Estimating the Likely Public Health Impact of Partner Notification for a Clinical Service: An Evidence-Based Algorithm

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Objectives. We present the first evidence-based method for estimating public health and cost impacts of partner notification (PN) that takes account of sexual partnership type.

Methods. Our algorithm uses routine clinical data, probability survey data, and transmission parameters. We propose 2 new epidemiological concepts to quantify PN impact: "[the] absolute reduction in onward transmission" and its reciprocal, "[the] number needed to treat to interrupt transmission" (i.e., the number of partners who need to be treated to interrupt 1 onward transmission). We demonstrate these concepts for 273 chlamydia cases diagnosed at a UK genitourinary medicine clinic.

Results. The number needed to treat to interrupt transmission (overall, for casual partners, and for regular partners, respectively) was 1.47, 1.11, and 2.50, respectively, for men younger than 25 years; 1.60, 0.83, and 1.25, respectively, for women younger than 25 years; 2.35, 1.39, and 2.08, respectively, for men older than 25 years; and 2.14, 0.93, and 2.08, respectively, for women older than 25 years.

Conclusions. PN that targets casual partners, rather than regular or live-in partners, prevents more secondary transmissions per partnership; it is also more resource intensive, but the public health benefit is greater. (*Am J Public Health.* 2011;101:2117–2123. doi:10.2105/AJPH.2011.300211)

Partner notification (PN) is acknowledged as an essential part of sexually transmitted infection (STI) care management.[1] The 2 main approaches to PN are patient-led PN and provider-led PN. The objectives of PN are both patient centered (i.e., reducing the risk of reinfection for index patients by treating their sexual partners) and partner centered (i.e., preventing onward transmission through testing and treating sexual partners).[2] Mathematical models have demonstrated the potential epidemiological impact of PN at the population level,[3–5] but they are not available in a form useful for individual clinical services planning or assessing the impact of their PN activity on local transmission patterns.

Clinical outcome measures of PN relate to the number of sexual partners treated per index case or the incidence of reinfection in index cases.[6] However, the types of sexual partnerships that patients have are likely to have a major epidemiological effect on whether index patients operate as "spread" networks or "dead-end" networks for transmission.[7] Data from Britain's second National Survey of Sexual Attitudes and Lifestyles (Natsal-2) show that individuals with casual sexual partners have greater numbers of (typically) casual partners than do individuals with regular or live-in partners. Thus, for example, treating a chlamydia patient's regular sexual partner could typically prevent reinfection, but treating the patient's casual partner(s) could prevent both reinfection and onward transmission. PN outcomes therefore need to be designed to focus not only on index patients but also on the type of partnership in which the infection occurred.

To date, few PN studies have taken account of the types of sexual partnerships that people have. Exceptions include a study of Seattle genitourinary medicine (GUM) clinic attendees, which reported that main partners were usually identified in PN interviews but other partner types were not, even when they were perceived to have transmitted the infection.[8] Another US study found that among adolescents, PN was more likely in relationships "with stronger affiliative and emotional ties."[9(p1133)] Similarly, a UK audit of HIV PN found that current partners were more likely to be notified than were former partners.[10] A recent study of accelerated partner therapy showed that choice of PN method related more to partnership type and issues of trust than to demography, gender of index patients, or gender of their partners.[11]

We developed a simple, evidence-based algorithm for clinicians and public health teams to use to estimate the likely short-term impact of their PN activity on preventing STI transmission, without imposing onerous data collection.

METHODS

We stratified by gender and age group the population of heterosexual index patients diagnosed with chlamydia at 1 GUM clinic in the United Kingdom over a 6-month period, using routinely collected clinic data, because partner numbers and partnership type vary by these characteristics.[12] We then further stratified index patients by the types of heterosexual partnerships they were likely to have had over the past year into the following 5 classes of sexual activity:

1. only a live-in partner (i.e., a married or cohabiting partner);
2. only regular partner(s);
3. only casual partner(s);
4. regular partner(s) plus casual partner(s);
5. a live-in partner plus regular partner(s), casual partner(s), or regular and casual partner(s).

