International Journal of Drug Policy 154 (2026) 105371

Contents lists available at ScienceDirect

International Journal of Drug Policy

journal homepage: www.elsevier.com/locate/drugpo

Provision of safer smoking equipment to reduce health harms and enhance service engagement among people who use crack: a realist informed review

Alexandre Piot [a,*], Casey Sharpe [a], Cedomir Vuckovic [a], Caitlynne McGaff [a], Jenny Scott [b], Vivian Hope [c], Lucy Platt [a], Magdalena Harris [a]

[a] Department of Public Health, Environments and Society, London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, London, WC1H 9SH, United Kingdom
[b] Centre for Academic Primary Care, Population Health Sciences, Bristol Medical School, University of Bristol, Canynge Hall, 39 Whatley Road, Bristol, BS8 2PS, United Kingdom
[c] Public Health Institute and School of Public and Allied Health, Liverpool John Moores University, 3rd Floor Tithebarn Building, 79 Tithebarn Street, Liverpool, L2 2ER, United Kingdom

ARTICLE INFO

Keywords:
Crack cocaine
Crack pipe
Harm reduction
Intervention
Service engagement

ABSTRACT

Background: Safer smoking equipment interventions for people who smoke crack cocaine have been unevenly implemented globally with most harm reduction policy and practice focused on preventing opioid and injecting related harms. There is a need to synthesise the international evidence on safer inhalation equipment provision for crack and understand how, why, for whom, and in what context can such interventions improve engagement with services, promote safer use practices, and reduce harm.

Methods: Bibliographic databases ($n = 8$) and grey literature sources were searched for reports on the distribution of safer inhalation equipment among adults who use crack. Data synthesis was applied around a realist framework, focusing on contextual factors and mechanisms which influenced the interventions' outcomes.

Results: Evidence from 16 peer reviewed and 6 grey literature studies was included. Overall, acceptability of safer inhalation interventions and uptake (≈ 90% in some studies) was high. Evidence pointed towards reduced pipe sharing, decreased injecting, and improved engagement with health and social services. However, implementation was frequently hindered by resource, political, and logistical constraints. Five context-mechanism-outcomes were developed covering service accessibility, integrated provision, tailored provision, peer-supported behaviour change, and organisational resilience against criminalisation and funding cuts. Service engagement and the adoption of safer crack use practices were greater when supportive contexts activate key mechanisms such as perceived safety, ease of access, perceived relevance, and peer-supported learning.

Conclusion: Although political, legal and funding constraints can impede implementation and optimal delivery, this review highlights the role of accessible, integrated and peer supported delivery models that services and policymakers can deploy to effectively reduce crack-related health harms and foster engagement with services.

Introduction

Globally, crack cocaine use is rising, a trend likely associated with the rapid increase in global production of cocaine (UNODC, 2023). Correspondingly, wastewater analysis indicates a significant rise in the consumption of cocaine products in Europe since 2015, with the estimated consumption doubling (European Union Drugs Agency, 2024). In North America, there has also been an increase in the use of psychostimulants such as crack since 2010 which has largely remained unaddressed whilst the opioid crisis unfolds (Fischer et al., 2021). In many countries, such as the UK, there is an absence of interventions which address the needs of people who use stimulants (Harris, 2020), including the provision of safer inhalation equipment for people who smoke crack cocaine despite preliminary indications of benefits to public health (Bergen-Cico & Lapple, 2015; Prangnell et al., 2017).

Interventions for people who use crack (PWUC) are often limited to psychosocial support and equipment provision. Typically, the latter includes needles and syringes for those who inject crack, or safer inhalation kits for those who smoke it. Safer inhalation kits generally contain a straight stem pipe made from heat-resistant glass, a metal gauze or brass

* Corresponding author.
E-mail address: alexandre.piot.20@ucl.ac.uk (A. Piot).

https://doi.org/10.1016/j.drugpo.2026.105371

Available online 5 June 2026

screen which is placed in the pipe to hold the drug being consumed (hereafter called suspension device), and a rubber mouthpiece to facilitate individual use practices and prevent oral burns (Strike & Watson, 2017). Safer inhalation kits also often include a wooden push stick to help place the suspension device within the pipe, lip balm, condoms, chewing gum and harm reduction based educational material.

Provision of stimulant inhalation equipment has primarily been informed by an HCV prevention remit, although evidence for this in the context of pipe sharing is equivocal (Hermanstyne et al., 2012; Macías et al., 2008). There are indications, however, that pipe provision can operate as a route transition tool, enabling reduction of injection practice (Leonard et al., 2008; Weeks et al., 2009) which is a primary risk for HIV and HCV transmission (Artenie et al., 2023). Route of administration transitions (or lack thereof) are strongly driven by personal preference, which can be shaped by perceptions of risk and social interactions, desires for safer/more controllable routes of administration in changing drug markets, and desires to maintain survival and well-being (Bonn et al., 2025; Harris et al., 2020). Facilitating access to options for safer inhalation through the provision of pipes and information on the benefits of transitioning, may encourage decreases in injecting practices. Additionally, given the lack of licensed pharmacological options for stimulant use (Ronsley et al., 2020), smoking equipment provision also serves as an important engagement tool with services (Bergen-Cico & Lapple, 2015; Chung et al., 2025) and can reduce the use of homemade pipes and their associated injuries such as cuts and burns (Frankeberger et al., 2019; Prangnell et al., 2017).

Currently, only 26 countries have some form of safer stimulant smoking kit distribution programme, operating under different legal frameworks (Harm Reduction International, 2025). Even in contexts where the distribution and/or possession of paraphernalia is permitted by law, other factors influence provision, including perceived need, service availability, funding priorities, as well as public and political perception. In the UK, it is illegal under the Misuse of Drugs Act 1971, Section 9A, to supply unexempt materials for the purpose of consuming a controlled drug. Only certain injecting materials and foil for smoking are currently exempt.

Crack cocaine use is rising in the UK, with a 19% increase in the number of people using only crack between 2017 and 2020, and a 24% increase in those using both crack and opioids during the same period (UK Health Security Agency; Office for Health Improvement and Disparities, 2023). After rising in 2022-23, the proportion of adults entering treatment for crack cocaine stabilised between 2023 and 2024 (n = 30,065) and 2024-2025 (n = 32,399) at 19% (Office for Health Improvement and Disparities, 2024, 2025). Modelling estimates from 2017 suggest that 29% of PWUC in England do not use opioids, and are therefore less likely to be engaged in services for people who use drugs (Hay et al., 2019) which could be attributed to a lack of relevant service offerings (Black, 2021; Lloyd et al., 2025; Public Health England & Home Office, 2019) and stigma (Duopah et al., 2024). Drug-related death registrations for 2024 in England and Wales showed that deaths where cocaine was detected in post-mortem toxicology rose for the 12th consecutive year, with 77% of these deaths occurring in men (Office for National Statistics, 2025). It is of note, however, that these figures do not distinguish between the routes of administration and therefore include all forms of cocaine use (e.g. insufflation, injection, inhalation).

Taken together, these trends underscore the need for an explanatory synthesis of the global evidence on the provision of safer inhalation kits, the primary intervention specifically addressing the needs of PWUC. In the absence of an existing synthesis, and in the context of increasing crack use alongside limited treatment options, the case for this synthesis is strengthened.

A realist informed review is suited to this task as it asks how, why, for whom, and in what circumstances do safer inhalation initiatives achieve (or fail to achieve) their aims by interrogating the interplay between context, mechanisms, and outcomes (CMO). Through a systematic mapping of CMO configuration across varied legal and service settings, we can move beyond the question of whether it works. This has already been addressed in a systematic review that reported distribution of inhalation kits led to health improvements (e.g. reduced oral injuries such as cuts and burns and respiratory issues) and a reduction in risky behaviours (e.g. pipe sharing, reliance on broken or makeshift pipes) (Tapper et al., 2023). Building upon this, through a realist lens we can identify transferable design principles which facilitate (or hinder) safer inhalation kit distribution, reduce harms, and open pathways to broader care for PWUC. The resulting configurational understanding is particularly valuable for jurisdictions where the provision of pipes remains contested or prohibited, as it provides practitioners and policymakers with evidence-based levers for implementing, adapting, and evaluating interventions within existing regulatory and resource constraints.

Methods

This review was conducted as part of a broader project evaluating an intervention to improve the health outcomes and service engagement for people who smoke crack cocaine (Harris et al., 2024).

Using pre-specified search terms, we searched 8 databases on May 15–16th 2024 (Medline, Scopus, Global Health, Web of Science, CINAHL, PsycINFO, Cochrane Library, and EMBASE) for public health and social science literature on evaluations that combined two search domains: 1) crack use and 2) safer inhalation kit interventions (e.g. crack kit, pipe, suspension devices, mouthpiece, etc). No limitations were placed on publication date. The search terms used for each database can be found in Supplementary Materials. Using similar search terms, grey literature was identified by searching preprint databases (MedRxiv, bioRxiv, PsyArXiv), Google, and the Health Research Board National Drug Library between July 11th and July 29th, 2024. Only the first 100 results of Google were considered, and incognito mode was used to limit bias in search results. Additionally, 27 individuals and organisations working in harm reduction were contacted to request if any relevant records were held. We also undertook forward and backward citation searching on included studies to locate further eligible literature.

This search was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Page et al., 2021).

Strategy for article selection and data extraction

English language qualitative, quantitative and mixed methods studies reporting primary data on an intervention that provided smoking equipment (including but not limited to pipes, suspension devices, mouth pieces, and push sticks) to PWUC and report at least one outcome related to health conditions, drug use risk practices, or access /

Table 1
Summary of the inclusion and exclusion criteria used for study selection.

Inclusion Criteria	*Exclusion Criteria*
Includes an intervention component which provides crack smoking equipment to PWUC, and primary data relating to the provision of crack smoking equipment	Studies which did not include distribution of equipment for safer smoking of crack.
Qualitative, quantitative and observational studies; either published or in the grey literature	Editorials, comment articles, conference posters, abstracts
Additional inclusion criteria for quantitative studies:	
Examines the association between the intervention/programme and an outcome of interest (e.g. injecting frequency, injecting-route transitions blood borne viruses viral infections, pipe sharing, respiratory health, service engagement)	
Additional inclusion criteria for qualitative studies:	
Explores the experience of the intervention from the perspective of people who use crack or service providers.	
Explores contextual factors that facilitate/inhibit crack pipe interventions	

engagement with services were eligible for inclusion (Table 1). Further inclusion criteria based on study design required quantitative studies to examine the association between the provision of crack smoking equipment and an outcome of interest, and qualitative studies to explore the experiences of the intervention from the perspective of PWUC / service providers or contextual factors that facilitated or inhibited the intervention.

We excluded studies where no intervention was implemented, editorials, commentaries, newspaper articles, conference posters/abstracts, and reviews where no primary data were presented.

Two reviewers independently assessed each title and abstract against the pre-specified inclusion/exclusion criteria (all authors), resolving disagreements by discussion at regular meetings. Where abstracts were unavailable, introduction and/or executive summaries were screened. Full texts were obtained for records deemed potentially eligible. For each study, two reviewers (AP and CS) independently reconfirmed eligibility during full text screening (recording exclusion reason where applicable). Data were extracted into Microsoft Excel by AP or CS on the intervention (date, location, safer smoking equipment offered, delivery method, theory/rationale), implementation (components/sequence, prohibited activities, tailoring, contextual factors), and evaluation (study design, sample size, demographic characteristics, outcomes results, limitations). A second reviewer (AP or CS) checked all extracted data against source reports, with discrepancies resolved through discussion and team consensus.

Data synthesis

Findings on the effectiveness of the intervention were first identified and synthesised. These findings are organised into three main areas of interest: engagement with services, drug use practices and health outcomes. We conducted a narrative synthesis, structured by a realist framework (Pawson & Tilley, 1997). Study level thematic summaries were developed, highlighting the interventions' impact and how this was achieved or hindered within a particular context. By comparing these data driven summaries across different context, mechanism, outcome (CMO) configurations, we identified recurring patterns linking specific intervention approaches to observed effects, addressing how, why, for whom, and in what context were the interventions successful or not. We then articulated overarching CMO models and presented these in a workshop with stakeholders, including drug treatment service workers/managers and people with lived experience of crack use, to receive feedback and ensure their relevance. Feedback from this workshop helped shape the final CMO model presented below. Furthermore, where data allowed, we conducted subgroup analyses to explore the differential impacts and experiences of the interventions among specific populations, including women, sex workers, and racially marginalised groups.

