Science Brief:
Evidence That HIV Cluster and Outbreak Detection and Response Strengthens HIV Prevention and Care Services

Contents

At a Glance

Cluster Detection and Response (CDR) involves understanding networks of people experiencing rapid HIV transmission; linking people in these networks to essential HIV and other related prevention and care services; and identifying and addressing gaps in programs and services, such as testing, HIV and other medical care, pre-exposure prophylaxis, and syringe services programs.

Overview

We have tools to diagnose, treat, and prevent HIV, but sometimes these services don't reach the people who need them the most. HIV cluster detection and response (CDR) is an important strategy to identify and close gaps in prevention and care services for communities experiencing rapid HIV transmission. [1]

Responding to clusters and outbreaks is important

- CDR is an essential public health service. [2] HIV clusters and outbreaks are signals that specific people and places are experiencing rapid transmission.
- Rapid transmission occurs because affected communities are not being reached by existing services due to stigma, discrimination, racism, poverty, and other social and structural factors.
- CDR helps health departments, community-based organizations and other partners respond to address inequities and make sure that resources are reaching the people and places that can most benefit from them.
- HIV clusters and outbreaks generally have very rapid transmission compared to the national average.
    - Transmission rates in molecular clusters average 8–11 times the national rate, and individual clusters and outbreaks have had transmission rates exceeding 30 times the national rate. [3] [4] [5] [6] [7] [8]
    - Rapidly growing clusters contribute disproportionately to future infections. [9]

Clusters and outbreaks are identified in multiple ways

- HIV clusters and outbreaks can be identified by:
    - Healthcare providers, community members, or health department partner services staff who notice changes in patterns of HIV diagnoses; [10] [11] [12] [13] [14] [15]

    - Analyzing surveillance data to identify increased diagnoses during a specific time period in a geographic area, sometimes called time-space clusters; [7] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] and
    - Analyzing HIV molecular data to identify clusters of highly similar HIV sequences, indicating rapid transmission. [8] [33] [34] [35] [36] [37] [38] [39]
- A detected cluster indicates a larger underlying network, which includes people with diagnosed and undiagnosed HIV and people who do not have HIV.
- In recent years, many of the largest responses have been to HIV outbreaks among people who inject drugs, which are often detected using non-molecular approaches, such as time-space analysis, partner services, or identification by providers or community members. [40] [41] These approaches are particularly effective at detecting rapid transmission when the typical number of people with newly diagnosed HIV is relatively low.
- HIV is most commonly transmitted sexually in the United States. Most clusters of rapid transmission identified through molecular analysis involve sexual transmission, including large clusters that are the same size as some large outbreaks among people who inject drugs. When first detected, molecular clusters are often small, indicating opportunities to respond early, link people to needed care and prevention services, and prevent transmission. [7] [8] [12] [38] [42] [43] [44] [45]
- CDR maximizes early detection of clusters and outbreaks and helps to identify the larger network of people affected by rapid transmission and tailor interventions to address gaps in their HIV care and prevention services. [7] [11] [12] [14] [30] [46] [47] [48]

Cluster and outbreak response leads to beneficial results

Many responses to HIV clusters and outbreaks have led to:

- Reductions in new HIV transmission and diagnoses;
- Improved HIV testing and diagnosis;
- Increased pre-exposure prophylaxis uptake;
- Expanded syringe services program utilization;
- Improved linkage to care, retention in care, and viral suppression; and
- Enhanced syndemic and structural interventions, including essential support services as well as prevention and care for syndemic conditions such as opioid use disorder and viral hepatitis.

Reductions in new HIV diagnoses and transmission

Key example: In an outbreak in Seattle, response interventions led to a decrease of 45% in HIV diagnoses among the affected population. [49]

Other selected examples:

- Northeastern Massachusetts: A substantial decrease in new injection drug use-related HIV diagnoses, from an average of more than 6 diagnoses per month to less than 2 diagnoses per month. [11]
- Cabell County, West Virginia: A decrease in HIV diagnoses from nearly 10 per month to less than one per month. [6]

- North Carolina: A lack of new cluster cases after a response, suggesting that response efforts ultimately prevented further transmission. [7]
- Indiana: The reduction of transmission below the epidemic threshold, suggesting that improving awareness of the outbreak, establishing a syringe services program, and deploying additional care services reduced transmission. [3]

