

# Priorities in the implementation of partner services for HIV/STIs in high-income nations: a narrative review of evidence and recommendations

Matthew R. Golden<sup>A</sup>, Jo Gibbs<sup>B</sup>, Charlotte Woodward<sup>B,\*</sup>  and Claudia S. Estcourt<sup>C</sup>

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

**\*Correspondence to:**

Charlotte Woodward  
Centre for Population Research in Sexual Health & HIV, Institute for Global Health, University College London, London, UK  
Email:  
[charlotte.woodward.20@alumni.ucl.ac.uk](mailto:charlotte.woodward.20@alumni.ucl.ac.uk)

**Handling Editor:**

Jason Ong

**Received:** 11 April 2022

**Accepted:** 30 June 2022

**Published:** 16 August 2022

**Cite this:**

Golden MR *et al.* (2022)  
*Sexual Health*, **19**(4), 309–318.  
doi:[10.1071/SH22060](https://doi.org/10.1071/SH22060)

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## ABSTRACT

Partner notification (PN) remains a crucial prevention tool to reduce sexually transmitted infection (STI) transmission and prevent STI-related morbidity. Although there have been a variety of different approaches taken to facilitate the notification, testing and management of sexual contacts of STIs and HIV, there is an increasing acknowledgement that these interventions are unscalable and have relatively little impact on disease transmission. At the same time, an expanding body of evidence supports a shift in the emphasis of STI outreach-related work from an exclusive focus on PN to an approach that incorporates epidemiologic data collection, case management, and PN, an approach that is sometimes called partner services (PS). In this review, we appraise the current evidence base for different PN interventions for STIs in high-income nations, make recommendations for best practices, present a schema for how public health programs might prioritise PS for different programs, and identify priority research questions related to PN.

**Keywords:** contact tracing, HIV/AIDS, partner notification, STIs.

## Introduction

Partner notification (PN) is a longstanding component of clinical and public health efforts to control sexually transmitted infections (STIs), including HIV infection.<sup>1,2</sup> The primary objective of PN is to ensure that potentially exposed sex and needle-sharing partners learn of their exposure, test for STIs, and receive recommended treatment. Due largely to variability in the severity of morbidity associated with different STIs and the scale of different STI epidemics, the approaches taken to achieve this goal have varied between infections (Table 1). Many nations have invested substantial resources to provide assisted partner notification services (APS) to persons with HIV and syphilis, relatively morbid and uncommon infections, while relying on less resource-intensive methods to promote PN for STIs such as gonorrhoea and chlamydia, which are more prevalent and associated with relatively low morbidity.

There is increasing recognition that our approach to PN is antiquated and inadequate. The public health PN system in the US, UK, and many other high-income nations was designed to confront the syphilis epidemic in the wake of the Second World War. In some nations, it was subsequently expanded to affect people with HIV infection and, less frequently, gonorrhoea and chlamydia. But the traditional approach to APS is resource-intensive, unscalable for most bacterial STIs, increasingly recognised as ineffective in promoting partner testing and treatment, and ill-suited to a world in which large numbers of people with STIs meet and communicate with their sex partners online and some sexually transmitted pathogens exhibit increased antimicrobial resistance (AMR).

The current system is not what we need, but that is not to say that PN is unimportant or should be abandoned altogether. The problem is that our current approach is unnecessarily narrow in scope and characterised by a poverty of imagination and resources. We have failed to consistently bring innovations to scale (e.g. expedited partner therapy (EPT)) and to define the value of new technologies in promoting PN and then deploy those

