Contact Tracing and Partner Notification Services for STI Prevention in the Digital Era:
A Literature Review

by

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Abstract

Background: Sexually transmitted infections (STIs) pose a significant public health concern. Easily communicable and associated with decades of stigma, STIs require robust and interdisciplinary approaches for their management and reduction. Over the last decade, STI rates have risen drastically, indicating a clear need for adaptions to public health responses. Contact tracing and partner notification services are used to aid in the prevention of STI's by identifying a person who has potentially been exposed to coordinate testing and care. This literature review examines studies done over the last 15 years that specifically discuss how the use of technology can be a strong tool in STI contact tracing, partner notification services, and coordinating testing. This essay aims to explore ways that technology has aided in the advancement of epidemiological prevention of STI's, unpack the limitations that exist in practice, and make recommendations for future directions.

Methods: Literature was collected through the online database Ovid Medline using keywords "contact tracing," "partner notification" and "partner notification services," "digital contact tracing," "epidemiology," and "sexually transmitted diseases" to narrow the search. Literature was then put through a screening process and assessed for eligibility against a set of inclusion and exclusion criteria. A total of 23 (n=23) articles were included in this literature review.

Results: The literature demonstrates that new forms of technology, including instant messaging and social apps, have the capacity to aid clinicians and public health practitioners in

more efficient contact tracing services while being a method of communication that is supported by communities included in studies. Modern technology as a tool for contact tracing is convenient for the client and eases provider burden in conducting contact tracing and sharing results. Limits and gaps in practice remain, namely concerns over privacy and data protection and staff reassignment and funding issues.

Keywords: contact tracing, sexually transmitted diseases and infections, epidemiology, technology, partner notification services.

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Preface

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1.0 Introduction

1.1 Background

Sexually transmitted diseases have been a public health concern for decades, with outbreaks and management techniques dating back into the 1800's. Unfortunately, in recent years, the US has seen rates of STIs reach all-time highs across the country (CDC, 2022). Without more robust and interdisciplinary public health responses, the rates of STIs will continue to rise in America. Epidemiological trends support this fact, serving as a call to action for public health agencies across the US to respond appropriately, including augmenting current contact tracing (CT) and partner notification services (PNS). Contact tracing and partner notification services are used to aid in the prevention of STI's by identifying a person who has potentially been exposed to coordinate testing and care. There are several avenues to choose from to achieve equilibrium between helpful and hindering, and ultimately create sustainable systems and practices that allow for successful use of technology in contact tracing. This essay aims to explore the ways that technology can both strengthen the practice of STI prevention and care as well as unpack the limitations that currently exist in implementation. This essay will draw on the lessons learned in HIV contact tracing, the use of digital contact tracing methods to respond to the COVID pandemic and aim to understand how technology can be utilized in public health to support the prevention and treatment of STI's.

1.1.1 Contact Tracing in Practice

Epidemiological surveillance refers to the practice of systematically collecting, analyzing, and interpreting disease and health trends in communities (CDC, 1988). It allows for agencies to determine the need for public health and/or government policy responses based on trends in the data. Response to epidemiological trends may include mandatory isolation and quarantine policies, as seen throughout the COVID-19 pandemic.

According to the CDC, contact tracing refers to the practice of identifying, testing, and treating people who have been exposed or potentially exposed to an infectious disease (2020). Contact tracing allows cases to be identified and isolated to prevent further transmission of the infectious agent. It is typically performed by public health officials and often involves interviewing the person who has been, or may have been, infected to gather information about people they may have exposed and contacting those people on their behalf (CDC, 2020). Contact tracing is a tool that is used in the broader practice of epidemiological surveillance.

Contact tracing is commonly used for STIs and comes in various forms, adapted for the type of infectious agent and the patients' unique needs. Commonly, those infected with an STI can utilize partner notification services (PNS), also referred to as partner services (PS) or partner notification (PN). Ideally, a person who has tested positive for an STI (referred to as the index patient) will share information about their partners who may be at risk for infection and will work with a disease intervention specialist (DIS) or public health official to contact those partners to schedule screening and testing, and if necessary, treatment (Ward, Bell, 2014; Magaziner et al., 2018). When the index patient seeks partner notification services, they typically have three options for notifying at risk partners: patient referral, provider referral, or contract referral, according to Magaziner et al. (2018). Patient referral means the index patient is encouraged to notify partners

of potential risk. Provider referral means a public health official or health care provider contacts the named at-risk partners on behalf of the index patient, ensuring the index patient remains anonymous. Contract (also referred to as conditional) referral means the index patient is required to notify at-risk partners by an agreed upon time; if they don't a health care provider or public health official will contact their partners on their behalf.

Partner services may include expedited partner therapy (EPT), or partner therapy (PT). EPT is the rapid delivery of pharmaceutical treatment to the sex partners of an index patient by providing the index patient with prescriptions for their sexual partners without the clinical examination of those sexual partners (CDC, 2023). While not used for every infection, EPT is a useful tool to mitigate spread and to encourage swift treatment. In the relevant literature on partner notification services, EPT is often mentioned.

When a person is notified of their exposure, the course of action is dependent on the infectious disease being traced. With viral infections like COVID, influenza, and RSV, instructions often include self-isolation and monitoring for symptoms and instructions to seek testing and medical care if symptoms develop over a set number of days (CDC, 2022). However, testing is almost always recommended for STIs due to the nature of transmission.

1.1.2 Epidemiology of STI's and COVID Impact

The CDC releases yearly epidemiological data for STIs on a 13-month delay. The most recent data released is found in the 2022 STI Surveillance Report published in January 2024 (CDC, 2024). The 2022 STI Surveillance Report includes national data on chlamydia, gonorrhea, syphilis, and congenital syphilis (syphilis in newborns). This data is presented in multiple data points, including total case numbers, rates of cases by age and sex, and rates in higher risk groups. It is

also divided by state and further by demographics in each state. The 2022 STI Surveillance Report reiterates the fact that STI treatment and prevention needs to be a public health priority.

In 2018, the CDC estimated the prevalence of STIs to be 1 in 5 Americans, and in 2022, more than 2.5 million cases of syphilis, gonorrhea, and chlamydia were reported (CDC, 2024). These numbers follow previous years and paint a continuous picture of STIs as a public health crisis in America, especially among those aged 15-24 and in MSM communities (CDC, 2024). Looking at the data from the last two decades in the US, the case rate of chlamydia has doubled, the case rates of gonorrhea have increased 40%, and the rates of primary and secondary syphilis have increased 400% (Crowley, Geller, Vermund, 2021).

When discussing the epidemiology of STIs in America, it is crucial to note the impact that the COVID-19 pandemic had on the rates of STIs during the years 2020-2022. During the early months of the COVID-19 pandemic in 2020, reported cases of STIs rapidly declined (CDC, 2022). This does not necessarily represent a decrease in actual cases but reflects the interruption of programming that provides testing, treatment, and screening due to the pandemic. STI rates then increased to pre-COVID levels later in 2020 and continued to rise in 2021 and 2022 (CDC, 2022). The CDC notes that data provided in 2020 and 2021 should be interpreted cautiously as it likely does not provide the true picture of STI rates during those years (2022). A study done by Wright et al. to examine the impact of the COVID pandemic on STI programming notes that 91% of the 59 US government (state or federal) funded STI programs had moderate to significant program interruptions, including staff reassignment and budgeting changes (2022), which could explain the decrease in case numbers due to staffing restraints and an inability to perform the same level of screening.

During this time, the US also saw a rise in cases of Mpox (formerly known as Monkeypox). While there is still not a definitive answer on whether Mpox should be classified as an STI, it can be contracted during sexual activity due to the close contact with potential lesions on the skin in the genital area (WHO, 2023; CDC, 2024). This global outbreak saw an increase in cases among the MSM and LGBTQ+ community and is often included in discussions involving STI treatment and prevention due to the demographic it impacted, and the strategies used for prevention being like those used for HIV and STI prevention (CDC, 2024).

1.1.3 Transmission and Risk Factors

As the name suggests, the most common transmission route for STIs is sexual. (CDC, 2024; Mayo Clinic, 2023). This includes engaging in vaginal, anal, or oral sexual activity (WHO, 2023). However, STIs can be transmitted through kissing, as is common with Herpes Simplex Virus (HSV) (Mayo Clinic, 2022), or during childbirth (Casalini, Beltrame, Carosi., 2001). The transmission of an infection from mother to child during birth is called vertical transmission and occurs commonly with HIV, gonorrhea, chlamydia, HSV, syphilis, and Hepatitis B Virus (HBV) (di Fillippo Villa, Navas, 2023; Casalini, Beltrame, Carosi, 2001).