This approach is defined as "realist informed" rather than a full realist review primarily because a fixed systematic search strategy was used, and stakeholders were engaged only after the initial CMO development, rather than employing an iterative search and continuous stakeholder engagement.

Protocol deviations

The protocol for this study was registered on PROSPERO (CRD42022380049). Following registration, we amended the search strategy to expand reach (included wildcard syntax) and decided against conducting a standardised quality assessment as originally planned. This decision was made due to the small number and heterogeneous design of eligible publications identified after the search was run. This was more in line with the realist framing and as our aim was to develop explanatory models of how the interventions operate, rather than to empirically estimate efficacy, it was not deemed essential. Sub-group analyses took place where data permitted. As most of the eligible studies precluded participants under the age of 18 and were based in urban settings, we were unable to conduct a sub-group analysis of youth or PWUC in rural areas.

Results

Study selection

Overall, 2434 peer reviewed studies were identified from 8 databases: Medline (n = 411), Scopus (n = 501), Global Health (n = 102), Web of Science (n = 412), Cumulative Index to Nursing and Allied Health Literature (CINAHL; n = 269), PsycINFO (n = 221), Cochrane (n = 41) and EMBASE (n = 477). Following deduplication, screening, and backward/forward citation searching, a total of 16 peer reviewed studies and 6 grey literature documents were included in the analysis (Fig. 1).

Study characteristics

Of the 16 peer-reviewed studies, nine were quantitative, three were qualitative, and four employed mixed methods (Table 2). One grey literature study was quantitative; one was qualitative and four were mixed methods. Most studies were conducted in Canada (n = 13), followed by the United States (n = 4), Mexico (n = 2), Ireland (n = 2) and Brazil (n = 1). A range of methodological approaches were employed, including cross-sectional/repeated cross-sectional (n = 14) (Bergen-Cico & Lapple, 2015; Cepeda et al., 2024; Chung et al., 2025; Frankeberger et al., 2019; Jagoe, 2014; Leonard et al., 2008; Malchy et al., 2011; Prangnell et al., 2017; Reid et al., 2023; Ross, 2015; Shang et al., 2023; Ti et al., 2012; Ti et al., 2011; Weeks et al., 2009), and ethnographic/qualitative research (n = 8) (Backé et al., 2012; Boyd et al., 2008; Domanico & Malta, 2012; Ivsins et al., 2011; Johnson et al., 2008; Miskovic et al., 2018; O'Hearie, 2013; O'Reilly & Mac Cionnaith, 2019). Certain publications which related to crack cocaine, but which did not provide primary data or intervention specific outcomes as described in our inclusion/exclusion criteria were not included (Cadet-Taïrou et al., 2021).

Interventions

All interventions provided safer inhalation kits, typically including a borosilicate glass pipe, mouthpieces to prevent burns and minimise sharing, as well as a crack suspension device (brass screens or metal gauze) for use within the pipe. Additional equipment components often included were push sticks, alcohol swabs, bandages, lighters, safer sex materials and printed harm reduction information (Frankeberger et al., 2019; Johnson et al., 2008; Malchy et al., 2011; Prangnell et al., 2017). One exception was an intervention which offered a menu of different harm reduction kits (e.g. safer injection, wound care, safer snorting), including safer inhalation kits containing alcohol wipes, lip balm, a mouthpiece, screens and a wooden push stick but no pipes due to state paraphernalia laws (Shang et al., 2023).

Harm reduction information components varied, with forms of delivery including in-depth peer-led information sharing (Cepeda et al., 2024; Domanico & Malta, 2012; Weeks et al., 2009), one-to-one guidance upon distribution (Malchy et al., 2011; Ross, 2015), or hard copy resources (Bergen-Cico & Lapple, 2015; Domanico & Malta, 2012; Frankeberger et al., 2019; Johnson et al., 2008; Ross, 2015).

Modes of equipment distribution included peer led outreach (Cepeda et al., 2024; Domanico & Malta, 2012; Weeks et al., 2009), mobile vans (Ivsins et al., 2011; Prangnell et al., 2017; Ross, 2015), fixed site services (Bergen-Cico & Lapple, 2015; Miskovic et al., 2018; Prangnell et al., 2017; Shang et al., 2023), or a combination of these (Backé et al., 2012; Ivsins et al., 2011; Ross, 2015).

Some papers reported on interventions they developed and/or implemented (Cepeda et al., 2024; Domanico & Malta, 2012;

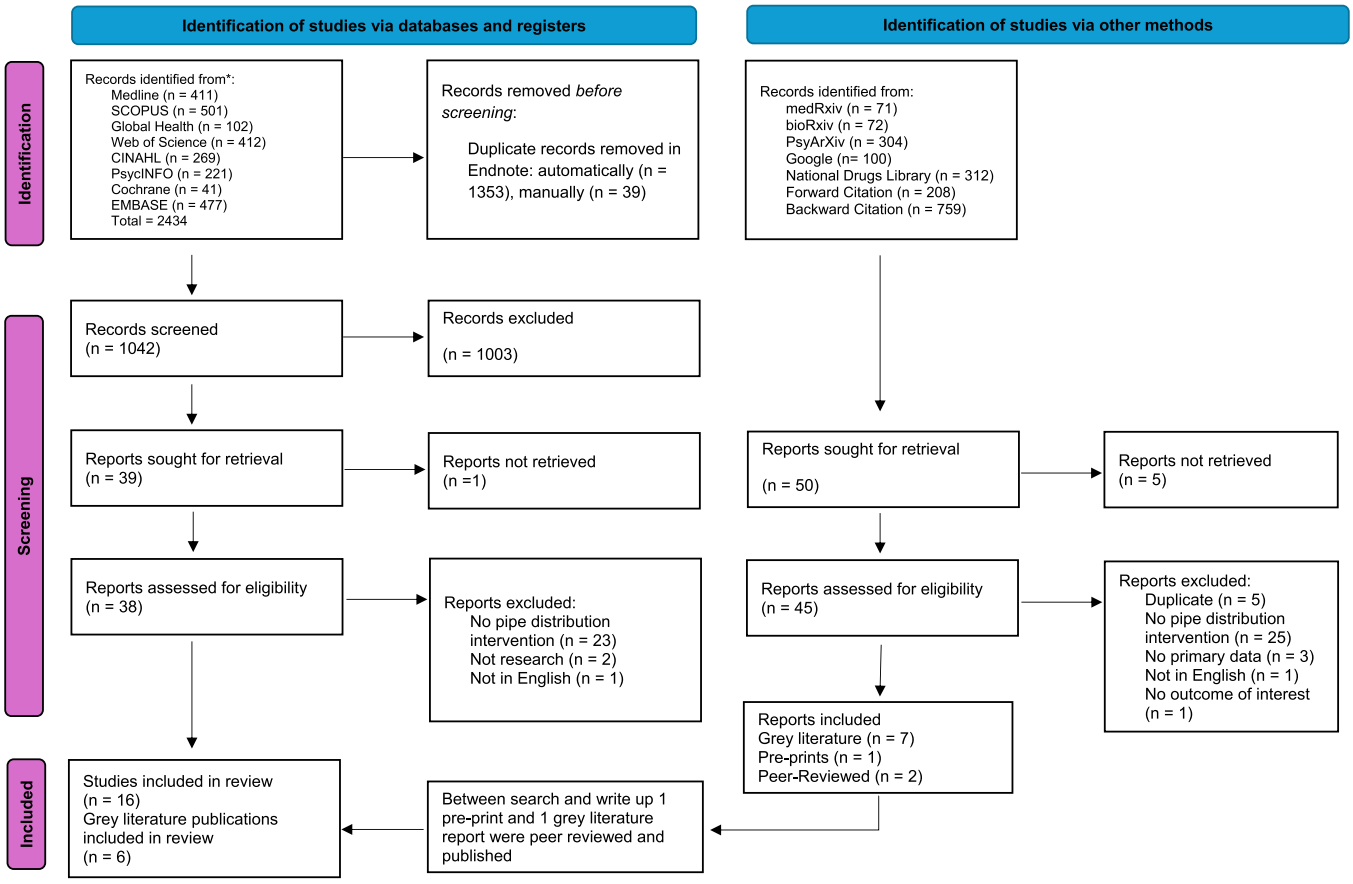

Fig. 1. PRISMA flow Diagram of study selection.

Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Frankeberger et al., 2019; Miskovic et al., 2018; O'Hearie, 2013; O'Reilly & Mac Cionnaith, 2019; Ross, 2015; Weeks et al., 2009), whereas others reported on the outcomes of interventions run by regional or local health authorities (Bergen-Cico & Lapple, 2015; Boyd et al., 2008; Chung et al., 2025; Ivsins et al., 2011; Jagoe, 2014; Leonard et al., 2008; Malchy et al., 2011; Prangnell et al., 2017; Ti et al., 2012; Ti et al., 2011). All interventions took place in urban settings.

The duration of distribution programmes varied significantly, from short-term initiatives like Mexico City's projection art installation project which ran for six weeks (Cepeda et al., 2024; Frankeberger et al., 2019), to programmes in Vancouver, Toronto and Winnipeg intended to be introduced and integrated into the local harm reduction and service delivery frameworks (Miskovic et al., 2018; Prangnell et al., 2017; Ross, 2015). While some initiatives, particularly on the West Coast of Canada, became permanent parts of the local harm reduction approach, other initiatives were terminated due to political or funding constraints (Chung et al., 2025; Jagoe, 2014).

Role of peers in delivering, refining, and increasing the reach of interventions

The role of peers (people with lived or living experience of crack use) varied across different interventions and was not always described. However, where peers were mentioned, they played a crucial role in facilitating access to services by sharing information and providing support within their communities (Domanico & Malta, 2012; Johnson et al., 2008; Weeks et al., 2009). In Hartford, formal harm reduction training sessions were offered to people who use drugs (PWUD), providing them with materials (e.g. harm reduction equipment and information leaflets) to distribute when conducting prevention interventions in their community (Weeks et al., 2009). A similar approach was taken in Brazil, where PWUD received informal peer-led training in harm reduction intervention delivery which they then propagated, emphasising the community-driven aspect of the intervention (Domanico & Malta, 2012). In Mexico City, community leaders delivered the education material and safer inhalation kits, though not all had lived experience of drug use. They received training in the use of the kits and how to teach others about it. Here too, much of the training was informal (Cepeda et al., 2024; Frankeberger et al., 2019). Even where peers were not explicitly central to the development or delivery of an intervention, they still played a key role in dissemination and offered feedback on how it could be improved (Boyd et al., 2008; Ivsins et al., 2011; O'Hearie, 2013).

Uptake of safer inhalation kits

Multiple studies noted high levels of adoption of safer smoking distribution services (Jagoe, 2014; Leonard et al., 2008; Ross, 2015). In Vancouver 94% of respondents had either accessed the service themselves or through someone else 12 months post implementation (Leonard et al., 2008). In Mexico City and Vancouver PWUC who received a safer smoking kit reported a significant increase in the use of borosilicate glass pipes provided in the kits with approximately 20% more reporting always using them post implementation (Frankeberger et al., 2019; Malchy et al., 2011). Reported factors contributing to the increased adoption of safer inhalation practices included exposure to harm reduction messages (Frankeberger et al., 2019) and the increased availability of pipes (Boyd et al., 2008). Additionally, participants

Table 2
List of included studies – locations, interventions being evaluated, and intervention descriptions.