**Table 1.** Terminology, types of partner notification, and public health evaluation metrics.

Terms	Definition
Index patient or index case	Person diagnosed with an STI who is interviewed to identify their sex partners and develop a partner notification plan
Partner or contact	Sex or needle-sharing partner who was potentially exposed to an STI or transmitted an STI to the index case
Partner notification	Activities undertaken to ensure that sex and needle-sharing partners of persons with an STI are tested and, as needed, treated
Partner services <sup>A</sup>	Activities undertaken by public health staff to investigate cases of STI and provide clinical and public health services, including assisted partner notification services, to index cases and their partners
Approaches to partner notification	
Patient referral (sometimes called passive referral)	Patient notifies their partners themselves
Assisted or enhanced patient referral	Patient notifies partners themselves, but receives counselling, referral cards, or other support
Provider referral	Counsellor or medical provider directly contacts partners to notify them and arrange their STI testing and treatment
Conditional (or contract) referral	Index case agrees to notify partner within an agreed time period and, if they do not do so, a counsellor or medical provider does so for them.
Expedited partner therapy (EPT)	Partner is treated without requiring that they first see a medical provider or undergo testing
Patient-delivered partner therapy	Index case is given medication or a prescription to give to a partner (most common type of EPT)
Accelerated partner therapy	Partner has a medical evaluation by telephone during the index patient's clinic visit and then the index case delivers a self-sampling kit and antibiotics to the partner
Assisted partner notification services (APS)	Global term that includes provider and conditional referral, but may also include more intensive approaches to assisted patient referral. Mostly used in literature related to HIV
Partner notification evaluation metrics <sup>B</sup>	
Reach	Proportion of potentially eligible persons receiving APS (Receipt of APS typically measured as being interviewed)
Contact index	Number of sex or needle-sharing contacts named per index case receiving APS
Testing index	Number of sex or needle-sharing contacts tested per index case receiving APS
Case-finding index	Number of contacts newly identified as having an STI per index case
Number needed to interview (NNTI)	Number of index cases who need to receive APS to identify a new case of STI (inverse of the case-finding index)
Epidemiologic (treatment) index	Number of contacts treated per index case, including contacts who do and do not test positive for an STI (usually used for syphilis)
Brought-to-treatment index	Number of infected contacts treated per index case (usually used for syphilis)

<sup>A</sup>Some areas have used the term 'field services' to more clearly indicate the outreach services that integrate services designed to benefit both index cases and their partners.

<sup>B</sup>Some programs also measure the number of partners notified, and separately report verified and index case reported outcomes.<sup>18,72</sup>

technologies effectively. Moreover, traditional public health PN efforts fail to capitalise on opportunities to achieve wider public health objectives (e.g. promotion of HIV pre-exposure prophylaxis [PrEP]). Increasing recognition of this reality has prompted a shift in STI outreach activities and an associated change in the terminology used to describe these activities from PN to partner services (PS) or field services, terms that include a wider array of interventions affecting both index cases and their contacts.

The need to modify the content and organisation of STI PS has accelerated in the context of the ongoing coronavirus disease 2019 (COVID-19) pandemic. Early experience with the COVID-19 pandemic highlighted the need for a trained and versatile workforce capable of effective contact tracing in response to emerging threats to the public's health. The staff employed to provide STI and HIV field services should be a central part of that workforce.

In this paper, we summarise evidence related to different approaches to PN for STIs in high-income nations, make recommendations related to STI PS best practices, and identify priority research questions related to STI PS. We do not address network interventions here and concentrate primarily on STIs other than HIV and on PS in high-income nations, recognising that the intervention is also important in low- and middle-income (LMIC) nations, a topic that has been reviewed elsewhere.<sup>3</sup>

### Traditional, assisted partner notification

The scientific literature typically describes three main approaches to PN: patient referral, provider referral, and conditional referral. However, these terms mask substantial

heterogeneity in the delivery of each of the interventions. For example, patient referral involves the index patient contacting their sex partner(s) to inform them of the need for testing and treatment and to refer them to a clinical/sexual health service. But, in some instances, clinics support index patients by providing them with online or paper information and resources or serial telephone calls to encourage PN. This type of patient referral has been termed enhanced or assisted patient referral. Provider referral involves the clinical service/public health team contacting sex partners directly and is usually done anonymously in that the provider does not disclose the index patient's identity. Here too, there is substantial variance in the intervention provided. Some health departments send public health workers to index cases' homes or workplaces, investing many hours of work in each case, whereas others rely primarily on phone calls, sometimes simply offering index cases assistance with little follow up.

