

risk factor, increased in Scotland after 2000 and remained at high levels until 2010–11.<sup>9</sup> Phylogenetic analysis of HIV sequences from the Glasgow outbreak reveals that the effective reproductive number (ie, the average number of secondary HIV infections originating from each individual) increased around the same period and peaked in 2009.<sup>10</sup> Increases in homelessness might have resulted in changes in network cohesion (ie, in the connectedness within injection networks). Even if risk behaviours over time remain stable, changes in network cohesion might explain increased transmission.<sup>11</sup> Thus, the introduction of HIV into a highly interconnected network of homeless people, along with the sharing of injecting equipment, might have triggered the outbreak. Additionally, the increased use of cocaine might have resulted in higher levels of HIV risk-taking behaviours and amplified transmission.

The size of the Glasgow outbreak was relatively small compared with those in Athens and Bucharest.<sup>1</sup> However, another intriguing question is why HIV transmission persisted for more than 3 years in Glasgow despite a multidisciplinary response that included linkage to HIV treatment of infected PWID, HIV education of those at risk, increased testing, and improved provision of injecting equipment.<sup>2</sup> This approach might have not been successful in reaching those most in need quickly enough. The fact that the epidemic was recognised 6 years after the peak of secondary transmission<sup>10</sup> suggests that there might be a subgroup of PWID not accessing services where they could be diagnosed and linked to treatment. Community-based approaches with peer-driven chain referrals, such as the ARISTOTLE programme in the Athens outbreak<sup>6,8,12</sup> where this strategy was used to seek, test, and treat PWID, can help to increase the penetration into injection networks and to quickly reach those most at risk for HIV.

The Glasgow outbreak, along with other recent epidemics among PWID, underlines how vulnerable this

population is to changes in the economic, social, and drug-market scene and how fragile the success of interventions can be in preventing HIV outbreaks. High-coverage harm reduction programmes should be combined with surveillance of HIV infection and associated behaviours through community-based programmes, with an effort to reach the most underserved populations and to react rapidly to potential threats.

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## Youth at risk of HIV: the overlooked US HIV prevention crisis

Since the 1980s, the number of estimated annual HIV infections in the USA has declined more than 60%, with a decline of 8% between 2010 and 2015.<sup>1,2</sup> Despite this improvement, disparities in HIV prevention and

treatment outcomes remain a concern, pointing to inadequate progress in curtailing the epidemic among key populations, such as adolescents and young adults aged 13–29 years. Between 2012 and 2016,

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HIV diagnoses among adolescents and young adults increased 6%, whereas HIV diagnoses among adults declined or stabilised over the same period.<sup>3</sup>

Nowadays, 41% of new HIV diagnoses occur among adolescents and young adults.<sup>3</sup> The rates of new HIV diagnoses are highest among racial and ethnic minority youth and young men who have sex with men (MSM).<sup>3</sup> Alarming, new diagnoses among Latino young MSM increased 17% between 2012 and 2016, and new diagnoses among black young MSM increased 9%.<sup>3</sup> Collectively, racial and ethnic minority young MSM accounted for 63% of new HIV diagnoses among adolescents and young adults in 2017.<sup>3</sup> Transgender youth, particularly transgender women, and the growing number of youth who inject drugs represent additional populations with increased vulnerability to HIV. Given this underappreciated youth HIV crisis, new data highlighting so-called micro-epidemics with elevated rates of HIV transmission events along social and sexual networks throughout the USA are important to note.<sup>4</sup> Using molecular diagnostic methods, the US Centers for Disease Control and Prevention (CDC) identified 60 HIV high-transmission clusters with up to 33 times the national transmission rate, consisting predominantly of adolescents and young adults, particularly Latinos, blacks, and young MSM.<sup>4</sup>

Adolescents and young adults get tested for HIV, use pre-exposure prophylaxis (PrEP), and achieve viral suppression at lower rates than do older individuals. For example, about half of HIV-positive young people aged 13–24 years in the USA are unaware of their HIV status.<sup>2</sup> Although the safety and efficacy of PrEP for adolescents and young adults has been established, PrEP services do not adequately reach young people with the greatest need. An estimated 700 000 at-risk adolescents and young adults in the USA could benefit from PrEP,<sup>5</sup> but only 27 330 prescriptions for PrEP have been issued to this population since 2012.<sup>6</sup>