Author, Year	Location	Publication type and Method (date data collection)	Sample characteristic (% women) (Recruitment Method)	Intervention Setting and Description	Aim
Domanico and Malta, 2012	5 cities, Brazil	Peer Reviewed Qualitative Observations and Interviews (2002-2005)	Programme coordinators and PWUC *n* = 30 (43.3%) (Convenience sampling)	Street outreach and fixed locations Peers recruited and trained as outreach workers distributed safer inhalation kits and provided social/ medical referrals	Investigate the operation and acceptability of the peer-led intervention
Jagoe, 2014	Calgary, Canada	Grey Literature Quantitative Cross-sectional survey (June 2010–April 2011)	Unstably housed PWUC recipient of a pipe *n* = 179 (26.8%) (convenience sampling)	Van outreach and Fixed locations Safer inhalation kit distribution and other harm reduction services offered	Determine the impact of the intervention on drug use behaviours and service utilisation
Leonard et al., 2008	Ottawa, Canada	Peer Reviewed Mixed Methods Cross-sectional interviews and questionnaires HCV antibody testing (October 2004–May 2006)	PWUC and inject drugs *n* = 167 (19–32% women; depending on evaluation stage) (convenience sampling)	Fixed locations Safer smoking kits and harm reduction education material made available at needle exchanges.	Characterise the operation of the intervention, evaluate its acceptability among people who inject drugs and smoke crack and evaluate the intervention's impact on HIV and HCV related drug use practices
Miskovic et al., 2018	Toronto, Canada	Peer Reviewed Mixed Methods Semi-structured interviews and programme statistics (November 2014–June 2017)	Clients, visitors, and staff of specialty HIV hospital n = n.r. (convenience sampling)	Fixed location Safer injection/inhalation kits available throughout hospital. Harm reduction education and referrals provided opportunistically	Evaluate if a hospital-based harm reduction intervention could reduce drug related harms in the community in and around the hospital
Backé et al., 2012¶	Winnipeg, Canada	Grey Literature Mixed Methods Service Evaluation (2004-2011)	Not described	Van outreach and fixed locations Safer inhalation kits and harm reduction education material	Characterise the operation/impact of the intervention and describe the context it took place in
Bergen-Cico and Lapple, 2015¶	Winnipeg, Canada	Peer Reviewed Evaluation of Extant Programme Assessment (October 2013–September 2014)	Not described	Van outreach and fixed locations Safer inhalation kits and harm reduction education material	Evaluate the effectiveness of distributing safer crack kits in Winnipeg
Ross, 2015¶	Winnipeg, Canada	Grey Literature Mixed Methods Service Evaluation (October 2013–September 2014)	Client of outreach service who requested a kit *n* = 136 (38%) (Convenience sampling)	Van outreach, home outreach and fixed locations Safer inhalation kits and harm reduction education material	Evaluate the functioning of the intervention and how well safer inhalation kits engage and promote the health of clients
Prangnell et al., 2017	Vancouver, Canada	Peer Reviewed Quantitative Longitudinal Prospective Cohort Surveys (Dec 2005–Nov 2014),	PWUC, members of the ACCESS or VIDUS cohorts *n* = 1718 (35%) (Purposive sampling and referrals from community organisations)	Setting not described Distribution of smoking material initially as a pilot (2011–2012) then harm reduction programme	Assess whether increased access to safer inhalation kits through health services was associated with a decrease in health problems
Ti et al., 2012	Vancouver, Canada	Peer Reviewed Quantitative Longitudinal Prospective cohort Surveys: (Dec 2009–May 2011)	PWUC, members of the ACCESS or VIDUS cohorts *n* = 914 (37.3%) (Purposive sampling and referrals from community organisations)	Fixed location Safer inhalation kits distributed at 4 sites	Evaluate access to crack pipes among PWUC in Vancouver and factors associated with difficulty accessing pipes
Malchy et al., 2011•	Vancouver, Canada	Peer Reviewed Quantitative Cross-sectional Surveys (Not described)	English speaking PWUC spending time in the DTES pre *n* = 206 (58.5%) post *n* = 150 (47.7%) kit recipient *n* = 106 (n.r.) (Convenience sampling, women purposefully oversampled)	Peer outreach, integrated outreach and van outreach Safer inhalation kits distributed by peers and harm reduction workers including a demonstration of assembly and discussion of sharing risks and referrals to health and social services	Evaluate the impact of safer inhalation kit distribution on crack smoking practices
Ti et al., 2011•	Vancouver, Canada	Peer Reviewed Quantitative Longitudinal Prospective Cohort Surveys (Dec 2010–May 2011)	PWUC, members of the ACCESS or VIDUS cohorts *n* = 503 (36%) (Convenience sampling and referrals from community organisations)	Fixed location Safer inhalation kits distributed through the provincial health authority	Identify the prevalence and correlates of pipe sharing
Boyd et al., 2008•; Johnson et al., 2008•	Vancouver, Canada	Boyd: Peer Reviewed Qualitative Field Notes and Semi-Structured Interviews (2007) Johnson: Grey Literature Mixed Methods, Interviews, Field notes and Surveys (2005-2008)	Boyd: PWUC who received a safer inhalation kit *n* = 27 (62.9%) (Purposive sampling) Johnson: PWUC who received a safer inhalation kit and women who participated in kit making circles n = n.r. (Convenience sampling)	Peer-outreach and van outreach Distribution of safer inhalation kits alongside harm reduction education demonstrations and referral services	Boyd: Understand harms associated with crack use and feasibility and acceptance of kit distribution Johnson: Report on the outcomes of the intervention and explore contextual factors which impacted its outcomes

(*continued on next page*)

Table 2 (*continued*)

Author, Year	Location	Publication type and Method (date data collection)	Sample characteristic (% women) (Recruitment Method)	Intervention Setting and Description	Aim
Ivsins et al., 2011	Victoria, Canada	Peer Reviewed Qualitative Semi-Structured Interviews (June–August 2010)	PWUC in Victoria $n = 16$ (48.4%) (Purposive sampling)	Street outreach, van outreach Safer inhalation kits without a pipe (only rubber mouthpiece) *and* Safer inhalation pipes including a pipe and a rubber mouthpiece	Explore the barriers, uptake, benefits, and improvements to safer inhalation kit distribution
O'Reilly and Mac Cionnaith, 2019	Dublin, Ireland	Grey Literature Qualitative Semi- Structured Interviews (September 2018–February 2019)	Former and current PWUC ($n = 17$ (29.4%)), Community members ($n = 5$) in Ballymun (Purposive sampling)	Street and home outreach, fixed location Safer inhalation kit distribution and health and social services	Identify patterns of crack use and explore the impact on communities and their members
O'Hearie, 2013	Dublin, Ireland	Grey Literature Mixed Methods Retrospective Ethnographic Survey (January–December 2012)	Clients who engaged with the street outreach service $n = 84$ (26.1%) (Convenience sampling)	Street outreach Needle exchange and safer inhalation kits distributed with pipes iteratively improved	Inform a harm reduction strategy and identify the most effective pipes to distribute
Frankeberger et al., 2019‡; Cepeda et al., 2024‡	Mexico City, Mexico	Peer Reviewed Quantitative Repeated Measure Survey Frankeberger: (June-July 2015) Cepeda: (June–November 2015)	PWUC, resident of Iztapalapa who had not received drug treatment in last 30 days. pre $n = 58$ (10.3%) post $n = 35$ (n.r.) (Snowball sampling)	Street Outreach Harm reduction messaging projected onto structures in the community. Safer inhalation kits distributed and accompanied by HIV education and harm reduction material and referrals for HIV testing	Frankeberger, 2019: Evaluate impact of safer inhalation kit distribution on crack use practices Cepeda, 2024: Assess the implementation, reach and acceptability of the intervention
Chung et al., 2025	N/A, USA	Peer Reviewed Quantitative Cross-sectional Survey (March–August 2023)	All USA NSPs known to be in operation in 2022 were invited to participate in the survey $n = 429$ (Comprehensive national sampling)	Setting: N/A Distribution of safer smoking supplies by harm reduction services	Assess whether pipe distribution led to more participant engagement and naloxone distribution in NSPs
Reid et al., 2023	Seattle, USA	Peer-Reviewed Mixed Methods Cross-sectional Survey (June–November 2018)	PWID living in King or Snohomish County, English readers $n = 555$ (38%) $n = 92$ reported crack use (Respondent driven sampling)	Setting: N/A Access to safer smoking supplies by local harm reduction services	Evaluate PWIDs that reside in Seattle's access to and interest in safer inhalation equipment and how these change injection rates
Shang et al., 2023	Pittsburgh, USA	Peer-Reviewed Quantitative Cross-sectional Survey (February – March 2023)	Clients of the service attending in person and staff $n = 141$ (n.r.) (Convenience sampling)	Fixed location Several types of harm reduction kits offered to clients visiting the office-based addiction service. Clients could choose from a menu of available kits. Staff were trained.	Describe and evaluate the implementation of harm reduction kit distribution within an office-based addiction treatment clinic
Weeks et al., 2009	Hartford, USA	Peer Reviewed Mixed Methods Repeated Measures Survey, Ethnographic Fieldwork and Interviews (December 2001–August 2004)	Current PWUD in Hartford Baseline $n = 523$ (25.1%) Follow-up $n = 367$ (n.r.) (Purposive sampling)	Peer-led street outreach Peers trained to deliver harm reduction intervention and provided with harm reduction materials including safer inhalation pipes to share in their community alongside harm reduction information and informal conversations	Evaluate the implementation and efficacy of a peer delivered HIV prevention intervention

Studies conducted on the same population/cohort are denoted with superscript symbols ¶,‡,•. Studies of the same intervention are presented in one row.
Abbreviations: ACCESS: AIDS Care Cohort to Evaluate Exposure to Survival Services (included HIV-positive individuals who used illicit drugs excluding cannabis in the past month); DTES: Downtown Eastside of Vancouver; HCV: Hepatitis C Virus; HIV: Human Immunodeficiency Virus; NSPs: Needle and Syringe Programmes; PWUC: People Who Use Crack; PWUD: People Who Use Drugs; VIDUS: Vancouver Injection Drug Users Study (included HIV-negative individuals who injected drugs in the past month)

highlighted the influential role of peers in disseminating harm reduction information, which further encouraged the adoption of safer practices (Boyd et al., 2008). One study which did not include pipes in their kits, had low uptake of safer inhalation kits (11%) (Shang et al., 2023) however this study took place in an addiction treatment service where patients were not all currently using drugs. This outcome was reflected in another study where two types of distribution took place, with and without pipes, where the intervention not including pipes had lower rates of engagement (Ivsins et al., 2011).

One intervention allowed clients to collect either full kits or individual components and the pattern of material collection changed over time (Leonard et al., 2008). Full kits were initially the most commonly collected safer smoking supplies, but participants increasingly chose individual items as the intervention progressed, with glass stems and suspension devices collected most often by the end of the evaluation period. The provision of individual kit components may help reduce waste from unwanted items thereby lowering costs and environmental impact compared to always providing full kits.

This finding aligns with the frequency of use of individual kit components among participants observed in other studies. Interventions which collected information on participants' use of individual pieces of equipment found that the most frequently used materials from the kits were those directly related to smoking practices like pipes and push sticks, whereas items like condoms and bandages were used less often

(Frankeberger et al., 2019; Johnson et al., 2008; Malchy et al., 2011; Ross, 2015).

Crack use practices

Across studies, the interventions promoted shifts towards safer crack use practices including reductions in pipe sharing, use of makeshift pipes, and injecting (Frankeberger et al., 2019; Ivsins et al., 2011; Jagoe, 2014; Leonard et al., 2008; Ross, 2015).

Sharing of pipes

The distribution of safer inhalation kits in Ottawa significantly reduced high-frequency pipe-sharing among those who shared pipes; reports of sharing "every time" in the last six months fell from 37% pre-implementation to 13% at 12-months post implementation (Leonard et al., 2008). Similarly, in Mexico City, "never/almost never" sharing in the past 30 days (no further definition is given) increased from 58% pre-implementation to 88% three months after the intervention ended (Frankeberger et al., 2019). Findings from other studies indicated that consistent stock availability, unlimited kit provision, ability to collect individual items such as mouthpieces, as well as the location and opening times of distribution points were key factors in reducing sharing (Boyd et al., 2008; Johnson et al., 2008; Ti et al., 2012). Conversely, limited time and space available for smoking crack due to being unhoused and concerns about police hindered the collection of kits, the ability to engage with the harm reduction information provided, the adoption of harm reduction practices, and was linked to increased sharing (Boyd et al., 2008; Ti et al., 2012).

Sharing may be promoted by the social nature of crack use, and the need of materials for smoking. Accordingly, a lack of paraphernalia can create social pressures around sharing (Boyd et al., 2008; Ivsins et al., 2011). Interventions disrupted these structural and social dynamics creating more possibilities to engage in safer practices through the increased availability of pipes and mouthpieces (Malchy et al., 2011). The use of mouthpieces may be particularly instrumental for individuals who seek to lend out their pipe to collect "recycle", the crack cocaine residue that builds on pipes and can be smoked again (Boyd et al., 2008), or in helping individuals avoid violent confrontations over pipes (Ivsins et al., 2011).

Use of mouthpieces

One study showed a significant ($p = 0.007$) increase in the use of mouthpieces from pre (53%) to post (69%) intervention (Malchy et al., 2011), though in another study this increase was not statistically significant (Frankeberger et al., 2019). Mouthpieces played a key role in encouraging individualised smoking practices (Ivsins et al., 2011; Malchy et al., 2011; Weeks et al., 2009) by allowing users to retain an individual mouthpiece even if a pipe was being shared (Malchy et al., 2011; Weeks et al., 2009). Adoption of mouthpieces was reinforced through social support, where peer discussions promoted the consistent use of personal equipment, further reducing the risks associated with social use (i.e. using crack with others rather than alone) (Weeks et al., 2009). Social use, which also increased at 12-months post intervention in Malchy et al. (2011), may be linked to reduced social pressure to share pipes, and thereby less avoidance of smoking groups, as greater availability made it more feasible for individuals to use their own equipment, supporting the existing preference for personal pipes over sharing expressed by some participants (Ivsins et al., 2011).