Although recent controlled studies from sub-Saharan Africa support the efficacy of provider and conditional referral for HIV,<sup>4-7</sup> the data supporting the efficacy of provider referral from high-income nations are limited and dated. Two randomised trials conducted in the 1980s, only one of which was published, found that provider referral increased partner treatment among male sexually transmitted disease clinic patients,<sup>8,9</sup> a finding also observed in a small trial of HIV PN.<sup>10</sup> However, other non-randomised experimental and quasi-experimental studies from the 1970s to the 1980s reported mixed results.<sup>11-15</sup> Moreover, several studies suggest that the effectiveness of traditional PS has eroded over time, and that many of the partners defined as treated through PN would have been treated in the absence of any intervention.<sup>16-18</sup> Summarising data from US studies of syphilis APS published between 1995 and 2003, Brewer reported a median brought-to-treatment index of 0.22, whereas a recent study of syphilis APS in seven US jurisdictions from 2015 to 2017 reported an index of 0.15.<sup>16,19</sup> HIV PN effectiveness also appears to have declined over time in both the US and UK.<sup>19-23</sup> Overall, these studies suggest that provider or conditional referral can increase PN and treatment, but the magnitude of that effect is uncertain, and most recent studies suggest the impact of the intervention is small.

## Expedited partner therapy and accelerated partner therapy

Starting in the 1990s, recognition that traditional PN was not scalable for gonorrhoea, chlamydia and trichomonas prompted a series of studies designed to improve partner treatment using lower-intensity interventions.<sup>24-27</sup> The basic idea behind these studies was to make it easier and quicker for the sex partner to access treatment and, in some

cases, testing and treatment. These interventions are known as EPT. EPT involves a healthcare professional giving the index patient antibiotics or a prescription for their partner(s) and has been used for PN in people with chlamydia, gonorrhoea, and *Trichomonas vaginalis*. A systematic review found that EPT results in lower proportions of index cases experiencing repeated curable STIs than simple patient referral,<sup>28</sup> though the impact of EPT on rates of recurrent gonorrhoea appears to be much greater than the impact on chlamydia or trichomonas.<sup>25</sup> A study from Washington State in the US found that EPT could be brought to scale when free EPT medication was made widely available and suggested that the intervention may have reduced chlamydia and gonorrhoea rates at the population level.<sup>29</sup> But efforts to widely implement EPT in other parts of the US have met with more limited success, owing to failure of medical providers to offer index cases the intervention, electronic medical records that have no mechanism to facilitate prescriptions for partners, and the fragmented nature of US healthcare financing, which discourages insurers from paying for medication for sex partners who are insured through other entities.<sup>30</sup>

EPT, as practised in the US, does not require that sex partners directly communicate with medical providers and does not comply with prescribing guidance in many countries. This led to the development of accelerated partner therapy (APT), an adaptation of EPT, which has been almost exclusively used in the UK to date.<sup>31,32</sup> APT complies with UK prescribing guidance because a healthcare professional assesses the appropriateness of prescribing antibiotics for the partner. In brief, the healthcare professional performs a telephone consultation with the sex partner in private during the index patient's clinic attendance. If medically safe, the index patient receives an APT pack, containing antibiotics and self-sampling kits for STI and HIV to deliver to their sex partner(s), or the clinic may post the APT pack to the sex partner. In pilot studies, APT resulted in faster sex partner treatment and greater overall numbers of sex partners treated when compared with routine care, but lower levels of testing for HIV and other STIs when offered without HIV testing as part of the pack.<sup>31,32</sup>

A recent large randomised controlled trial of APT for people with chlamydia showed that the offer of APT as an additional contact tracing method to usual care likely caused a small reduction in repeat chlamydia infection 12-24 weeks after treatment and an increase in proportion of sex partners treated, compared with usual care alone. The authors concluded that APT can be safely offered as a cost-saving contact tracing option for heterosexual people with chlamydia, and might reduce the risk of repeat infection, particularly for those in emotionally connected relationships, although uptake needs to be improved and novel approaches are needed for one-off partners.<sup>33-35</sup>

## Digital partner notification interventions for STIs and HIV

As global communication becomes increasingly digitalised, digital interventions could improve the effectiveness and efficiency of PN processes. The majority of digital PN interventions aim to improve notification rates (the proportion of sex partners informed) and include anonymised notification.<sup>36</sup> A variety of different digital health technologies have been used, including SMS, email, social media and PN apps. These are usually provided in addition to traditional PN methods. A low number of apps allows index patients to share their test results with sex partners and healthcare professionals.<sup>37</sup>

Many of the published evaluations of digital PN interventions are hypothetical preference studies. Of the studies included in a recent review,<sup>36</sup> very few were based on real-world PN for people with gonorrhoea, chlamydia, and/or syphilis,<sup>38–41</sup> and few reported ‘downstream’ sex partner outcomes, such as the number or proportion of partners tested or treated.<sup>39,40,42–46</sup> Data from Australia suggest that a digital PN intervention that allows users to notify contacts (either anonymously or by name) using short-message service (SMS) can be brought to scale with increased use over time.<sup>47</sup> Many studies of digital PN do not include a control group. The most common measure of effectiveness was number of partners notified and there is very little evidence on, or recognition of the importance of, health economic parameters and equity indicators or digital exclusion.

