



Evidence Review

Partner Notification

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Outcomes Related to STI Partner Notification

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Executive Summary

Partner notification is the cornerstone of infectious disease control, aiming to control onward transmission by treating exposed partners and prevent re-infection in the index case. This is a comprehensive literature review conducted for English-language manuscripts published throughout the world to examine the effect of partner notification strategies on index patient re-infection rates, changes in the behaviour of index patients or partners, incidence of sexually transmitted infections and blood borne infections in Canada, reaching high transmitters versus monogamous partners, acceptability of various partner notification strategies, costs and unintended harms of partner notification. The following are the key findings for this review:

Key Points

- Effective partner notification has been shown, through ecological studies and mathematical modelling, to be associated with a reduction in disease incidence. This may be explained by reduced onward transmission resulting from early detection and treatment.
- Rates of re-infection are most common among individuals with multiple partnerships and anonymous sex partners. Patient Delivered Partner Therapy (PDPT) is the most effective partner notification strategy for reducing rates of re-infection, especially in patients with gonorrhea or Chlamydia.
- Individuals with HIV and/or syphilis were 5 times more likely to demonstrate a change in risky behaviour (abstinence or greater condom use, reduction in needle-sharing activities) after receiving partner referral and counseling services than HIV- or syphilis-positive individuals who did not receive this service.
- Index cases are more likely to disclose a new diagnosis of a communicable disease to partners with whom they have been in long term relationships, especially if they have children together.
- Index cases prefer face-to-face patient-delivered partner notification (which may or may not include Patient Delivered Partner Therapy) than other modes. This is especially true within long-term or important partnerships. Other modes, such as physician notification or electronic notification (email or text messages) are more acceptable for casual or anonymous partnerships.
- Provider (physician) referral is the most effective mode of partner notification but is also the most expensive; patient referral is the least expensive strategy to the health care system.
- Partner notification can produce stress in relationships. However, relationships which received partner notification services are less likely to dissolve than relationships in which partner notification services were not conducted. Emotional and/or physical abuse after partner notification services occurs in 8%-24% of cases but the frequency of abuse events diminish over time. The fear of abuse, rejection, or stigmatization can result in a delay in notifying partners of a potential exposure and may affect sexual spontaneity and may alter other sexual activities.



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Introduction

Partner notification is the cornerstone of infectious disease control, aiming to control onward transmission by treating exposed partners and prevent re-infection in the index patient (1). Partner notification can be defined as notification of sex

or needle-sharing partners of infected persons of a possible exposure to a communicable disease, followed by encouragement for the partner to seek evaluation and treatment (2,3). Partner notification can be conducted in numerous ways described in the following table:

Table 1: Partner notification methods described in literature

Forms of Partner Notification	Description
Patient referral	This method involves an agreement between the index case's doctor (or other care provider) that the index case will inform all of his/her partners and make a suggestion to the partners to seek evaluation and treatment if necessary.
Provider referral	Partners are contacted and notified of a possible exposure by a physician or public health care provider (i.e. nurses). In the United States partner notification is also conducted by Disease Intervention Specialists (DIS) who are not medical professionals but receive specialized training in communicable disease follow-up activities. This may be done in-person or over the phone. Provider referral can include counselling for the index case as well as the provision of booklets or other educational material.
Contact slips	This mode of partner notification involves a clinician providing a slip for the index case to give to her or his contacts. The slip includes information about the type of infection the partner may have been exposed to and the need to be tested and treated.
Email notification	Email notification involves informing contacts via a private email service. Health care providers or public health nurses can send an email to an index case informing them of a possible exposure without disclosing the identity of the index case. An alternate method is for index cases to notify their partners anonymously through a partner notification internet service such as inSPOT.
Text message notification	The index case or a third party sends a text message to partners without disclosing the identity of the index case.
Patient Delivered Partner Therapy (PDPT)	The index case is provided with medication to give to their partner after they have informed the partner that he/she may have been exposed to a communicable disease.

In addition to having a direct effect on the health of index cases, partner notification affects disease incidence, rates of re-infection and risk behaviour. However, there may be unintended harm and societal costs as a result of partner notification programs. The objective of this review was to examine the effect of partner notification strategies on: index patient re-infection rates, changes in the

behaviour of index patients or partners, incidence of sexually transmitted infections and blood borne infections (STBBI) in Canada, reaching high transmitters versus monogamous partners, acceptability of various partner notification strategies, cost of partner notification, and unintended harm as a result of partner notification.