Although UK clinical services routinely collect some data from patients on their partnership types, these types of data currently are not routinely collated in an aggregate form. We therefore used data from Britain's most recent national probability survey of sexual behavior, Natsal-2, to estimate the proportion of index patients likely to be in each sexual activity class. We used only those Natsal-2 respondents who reported attending a GUM clinic in the 5 years before the interview (men, n=362; women, n=483) as the group most closely comparable to the clinic population.[13] (A small group of chlamydia-positive respondents was also available from Natsal-2, but not enough to stratify by gender, age group, and sexual behavior.[14]) Methodological details about Natsal-2 have been published[12,15] and are summarized in Appendix 1 (available as a supplement to the online version of this article at http://www.ajph.org).

Estimating the Number of Primary Transmissions

For index patients, we then estimated the number of each type of sexual partner considered (i.e., live-in, regular, and casual) in each age, gender, and sexual activity class, using Natsal-2 data. That is, we assumed that the number of partners that index patients had was similar to the median number of partners reported by GUM clinic attendees in Natsal-2 (Appendix 2, available as a supplement to the online version of this article at http://www.ajph.org). This enabled us to estimate the total number of partners that the index patients were likely to have had, from which we could estimate the potential number of primary chlamydia transmissions generated (i.e., transmissions from index patients to their sexual partners).

As others have noted,[16] uncertainty surrounds the epidemiological parameters influencing STI transmission, including the infectivity of the index patients, their partners' susceptibility, and the number (and type) of sexual acts.[17] Although it is difficult to quantify the first 2 factors, the total number of sex acts generally increases with increasing partnership duration, meaning that there is greater opportunity for transmission within a live-in partnership than in a regular partnership, and so on. Condoms are sometimes used, typically more often in casual and regular partnerships than in live-in partnerships and more often by younger people than by older people.[18,19] We therefore assumed that, among those younger than 25 years, the probability of chlamydia transmission is 0.3 per casual partnership, 0.4 per regular partnership, and 0.5 per live-in partnership, whereas, among those aged 25 years or older, we assumed that these probabilities are 20% higher (0.36, 0.48, and 0.60, respectively). Although there are no widely accepted standard estimates for these parameters, these probabilities are based on those published by Wasserheit and Aral,[7] which were refined in consultation with STI transmission modeling experts (written communication with K.M.E. Turner, PhD, October 2009; E.J. Adams, PhD, October 2009; R. White, PhD, November 2009; and M. Chen, PhD, November 2009).

Estimating the Number of Secondary Transmissions

We next estimated the number of secondary transmissions—that is, the number of transmissions that might have occurred from index patients' partners to their sexual partners, and thus the number of new chlamydia cases that were potentially preventable. Clinical services are unlikely to have aggregate data on the number of partners that index patients' partners have had, so we estimated this using the median number of new partners per year reported in Natsal-2 (Appendix 3, available as a supplement to the online version of this article at http://www.ajph.org). We stratified these medians by gender, age, and partnership type, and we assumed assortative mixing (e.g., casual partners having sex with casual partners). Having obtained an estimate of the number of partners' partners, we multiplied this by the assumed probabilities of chlamydia transmission described in the previous paragraph to estimate the number of secondary or onward transmissions.

Quantifying the Impact of Partner Notification

We propose that to quantify the impact of PN, the commonly used epidemiological measures number needed to treat and absolute risk reduction can be usefully adapted to the context of PN. In medicine, the clinical effectiveness and cost-effectiveness of a medication is often assessed by the number needed to treat—that is, the number of individuals with a specified condition who will need to receive a given therapy for a specified period to prevent the occurrence of 1 specified outcome of the condition.[20] The number needed to treat is the reciprocal of the absolute risk reduction, which is defined as the difference in risk of an outcome between the treated and untreated groups. We propose that the "number needed to treat to interrupt transmission" is the reciprocal of the "absolute reduction in onward transmission." The latter is the reduction in the number of onward transmissions achieved through successful PN in a population of index patients, expressed per partnership (e.g., a reduction from 0.8 to 0.6 onward transmissions per partnership). The corresponding number needed to treat to interrupt transmission is the number of partners who must successfully receive PN to prevent 1 new transmission. In this example, the reduction of 0.2 per partnership would generate a number needed to treat to interrupt transmission of 5 (1/0.2). The definition of PN success is summarized as the delivery of treatment to a partner that will eliminate infection if it is present, however this may be achieved (e.g., patient or provider methods). PN may involve various tasks such as identifying, contacting, testing, and treating partners. (By our definition, PN success is not simply a question of drug delivery and dosing, as it would then exclude, for example, treatment taken while sexually active with an as-yet-untreated index case).