One study found that mouthpiece acquisition was associated with increased sharing, although it is unclear if pipe sharing as measured occurred with or without the use of individual mouthpieces (Ti et al., 2011). If the increase in pipe sharing was a consequence of using individual mouthpieces, designed to minimise the spread of infectious disease by preventing direct contact with the pipe, then this increase may reflect a positive outcome of the intervention.

Injecting practices

The distribution of safer inhalation implements was associated with a reduction in injecting drugs across multiple settings (Backé et al., 2012; Jagoe, 2014; Leonard et al., 2008; Weeks et al., 2009), with one study reporting that 74.1% of people who injected at baseline ceased or reduced injecting at follow-up (Weeks et al., 2009). However, in one case where access to pipes was low, reduction in injecting was noted by only 12% of respondents (Reid et al., 2023). Participants attributed decreases in injecting to an intention to reduce injecting, the increased availability of individual pipes, and where there was a preference for smoking over injecting (Leonard et al., 2008). For some participants however, the provision of safer inhalation pipes did not change their pattern of injecting drug use, citing a preference for injection as a method of administration (Leonard et al., 2008).

Access and engagement with services

Tailoring Interventions

Feedback from PWUC was a key factor in maximising engagement and uptake of safer inhalation interventions (Domanico & Malta, 2012; Ivsins et al., 2011; O'Hearie, 2013). Adapting kits, particularly pipes, to community preferences resulted in greater satisfaction and engagement with the interventions in Brazil and Dublin (Domanico & Malta, 2012; O'Hearie, 2013). Strong preferences were also noted for the suspension devices distributed alongside pipes. Several studies highlighted user dissatisfaction with brass screens, citing difficulties in use and a preference, particularly in Canada, for "Brillo" (stainless steel scourer) (Boyd et al., 2008; Malchy et al., 2011; Ross, 2015). Several service users appreciated receiving Brillo that was pre-burnt, as this was thought to remove the chemical residue often found in commercial scourers. The appeal of obtaining pre-burnt Brillo motivated one user to preferentially engage with a service that the rest of the community had entirely dismissed for failing to provide glass pipes (Ivsins et al., 2011).

Enhanced engagement through safer inhalation kit distribution

In the Downtown Eastside of Vancouver (DTES), 43% of participants reported they had never been offered social or medical support (Johnson et al., 2008). The provision of safer inhalation kits was associated with increased engagement with specialised drug services in Hartford, Canada, and Dublin (Leonard et al., 2008; O'Reilly & Mac Cionnaith, 2019; Prangnell et al., 2017; Weeks et al., 2009) as well as health and social services among PWUC (Bergen-Cico & Lapple, 2015; Jagoe, 2014; Miskovic et al., 2018; Weeks et al., 2009). Additionally, in the USA, needle and syringe programmes (NSPs) which distributed pipes had a 62% higher rate of encounters with service users than those that did not (Chung et al., 2025). Bergen-Cico and Lapple (2015) noted that the service distributing safer smoking equipment recorded 4.5 times more encounters than a neighbouring NSP. Notably, in this study, 68% of encounters involving the distribution of safer inhalation materials resulted in the provision of additional services. Accessible interventions located in existing services that were felt to be safe and non-stigmatising were particularly valued and helped link clients to housing, social support and other harm reduction services (Miskovic et al., 2018). In turn, training helped build staff's skills in harm reduction, fostering greater trust with the community who felt their wellbeing was being considered (Backé et al., 2012; Miskovic et al., 2018; O'Hearie, 2013).

Role of peers in facilitating engagement with interventions

Peers played a crucial role in facilitating access to services by sharing information and providing support within their communities (Domanico & Malta, 2012; Johnson et al., 2008; Weeks et al., 2009). They guided individuals in navigating the mental, physical, and social challenges associated with crack use, often referring service users to appropriate

health and social services and advising on how to overcome obstacles in accessing these resources (Domanico & Malta, 2012). Additionally, peers contributed to refining interventions and developing new harm reduction materials (Domanico & Malta, 2012). Informal peer-led conversations and observational learning were instrumental in spreading harm reduction knowledge, as peers effectively transferred skills and information through everyday interactions (Boyd et al., 2008; Weeks et al., 2009). Participants in Victoria suggested that having peers distribute supplies, such as pipes, could improve intervention delivery due to the trust and community connections they possess (Ivsins et al., 2011). Despite these valuable contributions, peers faced challenges, including marginalisation beyond the intervention context and barriers such as police interference, which limited their roles within the formal structure of these programmes (Domanico & Malta, 2012; Johnson et al., 2008).

Engagement with printed harm reduction information

The inclusion of harm reduction information within safer inhalation kits was generally well received, with 71% of participants in Mexico City, Mexico reporting that they read the provided materials (Frankeberger et al., 2019) and 74% in Vancouver, Canada finding it useful (Johnson et al., 2008). However, the accessibility of this information is crucial, as some participants indicated that they did not engage with it due to literacy challenges, having already received the information, or lack of relevance (Boyd et al., 2008; Ross, 2015). Peer-to-peer conversations and demonstrations on how to use the pipes were alternative techniques used to disseminate harm reduction information and were highlighted as significant contributors to behaviour change in multiple studies (Boyd et al., 2008; Weeks et al., 2009).

Context associated with difficulty accessing pipes

Despite positive outcomes, several studies highlighted barriers to accessing smoking equipment. In Vancouver and Victoria, Canada, "no-go zones" and police interventions including the confiscation of drug paraphernalia hindered access for PWUC, reducing the effectiveness of harm reduction initiatives. In Victoria, service delivery via a mobile van further restricted consistent access to safer smoking supplies for some PWUC due to limited operating hours (Ivsins et al., 2011). Reasons cited by participants for difficulty accessing pipes included sources being closed, no sale of pipes nearby, and being out of the area where pipes are found (Ti et al., 2012). Additional factors associated with difficulty accessing pipes included sex work involvement, police presence, difficulty accessing health and social services, and health problems associated with crack use (Ti et al., 2012).

Stigma and political barriers were other significant obstacles. In Ottawa, Canada, local media and public criticism hindered safer inhalation initiatives (Leonard et al., 2008), while political backlash in the US led to the banning of federal funding for safer smoking initiatives (Chung et al., 2025). In Brazil, discontinuation of funding and police harassment also presented significant challenges for the continuation of interventions (Domanico & Malta, 2012). Limited time and space to use crack were also barriers for PWUC (Johnson et al., 2008), prompting a preference for discrete paraphernalia (Boyd et al., 2008). These findings underscore the need for harm reduction services to balance accessibility with sensitivity to the social environments in which PWUC live and operate.

Health related outcomes

Seven studies reported on health-related outcomes (Bergen-Cico & Lapple, 2015; Ivsins et al., 2011; Jagoe, 2014; Leonard et al., 2008; Weeks et al., 2009), including acute injuries such as burns and cuts to the mouth or fingers (Jagoe, 2014; Prangnell et al., 2017), respiratory symptoms (e.g. coughing blood, throat burns) (Boyd et al., 2008; Prangnell et al., 2017), and transmission of viral infections (e.g. the common cold, Hepatitis C Virus) (Bergen-Cico & Lapple, 2015; Ivsins et al., 2011). No studies reported on Covid-19 transmission or injecting related bacterial infections. Overall, evidence suggested distribution of safe inhalation kits had a positive effect on health outcomes, resulting in a reduction in transmission of viruses, oral cuts or respiratory symptoms for PWUC (Boyd et al., 2008; Ivsins et al., 2011; Prangnell et al., 2017). In one study 60% of respondents noted having fewer cuts or burns to the lips following the adoption of safer inhalation pipes, and another observed that 78% had not experienced these injuries more than once or twice following the introduction of pipes (Jagoe, 2014). In Vancouver, there was a significant decrease from 39.2% to 20.7% in people reporting crack-related problems (including oral lacerations, finger sores and cuts, raw throat or coughing blood) after the local health authority began distributing safer smoking kits (Prangnell et al., 2017). Analyses from the same study found that obtaining pipes through health services was associated with lower odds of reporting crack-related health problems (AOR = 0.82; 95% CI: 0.73–0.93) than obtaining pipes through other sources (e.g. homemade, local shops) even after adjusting for confounders, while sharing pipes was linked to more health problems (AOR = 1.73; 95% CI: 1.56–1.91)(Prangnell et al., 2017).

Interviews highlighted the benefits of harm reduction information provision, by raising awareness of sharing risks and facilitating adoption of the intervention to lower these risks (Ivsins et al., 2011). The perceived health benefits of the kits encouraged uptake, particularly in the adoption of more difficult to use brass screens over the preferred stainless-steel scourer as crack suspension devices. Information on the health benefits was more salient when accompanied by a hands-on demonstration by frontline staff, delivered by a peer, or when repeatedly delivered by both (Boyd et al., 2008)

There was weak evidence of the impact of safer inhalation interventions on HCV transmission. In Winnipeg, Canada, a province-wide decrease in HCV prevalence was observed during the scale up of provision of safe-inhalation kits (Bergen-Cico & Lapple, 2015). Similarly, a slight and non-significant reduction in HCV antibody prevalence from 63% (95%CI: 54-72; $n = 112$) to 56% (95%CI: 49–64; $n = 167$) was recorded among a sample of PWUC in Ottawa before and 1-year after the start of safer smoking kit distribution (Leonard et al., 2008). However, this is likely to reflect sampling variation rather than an impact of the intervention.

Subgroup analysis

Sex workers

Engagement in sex work was associated with difficulty accessing safer inhalation equipment (Ti et al., 2012). The authors speculated that this may be due to long working hours in remote locations, far from fixed distribution sites (Ti et al., 2012). Accordingly, sex workers in Victoria found mobile van distribution beneficial as it enabled them to access pipes at their place of work (Ivsins et al., 2011). This contrasted with other service users who found the mobile service inconvenient because of difficulties finding the van. It was also noted that the provision of pipes decreased the need to engage in sex work due to reduced financial pressure (Ivsins et al., 2011).

Pipe distribution also created opportunities to provide additional services to sex workers. This included sharing information about violent clients and fostering networks of safety and support (Bergen-Cico & Lapple, 2015; Ross, 2015).

Safer sex materials were often included in the kits and were commonly requested components (Johnson et al., 2008; Malchy et al., 2011; Ross, 2015); particularly useful, protective and potentially cost-saving for sex workers.

Table 3
Context, mechanism, and outcomes of safer inhalation kit distribution interventions for people who use crack. Summary of peer-reviewed and grey literature studies.