HIV testing expansion

Key example: In an outbreak in the Portland metropolitan area in Oregon, expanded testing was conducted in encampments for people experiencing homelessness, at a mobile syringe services program, and at three local organizations that serve persons affected by homelessness and substance use disorder. Additionally, the emergency department of an academic medical center began triage-based universal HIV testing. [31]

Other selected examples:

- Massachusetts: Doubled the number of field epidemiologists, expanded partner services to all new HIV diagnoses, conducted enhanced field investigation for 120 cluster members, and expanded HIV testing in emergency departments, homeless shelters, and jails. [11]
- Seattle, Washington: Expanded HIV testing in emergency departments, jails, syringe services programs, homeless encampments, social service organizations, and a mobile clinic with 2,394 tests performed in more than 80 locations. [14] [44] [49]
- Indiana: Established new testing sites leading to expansion from 23 HIV tests/month to >600 tests/month. [50]
- West Virginia: Expanded HIV testing to multiple locations and through peer recruitment and expanded partner services, including initiating follow-up with 528 partners and social contacts, increasing funded HIV tests in various settings from 139 per month to 272 per month, and implementing a new nurse-driven HIV testing protocol at a hospital, resulting in an increase from 47 tests in 2018 to 207 tests in 2019. [6] [17] [31] [51]
- Northern Kentucky: Expanded HIV testing among people who inject drugs in emergency departments. [52]
- Philadelphia, Pennsylvania: Increased community testing at mobile units and fixed sites. [25]
- North Carolina: Expanded testing at syringe services programs. [7]
- San Antonio, Texas: Implemented opt-out testing at county safety-net hospital. [53]

HIV and other medical care expansion and enhancements

Key example: In response to a cluster in Miami, the response team implemented onsite services to improve linkage to HIV care and viral suppression. Flexibility and continuous quality improvement led to the design of a culturally appropriate navigation program for a population experiencing challenges accessing care in a complex healthcare system, and 100% of persons with acute HIV achieved viral suppression. [12]

Other selected examples:

- Philadelphia, Pennsylvania: Identified and promoted one-stop shops providing comprehensive services, including HIV treatment and pre-exposure prophylaxis (PrEP). [25]

- Seattle, Washington: Added low-barrier HIV care through a mobile clinic for women who were experiencing homelessness, who have substance use disorders, or who exchange sex. [44] [54]
- West Virginia: Enhanced care coordination and same-day HIV care appointments in Cabell County and Kanawha County, leading to a personalized, multi-disciplinary care system and improved viral suppression rates. [6] [31]
- San Antonio, Texas: Strengthened linkage to care services, leading to a decrease in time from HIV diagnosis to an initial HIV care appointment from 13 days to 2 days. [55]
- Indiana: Established HIV medical care for the first time in Scott County, facilitating a viral suppression rate of 75%. [50]

Prevention program expansion (pre-exposure prophylaxis & syringe services)

Key example: In response to a large molecular HIV cluster among Hispanic/Latino gay and bisexual men in San Antonio, Texas, the health department collected additional data showing that preexposure prophylaxis (PrEP) was not reaching these men. An alliance of patient advocates, city public health officials, academic medical center staff, and people with HIV collaborated to respond, leading to expanding the number of facilities offering PrEP from 4 to 25. [55]

Other selected examples:

- West Virginia: Expanded PrEP access through training >100 providers and expanding the number of PrEP providers from 2 to 15. [6] [56]
- Indiana: Modified laws to allow the first syringe services program (SSP) in the state, which provided linkage to HIV testing and treatment among other services. The SSP contributed to substantial decreases in unsafe injection practices and reduced HIV transmission. [50] [57] [58]
- Seattle, Washington: Expanded PrEP provision at STD clinics, SSPs, and a mobile clinic. [54]
- Oregon: Changed SSP policies from 1:1 exchange to needs-based distribution. [31]
- Seattle, Washington: Established a new mobile SSP and expanded SSP services, which resulted in distribution of >87,000 syringes and decreased sharing of injection equipment. [54]
- Massachusetts: Changed a state law leading to expansion of SSPs across the state. [11] [40]
- West Virginia: Changed SSP policies to expand eligibility and increase syringes provided. [6]
- Philadelphia, Pennsylvania: Increased funding for local SSP and doubling of capacity for exchange. [25]

Syndemic and structural interventions

Key example: In response to an HIV outbreak in northeastern Massachusetts, clinical care has been integrated into community-based settings including settings providing syringe services. These care services include office-based substance use treatment, low-barrier hepatitis C treatment, and PrEP, including services through routine and street-based telehealth. Expanded services also address challenges related to homelessness and incarceration. [10] [59]