Public Health Impact and Costs of Partner Notification

Finally, we illustrate how clinical services might use the algorithm and the absolute reduction in onward transmission to estimate the public health impact and the associated costs of their PN activity. For illustrative purposes, we consider 3 hypothetical PN strategies (i.e., different probabilities of successful PN). The first hypothetical strategy assumes, as is often the case, that almost all live-in partners are treated; hence, the probability of successful PN is assumed to be 0.9. Here, the probability is assumed to be lower among regular partners (0.5), and lower still (0.1) among casual partners, reflecting the increasing difficulty of successful PN with partners of an increasingly casual nature. Reversing these probabilities, the second hypothetical strategy assumes a larger probability of successful PN with casual partners than with regular and live-in partners.

Finally, the third hypothetical strategy assumes that successful PN is equally probable for all partnership types. In Appendix 4 (available as a supplement to the online version of this article at http://www.ajph.org), users of the algorithm can change these values so that they can input their own probabilities of successful PN to ascertain the impact of their own PN effort.

We used hypothetical data on the cost of successful PN with different types of partners and assumed that this equated to £25 (US$40) per live-in partnership, £50 (US$80) per regular partnership, and £100 (US$160) per casual partnership, reflecting the tendency of PN to be more resource intensive with casual partners. However, using their own cost data, clinical services can use the algorithm to estimate their "total spending" on PN as well as the cost per onward transmission prevented by partnership type.

Data Analysis

We manipulated data and performed analyses using Microsoft Excel 2007 (Microsoft, Redmond, WA), and we generated Natsal-2 estimates in Stata version 10.0 (StataCorp LP, College Station, TX), taking into account the complex survey design of Natsal-2.[12,15] Statistical significance was considered as $P<.05$ for all analyses. The spreadsheet used for and showing these calculations is available as Appendix 4.

RESULTS

A total of 131 men and 142 women were diagnosed with chlamydia at 1 GUM clinic over a 6-month period. A larger proportion of women than men (60% vs 44%) were younger than 25 years. Table 1 shows the assumed distribution of index patients according to the 5 sexual activity classes described in Methods. Whereas men younger than 25 years were least likely to have had only a live-in partner in the past year, women younger than 25 years were least likely to have had only casual partners. By contrast, men younger than 25 years were more likely to report both regular and casual partners.

Likely Numbers of Partners

On the basis of the median number of sexual partners reported in Natsal-2 (Appendix 2), we estimated that the 273 index patients had had a total of 494 partners in the previous year. However, as is evident from Table 2, these 494 partnerships were unequally distributed by the gender and age of index patients. For example, although men younger than 25 years constituted 20.9% (57/273) of all chlamydia cases in this clinic's sample, their estimated 167 partnerships constituted 33.8% of all 494 partnerships. By contrast, men aged 25 years or older formed 27.1% (74/273) of chlamydia cases, and their 126 partnerships constituted a similar proportion (25.6%). Among women, 31.1% (85/273) of diagnoses were among women younger than 25 years, who were estimated to have formed 24.9% (123/494) of partnerships, whereas 20.9% (57/273) of diagnoses were among women aged 25 years or older, who were estimated to have formed only 15.8% (78/494) of partnerships.