Author	Context	Mechanism	Outcome
Peer Reviewed Studies			
Domanico and Malta, 2012	Peers received informal harm reduction training. Programmes struggled with funding, peer marginalisation, police harassment, and registration barriers.	Peer conversations addressed crack-related harms, shared service advice, and offered referrals. People who use crack co-designed and delivered the intervention, shaping outreach and materials. Community and media meetings helped explain goals and navigate implementation barriers.	Increased access to health, psychological, and social services (e.g. shelters or meal vouchers). Implementation of feedback increased acceptance of the intervention (e.g. safer inhalation implement design, adapted harm reduction materials). The availability of clean pipes led to safer crack use practices without affecting frequency of use.
Leonard et al., 2008	Participants could collect unlimited kits or individual items, including for others. Local media, political, and public opposition hindered safer inhalation kit distribution efforts.	Flexible kit collection and access to pipes expanded reach and reduced injecting for some. Evidence-based advocacy and public health support enabled implementation.	87% personally accessed the intervention at 12-months rising to 94% when including users who reported someone accessing the service on their behalf ($p < 0.01$). Injecting declined from 96% pre-implementation to 78% 12-months post-implementation ($p < 0.001$).
Miskovic et al., 2018	The hospital's location, safety, 24-h access, and anonymity. Training provided to staff on how to engage with clients	The foyer distribution point signalled openness, while staff training fostered confidence and open dialogue. The hospital felt safer for harm reduction than other services.	Kit distribution increased annually. The hospital setting drew in people who use drugs from the surrounding area, with many engaging reception staff for information on treatment, housing, social services, and naloxone.
Bergen-Cico and Lapple, 2015	Canada's first safer inhalation kit programme led by a regional public health authority due to concerns about HCV transmission.	Distribution of pipes created an attractive service offering for PWUC and facilitated development of relationships and trust with public health workers.	Compared to the sister needle exchange 4.5 times as many encounters were made by the inhalation kit programme. A large proportion of the engagement resulted in STBBI tests. 68% of encounters resulted in other services being provided.
Prangnell et al., 2017	DTES has Canada's largest open drug scene, high concentration of poverty. Crack pipe distribution implemented following a pilot by the local health authority.	Provision of safer inhalation equipment led to a reduction in the use of dangerous pipes and increased contact with health and harm reduction services	Accessing crack pipes via health services rose from 7.2% (2005) to 62.3% (2014), while reported health issues fell from 39.2% to 20.7% ($p < 0.001$). Those using only safer inhalation kits saw greater reductions (AOR = 0.82; $p < 0.001$).
Ti et al., 2012	Safer inhalation kits distributed through five distribution sites selected as part of a pilot project. Individuals restricted to one pipe a day.	Inadequate distribution infrastructure, criminalisation, stigma, social marginalisation or performing sex work impeded participant ability to access services.	Difficulty accessing pipes included was linked to: difficulty accessing services (AOR = 1.74; $p < 0.01$), pipe sharing (AOR = 1.69; $p < 0.01$), sex work involvement (AOR = 1.57; $p = 0.03$), noticing police where drugs are bought or used (OR = 1.47; $p < 0.01$), health problems associated with crack use (AOR = 1.37; $p = 0.02$).
Malchy et al., 2011	Pipe illegality fostered scarcity. Outreach teams offered limited kits and harm reduction information with demonstrations	Distribution of kits facilitated access to and use of safer inhalation kits. Metal screens distributed were hard to manipulate.	74% found the harm reduction card useful. Twelve months post-implementation, use of kit components (pipes, mouthpieces) increased significantly, while Brillo use remained high and unchanged.
Ti et al., 2011	Safer inhalation kits provided by provincial health service at low or no cost	Acquiring a mouthpiece enables protection from risks of sharing pipes when glass pipes are scarce, facilitating safer use practices	47.3% of participants reported sharing a crack pipe within the last 6 months. Sharing pipes was positively associated with: having acquired a mouthpiece (AOR = 1.91; $p < 0.01$), difficulty finding a new pipe (AOR = 2.19; $p < 0.01$).
Boyd et al., 2008	DTES is marked by deprivation, surveillance, and vulnerability. PWUC expressed concerns about visibility, criminalisation, privacy, and community distrust.	Informal learning and peer influence, repeated and hands-on demonstrations, improved access to equipment, the associated empowerment and dignity, and acknowledgment of lived experience all facilitated the adoption of safer inhalation intervention.	The availability of kits was perceived as important and dignifying. Possessing one's own kit supported changing practices. Being aware of harms did not always lead to consistent adoption of safer use practices, and adoption of these practices could take time, and were incremental rather than abrupt.
Ivsins et al., 2011	One service included pipes in kits, another did not. Distribution method varied between street outreach and fixed sites.	Educational support from frontline staff and decreased reliance on makeshift pipes led to positive health, economic, and social outcomes. Barriers were limited kits, police presence, restricted zones, and the van's limited availability.	Participants reported less pipe sharing, social tension, and reliance on sex work or crime. Additionally health benefits such as reduced transmission of infections such as colds and the flu noted. Most only used the service which distributed pipes.
Frankeberger et al., 2019	Mexico City saw high unsafe paraphernalia use and group smoking; pipe distribution and harm reduction messages projected onto buildings addressed this.	Increased availability of paraphernalia accompanied by harm reduction messaging encouraged safer smoking practices and reduced sharing.	Viewing a project harm reduction message increased borosilicate glass pipe use ($p = 0.008$), with 70.8% reading the health card. Borosilicate glass pipe use "always" or "almost always" increased from pre (7%) to post (27.3%) ($z = -3.132$, $p = 0.002$); those

(*continued on next page*)

Table 3 (*continued*)

Author	Context	Mechanism	Outcome
			"never" or "almost never" sharing increased from pre (57.9%) to post (87.9%) intervention ($z = -2.077$, $p = 0.038$).
Cepeda et al., 2024	Community based intervention conducted in the streets of one of the most marginalised and hard to reach neighbourhoods of Mexico City. (See Frankeberger, 2019)	Peer-led education and pipe distribution encouraged engagement, with the intervention's success relying on the research team's trust-building with the community.	At follow-up, 74% had attended at least one projection. The intervention was well received, with half citing crack-related messages as most impactful and qualitative data indicating greater HIV risk awareness. Significant decrease in 'never / almost never' using cans to smoke (67.2% to 90.9%)
Chung et al., 2025	Increasing rate of substances smoking. NSPs distributing pipes experienced more local government/law enforcement disruption than those that did not.	Provision of pipes created a harm reduction offering for those who prefer to smoke. Financial flexibility and institutional resilience in the face of political backlash facilitated continued distribution of pipes.	There were 187 NSPs (44%) that distributed pipes for smoking. Those that did distribute pipes reported more participant encounters (aRR = 1.62, 95% CI: 1.19–2.20) than those which did not.
Reid et al., 2023	Small numbers of NSPs offer safer inhalation kits for methamphetamine, heroin, or crack.	Provision of safer inhalation kits functions as a route transition tool, reducing the number of injections. Provision through NSPs facilitates access and trust.	12% of people who injected crack reported access to safer inhalation pipes. For participants without current access, 49% who used crack were interested in gaining it, and 65% said it would reduce injecting. However, only 12% of those with current access noted a reduction in injecting.
Shang et al., 2023	Co-location of kits within addiction care in urban setting. Many patients currently abstinent. Harm reduction kit menu offered to clients. Safer inhalation kits did not include pipes due to local laws.	Multidisciplinary staff training, discreet bagging of kits, and use of non-verbal menus to offer kit selection to all in-person clients.	Uptake was 11% (16/141) for safer smoking kits and 28% (40/141) for kits overall. Reduced stigma and disclosure burden, strengthening rapport and trust, even for those who did not ask for a kit.
Weeks et al., 2009	Drug user network in Hartford was tightly connected. Funding cuts reduced the outreach service availability prior to intervention implementation.	Peer delivery of the intervention increased exposure to culturally appropriate harm reduction messaging and effective delivery of the intervention components to hard-to-reach populations.	Advocates and their contacts accessed more services following the programme's health advocacy or training 74.1% of injectors at baseline ceased or reduced injection at follow up. Engagement with harm reduction programme increased mouthpiece use in 67.7% of cases ($p = 0.005$).
Grey Literature Studies			
Jagoe, 2014	Most participants were homeless, and the service was discontinued due to legal concerns surrounding the distribution of crack pipes.	Pipe distribution facilitated engagement and supported referrals to health services, while promoting safer use through access to appropriate equipment.	66% of users increased their use of other services, most commonly needle exchange, vaccinations, STBBI testing, and condom provision. 71% used a mouthpiece and 95.5% used glass or borosilicate glass pipes; 74.3% still shared pipes at least occasionally. Women were more likely to be Indigenous than men ($p < 0.001$) and more likely to use crack ($p = 0.005$)
Ross, 2015	Services offered by van outreach and home visits 6 nights a week and fixed location distribution.	Flexible, comprehensive services boosted uptake, with strategic van placement along high-use routes enhancing reach and engagement.	The van was the primary source of safer crack kits for 61% of clients. Over one year 48 marked interactions were new clients. While 65% could usually or always access a pipe when needed, women reported more difficulty than men ($p < 0.05$).
O'Reilly and Mac Cionnaith, 2019	Safer inhalation kits implemented to reduce risky crack use behaviours.	Distribution of pipes led to more people attending the service.	Although brief, the resulting interactions with kit recipients allowed for productive contact between service providers and clients.
Johnson et al., 2008	Women centred safer inhalation initiative in the DTES. Deprived and overpoliced neighbourhood, with opposition to the intervention from government (federal/ provincial).	Women focused groups catered to individual needs of this population and offered a space where feedback could be shared, and support given.	Feedback from the kit making groups improved the intervention and tailored it to needs increasing its relevance. The groups themselves were impactful and beneficial for the women involved. The intervention had strong reach especially among people who do not inject drugs.
Backé et al., 2012	Van outreach and fixed location pipe distribution implemented as part of a broader health equity strategy.	Low-threshold provision increased service accessibility and reduced scarcity of safer inhalation equipment. Service provision parameters (time, location, items available) reviewed throughout.	Reduction of pipe sharing and oral injuries. Some participants transitioned from injecting drug use to inhaling. Service offering adapted to the needs of clients leading to increased distribution of pipes.
O'Hearie, 2013	In response to increased crack use, outreach service undertook efforts to identify the type of crack pipes that maximised harm reduction.	User feedback recorded and implemented leading to the distribution of crack pipes that were preferred by the target population.	The provision of pipes facilitated the development of trust between the outreach workers and PWUC. Engagement with the street outreach worker increased with high-quality pipes and decreased with lower-quality ones.

Abbreviations: AOR: Adjusted Odds Ratio; CI: Confidence Interval; DTES: Downtown Eastside of Vancouver; HIV: Human Immunodeficiency Virus; NSPs: Needle and Syringe Programmes; OR: Odds Ratio; PWUC: People Who Use Crack; PWUD: People Who Use Drugs; STBBI: Sexually Transmitted and Blood-Borne Infections.

Women

Overall, there were fewer women engaged in the included studies than men, this may be a consequence of women being less present in the communities where the interventions took place. For example, in the downtown Eastside of Vancouver, the most investigated area in this review, the population was estimated to be 38% women around the time of the study (Boyd et al., 2008). However, there were a few exceptions where women were purposefully oversampled (Malchy et al., 2011; Boyd et al., 2008) to better understand the gendered experiences of crack use. In Vancouver, women-only kit making circles provided an alternative to sex work and a valuable safe space to discuss women specific challenges of living in the DTES (Johnson et al., 2008). These circles offered a space for peer support and rest, facilitating change through discussion of gaps in service provision and kit composition (Johnson et al., 2008). In Dublin, a large proportion (76%) of women engaging in a street outreach programme used their crack pipe distribution service. Out of 199 clients of the street NSP outreach service, 84 accessed crack kits, of whom 22 (24%) were women – with only 29 women accessing the service overall (O'Hearie, 2013). Women were more likely to experience health problems associated with crack use in Vancouver (Prangnell et al., 2017) and providing an extra mouthpiece to women was noted by a participant as particularly useful so they could lend their pipes out and collect "recycle" (crack residue) given their lack of resources compared to men (Boyd et al., 2008).

Racially marginalised populations

Few studies specifically mentioned how the intervention was received by and impacted racially marginalised populations, although in some settings such as Vancouver they were over-represented in the population of PWUD (Johnson et al., 2008). People of Indigenous heritage for example were over represented in the population of PWUC in several Canadian cities (Bergen-Cico & Lapple, 2015; Johnson et al., 2008). Furthermore, the impact of colonisation and intergenerational trauma on the marginalisation of Indigenous communities was highlighted (Bergen-Cico & Lapple, 2015). One study reported a significantly higher proportion of participants with Indigenous heritage in a post-intervention survey compared to pre-intervention, suggesting that the intervention may have been particularly effective in reaching this group (Malchy et al., 2011). Another study recruited peer-educators to reflect the primary ethnic groups within the local drug-using population, which was predominantly African American and Puerto Rican/Latino. This approach appears to have supported strong community engagement (Weeks et al., 2009)

Context (C), mechanism (M), outcome (O) configurations

Drawing upon the above results and contextual factors from the reviewed literature (Table 3) we have identified five CMO configurations (Fig. 2).