Methods

A review of published medical literature was conducted by searching MEDLINE using the following search terms: contact tracing, partner notification; HIV, *chlamydia*, gonorrhoea, syphilis, hepatitis; re-infection, recurrence; risk behaviour; cost, cost effectiveness; harm; acceptability. Eligible studies included both randomized and non-randomized controlled trials, pre- and post-test designs, and non-experiment observational and previous systematic reviews. The search was limited to English-language documents published since 1985. Selection of the final papers was made by this author.

Results

One hundred sixty-nine full text manuscripts were identified through the Medline search and 56 additional manuscripts were identified through searching references of the identified manuscripts. Of these, there were 18 systematic reviews. Upon full review, 142 manuscripts were excluded as they did not provide valuable information about partner notification issues relevant to this report. The remaining 85 articles were included for this document.

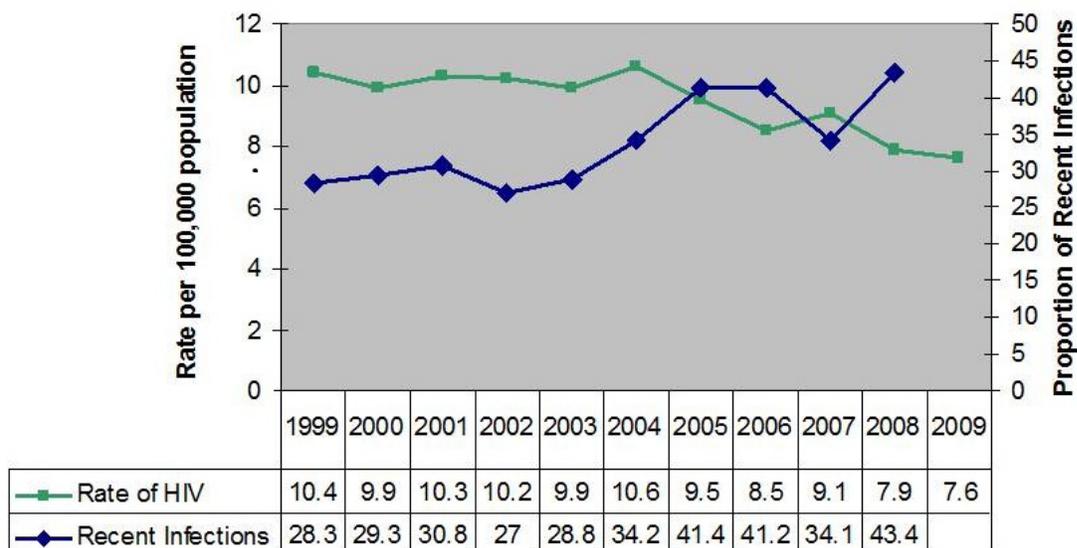
ing partners of exposure and possible acquisition of a communicable disease. The hope is that infected partners who are notified will be screened and treated earlier than if they sought care after becoming symptomatic or when attending a clinic for routine care. A number of ecological studies have shown that initiation of partner notification activities (or an increase in the number of partner notification activities) is associated with decreases in reported cases of disease in the context of good diagnostic and clinical services (4-8).

In British Columbia, for example, partner notification for HIV occurred through notification of index cases or with the assistance of physicians. When HIV became a reportable disease, notification activities were increased by providing public health clinicians to index cases, to either conduct notification activities or to support index cases to do it themselves. The British Columbia Centre for Disease Control (BCCDC) conducted an evaluation of mandatory reporting by looking at the benefits of enhanced contact tracing that accompanied HIV reporting (9). The evaluation revealed a significant decrease in the rate of newly reported infections between 2003 (when enhanced contact tracing occurred) and 2009 (Figure 1). In addition, the proportion of newly reported cases who were diagnosed within six months of infection (determined using detuned and BED testing methodology (10)) increased in the five years after public health began assisting with partner notification activities (11).

Impact of Partner Notification on STBBIs in Canada

The main goal of partner notification is to reduce the incidence and prevalence of STBBIs by notify-

Figure 1: Rate of newly reported cases of HIV and the proportion of recent infections in British Columbia before and after Public Health involvement with partner notification.