Other selected examples:

- Indiana: Expanded immediate access to health insurance in Indiana, addressing an important structural barrier to care and prevention; also included treatment for opioid use disorder, hepatitis A vaccination, linkage to hepatitis C virus testing and treatment, and naloxone

distribution, contributing to hepatitis A prevention despite an outbreak in neighboring counties and reducing endocarditis admissions. [50] [57] [58]

- Atlanta, Georgia: Addressed linguistic and structural barriers to HIV prevention and care among Hispanic and Latino gay and bisexual men in a response to molecular clusters. [38] [60]
- Minnesota: Expanded Ryan White HIV/AIDS Program transitional housing resources, increasing the number of clients served from an average of 14 per year to 70 in 2020. [61]
- Southern West Virginia: Funded 11 health care entities to expand community-level prevention programs. [19]
- North Carolina: Linked people to hepatitis B and C care and treatment. [7]
- Seattle, Washington: Distributed 457 naloxone kits through new syringe service programs. [49]
- West Virginia: Provided 824 referrals to substance use disorder treatment in Cabell County. [6]
- Boston, Massachusetts: Secured housing for 17 people after their HIV was diagnosed in association with an outbreak. [62]

Strategies for optimizing cluster detection and response

Implementing partnerships, processes, data systems, and policies to facilitate robust, real-time cluster detection and response

- **Partnerships:** Given the multidisciplinary and multisectoral nature of CDR and need for rapid response-driven decision making, strong partnerships and active engagement of all levels of public health and community organizations are essential for both routine and escalated responses. This engagement should include staff and leaders across local, state, and federal partners with diverse areas of expertise and authority to implement change across program areas. [6] [11] [13] [19] [25] [30] [31] [33] [36] [39] [49] [52] [63] [64] [65] [66] [67]
- **Community Engagement:** Involving local community members, including people with HIV, people who could benefit from HIV prevention, and organizations trusted by affected communities is critical for success. Involvement of these key partners, both before and during responses, provides critical input and perspective on challenges and barriers and can strengthen the interventions needed to stop outbreaks. [5] [6] [7] [11] [15] [30] [31] [36] [44] [48] [49] [50] [52] [53] [59] [60] [66] [68] [69] [70] [71] [72] [73] [74] [75] [76]
- **Data and Laboratory Reporting:** Because CDR depends on availability of high-quality and timely surveillance data, increasing the timeliness and completeness of laboratory reporting and automation of health department data processing practices can speed up detection of and response to clusters and increase opportunities to avert additional cases. [6] [34] [49] [77]
- **Data Integration:** Successful CDR requires analyzing and integrating data from multiple sources, including HIV, STD, and viral hepatitis surveillance; partner services; and care systems, while maintaining appropriate data protections. Some health departments have developed innovative approaches to data integration, incorporating data sources beyond case surveillance and partner services data, and incorporating regional data sharing and collaboration. [7] [15] [25] [39] [67] [73]
- **Funding:** Successful CDR leverages diverse funding resources, including HIV surveillance and prevention funding; opioid, overdose, and injury prevention funding; Ryan White HIV/AIDS Program funding; public health preparedness funding; and state funds. [6] [11] [39] [78]

Investigating and intervening in networks affected by rapid transmission

- **Understanding networks:** Understanding HIV transmission networks is essential for identifying intervention opportunities. A detected cluster indicates a larger underlying network, which includes people with diagnosed and undiagnosed HIV and people who do not have HIV. [33] [79] [80]
    - A variety of approaches can reveal the extent and characteristics of a network, social or structural barriers and other challenges to accessing services, and opportunities for public health interventions.
    - These approaches include review of existing health department data, HIV partner services expansion, peer recruitment strategies, and qualitative and quantitative data collection. [6 [10] [11] [12] [13] [15] [18] [25] [29] [30] [31] [33] [34] [35] [36] [49] [51] [52] [59] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93]
- **Linking network members to services:** As factors facilitating HIV transmission are revealed, this information should be used to strengthen linkage to and provision of critical services, including testing and subsequent re-testing for HIV, hepatitis B, hepatitis C, and STDs; pre-exposure prophylaxis; SSPs; HIV medical care; and other essential support services (e.g., housing, social services).