Acceptability of digital interventions to index patients is associated with relationship type.<sup>39,48–50</sup> This is not surprising given that some digital interventions involve anonymised sex partner messaging, and numerous PN studies have shown that index patients prefer telling their established (more emotionally connected) sex partners in person.<sup>51–53</sup> However, it is unclear whether people liked anonymous digital PN because of the anonymous aspect, or because the anonymous aspect was delivered digitally. Barriers to index patient uptake of digital PN interventions include concern that sex partners would not trust (or act on) the digital notification and worries about privacy and confidentiality.<sup>48,54,55</sup> Low trust in the received notification message is also a concern for sex partners and, to some extent, healthcare professionals,<sup>55–57</sup> and could affect subsequent care-seeking decisions.<sup>54</sup>

There remains considerable potential for digital interventions to enhance PN beyond simply notifying a greater proportion of exposed sex partners rapidly. More ambitious digital PN interventions could include comprehensive partner management,<sup>37</sup> including linking people with wider prevention interventions such as HIV PrEP, vaccinations, and risk reduction more broadly. One UK exploratory study of people with chlamydia managed within an online

eSexual health clinic enabled sex partners to do an online automated consultation and collect antibiotics from a community pharmacy.<sup>58</sup> Partner uptake was low, but those who accessed the PN and management system found it highly acceptable.

Digital PN interventions have intuitive appeal as they are responsive to how people meet partners within an increasingly digital world and could be rolled out at scale. However, although these interventions show promise in increasing the number of sex partners informed of their exposure to infection, the ‘active ingredient’ in many digital interventions is opaque and we do not know whether they lead to more partners getting tested and or treated. More work is needed to determine the place, if any, of digital PN interventions. This will ideally include controlled evaluations of sex partner and index patient outcomes such as numbers of partners tested and treated and health economic and equity analyses. We know that people make careful choices of preferred methods of PN for different infections and different partner types. Inclusive, co-designed, evidence-based digital interventions will be needed as part of a wider menu of PN options if we are to adequately meet people’s needs and expectations and impact STI and HIV transmission.

## Use of empirical treatment within PN

In many countries, antibiotics are recommended for sex partners of index patients for a range of STIs, either as well as or instead of testing. Historically, this made sense because nucleic acid amplification tests were available if routine testing options lacked sensitivity. In the era of highly sensitive tests for many STI pathogens and the emergence of AMR in pathogens such as *Neisseria gonorrhoeae* and *Mycoplasma genitalium*, some believe that this practice should be abandoned or reassessed<sup>59,60</sup> (syphilis is an exception here because serological tests are not highly sensitive in persons with incubating and primary syphilis). Such a change in practice would also potentially influence EPT and APT, both of which involve empiric treatment of partners. However, structural barriers such as access to care, the need to pay for testing in addition to treatment, the need to wait out the appropriate window period before testing, and the need to abstain from sex for a longer period may make this a challenge. Data from diverse populations on the safety and effectiveness of a test before treatment approach to partners are needed before the current practice of empiric therapy should be abandoned.

## Integrating outcomes other than STI treatment into partner notification

One way to improve the effectiveness and cost-effectiveness of PN may be to expand the intervention beyond STI