*Public Health Involvement in HIV Partner Notification began May 2003

The limitation to these studies is that, due to the study design, causation cannot be established. However, mathematical modelling has demonstrated an inverse relationship between partner notification activities and disease incidence. Du *et al.* (8) conducted a study that demonstrated reduction in reported cases of gonorrhea associated with partner notification. A multivariate negative binomial regression model for longitudinal analysis predicted that gonorrhea incidence rates decline by 6% for every 10% increase in the number of sex partners who had been notified and received treatment.

Re-infection

Re-infection is defined as having been previously diagnosed with a non-chronic infection, having received adequate (recommended) treatment and having a subsequent new diagnosis (12). Clinical detection of re-infection due to re-exposure must be differentiated from persistent infection due to treatment failure. This is done through interviewing the index case about treatment compliance, abstinence for an appropriate amount of time, and notification and treatment of sexual partners. Rates of re-infection may be used as an indicator of success for partner notification strategies.

Ten manuscripts were identified that described re-infection of STBBI, two of which were Canadian (12,13). **Table 2** shows the list of studies that reported rates of persistent or recurrent infection for *chlamydia*, gonorrhea, syphilis, and *Trichomonas vaginalis*.

The overall rate of subsequent infection (re-infection or new infection with another organism) is between 6-24% (Table 2) and varies by disease. Higher proportions of re-infection are found in populations co-infected with HIV. Predictors of re-infection includes younger age, greater number of sex partners, rapid acquisition of new sexual partners, a history of a STI, failure to treat all partners, and having a sex partner who is a commercial sex worker (15-17,20). Moreover, some have hypothesized that very early treatment of *chlamydia* infection affects natural immunity and therefore leaves a person susceptible to re-infection (13).

While rates of re-infection refer to a repeated infection with the original organism, it should be noted that subsequent infections of different organisms within the same period of follow-up were equally prevalent (14,15). This may reflect a lack of safer sex practices on the part of the index patient rather than poor notification and treatment of partners. Subsequent infection has also been attributed to having a new partner or concurrent partners. Peterman *et al.* showed index cases were twice as likely to have a subsequent infection if they had a new partner or had more than one partner than those without these changes (15). Recommendations have been made that rescreening for STI should be done within 6 months of a baseline infection if there is a change in partner or if all partners are not treated (17).

Rates of re-infection are directly related to the number or proportion of partners that were identified and locatable. The number of index cases having anonymous partners (ever) varies but has been shown to be as high as 60% in the general population (22). The proportion of *locatable* partners among different disease has also been found to vary: 41% - 87.3% for gonorrhea (23,24), 17% to 62% for *chlamydia* (25-28), 11% to 55% for syphilis (29,30). The rate of re-infection in index cases due to partners who did not receive partner notification is not known.

The effect of partner notification on rates of re-infection was reported in few studies. One randomized controlled trial reported a higher rate of re-infection of gonorrhea or *chlamydia* 4-8 weeks after their first infection with people randomized to standard patient referral (42%), compared to those randomized to patient delivered partner therapy (23%), or patient referral with an educational booklet (14%) (31). Some studies found that PDPT was more effective in reducing re-infection in patients with gonorrhea and *chlamydia*, compared to partner referral by index cases using contact slips (PDPT: 11.5% versus contact slips:25.5%) (32,33), although Golden *et al.* demonstrated that PDPT is more effective for gonorrhea than *chlamydia* (34). PDPT has also been shown to reduce re-infection in men with urethritis (31). A meta-analysis by Telle *et al.* (35)

Table 2: Literature describing frequency of re-infection and study populations for Chlamydia, gonorrhea, syphilis, and Trichomonas vaginalis.