Identifying and addressing gaps in programs and services revealed by cluster detection and response

- Amid a response, gaps in programs and services must be identified and addressed swiftly to limit transmission. Addressing gaps in lasting ways is crucial, and such improvements, whether made during or after a cluster response, are important for preventing future clusters and outbreaks. [55] [57] [63] [94]
- Outbreaks have occurred even in areas that were believed to have strong prevention programs, [10] [11] [14] [25] underscoring the opportunity for cluster response work to inform changes to prevention programming and support efforts to pursue continuous quality improvement.
- Gaps might be identified in the delivery of or access to testing, HIV and other medical care, pre-exposure prophylaxis, SSPs, or other services.
    - Programmatic response efforts may include strengthening these core HIV services and redoubling efforts to address social and structural gaps relating to homelessness, poverty, or stigma. [6] [7] [10] [11] [12] [14] [19] [25] [30] [31] [40] [44] [49] [50] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [81] [95] [62] [71]
- In addition to improving services, focused public health messaging is an important component of response. Numerous responses have also included prominent communications such as clinical advisories, dear colleague letters, health alerts, social media campaigns, and print materials intended for community members and providers that addressed notable topics in HIV prevention, testing, and care and dispelled misconceptions or myths. [6] [11] [14] [17] [19] [21] [22] [24] [25] [26] [27] [30] [36] [49] [94] [96]

Public perspectives on HIV molecular cluster detection for public health

- Several peer-reviewed articles have aimed to understand perspectives about HIV molecular cluster detection, also referred to as molecular HIV surveillance. These studies included

interviews or focus groups among people with HIV, people in communities experiencing disproportionately high rates of HIV, clinical service providers, public health staff, and researchers. Most participants cited the importance of molecular cluster detection for enhancing, expanding, and customizing HIV prevention methods. [97] [98] [99] [100] [101] [102]
    - Bollinger et al. interviewed 14 people with HIV and 10 people from communities experiencing disproportionately high rates of HIV. [97] Twenty-two (92%) participants expressed support for the use of HIV molecular cluster detection.
    - Rich et al. conducted focus groups of 10 public health staff and 7 researchers, all of whom demonstrated a positive perception of HIV molecular cluster detection. [98]
    - Other studies that included interviews with 18 people with HIV, 15 people in communities experiencing disproportionately high rates of HIV, 18 medical providers, and 29 public health professionals similarly reported that most participants recognized the value and potential of molecular cluster detection. [99] [100] [101] [102]
- Participants generally supported and trusted the community-based organizations and health departments with which they interacted. [99] [100] [101]
    - Interviews commonly identified knowledge gaps in community members' understanding of the purpose and process of molecular cluster detection. [99] [100] [102]
    - Providers who considered their services part of public health efforts were more supportive of its use than those who thought of their work as separate from public health. [100]
    - Participants emphasized the importance of continued and expanded community engagement and education. [97] [100] [101]
- Some community members and providers raised concerns about molecular cluster detection.
    - These concerns included consent issues, [99] [100] fear of data use in criminal cases against people with HIV, [100] mistrust of the government, [99] fear of inadvertent disclosure to partners or family, [100] increased stigma for affected populations, [100] and data privacy concerns. [97] [98] [99] [100]
    - Some concerns raised were not specifically about molecular cluster detection but HIV and public health surveillance in general, and how data are stored and handled. [97] [100] These wider concerns were related to the lack of consent for sharing information with public health agencies, potential violations of privacy and legal risk exposure, insurance discrimination, and stigma.
- In summary, although data show high levels of support for HIV cluster detection and response (CDR), some community members and providers have expressed concerns about aspects of this work.
    - Engaging communities and partners and expanding clear communication about CDR and public health surveillance is essential for HIV CDR programs.
    - This engagement can help health departments better understand and address community concerns and keep partners and the public informed.

Conclusions

- HIV cluster detection and response (CDR) is an essential public health service that guides HIV prevention resources to the people and places that can most benefit from them.

- CDR advances health equity by supporting people that traditional healthcare and public health systems have failed to serve adequately.
- CDR seeks to understand networks experiencing rapid HIV transmission and to identify and address gaps in and barriers to essential programs and services such as testing, medical care, pre-exposure prophylaxis, and syringe services programs. People in the transmission network are linked to needed services, and programs can better serve future clients.
- Many jurisdictions have used these response strategies and have shared evidence of improved outcomes related to HIV care and viral suppression, testing, use of prevention services, and reductions in transmission or new diagnoses.
- Community engagement can help health departments better understand and address community concerns about CDR and HIV surveillance and keep partners and the public informed.
- CDR strengthens HIV prevention through multidisciplinary, multisector collaboration to address underlying structural factors and gaps in service delivery.

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