Service accessibility and availability

The accessibility of safer inhalation supplies, such as hours of operation and location, was a key factor in determining the success of interventions (C). When interventions were delivered in low threshold, non-stigmatising environments and practical locations, PWUC were more likely to engage with the service, likely due to a reduced fear of criminalisation, social judgement and increased ease of access (M). This ultimately led to increased adoption of safer smoking practices and reduced health complications associated with pipe sharing (O). Furthermore, low barriers to access (C) facilitated more contacts between service users and providers, and therefore more opportunities for

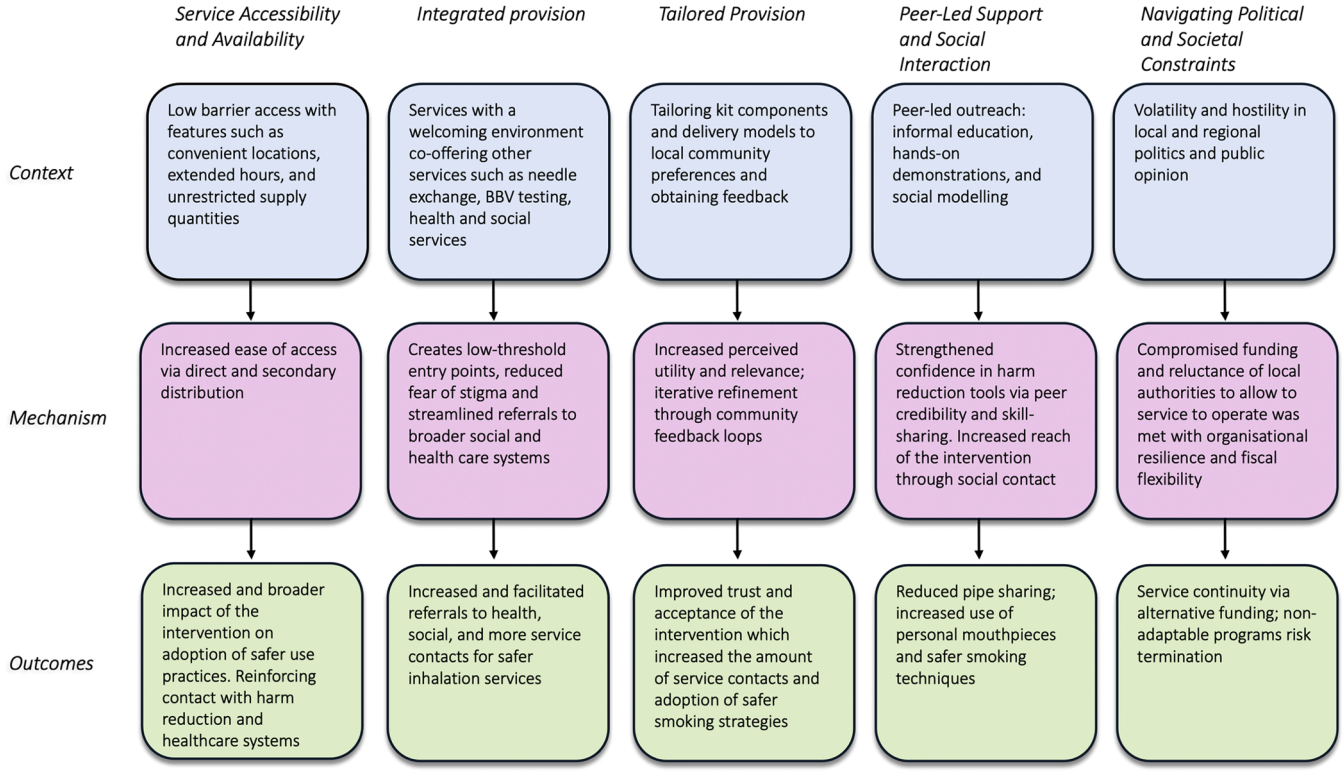

Fig. 2. Summary of Context-Mechanism-Outcome Configurations. Each column illustrates how specific contextual features such as service accessibility and navigating political constraints activate mechanisms such as trust-building, perceived utility or institutional adaptability, modify outcomes of the intervention such as service engagement, intervention reach, or adoption of safer crack use practices. These CMO configurations highlight the importance of community involvement, low-threshold access and flexible, integrated service design in achieving effective and sustainable positive outcomes.

interaction, increasing the trust of both in the intervention (M) resulting in more positively perceived outcomes of the intervention (O) (Backé et al., 2012; Miskovic et al., 2018).

Logistical constraints such as limited-service hours and supplies, geographic service gaps and law enforcement restrictions (C) reduced the effectiveness of interventions by creating barriers which limited people's willingness and ability to engage (M). Areas where safer smoking kits were not consistently available led to higher rates of sharing practices and decreased uptake of the intervention (O). Conversely, services which were easily accessible geographically, provided safer inhalation materials with reduced restrictions on what could be obtained, when, and how, had high rates of adoption within communities; this in turn also facilitated peer-to-peer secondary distribution of materials, and were preferred by service users leading to more positive outcomes (Boyd et al., 2008; Ivsins et al., 2011; Leonard et al., 2008; Malchy et al., 2011; Ti et al., 2011).

Integrated provision

Moreover, the provision of a welcoming anonymous and non-judgemental service environment co-located or co-offering comprehensive services alongside the distribution of safer inhalation supplies (C) provided PWUC with additional entry points to health and support systems (M) such as NSPs, naloxone provision, Sexually Transmitted and Blood-Borne Infections testing, housing support, and health referrals. This facilitated increased contact with or referrals to medical and social care service (O), enhancing the intervention's positive health outcomes (defined as the avoidance of health harms caused by unsafe smoking practices, or the adoption of safer smoking practices) (Bergen-Cico & Lapple, 2015; Chung et al., 2025). By providing integrated and comprehensive support, these interventions reinforced sustained service user contact with harm reduction and healthcare systems (Bergen-Cico & Lapple, 2015; Miskovic et al., 2018; Ross, 2015).

Tailored provision

Tailoring the interventions to align with community specific preferences (C) greatly increased acceptance, and the number/quality of service contacts (O). When harm reduction supplies matched the needs and expectations of PWUC, participants were more likely to perceive services as relevant and useful, reinforcing consistent harm reduction behaviours and service contacts (M). This sometimes involved an iterative process of collecting the views of community members and implementing change to align service offerings. Incorporating such community feedback (C) allowed harm reduction services to continuously refine their intervention (M), encouraging higher engagement with the intervention and better acceptance among the community (O) (Domanico & Malta, 2012; Johnson et al., 2008; O'Hearie, 2013).

Regional variations in preferred safer smoking materials (C) influenced the amount of service contact and equipment uptake (O). When harm reduction programmes aligned their material offerings with local preferences, PWUC were more likely to use services and adopt safer practices (M). Where services did not meet the preferences of the intended user base, adoption of safer smoking practices and service contact reduced, particularly impacted by the selection and type of materials distributed (e.g. 'Brillo' vs screens, and mouthpieces vs pipes) (Boyd et al., 2008; Ivsins et al., 2011).

Peer involvement and social interaction

Peer led support and social interaction were influential enabling factors (C) that facilitated the dissemination of harm reduction knowledge and reinforced engagement with safer inhalation initiatives (M), leading to greater adoption of harm reduction practices (O) (Boyd et al., 2008; Domanico & Malta, 2012). Through peer-to-peer interactions, PWUC were able to share harm reduction strategies, learn safer smoking techniques, and reinforce positive behavioural change (M), ultimately increasing adoption of safer inhalation practices (O) (Weeks et al., 2009). Peer-led conversations and hands on demonstrations (C) played a crucial role in reinforcing harm reduction behaviours (M), ensuring consistent use of safer inhalation tools and reducing risky practices like pipe-sharing (O) (Boyd et al., 2008). By normalising safer inhalation practices through peer education (C), peer interactions increased participants' confidence in the efficacy of harm reduction tools (M), leading to use of personal equipment such as mouthpieces and a reduction in the reliance on shared materials (O).

Navigating political and societal constraints

Local and regional politics also played a role in determining the feasibility and outcomes of the safer inhalation pipe distribution initiatives through their influence over drug policy (e.g. legality of pipe provision) and availability of funding. The specific barriers varied significantly across regions/time and were relatively volatile (C) compromising the availability of funding and willingness of local health and judicial authorities to permit the distribution of pipes (M), thereby restricting the possibility of initiatives to operate and/or expand their practice consistently (O). However, many organisations were able to adapt to changing political environments and funding landscapes. This resilience was facilitated by strategic adaptation and leveraging community trust to maintain service contact, enabling the continued provision of safer inhalation equipment despite external challenges (Chung et al., 2025; Domanico & Malta, 2012; Johnson et al., 2008). This was not always the case. In Alberta for example, concerns about crack pipe legality were expressed by the regional health service, resulting in the termination of the equipment distribution programme (Jagoe, 2014). In Pittsburgh, one service which was not legally allowed to distribute safer inhalation pipes in their kits, had notably low rates of patients collecting kits (Shang et al., 2023). This suggests that where legal restrictions prevent full safer smoking kits, contact with services and therefore beneficial outcomes may be limited.

In Canada, the federal government adopted a *four pillars* (prevention, treatment, enforcement, and harm reduction) approach to drug policy until 2007, when the number of pillars was reduced to three (prevention, enforcement and treatment) (Bergen-Cico & Lapple, 2015; Boyd et al., 2008; Johnson et al., 2008). While this approach removed support for harm reduction at the federal level, many regional (provincial and municipal) drug strategies maintained a focus on harm reduction (Bergen-Cico & Lapple, 2015; Boyd et al., 2008). In addition to federal pushback, some local stakeholders were fervently opposed to the provision of safer inhalation harm reduction (Johnson et al., 2008; Leonard et al., 2008). This meant that safer distribution programmes often operated in a hostile political climate with limited funding, increasing their precarity (C). Through organisational resilience and flexibility (M), services which persisted were able to prove their benefits and continue to operate (O).

In the United States, similar political opposition led to a federal ban on funding for safer smoking supplies, forcing NSP to rely on alternative sources of funding – this disproportionately affected department of public health (DPH) organisations as they are heavily reliant on federal resources (Chung et al., 2025). While community-based organisations (CBOs) were the most likely to distribute pipes compared to healthcare organisations and DPH organisations, they faced financial challenges that threatened their ability to sustain safer inhalation equipment distribution (C). Despite these challenges many CBOs managed to secure alternative funding to sustain their harm reduction activities. Their status as trusted community institutions helped maintain contact with clients and their increased fiscal flexibility allowed them to continue to operate (M). CBOs, though operating with less capital and therefore more financially strained, are required to be more adaptable and likely to persist as key harm reduction providers continuing to serve their communities through alternative sources of funding (O) (Chung et al.,

2025).

Discussion

Given the limited pharmacotherapy and harm reduction interventions available, as well as the significant health harms that accompany unsafe crack use practices, it is increasingly urgent to address the needs of PWUC, a marginalised and vulnerable population. Safer inhalation equipment distribution interventions for PWUC proved effective in increasing engagement with drug treatment and harm reduction services, facilitating changes in crack smoking practices, and improving health outcomes. Providing safer inhalation equipment offers an avenue to begin to address those needs, by meeting people where they are at with useful tools to facilitate a reduction of risk in their drug use practices and foster further engagement and trust building between services and (potential) service users.

The primary contribution of this realist informed review is the identification of five CMO configurations that help explain how safer inhalation interventions achieve, or fail to achieve, their harm reduction aims for crack cocaine, specifying in which contexts they operate and, where evidence allows, for whom. These dynamics, and the five CMO configurations they reflect, should guide policymakers, commissioners, and services implementing safer inhalation interventions in local contexts.

The need to tailor interventions according to local context and service user feedback was clear throughout the studies. The quality, type, and amount of inhalation kits distributed, as well as location and method of engagement, can vary according to local contextual factors and necessitate careful consideration to maximise intervention reach and efficacy (Miskovic et al., 2018; O'Hearie, 2013). Legislators, commissioners, and providers should therefore build in flexibility, enabling timely changes to kit components, supply levels, delivery sites/methods, and operating hours. It was noted that different groups may require accommodations to facilitate access to service, such as people who are unable to read requiring adapted harm reduction materials (Boyd et al., 2008; Johnson et al., 2008), expanding service hours and outreach efforts for sex workers (Ti et al., 2012), and addressing the systemic marginalisation of Indigenous or ethnic minority groups (Bergen-Cico & Lapple, 2015). Ongoing collaboration with target populations and meaningful involvement of people with lived/living experience was also key to several interventions (Cepeda et al., 2024; Weeks et al., 2009).

The importance of political context and community engagement resonates with O'Byrne and Holmes (2008) comparative case study of the implementation of a safer inhalation intervention in Ottawa and Toronto, Canada, which demonstrated that political receptivity and community involvement critically influenced the implementation and sustainability of crack equipment distribution programmes. Crucially, it emerged from their analysis that bottom-up models, wherein the implementation of safer inhalation equipment distribution programmes was driven by existing community coalitions, produced less visible opposition and were likely to be more sustainable. Although the top-down approach implemented in Ottawa produced quicker results, it was more vulnerable to political shifts (O'Byrne & Holmes, 2008). These differences could also be attributed to Ottawa's socially conservative socio-political climate characterising the local population and key institutional actors, such as the police chief and city councillors. Furthermore, as reported by Chung et al. (2025), community based organisations in the United States were more resilient than governmental ones. As evidenced throughout our analysis, community involvement emerged as a key factor in the success and continued development of safer inhalation interventions.