STIs do not exclude, and anyone who is sexually active can be at risk for contracting an STI. However, there are certain risk factors that may increase your likelihood of getting an STI. These risk factors include being HIV positive, being a man who has sex with other men (MSM), being pregnant, using illicit drugs, having multiple sexual partners, or being in the age range of 15-35 (CDC, 2024; Mayo Clinic, 2023). There are also certain behaviors that may increase the risk of contracting an STI or HIV, including unprotected sex, having multiple sex partners, having

anonymous sex, or using illicit drugs or alcohol that may impair a person's judgement and risk perception, and using or sharing injection drug needles (NIH, 2021).

1.1.4 History of Contact Tracing

The origin story of contact tracing is not fully known, with sources varying on how and when it began; however, it has been successfully used since at least the mid-19th century to mitigate the spread of various diseases, including influenza, syphilis, Ebola, tuberculosis (TB), HIV/AIDS, STIs, COVID-19, and Mpox (Brandt, 2022; Fairchild, Gostin, Bayer, 2020; El-Sadr et al., 2022). Contact tracing gained popularity in the late 1980s and early 1990s during the AIDS epidemic in the US as a tool to prevent disease spread but it remained unpopular in the gay and queer communities being affected by the HIV/AIDS epidemic (Jonsen, 1993; Dembosky, 2020). Many people in these communities cited fear and distrust of contact tracing, noting they were not eager to have their name associated with a list that identified gay people in the community to the government at a time where homosexuality was not accepted, even if it was in the name of disease prevention (Jonsen 1993; Dembosky, 2020). Barriers to practice have existed throughout the history of contact tracing. In the earlier days of HIV contact tracing, there was no technology to supplement the contact tracing efforts and the process was time consuming. It involved an employee going out into the 'field' (the community) to locate and contact people who had been exposed. There were also barriers in staff resources, political and societal influence and perception of the nature of the HIV/AIDS disease, and lack of widespread standardization that all acted as sufficient barriers to smooth practice. (Jonsen, 1993; Dembosky, 2020).

Contact tracing gained even more popularity at the onset of the COVID-19 pandemic. The respiratory illness that spread across the world sparked robust prevention programs, including well

established contact tracing centers (CDC, n.d.). One of the many benefits to the practice of contact tracing is that it is flexible and can be upscaled to meet the needs of outbreaks and adapted to fit the needs of groups that are at risk and then deescalated when disease trends reach endemic levels, as was seen in the COVID-19 pandemic.

While CT has been in practice for decades, much of the world only found out its true utility during the COVID-19 pandemic. Across the globe, agencies were introducing COVID-19 task forces which often included a robust contact tracing team. In some agencies, CT was performed by people interviewing each infected person to understand their latest contacts and movements and calling each at-risk person to notify them of possible exposure and next steps (Shahroz et al., 2021). However, the high number of cases that were occurring made it nearly impossible to do without the support of technology. Various tools were introduced to help mitigate the labor burden, including contact tracing apps that provided exposure notifications to individuals if they had been within 6 feet of an infected person for more than 15 minutes (Shahroz et al., 2021).

In the last 20 years, technology has advanced by leaps and bounds across all corners of society, with public health lagging slightly behind in its ability to bring current technology into current public health crises, like the climbing STI rates in America. Because of this, it is crucial to examine where these gaps lie in introducing wide-spread electronic contact tracing and partner notification practices and understand public perception and acceptability in using these tools.

2.0 Methodology

Using Ovid as a search engine to gather literature to be reviewed, a search – using a combination of key words, such as "contact tracing," "partner notification" and "partner notification services," "digital contact tracing," "epidemiology," and "sexually transmitted diseases" – was conducted to gather an initial yield of sources (see Table 2 for full search code). Ovid provided 416 sources to be reviewed (n=416). Using a developed exclusion/inclusion criterion, the 416 sources were reviewed for eligibility. To be considered for full text review, literature had to:

- Focus on STI notification services;

- Have been conducted in the United States;

- And have been published between 2010 and 2024.

In addition, the population of the study could be of any age but had to be:

- Patients with STIs;

- Partners of an infected person;

- Or healthcare providers.

Finally, the study had to focus on one of the following topics:

- Adherence to STI treatment and testing following a close contact notification;

- Facilitators and barriers to contact tracing of STIs;

- Gaps and successes in partner-notification services;

- The integration of technology into partner notification services.

Study settings were not limited and included clinical and community health settings, geographic regions such as counties, cities, and states in the US, as well as nation-wide studies. Primary studies such as randomized trials, experimental studies, mixed methods studies, and qualitative studies were included. Systematic or scoping reviews were not considered for inclusion. Studies had to have been written in English. Articles that were commentaries, conference proceedings, or opinion pieces were also excluded.

To begin eligibility screening, each of the 416 sources went through a title and abstract screen and were classified with "Go to Full Text Review" or "Exclude" with a given reason. The reasons for exclusion were reasons such as not being a US based study (n=37), focused on a different infectious disease or illness (n=37), focused on incidence and prevalence (n=48), or focused on unrelated clinical research including diagnostics, case studies, antimicrobial resistance, or complications from STIs (n=57). The full list of exclusionary reasons and associated number of articles excluded for each reason is found in Table 3.

After the initial screening, 130 articles were included in "Go to Full Text Review" (n=130). Each article was screened in its entirety for inclusion eligibility. Of the 130, 23 were fit the criteria outlined (n=23). An article was excluded during the full text review if it was not based in the US (n=22), or if it focused on expedited partner therapy, which was beyond the parameters of this essay (n=41). In addition, an article was excluded if it studied a different infectious disease, not an STI (n=2), if it was an editorial or commentary piece (n=6), or if it focused on treatment recommendations for STIs (n=4). A full list of exclusionary reasons for the full text review is available in Table 4 along with number of articles excluded for each reason.

This essay also drew on sources to supplement information written in the introduction and discussion sections which do not fall into the same inclusion or exclusion criteria. Sources utilized

for these sections are from reputable published sources and were gathered using Ovid or Google Scholar searches. The websites of the Center for Disease Control, the National Institutes of Health, the World Health Organization, and the Mayo Clinic were consulted to augment the technical terminology surrounding contact tracing and infectious diseases.

Terminology used throughout this essay may change based on the literature being reviewed as each source uses different abbreviations. For reference, a table is included in Appendix A.5 with common abbreviations.

3.0 Literature Review Results

3.1 Innovations and Best Practices

3.1.1 Technology as a Facilitator

In the last two decades, technology has vastly expanded, allowing us to stay connected every hour of every day. The Internet means we have the capacity to find answers to anything at any time and SMS messaging (known as texting) gives us the ability to stay connected with family and friends, our jobs, and often our health care providers. Naturally, one of the areas for innovative change in PNS is bringing CT practices into the digital age to match the current dating landscape. For one thing, the way we date is becoming more heavily dependent on internet dating websites or smartphone-based apps, with 30% of Americans and 53% of Americans aged 18-29 reporting that they have used a site or an app to date (McClain, Gelles-Watnick, 2023). Furthermore, it is known that MSM are frequent users of geosocial networking apps to date and have been using the internet to illicit sex since the beginning of internet dating in the early 2000s (Sun, Outlaw, 2015). These statistics, along with the trend of increasing rates of STIs across America, reveal the need to adapt how we contact trace and how we offer PNS to match the current dating landscape.

To this end, in the literature reviewed, there was research on using smart phones to text patients with STI test results or exposures, on using health-based apps to coordinate results and treatment, and on using geosocial networking apps for notification and information surrounding safe sex practices (Mobely et al., 2018; Cohen et al., 2017; Contesse et al., 2020; Cope et al., 2019; Kutner et al., 2021; Udeagu et al., 2014; Rahman et all., 2022; Ehlman et al., 2010; Hunter et al.,

2014; Spielberg et al., 2014; Rodriguez-Hart et al., 2015; Hightow-Wiedman et al., 2014; Pennise et al., 2015).