case-finding, to shift from an exclusive emphasis on PN to a more expansive model of PS.<sup>61</sup> STI PS present an opportunity to link index cases and their partners to HIV testing, PrEP, HIV medical care, and other services. In a country such as the US, where most STIs are diagnosed outside of specialised sexual health clinics, integrating HIV testing into population-based PS for bacterial STIs can significantly increase the proportion of index cases who test for HIV.<sup>62</sup> In North Carolina and Mississippi, 1.6% and 2.3% of index cases receiving syphilis PS were newly diagnosed with HIV infection when HIV testing was made an explicit PS goal.<sup>17,63</sup> Studies from Seattle, Chicago, and Iowa suggest that between one-quarter and one-third of HIV-negative men who have sex with men (MSM) who are not on PrEP can be successfully linked to PrEP through PS.<sup>64–66</sup> Data on the success of PS in relinking out-of-care HIV-positive persons to care are limited, but a study of syphilis and gonorrhoea PS in six US jurisdictions found that 29% of previously diagnosed HIV-positive persons receiving PS for syphilis or gonorrhoea in 2016–17 – 17 574 people – were out of care or not virally suppressed, suggesting that PS could play a large role in increasing engagement in HIV care.<sup>67</sup> In general, the marginal cost of integrating these outcomes into the services provided to people who are already receiving PS is low.<sup>68,69</sup> Whether these non-traditional outcomes can justify the expansion of PS programs beyond their current scope will depend on the relative cost-effectiveness of competing alternatives to achieve similar outcomes.

## Best practices and priority questions

Existing data suggest that the efficacy of traditional approaches to APS has eroded over time; EPT and APT have yet to go to scale, are not relevant to syphilis, and may not be ideal in an era of increasing AMR and concern related to antibiotic stewardship; and digital approaches, though intuitively appealing, are not known to be effective. These conclusions should animate an effort to modernise our approach to PS through an integrated program of public health practice innovation and research. There are many outstanding questions about how to organise and implement PS, but the existing literature and experience suggest some principles that should guide public health authorities as they revise and implement PS programs better suited to the contemporary HIV/STI landscape (Table 2). PN is voluntary and requires that workers maintain strict confidentiality, never revealing the identity of index cases to the partners they name. At the same time, APS is not a study nor is it a medical procedure; it's a public health activity. As such, the rules of informed consent applied to research studies and medical procedures do not necessarily apply. The United States President's Emergency Plan for AIDS Relief (PEPFAR), which funds activities to control the HIV pandemic in over 50 countries, recommends obtaining formal consent before enquiring about sexual partners and biological children. This is not routinely done in the US, Western European or Australia. Whether a formal consent process acts as a barrier to PN or a welcome reassurance is unknown. Different countries and local jurisdictions have different

**Table 2.** Principles guiding partner services program development.

	Comment/implications
<b>PS content</b>	
Patients should be given choices for how to notify their partners and ensure that they test	Programs should offer a range of methods for PS, tailored to different STIs in various index patients and for different sorts of partners
PS should address multiple objectives, marrying public health activities to activities that directly benefit index cases and partners	Programs should integrate the epidemiologic data collection, partner notification, and provision of services to index cases/partners
<b>Confidentiality and partner notification as a voluntary activity</b>	
PS requires strict protection of patient privacy and confidentiality	PS workers should never tell partners who gave them their names. Programs should implement legal protections against the use of APS data for non-public health activities
PS is a voluntary public health activity, but it is not a research activity, nor is it medical care	Patients can refuse PS, but formal informed consent processes, like those used in studies and for surgical procedures, need not always be part of APS
<b>Public health APS program organisation</b>	
Population focus with variable levels of intervention	Programs should seek to develop population-based programs for a diversity of STIs, adopting different strategies for different STIs
Defined priorities and variable response	Programs should define priority infections, populations, and activities, and vary the provision of services based on available resources and the changing burden of disease
Interdisciplinary teams	APS teams should include disease investigators, clinicians, epidemiologists
PS programs should be closely integrated with clinical services	Disease investigators need to have places to refer patients for walk-in services
Defined goals and monitorable outcome metrics	Programs should have benchmarks and monitor outcomes on a regular basis

perspectives on the balance between ensuring that PN is non-coercive and protecting the public's health. Good APS programs and workers respect the voluntary nature of APS, but also actively encourage index cases to ensure that their partners are notified, tested, and treated.