Reference	Disease	Re-infection with same organism	Time Period	N	Study Population
Ogilvie <i>et al.</i> , 2009 (12) (Canada)	Syphilis	20%	10 years	1536	Men and women with previous syphilis dx throughout BC
Brunham <i>et al.</i> , 2005 (13) (Canada)	Chlamydia	10%	14 years	33,917	Males and females 15-50 years old
Fortenberry <i>et al.</i> , 1999 (14) (USA)	Chlamydia	18%	1-6 months post-treatment	31	Adolescent females
	Gonorrhea	24%		21	
	Trichomonas	6%		21	
Peterman <i>et al.</i> , 2006 (15) (USA)	Chlamydia	10.7%	3 months	84	Heterosexual males and females 15-39 years enrolled in an HIV prevention counselling trial
	Gonorrhea	3.6%		84	
	Trichomonas	3.8%		84	
Mehta <i>et al.</i> , 2003 (16) (USA)	Gonorrhea	21.1%	4.8 yrs	8327	Males & females from an STD clinic > 12 yrs old and history of GC infection
LaMontagne <i>et al.</i> , 2007 (17) (England)	Chlamydia	21 - 30/100 person yr	Per person yr		Women 16-24 years attending general practices, family planning and genito-urinary clinics
Reitmeijer <i>et al.</i> , 2002 (18) (USA)	Chlamydia	20%	12 months	491	Males and females attending a STD clinic
Trent <i>et al.</i> , 2011 (19) (USA)	PID	21%	84 months	831	Women with previous history of PID (PEACH Study)
Dunne <i>et al.</i> , 2008 (20) (USA)	Chlamydia	13%	4 months	359	Men 15-35 years old participating in Ct screening demonstration project
Gatski <i>et al.</i> , 2010 (21) (USA)	Trichomonas vaginalis	18-35%	19 days	252	Women with HIV and Trichomonas vaginalis

showed that the risk of persistent or recurrent infections among patients who preferred PDPT was lower than those preferring patient referral (RR: 0.73 95% CI, 0.57-0.93). However, some report that PDPT, when integrated into clinical practice, resulted in no difference in re-infection rates between patients receiving PDPT and those who did not (36). Future research should evaluate the effectiveness of PDPT in clinical practices.

Effects of Partner Notification on Risky Behaviours

It is reasonable that frequency of risky behaviours can be expected to be reduced among individuals who participate in clinician (physician or nurse) partner notification as it provides an opportunity for education. Meta-analyses of high-risk behaviour in persons aware and unaware of their HIV status revealed that individuals are likely to reduce high-risk behaviour by 53% (95% CI, 45%-60%) just by being

made aware of a positive HIV status (37-40), thus substantiating the need for effective partner notification and follow-up.

Increased condom use has shown to be associated with partner notification and counselling: condom use within six months of a new diagnosis among people who received partner notification was 80%, compared to 50% for those who did not receive partner notification (42). This effect is seen in patients undergoing standard partner notification as well as PDPT when it is used as a partner notification strategy. Kissinger *et al.* found that study participants with HIV were more likely to use condoms after partner notification than participants with syphilis at 3 and 6 months follow-ups (41).

Results from a randomized controlled trial conducted by Kissinger *et al.* (31) showed that unprotected sex with a partner before the partner is treated was more common among patients who did not participate in PDPT than those who did (12.7% versus 8.4%, $p=.04$).

There is debate in the literature about whether partner notification has an effect on patients' having multiple partnerships. Some studies conducted between 1980 and 2000 report that a reduction in the mean number of partners per index cases in rural settings was associated with partner notification (43,44). However, more recent studies found that the number of partners per HIV index case was not significantly different between those who received partner notification and those who did not (42).

Although the literature suggests that partner notification is associated with a decrease in overall risky behaviour (37), little is known about the impact of partner notification on unsafe injection drug use behaviours. A study from China has reported that injection drug users who are notified that they were HIV positive reported a significant increase in condom use and were five times more likely to significantly lower needle sharing behaviours after being given their HIV positive diagnosis (45). Lowered needle sharing may be attributable to the fact that much needle sharing occurs among persons in close relationships including regular sexual partners (45).

Impact of Partner Notification on Reaching High Transmitters versus Monogamous Partners

Overall, partner notification is more prominent and effective among monogamous or "main partner" relationships than among relationships involving high transmitters. Several studies show that index cases are more likely to disclose a new diagnosis to partners with whom they have been in a long term relationship (especially if they have children together), than one-time or casual partnerships (42,46,47). Conversely, partnerships which are basically one-timers, or are "casual" partners are less likely to be notified of an exposure to an STI even when the exposed partner is locatable.