3.1.2 Geosocial Networking Apps

Geosocial networking apps – for example, Grindr, Scruff, and Jack'd – are commonly used by MSM seeking anonymous sex partners. Several studies have been conducted to analyze the dynamics of these apps in relation to perceptions, attitudes, and practices, including how STIs factor into the use of these platforms. A study conducted by Mobely et al in 2018 examined how trends in syphilis in North Carolina were influenced by app-based dating. Their findings showed no difference in probability of disclosing syphilis exposure to a partner regardless of how they met (app vs not on an app). In the discussion section, the authors note that utilizing these apps and internet-based methods of PNS could provide help in reaching a larger population of MSM who routinely use geosocial networking apps and who may be at risk for STIs (Mobely et al., 2018).

Similar themes were examined in a study conducted by Contesse et al. in 2022. This study invited MSM who had met a sexual partner on a geosocial networking app in the last year to complete a survey gauging their preferences and acceptance of app-based partner notification. This study presented three in-app options for sharing that this person is an at-risk contact and that their partner should seek STI or HIV testing: directly messaging their partner through their profile on the app (not anonymous), having the health department's profile send the message on the app, or receiving an anonymous in-app message. The results showed that while most respondents preferred to be notified by their partner directly (70% of the 791 respondents), almost all would get tested if they were notified of being at risk by either the health department's profile or the anonymous in-app message (95% and 85% respectively). While the 70% of respondents preferred

to notify their partners themselves, 74% were comfortable with the idea of using in-app anonymous messaging and 85% were comfortable with the health department profile notifying their partners (Contesse et al., 2022). These statistics supports the notion that integrating PNS and CT into technology positively responds to current trends in dating apps and STI risk in MSM, and that it allows for quicker testing, treatment coordination, and further prevention (Contesse et al., 2022; Mobely et al., 2018).

Another study, done by Udeagu et al. in 2014 and conducted in New York City, looked at how public health officials can utilize the internet and texting to do contact tracing for HIV. NYC's HIV Field Services Unit (HIV FSU) implemented enhanced PNS and CT via texting and internet (Udeagu et al., 2015). They looked at "nontraditional" contact tracing (via the internet or by texting) and compared it to "traditional" contact tracing (by landline phone or by posted mail). The sample population for this study focused those who had recently tested positive for HIV and elicited PNS between January 2011 and October 2012 for the partners they named as being potentially at risk. While not exclusionary, the sample size was mostly MSM. The authors noted that in this population the use of geosocial networking apps is common. Not knowing one's partner, including their contact information, is also common. This poses a challenge when eliciting PNS (Udeagu et al., 2014). The authors conclude that using a combined approach of txtPNS, IPNS, and traditional PNS allows for greater identification of at-risk partners.

3.1.3 Apps for Partner Notification Services and Contact Tracing

Along with the surge in smartphone use came a surge in health-based apps for smartphones. According to the Patient Safety Network (PSNetwork), there are currently more than 350,000 healthcare-based apps available on the global market (2022). This includes, but is not limited to, apps that allow you to track fitness, food, or calories, offer guided meditations and mental health support, provide pharmaceutical management, aid in diabetes control, and help promote relapse prevention. Telemedicine apps allow you to communicate with a provider. In this growing industry, there is the potential to integrate PNS into health-based apps.

For example, Cohen et al. found that using a smartphone app to allow providers to share test result and counsel patients led to a decrease in the number of days between a positive test and initiating treatment (2017). The study used Healthvana, an app that is marketed as a patient engagement platform, at various AIDS Healthcare Foundation (AHF) Wellness Centers in the US. The population for this study were males who were seeking chlamydia, gonorrhea, or syphilis testing at AHF Wellness Centers in California and Florida. Results showed that using Healthvana at AHF Wellness Centers decreased the number of days between test and notification, from 8 days to 6, and the number of days between test and treatment, from 12 to 10 days (Cohen et al., 2017). These findings support using a smartphone to share STI test results and initiate treatment as a successful public health tool.

Another study, done by Kutner et al. in 2021, examined the use of SMARTtest, an app dedicated to self and partner testing for HIV and syphilis. Participants (a sample of 59 transgender women and cisgender men) were interviewed and asked to share their interest in using an app to disclose test results to partners, health care providers, or social networking sites (social media or geosocial networking apps). SMARTtest guides a user through at-home self-testing and allows the

user to then share those verified results with a third party (Kutner et al., 2021). The discussion of this study provides evidence that there are generally very positive attitudes towards the use of this type of app in public health practice: they promote routine STI testing, aid in mitigating the spread of STIs in at-risk communities, and link users to care, including treatment and PNS (Kutner et al., 2021).

The utility of apps in public health is supported by a study done on apps in STI interviews to locate sexual partners of index patients (Pennise et al., 2015). This study looked at a multi-infection STI investigation that occurred in 2013 in Monroe County, NY. If an index patient indicated meeting a partner online, the disease intervention specialist (DIS) had access to smartphone apps to contact these at-risk partners through their profiles on behalf of the index patient. The authors concluded that allowing DIS to utilize apps to perform PNS resulted in improved notification and case finding (Pennise et al., 2015).

3.1.4 Texting / Electronic Messaging

Every day in the US, 6 billion texts are sent (Vermont Government, n.d.). Convenient, reliable, and versatile, texting remains one of the main ways we stay connected and even to receive emergency notifications. It also has a place in public health by means of contact tracing.

Many studies have been done to assess how integrating texting into the practice of CT and PNS allows for quicker initiation and greater convenience. For example, a 2015 study done by Rodriguez-Hart et al. found that those who receive STI test results by text received treatment 1 to 3 days sooner than those who opted results over the phone. This study was done in three Florida counties and the sample included anyone accessing STI testing between February 2012 and January 2013. The authors conclude that the use of texting to share results is a strong alternative

to traditional phone call notification and was associated with a decrease in days from test to treatment and, in turn, allowed index patients to be removed from the chain of transmission sooner. The authors also note that texting was associated with a decrease in the time burden on clinic staff (Rodriguez-Hart et al., 2015).

Similar themes were explored by Rahman et al in their 2022 article. They examined how electronic notification (via text or email) improved patient satisfaction and treatment, and reduced staff burden. Their sample involved patients diagnosed with chlamydia or gonorrhea at Parish Health Units in Louisiana. The authors noted that an automated system (Chexout) used to send test results to patients decreased time between test and notification and increased patient treatment success. They also found that patients were satisfied with this protocol and that nurses and staff spent less time notifying patients via traditional methods (letters or phone calls) and more time providing patient care (Rahman et al., 2022). Texts permit a smoother notification process for the need to get tested, for the communication of a positive test result, and ultimately mitigate the transmission of STIs in the community.

Further to the studies by Rahman et al. (2022) and Rodriguez-Hart et al. (2015) is the study by Cope et al. in 2019 that assessed patient opinions about electronic messages for test results and partner notification. This study was based in Durham, North Carolina and aimed to understand patient satisfaction with receiving notification by text about test result or possible exposure. This clinic used Chexout, an automated system that allows providers to send notifications to an email address or phone number. The authors found that of the 113 people who enrolled to receive notification via text (n=113), 99.0% were satisfied with using this method of communication and 92% said that receiving their results via text was easy (Cope et al., 2019). This confirms that utilizing technology has the capacity to benefit patients and providers.

3.1.5 Internet or Social Media Contact Tracing

Another avenue of innovation in the world of improving PNS and CT practices is the utilization of the internet and social media sites. In data published in 2024, 97.1 Americans reported using the internet (Petroysan, 2024). Similar statistics are seen in social media use. There were 314.76 million social media users in the US in 2023 (Dixon, 2024). To match these staggering numbers, it is important to understand how the internet and social media allow us to stay connected and to be reached, even by DIS.

A 2010 study done by Ehlman et al. reported that utilizing internet based PNS (IPNS) increased the ability to contact individuals identified as being at risk. Their study evaluated the Washington, DC Department of Health IPSN program for syphilis detection. From January 2007 until June of 2008, there were 361 syphilis patients and a total of 888 sex partners identified as at risk. Of these 888 people investigated, public health officials contacted 381 of them of them via the internet. They concluded that without the use of IPNS, these 381 partners would not have been investigated or notified of their exposure, leading to the conclusion that utilizing IPSN services allows for wider reach during CT and PNS and aids in preventing further community transmission of STIs (Ehlman et al., 2010). Similar results were seen in North Carolina where investigators used IPSN and txtPSN to initiate CT. Hightow-Weidman et al. examined how, when utilizing a combined approach of IPSN and txtPSN, they were able to identify more contacts than when using a traditional PNS approach (calling, mail) (2014). The authors report similar findings to Ehlman et al. (2010) and state that using IPSN and txtPSN facilitates greater identification of contacts and smoother linkage to care (Hightow-Weidman et al., 2014).