Ideally, APS programs develop a comprehensive, population-based approach to PS that employs an array of methods of variable cost and intensity based on the scale of different STI epidemics, the morbidity associated with different infections, evidence on the effectiveness and

**Table 3.** Example prioritisation tiers for partner services for HIV/STI.

Index case population	Approach	Primary goals
<b>Tier 1</b>		
Pregnant women with syphilis or HIV with an unsuppressed viral load (VL)	High-intensity APS with case management to ensure linkage to medical and social services	Prevention of transmission to child and associated morbidity/mortality
Acute HIV infection		Prevention of transmission and morbidity in index case
<b>Tier 2</b>		
Untreated syphilis	High-intensity APS with case management to ensure linkage to medical and social services	Prevention of HIV/Syphilis transmission and morbidity in index case (emphasis on preventing congenital syphilis)
New HIV diagnosis		
Complicated syphilis (ocular, neuro-, otosyphilis)		
Bacterial STI in patients with an unsuppressed VL		
Previously diagnosed HIV+ persons known to be in- jurisdiction with a high or consistently unsuppressed VL		
Syphilis in MSW		
Cephalosporin-resistant GC	Prevention of transmission-resistant gonorrhoea – epidemiologic data collection	
<b>Tier 3</b>		
Syphilis in women of child-bearing age	Intermediate-to-high intensity APS with case management to ensure linkage to medical and social services	Prevention of syphilis transmission (emphasis on preventing congenital syphilis)
GC/CT in untreated pregnant women		Prevention of morbidity in mother and child
GC in diagnosed, untreated persons <sup>A</sup>		Treatment of Index Cases
Syphilis in HIV- MSM/TG not on PrEP		Linkage to PrEP
Surveillance-identified HIV+ persons thought to be viremic or out of care		Linkage to HIV Care
CT in diagnosed, untreated persons <sup>A</sup>	Treatment of Index Cases	
<b>Tier 4</b>		
GC and CT in MSM/TG persons not on PrEP	Intermediate-intensity APS and case management to ensure linkage to medical care	Linkage to PrEP
<b>Tier 5</b>		
GC in MSW	Intermediate-to-low intensity APS (including online PS, EPT)	Prevent morbidity in women
Syphilis in MSM/TG persons on PrEP or virally suppressed		Prevent syphilis transmission
GC in women		Prevent GC transmission
<b>Tier 6</b>		
CT in MSW	Low-intensity APS (including online PS, EPT)	Prevent transmission, morbidity in female sex partners, and re-infection
CT in women		
GC/CT in MSM and TG persons		

Adapted from ref. 61. Prioritisation reflects consideration of PN as a strategy that integrates epidemiological data collection, partner notification, and improving the management of index cases, and is aligned with the principle of marrying the index case's interest to the public health interest.

<sup>A</sup>Persons tested through public health clinics may be a higher priority than persons tested outside of public health. Women are higher priority than men when providing services to persons with untreated STIs.

CT, *Chlamydia trachomatis*; GC, *Neisseria gonorrhoeae*; TG, transgender; MSM, men who have sex with men; MSW, men who have sex with women; PrEP, pre-exposure prophylaxis; VL, HIV viral load.

cost-effectiveness of interventions, and the resources available. The content of PS interventions should vary, but in almost all instances should seek to integrate epidemiologic data collection to fulfill important surveillance functions (Gibbs *et al.*<sup>70</sup>), activities that benefit index cases (e.g. linkage to HIV and PrEP), and activities designed to prevent disease transmission and/or benefit cases' sex and/or needle-sharing partners. The diverse objectives of PS programs and the frequent need to triage cases based on characteristics such as gender, gender of sex partners, and HIV status requires an interdisciplinary team that includes epidemiologists, clinicians, and disease investigators skilled in aspects of case management. Table 3 presents an example of how a program might prioritise services, focusing the most intensive and costly interventions on pregnant women with HIV and syphilis (Tier 1 in the example) while providing low-cost, low-intensity interventions (e.g. EPT, online notification) for highly prevalent infections with less associated morbidity and AMR concerns, such as chlamydia (Tier 6). These priorities will vary depending on the epidemiology of different infections in different settings, as well as the objectives PS programs seek to advance. As shown in the table, in many instances, PN and treatment may not be the primary objective of PS. For example, among HIV- negative MSM with syphilis, promoting increased use of PrEP among index cases may be more important than PN, particularly given evidence that our current approach to PN among MSM yields very modest benefits.