Similarly, adolescents and young adults living with diagnosed or undiagnosed HIV have consistently worse outcomes across the HIV treatment continuum than do people with HIV aged 25 years and over. More than a quarter of adolescents and young adults diagnosed with HIV do not receive HIV care within a month of diagnosis, a rate that is higher than for older age groups.<sup>7</sup> Around a quarter of adolescents and

young adults are not retained in care, representing retention-in-care rates below the average across all age groups.<sup>7</sup> Only 51% of adolescents and young adults who have been diagnosed with HIV achieve viral suppression, which is a smaller proportion than among older individuals,<sup>7</sup> and research shows around a third of adolescents and young adults who achieve viral suppression do not sustain it.<sup>8</sup>

Within the youth HIV epidemic there is unequal access to preventive and acute health-care services for key populations, including sexual and racial and ethnic minorities.<sup>9</sup> Additionally, young people aged 18–29 years have lower rates of health insurance than older individuals,<sup>9</sup> and adolescents under 18 years face unique regulatory, insurance, and confidentiality challenges to accessing HIV services. For example, in many jurisdictions, prescribing PrEP to adolescents in the absence of parental or guardian consent is not allowed.<sup>10</sup> Issues of confidentiality also represent important barriers to accessing HIV prevention services for adolescents and young adults, and in around half of US states, medical information of people under 18 years related to HIV services can be disclosed to parents without adolescent consent.<sup>10</sup> Furthermore, vulnerable adolescents and young adults in socio-economically disadvantaged environments are at increased risk of outcomes that shape negative health trajectories. These include low access, engagement, and quality of health-care services, as well as low educational achievement, poverty, and poor housing conditions.<sup>11</sup> Specifically, youth populations at highest risk for HIV infection, such as young MSM of colour, transgender youth, and injection drug users, routinely experience stigmatisation and discrimination on the grounds of racism, homophobia or transphobia, and social exclusion.<sup>12</sup> As a result, these groups often mistrust health-care providers and broader systems of health care.<sup>12</sup>

Unfortunately, many existing HIV services in the USA do not meet the needs of at-risk adolescents and young adults. National efforts to adopt novel, differentiated, and age-specific approaches for adolescents and young adults are sorely needed.

First, in addition to guideline-based routine HIV testing of adolescents and young adults in primary care, innovative testing approaches outside of health-care settings are needed to target key populations

with insufficient access to health-care services. Partner-based index case testing of newly or acutely infected, virally unsuppressed, and PrEP non-adherent youth who are most likely to transmit or acquire HIV should be prioritised. Beyond partner-based testing, novel network-based approaches that use targeted testing in high-risk networks, including micro-epidemics identified by the CDC, have been successful in identifying undiagnosed people with HIV.<sup>13</sup> Furthermore, home-based self-testing has been shown to reach MSM who have never tested for HIV.<sup>14</sup> Lastly, the CDC recommends venue-based testing programmes in settings frequented by vulnerable youth populations.<sup>15</sup>

Second, emerging evidence supports the scale up of differentiated care models that align delivery systems for HIV prevention and treatment with the specific needs of vulnerable key populations.<sup>16</sup> Youth-centered differentiated HIV service delivery engages contextual support factors, including family members, and involves multidisciplinary services that integrate primary, sexual and reproductive health, substance use, and mental-health care services with HIV treatment, prevention, and case management.<sup>17</sup> Promising differentiated care models closely monitor patients' outcomes to prioritise more intensive services for youth who need more support.<sup>16</sup>

Finally, education, awareness, and service access are important areas for policy responses to the youth HIV prevention crisis. The absence of universal comprehensive sex education in the US school system should be addressed. Today, fewer than half of all states mandate medically accurate sex and HIV education.<sup>18</sup> Furthermore, given declines in condom use among youth,<sup>19</sup> programmes aimed at boosting access to condoms and providing guidance for consistent and correct use are essential. Funding programmes that promote engagement and retention in HIV services among adolescents and young adults could also be beneficial, including social media marketing to reduce stigma and support mental health for vulnerable groups. Lastly, regulatory access barriers to sexual and reproductive health services and PrEP need to be eliminated across states.<sup>10</sup>

Despite population-level progress, increased efforts to reduce disparities among the growing number of HIV-positive adolescents and young adults in the

US are needed. A paradigm shift in HIV prevention research, practice, and policy is warranted. National efforts should prioritise differentiated and youth-friendly HIV prevention models, and address social determinants shaping engagement and retention in prevention services among adolescents and young adults.

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