Estimated Numbers of Primary Transmissions

Using the assumed probabilities of chlamydia transmission described in the Methods section, we calculated the likely number of primary transmissions for the different types of sexual partnership if no PN had occurred

TABLE 1—Assumed Percentage Distribution of Index Patients at a Single Genitourinary Medicine Clinic, by Gender, Age Group, and Sexual Activity Class: Great Britain, 1999–2001

	Men		Women	
Sexual Activity Class[a]	<25 Years, %	≥25 Years, %	<25 Years, %	≥25 Years, %
Only live-in partner[b]	8.8	35.1	31.8	36.8
Only regular partner(s)	31.6	16.2	30.6	26.3
Only casual partner(s)	15.8	13.5	3.5	10.5
Regular and casual partner(s)	29.8	16.2	15.3	10.5
Live-in[b] and regular or casual[c] partner(s)	14.0	18.9	18.8	15.8

Note. We assumed that, compared with respondents in the Second National Survey of Sexual Attitudes and Lifestyles (Natsal-2) who reported attending a genitourinary medicine clinic in the 5 years before the survey interview, index patients (men, n = 362; women, n = 483) were similarly distributed across the 5 sexual activity classes. Columns may not total to 100% due to rounding.
[a]Sexual activity class in the past year.
[b]A live-in partner refers to either a spouse or a cohabiting partner.
[c]A live-in partner and regular partner(s), casual partner(s), or regular and casual partner(s). Regular and casual partners are considered together because of the relatively small proportion of people in the category "live-in and regular partners."

TABLE 2—Estimated Number of Sexual Partners, by Partnership Type, Gender, and Age Group of Index Patients at a Single Genitourinary Medicine Clinic: Great Britain, 1999–2004

	Men[a]		Women[a]	
Partnership Type	<25 Years (n = 57), % (No.)	≥25 Years (n = 74), % (No.)	<25 Years (n = 85), % (No.)	≥25 Years (n = 57), % (No.)
Live-in partners[b]	8 (13)	32 (40)	35 (43)	38 (30)
Regular partners	30 (50)	28 (35)	38 (47)	32 (25)
Casual partners	62 (103)	40 (51)	27 (33)	30 (22)
Total	100 (167)	100 (126)	100 (123)	100 (78)

Note. We assumed that, compared with respondents in the Second National Survey of Sexual Attitudes and Lifestyles (Natsal-2) who reported attending a genitourinary medicine clinic in the 5 years before the survey interview, index patients were similarly distributed across the 5 sexual activity classes shown in Table 1, and reported similar numbers of partners.
Source. Data from Nastal-2 were used with data from the genitourinary medicine clinic to calculate estimates.
[a]Because of rounding, totals may differ slightly from the sum of the numbers expressed to 0 decimal places.
[b]Live-in partners refers to either a spouse or a cohabiting partner.

TABLE 3—Estimated Chlamydia Transmissions and Corresponding Absolute Reduction in Onward Transmission and Number Needed to Treat to Interrupt Transmission, Assuming No Partner Notification, at a Single Genitourinary Medicine Clinic: Great Britain, 1999–2004

Partnership Type	Men		Women	
	<25 Years	≥25 Years	<25 Years	≥25 Years
Primary chlamydia transmissions from index patients				
Live-in partnerships				
No. of transmissions	6	24	22	18
Assumed probability of transmission, %	50	60	50	60
Total no. of partnerships	13	40	43	30
Regular partnerships				
No. of transmissions	20	17	19	12
Assumed probability of transmission, %	40	48	40	48
Total no. of partnerships	50	35	47	25
Casual partnerships				
No. of transmissions	31	18	10	8
Assumed probability of transmission, %	30	36	30	36
Total no. of partnerships	103	51	33	22
Primary transmissions,[a] total no.	58	59	50	38
All partnerships, total no.	167	126	123	78
Secondary chlamydia transmissions from index patients' partners				
Live-in partnerships				
No. of transmissions	0	0	0	0
Assumed probability of transmission, %	50	60	50	60
Total no. of partnerships	0	0	0	0
Regular partnerships				
No. of transmissions	20	17	38	12
Assumed probability of transmission, %	40	48	40	48
Total no. of partnerships	50	35	94	25
Casual partnerships				
No. of transmissions	93	37	39	24
Assumed probability of transmission, %	30	36	30	36
Total no. of partnerships	310	102	131	67
Secondary transmissions,[a] total no.	113	53	77	36
All partnerships, total no.	361	137	225	93
AROT and NNTIT[b]				
Live-in partnerships				
AROT	0	0	0	0
NNTIT	∞	∞	∞	∞
Regular partnerships				
AROT	0.40	0.48	0.80	0.48
NNTIT	2.50	2.08	1.25	2.08
Casual partnerships				
AROT	0.90	0.72	1.20	1.08
NNTIT	1.11	1.39	0.83	0.93
All partnerships				

Continued

(Table 3). In total, 205 (58+59+50+38) primary chlamydia transmissions were estimated to have occurred between the index patients and their 494 partners.