Providing physical tools to reduce harm, in particular the pipes themselves, was highly valued and a key component in facilitating change (Boyd et al., 2008); where they were not included engagement was lower (Ivsins et al., 2011; Shang et al., 2023). This mirrors the NSP evidence base, where access to sterile equipment is a core mechanism underpinning harm reduction and engagement (Hurley et al., 1997; MacDonald et al., 2003). In other harm reduction settings such as drug consumption rooms, care is similarly enacted through the provision of everyday necessities (Mogensen & Duff, 2025). However, while highly valued (Duncan et al., 2021), the staff controlled nature of these resources can generate tensions regarding autonomy and dependence (Mogensen & Duff, 2025). Moreover, our analysis also shows that the quality of materials played an important role in changing practices, as participant satisfaction with various kit components such as mouthpieces, gauze and pipes influenced how much they were used and the amount of engagement with services (Domanico & Malta, 2012; Ivsins et al., 2011; O'Hearie, 2013). As seen with low dead-space syringes, equipment quality is pivotal, and acceptance hinges on assurance that the new tools function as well as the original equipment. However, uptake is also shaped by broader factors, including awareness or availability of alternatives, and early experiences (Kesten et al., 2017).

Our findings also align with those of other realist reviews on harm reduction measures, suggesting that a universal set of underlying mechanisms may drive positive outcomes across a range of interventions. For example, the mechanisms of trust and perceived safety have also been identified as key factors in the delivery of opioid agonist therapy (McCulloch et al., 2025), overdose prevention centres (Keemink et al., 2025), and drug checking services (Masterton et al., 2022). Additionally, tailoring interventions and providing low-threshold access was identified as a key enabling context in our synthesis, mirroring findings from realist reviews of NSPs (McCulloch et al., 2025) and naloxone provision (Miller et al., 2022). Finally, incorporating peer support and non-judgemental environments was important enabling contexts across different interventions and contexts (Masterton et al., 2022; McCulloch et al., 2025; Miller et al., 2022).

Evidence was mixed with regard to how the frequency of crack use was impacted by the distribution of pipes. Taken together however, the evidence reviewed indicates that the provision of equipment did not encourage increased consumption of crack, nor did the lack of safe materials prior to the intervention deter individuals from smoking (Domanico & Malta, 2012; Leonard et al., 2008; Weeks et al., 2009). It is important to highlight that an increase in rates of smoking may represent a shift away from injecting, a harm reduction strategy adopted by many people who use drugs in the US in the wake of increases in synthetic opioids on the drug market (Chung et al., 2025). Additionally, the frequency of crack use is likely to be impacted by a range of structural and environmental factors such as drug market variability, money generating activities, changes in policing practices, and social norms around drug use (Roy et al., 2012) which are not all accounted for or reported in the studies presented.

A previous narrative review examining the integration and impact of safer inhalation kits into harm reduction interventions found that these services can reduce engagement in higher-risk drug use practices and improve health outcomes, aligning with our findings (Tapper et al., 2023). The review also highlighted that inhalation (as opposed to injection) can be employed as a protective behaviour to reduce the risk of overdose and transmission of infectious diseases, though this analysis was not specific to crack cocaine use, highlighting the multifaceted effectiveness of safer inhalation interventions (Tapper et al., 2023). Studies included in our review also observed that people smoked drugs other than crack or stimulants on safer inhalation pipes, and that they are linked to reductions in injecting across multiple drug types (Leonard et al., 2008; Weeks et al., 2009). Although literature on other inhaled stimulants such as methamphetamine was beyond the scope of this review, the overarching CMO configurations are likely applicable to harm reduction for any smoked stimulant. Nevertheless, generalisability of specific findings may be limited by differing pharmacology, equipment needs/preferences, and social/cultural dynamics, particularly in regions where methamphetamine use is confined to distinct sub-groups.

Limitations

The primary limitation of this review is the reliance on evidence from predominantly Western countries in the global North. Most of the studies (13 out of 22) took place in Canada, and few took place outside North or South America ($n = 5$) which may limit the generalisability of results to non-Western countries and different socio-political environments. Additionally, several studies reported evaluations of the same intervention or similar cohorts of participants. Further limiting generalisability, we did not include literature on the provision of safer smoking equipment for drugs other than crack. Specific findings such as equipment preferences, drug use patterns, and social dynamics may not generalise to other inhaled stimulants. Most studies reported short-term or immediate post-intervention outcomes, limiting understanding of the long-term sustainability and enduring impacts of safer inhalation pipe distribution. The context within which the interventions took place was not always thoroughly described, limiting the inferences which could be made. For instance, description of subgroups and stratified analysis, allowing a thorough understanding of 'for who' these interventions work was often lacking. All evaluations were observational, with no comparison group or random allocation. Therefore, causal inference cannot be made, and all results could be affected by confounding. While a delay occurred between the primary literature search and the final submission of this manuscript, our results are intended to provide a primary explanatory attempt based on the extant literature at the time of writing rather than a definitive model. Finally, results were largely drawn from small samples of self-reported data introducing potential sources of bias such as recall bias and social desirability bias. Nevertheless, the range of methodologies employed combined with the consistency of findings across studies increases the robustness of the overarching conclusions drawn.

Conclusion

Across a range of delivery modalities and contexts, the distribution of safer inhalation kits facilitated contact with drug services, notably resulting in referrals to a range of health and social care services. Reductions were also noted in risky crack use behaviours such as pipe sharing, makeshift pipe use, and injecting. Preliminary indications of improvement in health outcomes for people who use crack were also observed, including reduced injuries associated with the use of makeshift pipes.

Together, these findings contribute to a refined programme theory in which the effectiveness of safer inhalation interventions is not only determined by what is distributed, but how, by whom, and in what context. The mechanisms of trust, relevance, and social reinforcement are activated through service accessibility and reliability, contextual/cultural sensitivity, and peer involvement. These factors should guide both future implementation and evaluation efforts.

Our synthesis also underscores delivery realities: implementation is frequently constrained by law and policing practices, volatile funding and logistical difficulties.

The flexibility of services (e.g. in supply levels, kit composition, distribution hours/location) was a necessary contextual enabler to optimally deliver interventions and meet the needs of their clients, who often already suffered from material and social deprivation.

In addition, the ability of services to operate with minimal police interference and legal pressures was also crucial in ensuring optimal delivery and sustainability. Uncertainty with regards to the legality of interventions was a key reason for the termination of interventions, and police involvement hindered peers' ability to optimally contribute.

Funding sources

The SIPP Study is funded by the National Institute for Health and Care Research (NIHR) Public Health Research programme (NIHR133118). The views expressed are those of the authors and not necessarily those of the NIHR, the Department of Health and Social Care, or the NHS. The funders had no involvement in the study design; collection, analysis, or interpretation of data; report writing; or decision to submit the article for publication.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used ChatGPT (GPT-5, OpenAI) to revise the manuscript text for clarity and readability. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

Alexandre Piot: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Casey Sharpe:** Writing – review & editing, Visualization, Validation, Methodology, Data curation. **Cedomir Vuckovic:** Writing – review & editing, Methodology, Data curation. **Caitlynne McGaff:** Writing – review & editing, Data curation. **Jenny Scott:** Writing – review & editing, Methodology, Funding acquisition, Data curation, Conceptualization. **Vivian Hope:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Data curation, Conceptualization. **Lucy Platt:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Data curation, Conceptualization. **Magdalena Harris:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2026.105371.

References

Artenie, A., Stone, J., Fraser, H., Stewart, D., Arum, C., Lim, A. G., McNaughton, A. L., Trickey, A., Ward, Z., & Abramovitz, D. (2023). Incidence of HIV and hepatitis C virus among people who inject drugs, and associations with age and sex or gender: A global systematic review and meta-analysis. *The Lancet Gastroenterology & Hepatology, 8*(6), 533–552. https://doi.org/10.1016/S2468-1253(23)00018-3

Backé, H., Bailey, K., Heywood, D., Marshall, S., & Plourde, P. (2012). Safer crack use kit distribution in the Winnipeg health region. https://sagecollection.ca/wp-content/uploads/2015/04/scukdistributioninthewinnipeghealthregion-revisedoct2012.pdf.

Bergen-Cico, D., & Lapple, A. (2015). Examination of safe crack use kit distribution from a public health perspective. *World Medical & Health Policy, 7*(4), 349–367. https://doi.org/10.1002/wmh3.169

Black, C. (2021). Review of drugs part two: Prevention, treatment and recovery. https://www.gov.uk/government/publications/review-of-drugs-phase-two-report.

Bonn, M., Kerr, T., Boyd, J., Rudzinski, K., McNeil, R., & Ivsins, A. (2025). A qualitative study exploring motives for the transition from injecting to smoking drugs in Vancouver, British Columbia. *International Journal of Drug Policy, 145*, Article 104982. https://doi.org/10.1016/j.drugpo.2025.104982

Boyd, S., Johnson, J. L., & Moffat, B. (2008). Opportunities to learn and barriers to change: Crack cocaine use in the Downtown Eastside of Vancouver. *Harm Reduction Journal, 5*, 1–12. https://doi.org/10.1186/1477-7517-5-34

Cadet-Taïrou, A., Jauffret-Roustide, M., Gandilhon, M., Dambélé, S., & Jangal, C. (2021). Main results of the Crack study in the Ile-de-France region - Overview. https://www.