Historically, MSM are regarded as having a high number of concurrent or consecutive partners including anonymous partners (48-50). This can make partner notification particularly challenging. In a study of HIV partner referral services, MSM acknowledged having significantly more partners than (strictly) heterosexual men and women; however, the partner index (partners/interviewed index cases) is approximately the same compared to heterosexual men and women (75). This can be explained by MSM acknowledging a smaller proportion of their total partners to physicians or public health nurses who were tasked with providing partner notification. A study by Hogben *et al.* (29) found that the number of partners contacted through Disease Intervention Specialists (DIS) was only slightly lower when the index case was heterosexual compared to when the index case was MSM. In fact, in one study, the NNI (number of index cases needed to be interviewed to find one case of HIV) was lower in MSM than heterosexuals (12.1 vs 22, respectively). Factors that inhibit partner notification with MSM include partner anonymity or pseudo-anonymity. In addition the rapport between DIS and index cases impacts cooperation of the index depending on if the interaction is perceived by the index case to be a positive or negative experience (29).

The number of anonymous sex partners among 'high transmitter' populations can be very high and makes partner notification difficult. A study related to partner notification for syphilis among MSM (29) reported the prevalence of anonymous sex was between 44.9% to 88.5% in eight cities in the United



States. The main reason for the lack of partner information was that some high transmitter individuals were not interested in seeing the partner again and therefore did not collect locating or identifying information (29).

Preferences for Different Partner Notification Strategies

Patient Referral

Although patient referral has been demonstrated to be less effective than provider referral (51), patient referral is practiced more frequently (3,52-55). This is mainly because provider referral is resource intensive and not feasible with highly prevalent diseases such as *Chlamydia* and gonorrhea (51,52). In some jurisdictions, patient referral has been shown to be preferred by patients over clinician referral (87% versus 23%)(55) and has been reported to be preferred over receiving a letter, a phone call, text message, or an email from a clinic about possible exposure with a recommendation to contact a care provider (3). A qualitative study conducted with 118 MSM (54) revealed that the preferred method of partner notification was direct face-to-face notification rather than having third party involvement. This may stem from a perception that third party involvement would be an invasion of the contacted partner's privacy. In the US, some populations report that if the third party is a Health Department staff person, patient referral is overwhelmingly preferred (76-94%) due to a dislike for the service, a lack of trust of the Health Department and a lack of awareness that the Health Department provides this service (53).

The low numbers of partners who were actually notified has been associated with patient referral and has been attributed, by some, to low levels of notification self-efficacy. Notification self-efficacy is a person's belief about his or her capacity or ability to inform their partners (14). There is evidence to suggest that individuals with high self-efficacy have higher rates of partner notification (14,56). Partner notification and counselling strategies that address this issue may result in increased notification rates when patient referral strategies are used.

Provider Referral

For the purposes of this report, provider referral refers to referral conducted by primary clinicians, clinicians from specialty clinics (e.g., STI, genitourinary medicine (GUM) clinics), DIS (United States) or Public Health Care providers. While the results of partner notification are quite different between these groups, much of the literature does not differentiate between them. Provider referral has historically been thought to be the most effective means of locating and treating exposed partners (1), however, patient preferences for provider referral varies. A systematic review conducted by Mathews *et al.* (1) revealed that provider referral is preferred over patient referral when anonymity is particularly important. This is especially true for HIV partnerships. Others have shown that provider referral is preferred by individuals with problematic substance use. In a study conducted by Levy *et al.* (57), people abusing substances who were newly diagnosed with HIV were found to prefer provider referral (82%) for at least one partner (covering 71% of partners).

Email/Internet notification

Email and other forms of internet partner notification are becoming ubiquitous and evidence surrounding the feasibility and acceptability of these interventions is beginning to emerge. The benefit of e-partner notification is that it provides an opportunity for index cases to notify partners they might not otherwise notify, in an anonymous way. The disadvantage is that it may be perceived as impersonal.

Overall, internet partner notification has been moderately accepted suggesting that it is a good tool which can be used in conjunction with other partner notification strategies. An Australian study confirmed that internet partner notification is acceptable to index patients who are reluctant to

notify recent partners in person. In this study 30% of index patients who had not notified all recent partners stated they would use internet/text mechanisms if they were available.