Estimated Numbers of Secondary Transmissions

Live-in partners are assumed to have a median of zero new partners per year, so we assumed no onward or secondary transmission within live-in partnerships. By contrast, we assumed the median number of new regular partners per year to be 1 (except among male partners of index patients ≤25 years, for whom the median was 2 partners; Appendix 3). As expected, the number of new partners was highest for casual partners of index patients, ranging from 2 to 4 partners (Appendix 3). Multiplying these likely numbers of new partners by the probability of chlamydia transmission gave the likely number of secondary transmissions (Table 3). In total, an estimated 279 (113+53+77+36) secondary chlamydia transmissions were likely to occur between the index patients' partners and their estimated 816 (361+137+225+93) partners. Thus, together with the 205 (58+59+50+38) primary transmissions shown in Table 3, we estimated that the 273 index patients generated a total of 484 new chlamydia cases. Given these results, if PN was successful only with live-in partners (i.e., only these partners were identified, tested, and treated), then, regardless of age group and gender, over half of all transmissions generated would not be treated or prevented, as the greatest proportion of transmissions stem from casual and regular partners.

Quantifying Partner Notification Impact

We then used the absolute reduction in onward transmission and the number needed to treat to interrupt transmission to compare the impact of different PN intensities by partnership type.

Given the assumptions described in the Methods section, overall, successful PN needed to be achieved with more than 1 partner per index case to prevent 1 onward (secondary) transmission, as the numbers needed to treat to interrupt transmission were all greater than 1 for the 4 patient groups considered (Table 3).

TABLE 3—*Continued*

AROT	0.68	0.42	0.63	0.47
NNTIT	1.47	2.35	1.60	2.14

Note. AROT = absolute reduction in onward transmission; NNTIT = number needed to treat to interrupt transmission.
Source. Data from the Second National Survey of Sexual Attitudes and Lifestyles were used with data from the genitourinary medicine clinic to calculate estimates.
[a]Because of rounding, totals may differ slightly from the sum of the numbers expressed to 0 decimal places.
[b]We calculated the estimated no. of transmissions assuming the partner numbers shown in Appendices 2 and 3 for index patients and index patients' partners, respectively. The absolute risk of transmission is calculated as the no. of secondary transmissions divided by the no. of index cases' partners. The NNTIT is calculated as the reciprocal of the AROT.

However, when we considered the number needed to treat to interrupt transmission by partnership type, a smaller number of PN successes were required to prevent 1 onward transmission for casual partners than for regular partners. Thus, among men younger than 25 years, the number needed to treat to interrupt transmission was 1.11 for casual partners, which means that only 1.11 casual partners needed to be successfully identified and treated via PN to prevent 1 onward transmission. By contrast, successful PN would need to occur with 2.5 regular partners of male index patients younger than 25 years to have the same impact. Differences were also evident between genders and between age groups, illustrating the relative intensities of effort required with different population groups.

Because behavioral parameters may vary between populations (e.g., by ethnicity), and because transmission parameters are hard to measure and therefore uncertain, we undertook sensitivity analyses to check the robustness of these patterns. Appendix 5 (available as a supplement to the online version of this article at http://www.ajph.org) shows the impact on the size of the number needed to treat to interrupt transmission that results from varying the assumptions regarding (1) whether the probability of chlamydia transmission varies by partnership type or can be assumed to be broadly constant and (2) the number of partners that index patients and their partners may have, as calculated by using the lower quartiles, medians, and upper quartiles (Appendices 2 and 3). In all scenarios, the number of PN successes required among casual partners was considerably lower than that required among regular partners, and the number of PN successes required among regular partners was lower than that needed among live-in partners; i.e., the number needed to treat to interrupt transmission was smallest for casual partners.