Moreover, in 2014 Spielberg et al. reviewed an e-service system for the prevention, diagnosis, and treatment of STIs in 4 counties in California. In 2012, an e-service portal called

eSTI was launched as a trial which provided safe sex education, the ability to order self-test swabs for chlamydia, gonorrhea, and trichomoniases, e-prescriptions, e-partner notification, and data integration with clinic health records. This portal was geared towards women and only vaginal swabs were provided in the self-tests. Of the 217 enrolled women, 67% completed their test kit and mailed it back for testing, 92% of these women viewed their results online, and all participants who tested positive were given e-prescriptions to immediately link them to care. There were very high rates of patient satisfaction: 99% of those who completed a follow up survey stated they would recommend it and 95% preferred it to in-clinic visits (Spielberg et al., 2014). The authors note that technology like this has the potential to increase diagnosis and treatment, allow for online PNS, and be a strong tool for STI prevention and the promotion of sexual health. It is important to note that this portal was introduced in 2012. In the last 12 years, significant software development has occurred, and similar e-service portals can continue to be streamlined into an app or third-party website to allow for the wider reach of services.

Likewise, in 2010 Ling et al. evaluated a web-based test result system in an urban STI clinic. They found that the use of an automated system to deliver results online allowed patients to check their result status at any time of day, increasing convenience. When combined with the option to call, patients felt an overall satisfaction with the level of communication pertaining to their results they had with the clinic. This study adds to the literature supporting the use of technology to supplement more traditional methods, to streamline services, and to makes them more efficient and accessible to the patient (Ling et al., 2010).

Another example of the success of the internet and social media for PNS and CT comes from Wisconsin. This article examined Facebook-augmented PNS in a cluster of syphilis cases in Milwaukee (Hunter et al., 2014). Using Facebook, DIS were able to identify cases that were

otherwise untraceable in the outbreak, and then link patients to testing and treatment. The authors note that while useful, IPSN should not outright replace traditional methods of PNS, but instead be used to complement PNS.

3.1.6 Technology to Meet the Needs of Populations

Currently, people aged 15-30 make up almost half of the new cases of STIs in the US each year (CDC, 2024). Because of such high numbers in this age demographic, it is crucial to ensure that the way we are providing test results, safe sex promotion, and PNS matches the communication style that is preferred in this age group. In this case, we know that the younger generation is chronically connected via smartphones and using these methods of electronic communication has been found to be successful in STI care and treatment, as examined by Reed et al. in studies they published in 2014 and 2015.

In 2014, Reed et al. conducted a study using a 2x3 factorial design that examined which combination or option was most effective in notifying adolescents aged 14-21 in Ohio of their STI test result and offering post-test counselling, including PNS. From this study, they concluded that the combination of a phone call to the mobile device and a text message facilitated the successful notification of STI test results to patients and the opportunity to begin treatment, PNS, and post-test counselling. Similarly, in 2015, Reed et al. published a second study with similar results. They examined how using text messaging would improve the notification of positive STI tests in adolescents. The results of this study, which was a qualitative study with a convenience sample of 40 teenagers who presented to the ER with STI symptoms, concluded that text messaging is an extremely promising method for communicating test results and health related information to adolescents (Reed et al., 2015). They suggest that since text messaging is an effective tool in

notification of test results, that this method could lead to improved patient outcomes through quicker initiation of treatment and reduced STI rates through more successful contact tracing and PNS. In addition, it could prevent loss to follow up, and lead to better understanding of sexual health and STI prevention in this generation (Reed et al., 2015). The study resulted in an almost 12% improvement in notification rates among the female population of the study, compared to the group that was attempted to be contacted by phone.

3.1.7 Technology as a Cost Reducer

Healthcare spending in the US is enormously complex; the country is often criticized for its healthcare spending policies (Branning, 2016). In two of the research articles reviewed for this essay, the use of online platforms utilized for providing STI results, coordinating testing, and contact tracing were associated with the potential for lowering clinic costs. Rahman et al (2022) discuss how, when it comes to something like contact tracing for STIs, clinics should have access to low-cost measures to implement on a widespread basis, and that online platforms like Healthvana and Chexout can offer that. Similarly, in the 2014 study done by Spielberg et al, the e-service portal for at-home testing was associated with being a cost-effective method for widespread practice. This is also supported in a 2011 study by Huang et al. Their work in comparing traditional in-person clinic screening with an online, at-home STI test found that the internet-based screening strategy resulted in approximately $41,000 in direct medical cost savings for the clinic. These three studies support the notion that finding cost-effective ways to implement comprehensive STI screening and testing is crucial and that leaning on online portal services may be the solution (2011, 2014, 2022,). It should be noted that both Rahman and Spielberg comment that further, in-depth

research should be conducted on this specific avenue of STI prevention, but preliminary and small-scale implementation show promising reductions in costs (2014, 2022)

3.2 Challenges and Barriers to Facilitation

3.2.1 Technology as a Barrier

While our world is becoming more and more technology dependent, it does not mean there aren't gaps in practice to widespread implementation of technology, especially in public health and health care. In a comprehensive, qualitative study done by Iyer et al. based in Massachusetts, several barriers surrounding the introduction of an electronic based PNS platform were discussed (2023). Iyer et al. performed semi-structured interviews with patients at a Boston-area sexual health clinic as well as with field epidemiologists from the Massachusetts Department of Public Health. In these interviews, they identified six main coded themes (n=6) (Iyer et al., 2023).

- 2 core concepts:
  - partner notification being a relational process,
  - partner notification being situation dependent,
- 3 values to address for an effective electronic partner service platform:
  - trust versus mistrust,
  - privacy concerns,
  - stigmatization issues,
- 1 actionable item when developing an ePNS platform:

o   any state-wide electronic partner services must be customizable to the user at each step.

When it comes to PNS, we know that one size doesn't fit all. Some people prefer to notify their partners directly, while others prefer to remain anonymous. Relationship dynamics also play a part in how someone chooses to notify a partner (polyamorous vs monogamous relationships, hook-ups vs long term relationships, etc.). This comes up as a common theme in the interviews done by Iyer et al., with patients feeling certain obligations based on levels of intimacy reached with a partner (2023). They also note that situations play a role in how a partner is contacted, such as geographic location, emotional capacity, and the ability to reach them at all being barriers to making contact.

Stigma is a huge factor in STI testing and treatment, dating back decades. The interviewees in the Iyer et al. study refer to feeling as though it is shameful to receive a call from a DIS letting them know of their positive test or of their potential exposure. Similarly, they feel as though they are being condescended to and lectured about their sexual habits, deterring them from wanting to discuss legitimate concerns further (Iyer et al., 2023). This is especially seen in the MSM and non-white patients who were interviewed. They note that any ePN platform needs to be inclusive in language and to avoid blame.

Both epidemiologist and patient groups identified concerns with privacy and legitimacy of technology platforms involved in STI care. Concerns included people thinking that an automated message from a platform notifying them of exposure may be interpreted as spam or junk, or that it has the potential to be used to harass partners. Solutions to these concerns involved ensuring that language conveys the legitimacy of it by including a reference to, or even a link to, the Massachusetts State Public Health department website. Follow up phone numbers for patients to

call is another solution. Along these lines, some patients also felt concern with the government being involved in their health care which was rooted in fear of government surveillance. To combat this, there should be an effort to cultivate trust in the system by understanding the cultural factors that may be causing these legitimate concerns, including immigration status or language barriers (Iyer et al., 2023).

Echoing these concerns were comments about privacy and information sharing. Concerns included data tracking about a private health matter and information that may cause emotional distress being shared. For example, patients reported feeling unease about their messages being hacked or viewed by the government. As well, participants note that the disease being traced plays into the messages. They discuss how they may feel more stressed receiving a message that does not include the exposed infection, stating they would want to know if it was something treatable like chlamydia or something lifelong like HIV. Including the disease in the message may compromise anonymity, and there was not any consensus discussed by the authors on how to mitigate these concerns, besides making the message customizable to the patient (Iyer et al., 2023).