Good field services programs give index cases and partners choices. In high-income nations, most index patients prefer to tell their sex partners directly,<sup>52</sup> but preferences, where choices exist and/or in hypothetical preference studies, are associated with sex partner type.<sup>50,52</sup> In high-income nations, provider referral tends to be restricted to one-off or less emotionally connected (casual) partners. Giving patients alternatives, so that they can choose the most acceptable PN method, which might differ for different sex partners, is considered optimal practice.<sup>71</sup>

PN programs need to be able to change in response to changing needs and circumstances. In some countries, the COVID-19 pandemic required programs to transfer many STI disease investigators (public health staff who investigate cases of STI and provide APS) to new roles related to COVID-19 case investigation and contact tracing. This required reprioritising STI PN work and highlighted the importance of trained disease investigators in a public health emergency. Some nations, such as the US, are now investing substantial new resources to build larger teams of disease investigators, some of whom will focus on STIs. Although generic skills underpin all contact tracing practice, STIs and HIV present additional challenges due to the stigma associated with these infections and training needs to address the additional sensitivities in this field. This reality should prompt an effort to define core disease investigator competencies as well as the more specialised skills needed for different contact tracing activities. Such training

**Table 4.** Major outstanding questions in APS research.

Do provider and contract referral increase the number of partners diagnosed with HIV and syphilis in high-income nations?
How much do these interventions increase case-finding and what is the cost-effectiveness of these interventions relative to other case-finding activities.
How can programs improve each component along the continuum from partner elicitation to linkage of infected partners to care?
What components of patient and provider referral are effective and cost-effective (e.g. serial telephone/SMS follow up, field investigation) for different STIs and in different populations?
What other aspects of APS program implementation are associated with success in achieving different outcomes (e.g. partner notification and treatment, linkage to care or PrEP) and how does this vary in different populations?
Do online partner notification technologies increase partner notification, testing, and treatment of infected partners?
Are these interventions cost-effective?
What are the critical components of these interventions?
What ancillary services can be built into these systems to promote outcomes like linkage to PrEP?
What populations, if any, benefit from different PN interventions and at what cost?
What types of PN intervention reach one-off sexual partners?
What is the role of epidemiological treatment within PN for different infections in different populations?
Are EPT and/or APT safe and effective in MSM?
Can EPT still be used for gonorrhoea? What regimen should be used?
Is doxycycline safe and effective for EPT?
How does expanding APS outcomes to include things like linkage to PrEP alter the cost-effectiveness of providing APS?
Do the new outcomes justify an expansion of APS and in which populations?
What other aspects of APS program implementation are associated with success in achieving different outcomes (e.g. partner notification and treatment, linkage to care or PrEP) and how does this vary in different populations?

programs should prepare investigators to focus on specific areas of communicable disease while ensuring that they are prepared to shift work in response to an emergency.

Although the existing body of scientific data and long experience allows one to define some best practices related to PN, a great deal of PN work lacks a sound scientific footing. Developing a more effective approach to this basic aspect of HIV/STI disease control requires a robust research agenda. Table 4 presents some key outstanding questions in PN-related research. These include the need for more and better data on all components of PN discussed above: traditional APS, EPT/APT, digital interventions, and outcomes other than case-finding and partner treatment.

PN remains a cornerstone of efforts to control HIV/STIs. The current system used in most high-income nations is outdated, but the field is not bereft of promising opportunities to improve PN outcomes. Achieving that objective will require investments in an integrated program of research and public health practice improvement and an openness to changes in how programs are organised, staffed, and monitored.

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**Data availability.** Data sharing is not applicable as no new data were generated or analysed during this study.

**Conflicts of interest.** Claudia Estcourt and Matthew Golden are guest Editors of *Sexual Health*, but were blinded from the peer-review process for this paper. All other authors declare that they have no relevant conflicts of interest.

**Declaration of funding.** Research reported in this publication was supported by the University of Washington/Fred Hutch Center for AIDS Research, an NIH-funded program under award number AI027757, which is supported by the following NIH Institutes and Centers: NIAID, NCI, NIMH, NIDA, NICHD, NHLBI, NIA, NIGMS, NIDDK.

#### Author affiliations

<sup>A</sup>Center for AIDS and STD, University of Washington, and Public Health – Seattle & King County, Seattle, WA, USA.

<sup>B</sup>Centre for Population Research in Sexual Health & HIV, Institute for Global Health, University College London, London, UK.

<sup>C</sup>School of Health & Life Science, Glasgow Caledonian University, Glasgow, UK.