Public Health Impact and Costs of Partner Notification

To show how clinical services might use the algorithm, Table 4 compares the public health impacts (in terms of the likely number of secondary transmissions averted) of our 3 hypothetical PN strategies together with their associated costs for male index patients younger than 25 years. As explained in the Methods section, the first hypothetical PN strategy achieves successful PN with almost all live-in partners, half of regular partners, and 1 in 10 casual partners. Although this strategy may cost the least to implement (total cost = £2585.41, or $4136.66), the cost per secondary case prevented is the highest of all 3 scenarios (£133.42, or $213.47) because it averts relatively few secondary transmissions. By contrast, the second strategy achieves successful PN with almost all casual partners, half of regular partners, and 1 in 10 live-in partners. Although it is the most expensive strategy to implement of the 3 considered, with a total cost of £10 595.78 ($16 953.25), the cost per secondary case prevented is the lowest (£112.95, or $180.72) because a greater number of secondary transmissions are averted. Thus, in this example, it is evident that PN with male index patients' casual partners may be more resource intensive relative to PN with these patients' regular and live-in partners, but the public health benefit is far greater.

DISCUSSION

We have described an evidence-based algorithm that clinicians and public health teams can use to estimate the impact of their service on preventing STI transmission. Additionally, we have shown how the potential impact of PN on a local population can be quantified for different patient groups by using 2 new epidemiological measures: the absolute reduction in onward transmission and the number needed to treat to interrupt transmission. This approach enables an estimation of partner-centric outcome measures of PN to complement existing patient-centric measures and underpin cost-effectiveness estimates.

Although mathematical modeling studies have shown PN to be an important intervention in transmission prevention,[3–5] they do not enable quantification of the impact of PN in specific local populations. This study is a first attempt to translate dynamic approaches to STI control into a tool for planning and prioritizing within health services, while recognizing the wider and guiding role of dynamic modeling.

Although we have considered only chlamydia, our algorithm can easily be adapted to other treatable STIs, such as gonorrhea. We plan to develop similar models for other STIs, although further work will be required for infections for which infectivity is not a dichotomous variable. The approach can also be adapted for other infectious diseases that require contact tracing, such as hepatitis B and tuberculosis.

Although there is uncertainty and variability surrounding the parameters used in our algorithm, sensitivity analyses undertaken to explore the vulnerability of the algorithm to uncertainty were reassuring. The algorithm relies heavily on data from Natsal-2, which were collected from 1999 to 2001. It can, however, easily be revised as new data become available and adapted to different settings.

The Natsal-2 classifications of partnership types (live-in, regular, and casual) may not correspond to classifications used in clinical practice; however, there is always subjectivity in describing partnerships, with women more likely than men to regard a partnership as regular rather than casual.[21,22] We treated age crudely, stratifying it into 2 groups, although using age 25 years as a threshold does correspond to age groups currently used for UK surveillance.[23] Stratification by race/ethnicity and sexual orientation would also have been desirable because those characteristics are

TABLE 4—Public Health Impact and Associated Costs of Varying Assumptions About the Probability of Successful Notification of the Partners of Male Index Patients Younger Than 25 Years, at a Single Genitourinary Medicine Clinic: Great Britain, 1999–2004

	Partnership Type			
PN Strategy	Live-In	Regular	Casual	All
Strategy 1				
Probability of successful PN, %	0.9	0.5	0.1	NA
Successful PNs likely,[a] no.	12	25	10	47
Secondary transmissions likely averted,[b] no.	0	10	9	19
Cost for all successful PNs,[c] £	292.41	1259.22	1033.79	2585.41
Cost per secondary transmission prevented,[d] £	∞	125.00	111.11	133.42
Strategy 2				
Probability of successful PN, %	0.1	0.5	0.9	NA
Successful PNs likely,[a] no.	1	25	93	120
Secondary transmissions likely averted,[b] no.	0	10	84	94
Cost for all successful PNs,[c] £	32.49	1259.22	9304.08	10 595.78
Cost per secondary transmission prevented,[d] £	∞	125.00	111.11	112.95
Strategy 3				
Probability of successful PN, %	0.5	0.5	0.5	NA
Successful PNs likely,[a] no.	6	25	52	83
Secondary transmissions likely averted,[b] no.	0	10	47	57
Cost for all successful PNs,[c] £	162.45	1259.22	5168.93	6590.60
Cost per secondary transmission prevented,[d] £	∞	125.00	111.11	116.45