Taking all these themes, the authors and participants discuss options to make customizable changes to the ePN services at each step. This includes the ability to include or not include your name, whether to identify the disease exposed to, ensuring participants can have the text translated to another language if needed, and allowing patients to choose to send the notification or have a clinician send it on their behalf. These customizations would allow for more efficient linkage to care for partners being notified and higher user satisfaction (Iyer et al., 2023).

As seen in the literature reviewed, technology is a useful tool that has had positive receptions with patients and clinicians; however, there are still barriers and items to consider when implementing a widespread electronic patient notification system, especially in the current

political-social climate (Iyer et al., 2023). As well, it should be noted that there were limitations to the study conducted by Iyer et al. First, the sample size was not diverse and primarily comprised white men who have sex with men. Secondly, they were not able to conduct interviews with adolescents. They suggest further studying should be done with this age group as they currently make up nearly half of the new STI infections in the US (Iyer et al., 2023).

3.2.2 InSPOT

Bridging off the study by Iyer et al., the introduction of a technology-based tool for partner notification can have unintended outcomes, for example, inSPOT. When it came to PNS for MSM, the internet had been long used as a tool because this group often uses the internet to elicit sex (Levine et al., 2008). Because of that, inSPOT was developed. It was a website that allowed people to send anonymous e-cards to sexual partners to disclose their STI test results. These e-cards were humorous in nature, with phrases like "Got laid. Was happy. Got Tested. Wasn't healthy. Better get your own STD checkup soon" (Levine et al., 2008).

While developed as a tool to promote PNS in MSM, studies that review inSPOT indicate that it was not as effective as traditional PNS methods. For example, a 2012 evaluation of inSPOT by Plan et al. found that despite the 50,000 e-cards sent, it was not shown to be an effective method of ensuring people receive testing following a notification. The authors surveyed a high-volume of sexual health clinics that served MSM in the Los Angeles region between 2007 and 2009. The surveys asked patients if they had heard of inSPOT, if they had used inSPOT, if they had ever received an inSPOT e-card, and if so, if they had gone to seek testing. The results showed extremely low levels of knowledge or use of the service. According to Plant et al., part of the

reason inSPOT has had so many e-cards sent may be due to curiosity or prank or scam emails. They do note that, in theory, inSPOT is a good practice.

Similar findings were explored by Kerani et al. in 2011. They aimed to understand perceptions surrounding using patient-delivered partner notification and using inSPOT to deliver exposure notification to partners. While they found that inSPOT was deemed acceptable as a service, most people who had enrolled surveyed had no interest in using it. In the end, they had to halt the study due to low enrollment of eligible participants (81% of those eligible and invited to participate declined enrollment); the authors note that results should be interpreted cautiously (Kerani et al., 2011). Another study conducted by Kerani et al. in 2013 found similar results with a higher sample number. This study examined perceptions and response to receiving either PDPT or an anonymous e-card from inSPOT notifying them of exposure. In these results, it was found that there was interest in using inSPOT, but a low percentage of participants said that they would seek testing if they received an inSPOT postcard. Both studies by Kerani et al. support the findings of Plant et al from 2012.

Looking at inSPOT in heterosexual relationships, Rietmeijer et al. examined recognition and usage of the online postcard website in an STI clinic in Colorado (2011). While the study was not limited to straight patients, the clinic that was surveyed predominantly sees straight clients and those in heterosexual relationships. Through surveys provided to gather baseline and then to assess usage and awareness, it was found that inSPOT was not an effective partner service for this clinic, a predominantly straight/heterosexual, urban STI clinic.

It should be noted that inSPOT was developed in an era before the widespread norm of social media and constant online connection. Any interpretation of these evaluation studies should be mindful of the fact that technology has changed in the last decade, as have perceptions of online

partner services. As well, one of the studies had extremely low enrollment and does not provide a complete picture of the perceptions in the target population.

3.2.3 Staff and Budget Resources

Another barrier seen across multiple sectors in the American workforce is staffing constraints. Having insufficient staff numbers to perform job tasks is a recurring theme in public health settings, including in DISs. In an assessment of STI PNS in state and local health departments across the US, Cuffe et al. review how staffing interruptions or reassignments and budget cuts impact the ability for DIS to work effectively (2018). These staff interruptions may be due to public health emergencies or budget adjustments; either way, they impact the smooth delivery of essential STI prevention and care services. Published prior to the COVID-19 pandemic, this article nicely foreshadows what was seen across the nation when there was widespread staff reassignment due to the respiratory illness that caused the pandemic.

Similar findings were discussed in the 2018 article by Magaziner et al. This study focused only on New England states (New Hampshire, Maine, Vermont, Massachusetts, Rhode Island, and Connecticut) and looked at opportunities and challenges in providing PNS in this region. When examining challenges, Magaziner et al. report that across the New England states, limited funding for staff was a consistent barrier to optimal PNS provision. They note that these staffing shortages led to most states being unable to provide PNS for chlamydia and led to limited PNS for gonorrhea in Massachusetts, New Hampshire, and Rhode Island (Magaziner et al., 2018). It should be noted that the New England states all expressed a desire to expand their PNS programming but were limited due to funding and staff constraints.

4.0 Discussion

As a public health crisis, STIs intersect with different public health sectors, including infectious disease management, behavioral and community health, health policy, and epidemiology. Because of this, the public health implications of STIs vary, from the increase in healthcare costs to life-long complications from un-treated STIs, and from social stigma to policy making. Based on data from 2018, it was estimated that STIs carried a $15.9 billion in lifetime direct medical costs in the US (CDC, 2022; Harrell et al., 2021). As well, STIs carry an assortment of complications that can be extremely harmful to a person, including arthritis, pelvic inflammatory disease, infertility, heart disease, and certain cancers (Mayo Clinic, 2023). Stigma around STIs also runs deep, due to misconception and misunderstanding, and due to religious beliefs and homophobia (Planned Parenthood, 2023). Moreover, some groups harbor a systemic distrust of medical and government officials that hinder the provision of adequate care and services, and sensitive adaptations should be made to serve these groups.

When it comes to STI care, early intervention is key. Without timely treatment, STIs can create life-long health complications in otherwise healthy individuals, especially women and children. Common health complications include pelvic inflammatory disease, infertility, ectopic pregnancies, and cervical cancer (NIH, 2023). To mitigate these potential risks, early treatment and intervention is key (NIH, 2023). Luckily, the use of new technologies can assist in this. By utilizing electronic contact tracing methods and e-testing services, the initiation of treatment and testing is expedited, as seen in the study by Cohen et al (2017). By utilizing Healthvana, patients who received their coordination of care through the online platform were found to receive treatment and test results 2 days sooner. This provides evidence new technologies aid in the quicker

delivery of services, ultimately aiding the patient and reducing life-long medical costs associated with STI complications.

Another barrier to STI prevention is stigma. This is deeply rooted and hard to untangle, stemming from various preconceived notions and belief systems. Commonly, stigma can be attributed to lack of understanding and therefore negative perceptions, or it can be due to religious or political beliefs. Stigmas are also based on decades of preconceived notions that need to be torn down, including the idea that teenagers don't have sex and that STIs only occur in gay men. One of the ways reduce this noise is to utilize technology and create social marketing campaigns that address specific populations.

4.1 Limitations

This essay has limitations. The first limitation was the availability of relevant research. The aim of this literature review was to dissect the use of technology as both a tool and a factor in STI prevention through contact tracing. Because this is a narrow topic and because the practice is evolving constantly as the technology itself evolves, much of the literature concluded that further research needs to be conducted to understand the more widespread implications and usage of integrating technology into STI contact tracing. Therefore, it limits the definitive statements and offers more preliminary and suggestive conclusions.

Secondly, much of the literature reviewed focused on a narrow demographic, mostly MSM in urban areas. While some studies touched on adolescents and addressed racial groups, the overall demographic explored in the literature reviewed was not completely representative of the demographics that are at higher risk of contracting STIs, including teenagers and BIPOC groups

in the US (CDC, 2020). As well, within these two at-risk groups, there are special considerations around stigma that need to be unpacked and addressed when creating group-specific interventions.

4.2 Recommendations

4.2.1 Social Marketing

Social marketing is a public health tool that applies marketing strategies to create and share information with targeted audiences to improve health outcomes through encouraging changed behavior (University of Michigan, 2023). Successful social marketing interventions deliver messages that consider the demographic, their perceptions, and values, and how the message is most effectively shared. Some of the ways we can integrate social marketing and technology into contact tracing and STI prevention include social media campaigns and in-app informational messages.

