Integrations and convenience	1
23				

24	<p>When designing how the index patient interacts with the digital system, prioritise ease and simplicity. Include additional content only where it is needed, for example, after clicking on "How does notification work?" or "Is this anonymous?", or in a FAQs section. Ease and simplicity could then be emphasized/demonstrated, for example via a short animation/GIF.</p>	6.1, 12.1	Empowering and supporting the patient	2
25	<p>Provide a pre-set/generic editable notification message that index patients can use to save time or share with sex partners in combination with face-to-face notification.</p>	12.5	Empowering and supporting the patient	4
26	<p>Use language that indicates a helping/caring role for the index patient (e.g., in calls to action - "Help your partner get tested" as opposed to "Complete partner notification details"). This may also focus on how notification benefits the health and wellbeing of a community.</p>	5.3	Normalising PN as an act of caring	2

27	Avoid potentially stigmatising language, including that which can be read as signifying blame, or that suggests the direction of infection transmission. For example, avoid implying an active role of the index patient in transmitting the infection - "People you've recently had sex with are also at risk of having [the STI]" instead of "You may have transmitted the infection to your sex partners".	12.1	Normalising PN as an act of caring	1
28	Align language (and user experiences) with common digital norms such that interactions with the system are familiar and digital literacy requirements reduced. For example, after submitting a form, the index patient may expect a submission confirmation to appear on the screen or via email. If this doesn't occur they may assume the form did not submit.	12.1	Integrations and convenience	1
29	Provide access to practical support if the index patient is struggling with notification through the system, e.g., via FAQs or a helpline. This may be due to digital literacy or because of some difficulty or complexity in their specific situation, for example	3.2	Empowering and supporting the patient	1

	limited contact details.			
30	In the case of notification via a healthcare professional (HCP) or community-based organisation (CBO), highlight that the HCP/CBO can provide guidance and signposting for the sex partner regarding consequent testing/treatment and answer health-related questions.	5.3	Empowering and supporting the patient	1
31	Share or signpost positive but realistic written or video stories from people who have received a notification and subsequently tested, possibly digitally.	5.3, 6.3, 6.1	Normalising PN as an act of caring	2
32	Emphasise that notification benefits the health and wellbeing of those within the index patient's community, possibly through peer-led online stories or videos.	5.1, 5.3	Normalising PN as an act of caring	3