Online partner notification services are beginning to emerge in Canada. inSPOT is an online partner notification service which started in the United States in 2004 and is now being implemented in Vancouver, Ottawa and Toronto. inSPOT receives over 750 visits to the site daily with 30,000 visitors sending nearly 50,000 e-cards since the site was first launched in 2004 (58). This suggests a large level of user satisfaction.

A study from the US found that 92% of MSM using internet sex partner websites would use internet partner notification in some capacity (i.e. either get public health to notify partners through email, or notify them themselves by email) (59). Men who had no previous STD were more likely to email their regular partner themselves but asked public health to notify other partners. Users of internet partner notification have suggested that partner notification emails should include information about specific health centers where they could be screening and treated, or a phone number to contact a public health specialist (60).

Although internet partner notification strategies have been reported to be acceptable by many, there are some reports suggesting that face-to-face or telephone notification is preferred because it felt more caring or considerate (54,61). There are concerns that emails and texts could be misunderstood, not taken seriously, be shown to others or be received by others. In addition, hostile responses to text messages have been reported. However, studies like these are context-specific and results can vary across different contexts. Furthermore, recent data have shown that electronic partner notification is less efficient in bringing people to care than in-person efforts and therefore should be used in conjunction with other efforts (62).

Patient Delivered Partner Therapy (PDPT)

An important goal of partner notification for all infected people is the medical management of sexual and needle-sharing partners including testing, treatment and counselling. However, encouraging partners to get a medical evaluation and treatment



can be challenging for many index cases. PDPT, also known as expedited partner therapy (EPT) is a method that has been used to facilitate prophylactic treatment of an exposed contact without medical assessment. The efficacy of PDPT has been well described (32,34,63-66). Randomized trials show that index cases are three times more likely to notify their partners using PDPT compared to patient referral (66).

Although clinician referral is more effective than patient referral in terms of partner follow-up (51,67) patient referral is the method most often used by health care professionals in many jurisdictions (68,69) despite evidence that shows that patient referral is less effective in bringing partners to a medical clinic for evaluation and treatment (69,70). Therefore PDPT is a feasible option to supplement other partner notification strategies.

Preferences for different methods of PDPT are widely discussed in the literature with mixed reviews. Some researchers report that standard partner referral is preferred over PDPT and provider referral was preferred by more than half of study participants (46). However, other reports demonstrate that PDPT is both feasible and more acceptable than other partner notification modes such as contact slips and internet notification. In South Africa, 85% of women in a study chose PDPT over patient referral using contact slips (71). The main reason for choosing PDPT over contact slips included a concern that their partner might initially agree to visit a clinic but would not do so. Among the women not choosing PDPT, the reasons included fear of partners' anger and fear of accusations of promiscuity.

In addition to considering the preferences of patients, the preferences of clinicians related to PDPT should also be considered. There is much discussion in the literature about the legalities of PDPT influencing clinician willingness to provide PDPT to their clients. Pavlin *et al.* (72) reported that slightly fewer than half of the general practitioners in an Australian study felt favourably about PDPT. Some physicians prefer PDPT to no treatment at all, while others were concerned that PDPT is not legal in all jurisdictions, does not represent best practice, and may result in a lost opportunity to do full assessment and medication contraindications. PDPT also does not allow for further tracing of the partners other sexual contacts.

Overall, the acceptability, feasibility, and effectiveness of various partner notification strategies vary across different risk groups and populations. Caution must be taken to consider the practical and cultural context when implementing new strategies (73).

Cost

Reporting the cost of partner notification is quite difficult and is not easily done through a literature review. **Table 3** summarizes cost analyses from various studies. Costing of partner notification efforts depends on the incidence of disease in both low and high risk populations, the partner index (the

number of partners elicited per index case), the number of positive partners discovered through partner notification, the number of hours spent per index case and partners, and the hourly wage for the person conducting the partner notification activities.

Figure 2 illustrates an example of this from a cost analysis conducted for HIV partner notification in San Francisco (74).

The cost per new case of HIV identified, as calculated above, provides important information for program planners and policy makers and can be compared to the number of new cases averted to determine cost effectiveness. Another metric useful in examining the cost of partner notification is the number of index cases that need to be interviewed in order to detect one new infection among partners (NNTI). The NNTI varies with the prevalence of each disease as well as the effectiveness of various partner notification strategies. For example, a National US study of HIV partner notification found that 13.8 index cases needed to receive patient counselling and referral services in order to diagnose one new case of HIV (NNTI=13.8) (75).