Creating informational pop-up messages on different dating apps is one way to utilize technology to promote safe sex and STI prevention in the world of online or app-based dating. This is already being done on Grindr, a geosocial networking app that connects men seeking sex with other men. Grindr has worked on several social marketing campaigns over the years, including pop-up pages that promote free, at home HIV testing and linkage to care, the ability to create a reminder when one is due for an HIV test, and information on the nearest STI testing centers (Huang et al., 2017; McNeil, 2018). These practices are ahead of the times and are paving the way for other dating apps seeking to offer similar services to reach wider nets of people. As well, Grindr has been used as a means of conducting contact tracing. Academic literature on this

specific case is limited, but a CBS news article outlines Iowa's Linn County Health Department and how it utilized the Grindr app to locate and contact people who may have been exposed to an STI and to coordinate testing (CBS, 2022).

Social media platforms are commonly used to conduct social marketing campaigns. Utilizing social media is helpful in targeting teenagers, as they are chronically online and constitute just under half of the new STI infections each year (CDC, 2022; Anderson et al., 2023). When creating social marketing campaigns and putting them on social media, it's important to consider what social media platforms to use. While Twitter (X) and Facebook used to be the top contenders for social media platforms, both have seen a steady decline in youth users in the last 10 years. Now, Instagram, TikTok, and Snapchat are the most popular social media platforms for teenagers (Anderson et al., 2023). Therefore, social media campaigns should be created for these platforms and take into consideration how to effectively communicate information that is engaging as well as age appropriate and culturally sensitive, and that encourages a change in behavior (University of Michigan, 2023). Utilizing these apps may be helpful in recruiting young adults to participate in research about STI prevention and perceptions, and in addressing the lack of research in this population. The "promoted" features on Snapchat, Instagram, and TikTok offer a way to share research studies on the topic and encourage teens to sign up to participate.

To utilize social marketing to address racial groups in the US, we must consider the foundational values in health promotion and emphasize working with a community and not for a community. To do this, we need to create social marketing strategies that promote visibility of the experiences that racial groups in America face when accessing health services. For example, the faces of social marketing campaigns should be members of the BIPOC groups we would like to

work with. Partnering with BIPOC influencers to leverage their platforms is a way to share messages on STI prevention, treatment, and testing.

4.2.2 Expanded Research

One of the key limitations in most of the literature reviewed was the lack of diverse samples to study. To gauge how to best serve the at-risk populations there needs to be behavior and perception studies conducted to understand how to implement practice and policy to effectively address STI prevention in at risk groups. Research should aim to understand the hesitation to trust contact tracing teams, the perceptions that at-risk groups have about the services available to them, and the recommendations that they may have for successful technology-based contact tracing services.

4.2.3 CDC Toolkit

In order to aid in facilitating widespread implementation of technology and e-based PNS and CT services, there could be an introduced Toolkit from the CDC. Having federal guidance on programming allows for States to build programs with these tools and references and adapt to the needs of their states. The CDC has Toolkits available on their website for multiple public health initiatives including COVID-19 response, digital media in public health, vaccine clinics, program evaluation guidelines, healthcare associated infection prevention, addiction medicine, and hypertension management, among dozens of others (CDC, n.d.). By creating a Digital Contact Tracing Toolkit, there is a push for states to implement these programs in their health departments and provides helpful guidelines for initial implementation.

4.3 Conclusion

Overall, public health has come miles from the early days of contact tracing and has found ways to innovatively introduce technology into contact tracing practice. While there have been significant advancements, there are still gaps that hinder public health agencies in implementing successful technology-based contact tracing and STI prevention. These opportunities include diversifying the research and creating successful social marketing campaigns. Ideally, this will permit better introduction of services and aid in dismantling stigma. Finally, more financial analysis is required to understand the costs of, and potentials savings in, digital contact tracing.

Whichever stream of public health you are a part of, there is room in your field to mitigate and prevent STIs in America.

Table 1: Ovid Medline Search Strategy

Literature Search Description	
Provider / Interface	Ovid
Database	MedlineALL
Date Searched	February 29th, 2024
Database Update	1946-February 28th, 2024
Search Developer(s)	Helena M. VonVille; Harriet Wright
Limit to English	Yes
Date Range	2010-2024
Publication Type	Limited to scholarly publications
Search Filter Source	https://hsls.libguides.com/Ovid-Medline-search-filters/limiters

Table 2: Ovid Medline Search Strategy Key Search Code

	Search Terms
1	Contact Tracing/
2	((contact* or patient or partner*) adj2 (epidemiology or investigation* or notification* or notifie* or notify or tracing)).ti,ab,kf.
3	1 or 2
4	sexually transmitted diseases, bacterial/ or chlamydia infections/ or gonorrhea/ or syphilis/
5	(chlamydia or gonorrhea or (sexually adj transmitted) or sti or stis or syphilis).ti,ab,kf.
6	4 or 5
7	3 and 6
8	7 not ((exp africa/ or exp asia/ or exp australia/ or exp canada/ or exp central america/ or exp europe/ or exp south america/) not (north america/ or exp united states/))
9	limit 8 to english language
10	limit 9 to yr="2010 - 2024"

Table 3: Title and Abstract Screen

Screen Titles/Abstracts	
Exclusion reasons	**Total # for each reason**
Not a US study	37
Was some other infectious disease, not an STI	37
Community perceptions/attitude study	14
Was a systematic or scoping review	14
Was an editorial, comment, conference proceeding, etc.	10
Incidence/prevalence study	48
Test sensitivity/specificity	24
Treatment Recommendations	34
Unrelated Clinical Research	52
Duplicate Source	2
Policy Recommendations	9
Out of time frame	3
Sum of "EXCLUDE" by reason	**284**

Table 4: Full Text Review

Full Text Review	
Exclusion reasons	**Total # for each reason**
Not a US study	22
Was some other infectious disease, not an STI	2
Community perceptions/attitude study	1
Was a systematic or scoping review	4
Was an editorial, comment, conference proceeding, etc.	6
Incidence/prevalence study	5
Test sensitivity/specificity	3
Treatment Recommendations	4
Unrelated Clinical Research	3
Duplicate Source	0
Expedited Partner Therapy Focus	41
Out of time frame	0
Out of scope	14
Text Unavailable	1
Sum of "EXCLUDE" by reason	**106**

Table 5: Key Terminology, Abbreviations, and Definitions

NAME	DEFINITION	COMMON ABBREVIATIONS
Sexually Transmitted Diseases, Infections, or blood borne infections.	Infection or disease that occurs because of transmission during sexual activity. Sexually transmitted blood borne infections refer to a pathogen that can be transmitted during sexual activity or by blood exposure, such as HIV or Hepatitis. Acronyms are often used interchangeably but all refer to the same concept.	STI: sexually transmitted infection STD: sexually transmitted disease STBBI: sexually transmitted blood borne infections
Contact Tracing	Refers to the practice of identifying individuals who have been exposed to an infectious agent to test and treat them.	CT: contact tracing
Disease Intervention Specialist	Trained professionals that perform PNS and CT for STIs. They aid in identifying and locating partners and letting them know they may have been exposed and referring them to testing and treatment.	DIS: Disease Intervention Specialist
Partner Notification Services, Partner Services, Partner Notification	Refers to notifying someone that a partner they have engaged in sexual activity with has tested positive for an STI. The identified person is then screened and tested, and if necessary, treated. Common acronyms are all used interchangeably for the same premise.	PNS: Partner notification services PS: Partner services PN: Partner notification
Patient Delivered Partner Notification	Refers to a patient letting a partner know that they have been exposed to an STI. Happens independently from a clinician. All acronyms for this are used interchangeably but vary by literature sources.	PDPN: Partner Delivered Partner Notification PDPNS: Partner Delivered Partner Notification Services PDPS: Partner Delivered Partner Services