ofdt.fr/sites/ofdt/files/2023-08/field_media_document-3417-doc_num–explnum_id-32647-.pdf.
Cepeda, A., Nowotny, K. M., Frankeberger, J., Mora, E. Z., Natera-Rey, G., & Valdez, A. (2024). HIV prevention and crack harm reduction using projection mapping in Mexico city. *Health Education Journal, 83*(5), 544–559. https://doi.org/10.1177/00178969241253802
Chung, E. O., Patel, S. V., Wenger, L. D., Humphrey, J. L., Sukasih, A., Bluthenthal, R. N., Tookes, H. E., Des Jarlais, D. C., Glick, S. N., & LaKosky, P. A. (2025). Association of safer smoking supply distribution with participant encounters and naloxone distribution from syringe services programs: Findings from the National survey of syringe services programs in the United States. *Drug and Alcohol Dependence Reports, 14*, Article 100317. https://doi.org/10.1016/j.dadr.2024.100317
Domanico, A., & Malta, M. (2012). Implementation of harm reduction toward crack users in Brazil: Barriers and achievements. *Substance Use & Misuse, 47*(5), 535–546. https://doi.org/10.3109/10826084.2012.644170
Duncan, T., Sebar, B., Lee, J., & Duff, C. (2021). Mapping the spatial and affective composition of care in a drug consumption room in Germany. *Social & Cultural Geography, 22*(5), 627–646. https://doi.org/10.1080/14649365.2019.1610487
Duopah, Y. A., Moran, L., Elmusharaf, K., & Kelly, D. (2024). Breaking barriers: A qualitative exploration of healthcare access for crack cocaine users in Limerick. *BMC Health Services Research, 24*(1), 1450. https://doi.org/10.1186/s12913-024-11920-1
European Union Drugs Agency. (2024). Wastewater analysis and drugs — a European multi-city study. https://www.euda.europa.eu/publications/html/pods/waste-water-analysis_en#data-explorer.
Fischer, B., O'Keefe-Markman, C., Lee, A., & Daldegan-Bueno, D. (2021). Resurgent', 'twin' or 'silent' epidemic? A select data overview and observations on increasing psycho-stimulant use and harms in North America. *Substance Abuse Treatment, Prevention, and Policy, 16*(1), 17. https://doi.org/10.1186/s13011-021-00350-5
Frankeberger, J., Cepeda, A., Natera-Rey, G., & Valdez, A. (2019). Safer crack kits and smoking practices: Effectiveness of a harm reduction intervention among active crack users in Mexico City. *Substance Use & Misuse, 54*(4), 592–600. https://doi.org/10.1080/10826084.2018.1528460
Harm Reduction International. (2025). Global State of Harm Reduction 2025: Update to Key Data. https://hri.global/publications/global-state-of-harm-reduction-2025-update-to-key-data/.
Harris, J., Shorter, G. W., Davidson, G., & Best, P. (2020). Risk perception, changing social context, and norms prevent transition to regular injection among people who smoke heroin. *Drug and Alcohol Dependence, 208*, Article 107878. https://doi.org/10.1016/j.drugalcdep.2020.107878
Harris, M., Scott, J., Hope, V., Busza, J., Sweeney, S., Preston, A., … Platt, L. (2024). Safe inhalation pipe provision (SIPP): protocol for a mixed-method evaluation of an intervention to improve health outcomes and service engagement among people who use crack cocaine in England. *Harm reduction journal, 21*(1), 19. https://doi.org/10.1186/s12954-024-00938-7
Harris, M. (2020). An urgent impetus for action: Safe inhalation interventions to reduce COVID-19 transmission and fatality risk among people who smoke crack cocaine in the United Kingdom. *International Journal of Drug Policy, 83*, Article 102829. https://doi.org/10.1016/j.drugpo.2020.102829
Hay, G., Rael dos Santos, A., Reed, H., & Hope, V. (2019). Estimates of the prevalence of opiate use and/or crack cocaine use, 2016/17: Sweep 13 report. https://www.ljmu.ac.uk/~/media/phi-reports/pdf/2019_03_estimates_of_the_prevalence_of_opiate_use_andor_crack_cocaine_use_201617_sweep_13_.pdf.
Hermanstyne, K. A., Bangsberg, D. R., Hennessey, K., Weinbaum, C., & Hahn, J. A. (2012). The association between use of non-injection drug implements and hepatitis C virus antibody status in homeless and marginally housed persons in San Francisco. *Journal of Public Health, 34*(3), 330–339. https://doi.org/10.1093/pubmed/fds018
Hurley, S. F., Jolley, D. J., & Kaldor, J. M. (1997). Effectiveness of needle-exchange programmes for prevention of HIV infection. *The Lancet, 349*(9068), 1797–1800. https://doi.org/10.1016/S0140-6736(96)11380-5
Ivsins, A., Roth, E., Nakamura, N., Krajden, M., & Fischer, B. (2011). Uptake, benefits of and barriers to safer crack use kit (SCUK) distribution programmes in Victoria, Canada—a qualitative exploration. *International Journal of Drug Policy, 22*(4), 292–300. https://doi.org/10.1016/j.drugpo.2011.05.005
Jagoe, L. (2014). *The impact of crack pipe distribution on drug use and healthcare utilization*. https://doi.org/10.11575/PRISM/28178.
Johnson, J., Malchy, L., Mulvogue, T., Boyd, S., Buxton, J., & Loudfoot, J. (2008). Lesson learned from the score project: A document to support outreach and education related to safer crack use. https://www.tni.org/files/publication-downloads/score-lessons-learned.pdf.
Keemink, J. R., Stevens, A., Shirley-Beavan, S., Khadjesari, Z., & Shorter, G. W. (2025). Four decades of overdose prevention centres: Lessons for the future from a realist review. *Harm reduction journal, 22*(1), 36. https://doi.org/10.1186/s12954-025-01178-z
Kesten, J. M., Ayres, R., Neale, J., Clark, J., Vickerman, P., Hickman, M., & Redwood, S. (2017). Acceptability of low dead space syringes and implications for their introduction: A qualitative study in the West of England. *International Journal of Drug Policy, 39*, 99–108. https://doi.org/10.1016/j.drugpo.2016.09.005
Leonard, L., DeRubeis, E., Pelude, L., Medd, E., Birkett, N., & Seto, J. (2008). "I inject less as I have easier access to pipes": Injecting, and sharing of crack-smoking materials, decline as safer crack-smoking resources are distributed. *International Journal of Drug Policy, 19*(3), 255–264. https://doi.org/10.1016/j.drugpo.2007.02.008
Lloyd, C., Papworth, A., Page, G., Bhardwa, B., & May, T. (2025). Unmet treatment need among heroin and crack users and dependent drinkers: Final report. https://www.york.ac.uk/media/business-society/research/documents/Unmet%20Treatment%20Needs%20NIHR203449%20Final%20Report.pdf.
MacDonald, M., Law, M., Kaldor, J., Hales, J., & Dore, G. J. (2003). Effectiveness of needle and syringe programmes for preventing HIV transmission. *International Journal of Drug Policy, 14*(5-6), 353–357. https://doi.org/10.1016/S0955-3959(03)00133-6
Macías, J., Palacios, R. B., Claro, E., Vargas, J., Vergara, S., Mira, J. A., Merchante, N., Corzo, J. E., & Pineda, J. A. (2008). High prevalence of hepatitis C virus infection among noninjecting drug users: Association with sharing the inhalation implements of crack. *Liver International, 28*(6), 781–786. https://doi.org/10.1111/j.1478-3231.2008.01688.x
Malchy, L., Bungay, V., Johnson, J. L., & Buxton, J. (2011). Do crack smoking practices change with the introduction of safer crack kits? *Canadian Journal of Public Health, 102*(3), 188–191. https://doi.org/10.1007/BF03404893
Masterton, W., Falzon, D., Burton, G., Carver, H., Wallace, B., Aston, E. V., Sumnall, H., Measham, F., Gittins, R., & Craik, V. (2022). A realist review of how community-based drug checking services could be designed and implemented to promote engagement of people who use drugs. *International Journal of Environmental Research and Public Health, 19*(19), Article 11960. https://doi.org/10.3390/ijerph191911960
McCulloch, P., Shaw, A., Gilchrist, G., Matheson, C., Maxwell, M., Neale, J., Myring, G., McLeod, H., Hickman, M., & Vickerman, P. (2025). Optimal provision of opiate substitution therapy and needle and syringe programmes: A multi-method realist evaluation. *Health Technology Assessment (Winchester, England), 29*(64), 1. https://doi.org/10.3310/HGDS4449
Miller, N. M., Waterhouse-Bradley, B., Campbell, C., & Shorter, G. W. (2022). How do naloxone-based interventions work to reduce overdose deaths: A realist review. *Harm Reduction Journal, 19*(1), 18. https://doi.org/10.1186/s12954-022-00599-4
Miskovic, M., Chan Carusone, S., Guta, A., O'Leary, B., dePrinse, K., & Strike, C. (2018). Distribution of harm reduction kits in a specialty HIV hospital. *American Journal of Public Health, 108*(10), 1363–1365. https://doi.org/10.2105/AJPH.2018.304600
Misuse of Drugs Act (1971 c.38). (1971). https://www.legislation.gov.uk/ukpga/1971/38/contents.
Mogensen, S. I., & Duff, C. (2025). Negotiating care and control: Women's experiences of two harm reduction services in Copenhagen. *Sociology of Health & Illness, 47*(8), Article e70093. https://doi.org/10.1111/1467-9566.70093
O'Byrne, P., & Holmes, D. (2008). Evaluating crack pipe distribution in Canada: A systems change case study. *Addiction Research & Theory, 16*(2), 181–192. https://doi.org/10.1080/16066350701437283
O'Hearie, G. (2013). Cracking on a harm reduction report based on the findings of a street outreach harm reduction service for crack cocaine in Clondalkin. https://www.drugsandalcohol.ie/19845/1/Bawnogue_Cracking_On_Report_Final.pdf.
O'Reilly, L., & Mac Cionnaith, C. (2019). Crack cocaine use in Ballymun: An evidence base for interventions. https://www.drugsandalcohol.ie/31345/1/Ballymundtf%20Report%20Book%20online.pdf.
Office for Health Improvement and Disparities. (2024). Adult substance misuse treatment statistics 2023 to 2024: Report. https://www.gov.uk/government/statistics/substance-misuse-treatment-for-adults-statistics-2023-to-2024/adult-substance-misuse-treatment-statistics-2023-to-2024-report?utm#trendsover-time.
Office for Health Improvement and Disparities. (2025). Adult substance misuse treatment statistics 2024 to 2025: Report. https://www.gov.uk/government/statistics/substance-misuse-treatment-for-adults-statistics-2024-to-2025/adult-substance-misuse-treatment-statistics-2024-to-2025-report#trendsover-time.
Office for National Statistics. (2025). Deaths related to drug poisoning in England and Wales: 2024 registrations. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsrelatedtodrugpoisoninginenglandandwales/2024registrations.
Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 372*. https://doi.org/10.1136/bmj.n71
Pawson, R., & Tilley, N. (1997). An introduction to scientific realist evaluation. In E. Chelimsky, & W. R. Shadish (Eds.), *An Introduction to Scientific Realist Evaluation* (pp. 405–418). SAGE Publications, Inc.. https://doi.org/10.4135/9781483348896.n29
Prangnell, A., Dong, H., Daly, P., Milloy, M., Kerr, T., & Hayashi, K. (2017). Declining rates of health problems associated with crack smoking during the expansion of crack pipe distribution in Vancouver, Canada. *BMC Public Health, 17*, 1–7. https://doi.org/10.1186/s12889-017-4099-9
Public Health England, & Home Office. (2019). Increase in crack cocaine use inquiry: Summary of findings. https://www.gov.uk/government/publications/crack-cocaine-increase-inquiry-findings/increase-in-crack-cocaine-use-inquiry-summary-of-findings.
Reid, M. C., Oliphant-Wells, T., Moreno, C., Ketchum, J., Fitzpatrick, T., McMahan, V. M., & Glick, S. N. (2023). High levels of interest in access to free safer smoking equipment to reduce injection frequency among people who inject drugs in Seattle, Washington. *Drug and Alcohol Dependence Reports, 7*, Article 100163. https://doi.org/10.1016/j.dadr.2023.100163
Ronsley, C., Nolan, S., Knight, R., Hayashi, K., Klimas, J., Walley, A., Wood, E., & Fairbairn, N. (2020). Treatment of stimulant use disorder: A systematic review of reviews. *PloS One, 15*(6), Article e0234809. https://doi.org/10.1371/journal.pone.0234809
Ross, C. (2015). Street connections/outreach services program monitoring and evaluation report. https://sagecollection.ca/wp-content/uploads/2015/04/street_connections_evaluation_-_final_april_2015.pdf.
Roy, E., Arruda, N., Vaillancourt, E., Boivin, J.-F., Morissette, C., Leclerc, P., Alary, M., & Bourgois, P. (2012). Drug use patterns in the presence of crack in downtown Montréal. *Drug and Alcohol Review, 31*(1), 72–80. https://doi.org/10.1111/j.1465-3362.2011.00299.x

Shang, M., Thiel, B., Liebschutz, J. M., Kraemer, K. L., Freund, A., & Jawa, R. (2023). Implementing harm reduction kits in an office-based addiction treatment program. *Harm Reduction Journal, 20*(1), 163. https://doi.org/10.1186/s12954-023-00897-5

Strike, C., & Watson, T. M. (2017). Education and equipment for people who smoke crack cocaine in Canada: Progress and limits. *Harm Reduction Journal, 14*, 1–7. https://doi.org/10.1186/s12954-017-0144-3

Tapper, A., Ahern, C., Graveline-Long, Z., Newberger, N. G., & Hughto, J. M. (2023). The utilization and delivery of safer smoking practices and services: A narrative synthesis of the literature. *Harm Reduction Journal, 20*(1), 160. https://doi.org/10.1186/s12954-023-00875-x

Ti, L., Buxton, J., Wood, E., Zhang, R., Montaner, J., & Kerr, T. (2011). Difficulty accessing crack pipes and crack pipe sharing among people who use drugs in Vancouver, Canada. *Substance Abuse Treatment, Prevention, and Policy, 6*, 1–5. https://doi.org/10.1186/1747-597X-6-34

Ti, L., Buxton, J., Wood, E., Shannon, K., Zhang, R., Montaner, J., & Kerr, T. (2012). Factors associated with difficulty accessing crack cocaine pipes in a Canadian setting. *Drug and Alcohol Review, 31*(7), 890–896. https://doi.org/10.1111/j.1465-3362.2012.00446.x

UK Health Security Agency; Office for Health Improvement and Disparities. (2023). Estimates of opiate and crack use in England: Main points and methods. Retrieved from https://www.gov.uk/government/publications/opiate-and-crack-cocaine-use-prevalence-estimates/estimates-of-opiate-and-crack-use-in-england-main-points-and-methods.

UNODC. (2023). Global report on Cocaine 2023 – Local dynamics, global challenges (United Nations Publications). https://www.unodc.org/documents/data-and-analysis/cocaine/Global_cocaine_report_2023.pdf.

Weeks, M. R., Li, J., Dickson-Gomez, J., Convey, M., Martinez, M., Radda, K., & Clair, S. (2009). Outcomes of a peer HIV prevention program with injection drug and crack users: The risk avoidance partnership. *Substance Use & Misuse, 44*(2), 253–281. https://doi.org/10.1080/10826080802347677