Cost-benefit analyses using the metrics described should be conducted for each jurisdiction with consideration of disease prevalence and the type of partner notification strategies used.

Figure 2:

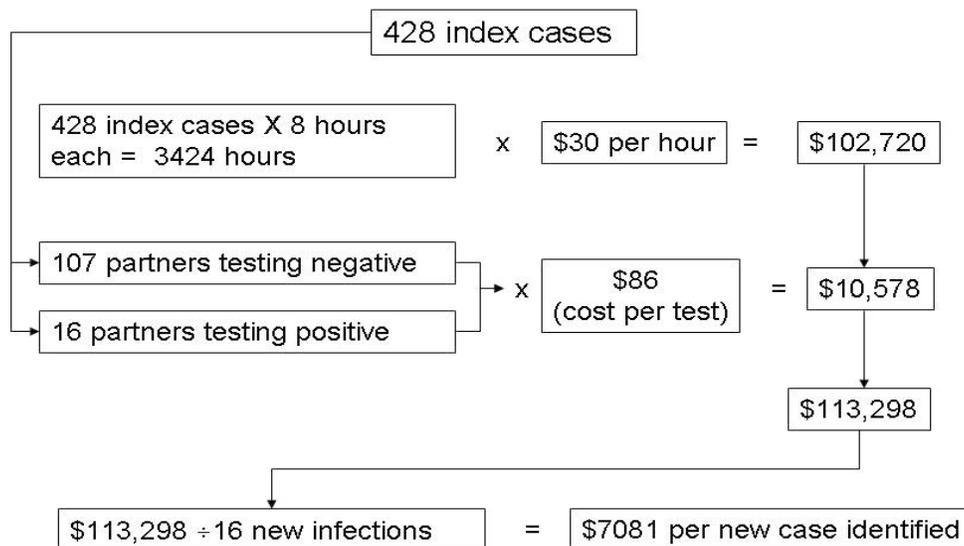


Table 3: Cost analyses related to partner notification in various studies

Study	Participants	Currency	Year	Disease	Findings
Mathews <i>et al.</i> , (1)	Review article - 11 studies	US	2002	Gonorrhea; non-gonococcal urethritis;	Cost per partner treated: - Provider (Physician): \$85; - Provider (nurse): \$18; - DIS: \$158; Cost per partner with a positive culture: - Provider (Physician): \$675; - Provider (nurse): \$120; - DIS: \$845; Contract referral is >3 times more costly per infected partner treated than standard patient referral.
				Syphilis	Cost for contract referral OR provider referral with field blood testing: \$290-\$315 per partner tested; \$396-\$452 per partner treated.
					General comment: provider (physician) referral is the most effective but also the most expensive; patient referral is the least expensive to the health care system.
Howell <i>et al.</i> , (76)	Hypothetical cohort		1997	PID	- Cost saved by partner notification per 1,000 index patients (Chlamydia): men as index: \$247,000; women as index: \$33,000. - Cost saved by partner notification per case of PID averted: men as index: 64 averted; women as index: 20 averted.
Gift <i>et al.</i> , (77)	Incarcerated men and their female partners	US	2006	Chlamydia (PID and Epididymitis and orchitis)	Partner notification per index male interviewed: \$54.82; Estimation costs for notified female partners not previously treated: \$71.00; Sequelae costs: epididymitis and orchitis per case: \$435; PID per case: \$1395.
Reynolds <i>et al.</i> , (78)	Positive syphilis tests in the Houston County Jail Laboratory	US	2001	Syphilis	The average cost per case detected is \$405 for provider referral.
Turner <i>et al.</i> , (79)	Economic and math modelling	UK	2010	Chlamydia	In 2008-2009 screening costs £506 per infection treated; Partner notification with screening £9 - £27 per index case excluding treatment and testing; increasing the effectiveness of partner notification costs less than increasing screening; As the number of partners confirmed tested goes up the cost per treated infection goes down per positive index case.
Varghese <i>et al.</i> , (80)	Clinic with HIV prevalence 1.5%: math modeling	US	1997	HIV	Counselling and testing prevents 8 infections; Counselling these 8 people prevents another 1.2 HIV infections; Cost to find one partner and offer testing (provider referral): \$439; Cost per case averted is \$32,000 when partner notification is added to existing counselling and testing program.
Ahrens <i>et al.</i> , (74)	Patients with HIV at the San Francisco STD clinic	US	2007	HIV	NNTI: acute infection 25, non-acute: 21, longstanding infection 39; \$7081 per new acute and non-acute case identified;



Unintended Harm Related to Partner Notification

The majority of information published about harm related to partner notification is found in the HIV and STI literature. The most frequently reported harms reported as a result of partner notification include partnership dissolution, domestic violence, and stigma. These reports of harm have caused policy makers to re-examine partner notification strategies (81).