Internet Based Partner Notification Services	Refers to utilizing the internet to locate and communicate with those who were identified as at risk for an infection.	IPNS: Internet Partner Notification Services
Text Based Partner Notification Services	Refers to texting an individual that they have been identified as at risk for an infectious agent based on an exposure.	txtPNS: texting partner notification services
Expedited Partner Therapy	Refers to empirically treating the sexual partners of an index patient that has tested positive for chlamydia or gonorrhea without having them see a clinician for testing. Prescription is provided to the index patient to give to a partner. Allows for expedited treatment and commonly used in monogamous relationships or patients with few sexual partners.	EPT: Expedited Partner Therapy Also commonly called Partner Therapy.
Men who have Sex with Men	This refers to a male-identifying person or someone with male genitalia engaging in sexual activity with another man	MSM: Men who have sex with men
Anonymous Sex	Refers to casual or one time sex between partners who know very little about each other where sex is the only part of the relationship.	Anonymous Sex
Index Patient	Refers to the person who has tested positive for an infection and starts the chain of contact tracing.	IndexPT: Index Patient
LGBTQQIP2SAA:	Refers to people who identify as lesbian, gay, bisexual, transgender, queer, or anything else along the gender and sexual identity spectrum. Common acronyms all refer to the same thing, but literature varies in usage.	LGBT: Lesbian, Gay, Bisexual, Transgender LGBTQ: Lesbian, Gay, Bisexual, Transgender, Queer LGBTQ+: Lesbian, Gay, Bisexual, Transgender, Queer, and other

		LGBTQQIP2SAA: Lesbian, Gay, Bisexual, Transgender, Queer, Questioning, Intersex, Pansexual, Two-Spirited, Asexual, Ally
BIPOC	Refers to Black, Indigenous, People of Color. The term intends to center the experiences of this group and emphasize solidarity.	BIPOC (phonetically: Bye-Pock): Black, Indigenous, People of Color.
Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome	A virus that attacks the body's immune system and causes it to attack itself. Without treatment, it can develop into acquired immunodeficiency syndrome (AIDS), which is fatal. There is no cure for HIV, but it can be managed well through antiviral medications and few cases in the US progress into AIDS.	HIV: Human Immunodeficiency Virus AIDS: Acquired Immunodeficiency Syndrome

Table 6: Summary of Literature Sources

AUTHOR	TITLE	DATE	SUMARY
Cohen, A., Zimmerman, F., Prelip, M., Glik, D.	A Smartphone Application to Reduce Time-to-Notification of Sexually Transmitted Infections	2017	This study measured the implementation of health app Healthvana in an STI clinic setting and its impact on days between test and result notification of STI's. They conclude that smartphone apps like Healthvana are promising to assure clients are notified of their results in a timely manner.
Contesse, M. G., Fredericksen, R. J., Wohlfeiler, D., Hecht, J., Kachur, R., Strona, F. V., & Katz, D. A.	Acceptability of Using Geosocial Networking Applications for HIV/Sexually Transmitted Disease Partner Notification and Sexual Health Services	2020	This study looked to examine the acceptability of using geosocial networking apps to perform contact tracing and notifying a partner of STI exposure. The study focused on SMS who had met a partner on an app in the last year. Overall positive perceptions.
Cope, A. B., Seña, A. C., Eagle, C., Pol, A., Rahman, M., & Peterman, T. A	Assessing patient opinions about electronic messaging for gonorrhea and chlamydia result notification and partner services, Durham, North Carolina	2019	Measuring the acceptability of using electronic text messaging to inform patients of their chlamydia and / or gonorrhea test results in Durham, North Carolina. Population agreed this method is easy and acceptable to use.
Cuffe, K. M., Leichliter, J. S., & Gift, T. L.	Assessing Sexually Transmitted Disease Partner Services in State and Local Health Departments	2018	Aimed to determine the effect of budget cuts and staff reassignment on state and local health department ability to offer successful partner notification services and STI prevention programming.
Ehlman, D. C., Jackson, M., Saenz, G., Novak, D. S., Kachur, R., Heath, J. T., & Furness, B. W.	Evaluation of an innovative internet-based partner notification program for early syphilis case management, Washington, DC, January 2007-June 2008.	2010	Evaluation of the first 18 months of the Health Internet-Based Partner Notification program for early syphilis detection.
Hightow-Weidman, L., Beagle, S., Pike, E., Kuruc, J., Leone, P., Mobely, V., Foust, E., Gay, C.	"No one's at home and they won't pick up the phone": Using the Internet and text messaging to enhance partner services in North Carolina	2014	This study compared traditional PNS / CT methods to internet and text based PNS / CT in North Carolina. Using electronic based methods augmented the ability to detect new HIV cases and syphilis diagnoses through earlier detection from successful PNS / CT.

Hunter, P., Oyervides, O., Grande, K. M., Prater, D., Vann, V., Reitl, I., & Biedrzycki, P. A.	Facebook-Augmented Partner Notification in a Cluster of Syphilis Cases in Milwaukee	2014	Examine how utilizing social media like Facebook allows for wider reach and greater contact made with individuals exposed in outbreaks. This study reviewed these methods being used in an outbreak of syphilis in Milwaukee.
Kerani, R.P., Fleming, M., DeYoung, B., Golden, M. R.	A randomized, controlled trial of inSPOT and patient-delivered partner therapy for gonorrhea and chlamydial infection among men who have sex with men	2011	Examining the efficacy of patient driven PNS / CT using inSPOT webservice. This study had low enrollment and found that few participants were willing to use inSPOT.
Kerani, R. P., Fleming, M., & Golden, M. R.	Acceptability and intention to seek medical care after hypothetical receipt of patient-delivered partner therapy or electronic partner notification postcards among men who have sex with men: The partner's perspective	2013	A survey that aimed to understand willingness to seek testing and care if notified by anonymous methods or inSPOT. Participants reported lower intention to seek care if notified anonymously.
Kutner, B. A., Pho, A. T., López-Rios, J., Lentz, C., Dolezal, C., & Balán, I. C	Attitudes and perceptions about disclosing HIV and syphilis results using SMARTtest, a smartphone app dedicated to self- and partner-testing	2021	Examining how apps to test for STIs (HIV and syphilis) may facilitate notification and linkage to care. Successful implementation, but authors noted a few privacy and digital security concerns that need to be addressed for widespread implementation.
Ling, S. B., Richardson, D. B., Mettenbrink, C. J., Westergaard, B. C., Sapp-Jones, T. D., Crane, L. A., Nyquist, A.-C., McFarlane, M., Kachur, R., & Rietmeijer, C. A	Evaluating a web-based test results system at an urban STI clinic.	2010	Evaluating an online system at a sexual health clinic. Results found that online notification decreased the number of calls coming into the clinic but had no effect on overall proportion of patients receiving their results on time.
Iyer, S., Zionts, D., Psaros, C., Tyagi, A., Jaralimoca, J., Platt, L., Kalweit, A., Ard, K., Bassett, I.	Electronic Partner Notification for Sexually Transmitted Infections: A Qualitative Assessment of Patient, Clinical	2024	Qualitative study that used interviews with patients and epidemiologists to explore the barriers and benefits to electronic partner notification services.

	Staff, and State Field Epidemiologist Perspectives		
Magaziner, S., Montgomery, M. C., Bertrand, T., Daltry, D., Jenkins, H., Kendall, B., Molotnikov, L., Pierce, L., Smith, E., Sosa, L., van den Berg, J. J., Marak, T., Operario, D., & Chan, P. A.	Public health opportunities and challenges in the provision of partner notification services: The New England experience	2018	Examining PNS programs across New England to understand barriers to practice and the key parts of successful PNS approaches and processes.
Mobley, V., Cope, A., Dzialowy, N., Maxwell, J., Foust, E., & Samoff, E.	A Comparison of syphilis partner notification outcomes by reported use of internet-based apps to meet sex partners in North Carolina, 2013–2016.	2018	This study looked at how likely partners are notified between people using apps to meet partners vs not. The authors observed no difference in the proportion of likelihood of notification.
Pennise, M., Inscho, R., Herpin, K., Owens, J., Bedard, B. A., Weimer, A. C., Kennedy, B. S., & Younge, M.	Using Smartphone Apps in STD Interviews to Find Sexual Partners	2015	This study allowed DIS to have access to smartphone apps to elicit PNS through online apps if traditional methods were unsuccessful. They conclude that using smartphones to supplement traditional methods is a successful method to PNS and case notification and finding.
Plant, A., Rotblatt, H., Montoya, J. A., Rudy, E. T., & Kerndt, P. R.	Evaluation of inSPOTLA.org: An Internet partner notification service.	2012	Aimed to provide quantitative data about the service of inSPOT for actual partner notification purposes. They concluded there is limited evidence of widespread usage and success.
Rahman, M. M., Johnson, C., Whyte, M., Ewell, J., Cope, A. B., Chandler, Y., Bennett, T. S., Gray, T., Gruber, D., & Peterman, T. A.	Electronic Messaging for Gonorrhea and Chlamydia Test Result Notification, Improving Treatment and Patient Satisfaction	2022	This study allowed clinics in Parish Health Units in Louisiana to provide STI results via an electronic software, Chexout, to mitigate clinic staff burden. The program was successful in improving notification and reducing staff burden.
Reed, J. L., Huppert, J. S., Gillespie, G. L., Taylor, R. G., Holland, C. K., Alessandrini, E. A., & Kahn, J. A	Adolescent patient preferences surrounding partner notification and treatment for sexually transmitted infections	2015	Reed et al aimed to understand the perceptions of adolescents having to receive STI test results. Their qualitative study showed that there was a preference to receive results via text message.
Reed, J. L., Huppert, J. S., Taylor, R. G., Gillespie, G. L., Byczkowski, T. L., Kahn, J. A., & Alessandrini, E. A	Improving sexually transmitted infection results notification via mobile phone technology.	2014	This study aimed to improve adolescent STI notification using mobile phone technology and STI information cards.