Note. NA = not applicable; PN = partner notification. Strategy 1 assumes that almost all live-in partners are treated; hence, the probability of successful PN is assumed to be 0.9. The probability is assumed to be lower among regular partners (0.5), and lower still (0.1) among casual partners, reflecting the increasing difficulty of successful PN with partners of an increasingly casual nature. Reversing these probabilities, strategy 2 assumes a larger probability of successful PN with casual partners than with regular and live-in partners. Finally, strategy 3 assumes that successful PN is equally probable for all partnership types.

Source. Data from the Second National Survey of Sexual Attitudes and Lifestyles were used with data from the genitourinary medicine clinic to calculate estimates.

[a]Likely number of successful PNs with index patients' partners obtained by multiplying the probability of successful PN by the likely number of partners of each type (shown in Table 2).

[b]Obtained by multiplying the likely number of successful PNs with index patients' partners by the absolute risk reduction.

[c]Cost for all successful PNs with index patients' partners is assumed to be £25 (US $40) per live-in partnership, £50 (US $80) per regular partnership, and £100 (US $160) per casual partnership. These cost data are hypothetical and are for illustrative purposes only, as clinical services should use their own cost data.

[d]Obtained by dividing the likely number of secondary transmissions by the cost for all successful PNs with index patients' partners.

associated with both partner numbers and the probability of STI acquisition, but Natsal-2 data were insufficient for this purpose,[24] although other data sources[25] could also be harnessed.

We assumed assortative mixing by behavior and partnership type, because of the difficulty of obtaining data on partners' current behaviors and partnerships. However, this is a reasonable assumption given the extent of assortative mixing in the population.[26]

Our analyses show that future debate about and research on PN provision need to develop a partnership-oriented focus regarding which index patients should be offered more intensive support for public health benefit. The existing emphasis on different strategies for PN (e.g., patient, provider) has a service-oriented focus regarding the types of PN services offered. This focus now needs to be explicitly linked to strategic decisions regarding what kind of support should be offered to index patients, according to their different kinds of partnership history. Although clinicians recognize that one approach to PN does not fit all types of sexual partner, outcome measures must also reflect the public health importance of partnership type. Patient-centric measures conceal huge variations in transmission potential by partner type. Clinical services should routinely adopt partner-centric outcome data and should audit their PN data by partner type. This will allow them to explore the implications of different approaches to targeting PN activity and assess the public health outcomes of the service.

England's standard guidance for PN activity emphasizes the importance of transmission prevention, but its proposed outcome measures are patient-centric and do not adequately address the question of secondary prevention.[27] In 2003, de Souza and Munday recommended in the context of HIV that "increased efforts should be made to offer provider notification to previous, identifiable partners,"[10(p855)] not just current, regular partners. For chlamydia, too, focusing on regular or live-in partners means that for some population groups, a large proportion of partners, typically casual partners, will not be reached, with implications for onward transmission of STIs to their partners. Our algorithm has a role to play in providing epidemiological evidence aimed at assessing and justifying the public health value of more expensive and challenging PN activity with casual and former partners, which is provided to varying degrees in different places.[28] Without a better understanding of how to harness the relative transmission prevention potential of different partnership types, evidence-based PN practice cannot progress. ■

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Contributors

C.H. Mercer and J.A. Cassell conceptualized the study. C.H. Mercer collated and analyzed the data and wrote the first draft of the article. C.R.H. Aicken and C.S. Estcourt collaborated on the study. M.G. Brook provided the aggregate clinical data and advised on their interpretation. All authors contributed to the redrafting of the article.

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Human Participant Protection

Because this study involved collation of published data, ethical approval was not required.

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