Partnership Dissolution

In some cases, when individuals are made aware that their partners have acquired an STI or HIV, blame and mistrust may occur which can lead to emotional or physical abuse and partnership dissolution. This is especially true when incurable infections such as herpes or HIV are implicated (41). However, the body of literature addressing partner notification indicates that partnership dissolution occurs less often when partner notification occurs. A study by Kissinger *et al.* involving index cases with HIV and syphilis (41)

reported that 46.8% of 220 relationships in their study cohort dissolved. However, 35% of relationships where partner notification occurred dissolved compared to 53% in relationships where partner notification did not occur. Partnerships were twice as likely to dissolve if partner notification did not occur and three times more likely to dissolve if the partnership was casual. These findings are confirmed by others (42,82).

Domestic Violence

The most common harm reported in the literature is domestic harm. The discovery that one's sex partner is infected and that one has been exposed may cause the partner to blame the index case and lead to emotional abuse and/or physical violence. This harm is experienced by both men and women. Studies report that the prevalence of emotional abuse or physical harm post-partner notification ranges from 7.7% (syphilis infections) to 24.2% (HIV infections) (41,81). If these partnerships do not dissolve, the frequency of violent or emotional

abuse events diminish over time. In some cases the frequency of fear of violence was greater than the frequency of actual violence (83). An evaluation of HIV reporting conducted in British Columbia reported that, despite community fear that HIV reporting would result in increased domestic violence, no incidence of violence were reported during the 2-year evaluation period (9).

There are some reports that index cases will avoid informing their partners of their exposure due to fear of personal safety (53) while others report that partner notification was still important despite past history of domestic violence (71). A qualitative study conducted by Maher *et al.* (84) with 460 women from Newark and Miami revealed that 16% of participants experienced domestic violence and an additional 6% feared domestic violence. All 460 women were offered an HIV test. In this study, having experienced domestic violence or the fear of violence was not a deterrent to HIV testing.

Strain on Relationships

For many relationships, abuse or relationship dissolution occurs but relationships can become strained in other ways. Domestic quarrels have been reported in 11%-27% of STD positive men (73). Newton *et al.* conducted a qualitative study (61) which found that notification of an STI can affect sexual spontaneity, alter other sexual activities, and can create tension within the relationship because it changes the way partners feel about engaging in sexual activities. This can cause conflict and miscommunication within the relationship. In addition, some partners choose to delay or avoid sexual activity with a new partner in order to avoid having to disclose their STI status (61,85,86).

Stigma

The decision to notify or not notify partners can be stressful and anxiety-producing. The majority of participants report that they experience feelings of depression, anxiety or fear when they felt they had to disclose their STI to another individual, leading to feelings of isolation (85). Many respondents reported that they tried to avoid disclosing their STI where possible, primarily because of a fear of rejection and the fear of stigmatization (87). This is especially true with chronic infections such as HIV or herpes, but also true of curable infections such as syphilis, gonorrhea or *chlamydia* (85). Some are afraid of the



information travelling to unintended others; others ended relationships before they became sexual.

Summary

Partner notification, when conducted effectively, is an important public health mechanism for controlling disease and has been shown to reduce incidence and prevalence of STBIs. When partner notification is accompanied by patient and partner counselling, a reduction in the frequency of risky behaviours such as unprotected sex can be realized. Rates of re-infection may be an indicator of poor coverage of partner notification efforts; however, early evidence suggests that recent innovative partner notification strategies result in lowered rates of re-infection. These new strategies, including PDPT and internet-based programs have been shown to be both feasible and acceptable and, when used in conjunction with traditional methods may reduce the direct costs of partner notification activities and effectively reach populations which are typically hard to reach using other methods.

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