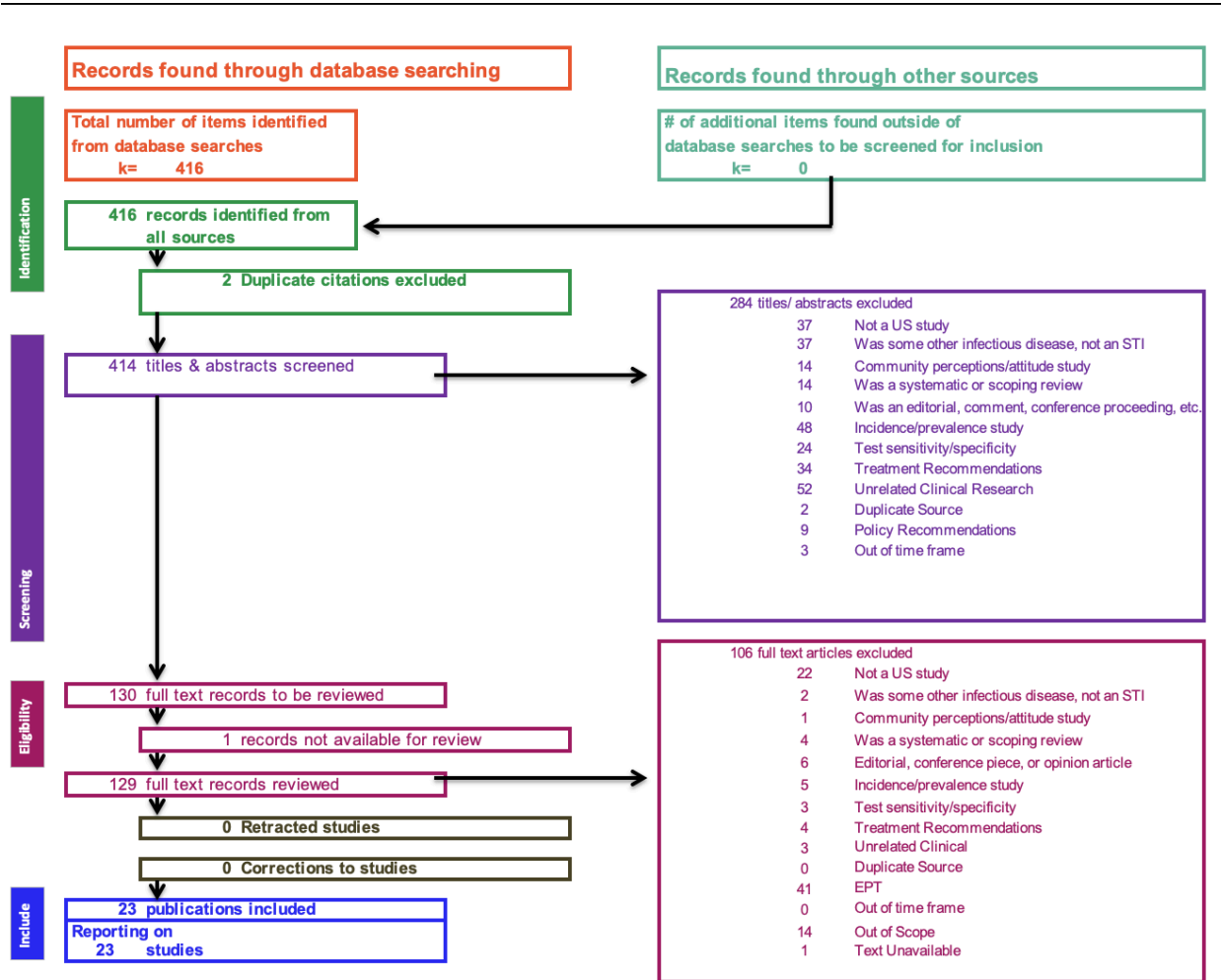|			
Rietmeijer, C. A., Westergaard, B., Mickiewicz, T. A., Richardson, D., Ling, S., Sapp, T., Jordan, R., Wilmoth, R., Kachur, R., & McFarlane, M.	Evaluation of an online partner notification program	2011	This study examined the use of inSPOT in a Colorado STI clinic. They conclude that the use of inSPOT is not effective as a widespread intervention among heterosexual populations.
Rodriguez-Hart, C., Gray, I., Kampert, K., White, M., Wolfe, C., Wilson, M., & Cooksey, A	Just text me! Texting sexually transmitted disease clients their test results in Florida, February 2012-January 2013	2015	This study was an evaluation of the Florida STD Texting Project that aimed to provide STI test results to patrons via text to reduce time between notification and initiation of treatment. This study showed that this program was successful in its aims.
Spielberg, F., Levy, V., Lensing, S., Chattopadhyay, I., Venkatasubramanian, L., Acevedo, N., Wolff, P., Callabresi, D., Philip, S., Lopez, T. P., Padian, N., Blake, D. R., & Gaydos, C. A.	Fully integrated e-services for prevention, diagnosis, and treatment of sexually transmitted infections: Results of a 4-county study in California.	2014	This study evaluated a pilot eSTI portal in Northern California. This portal allowed women to seek at-home STI self-testing and provided linkage to care if positive. They conclude that these types of programs should be widespread to improve STI prevention.
Udeagu, C.-C. N., Bocour, A., Shah, S., Ramos, Y., Gutierrez, R., & Shepard, C. W.	Bringing HIV partner services into the age of social media and mobile connectivity.	2014	Udeagu et al. augmented traditional PNS/ CT methods in NYC by introducing texting and internet-based methods to the traditional methods. This blend of methods allowed for greater identification of previously untraceable partners.

Appendix A.2 Charts

Records found through database searching	Records found through other sources
Total number of items identified from database searches **k= 416**	**# of additional items found outside of database searches to be screened for inclusion** **k= 0**

416 records identified from all sources

2 Duplicate citations excluded

414 titles & abstracts screened

284 titles/ abstracts excluded
- 37 Not a US study
- 37 Was some other infectious disease, not an STI
- 14 Community perceptions/attitude study
- 14 Was a systematic or scoping review
- 10 Was an editorial, comment, conference proceeding, etc.
- 48 Incidence/prevalence study
- 24 Test sensitivity/specificity
- 34 Treatment Recommendations
- 52 Unrelated Clinical Research
- 2 Duplicate Source
- 9 Policy Recommendations
- 3 Out of time frame

130 full text records to be reviewed

1 records not available for review

129 full text records reviewed

106 full text articles excluded
- 22 Not a US study
- 2 Was some other infectious disease, not an STI
- 1 Community perceptions/attitude study
- 4 Was a systematic or scoping review
- 6 Editorial, conference piece, or opinion article
- 5 Incidence/prevalence study
- 3 Test sensitivity/specificity
- 4 Treatment Recommendations
- 3 Unrelated Clinical
- 0 Duplicate Source
- 41 EPT
- 0 Out of time frame
- 14 Out of Scope
- 1 Text Unavailable

0 Retracted studies

0 Corrections to studies

23 publications included
Reporting on 23 studies

Identification | Screening | Eligibility | Include

Figure 1: PRISMA Flow Chart

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