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Abstract | Drawing on the Global Policing Database (GPD), this review assesses the impact of supplier arrests and seizures on drug crime, drug use, drug price, drug purity, and drug harm outcomes. Just 13 impact evaluation studies (reported in 18 documents) met inclusion criteria. An evidence and gap map was constructed, showing that research to date relates primarily to drug harms, followed by drug crime and drug price, and that there are significant gaps in the impact evaluation literature. The results of this review demonstrate the limited amount of high-quality scientific evidence that can be used to examine the impact of supplier arrest and seizure on a range of drug-related outcomes.

The impact of arrest and seizure on drug crime and harms: A systematic review

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About two-thirds of the Australian Government drug response budget goes to law enforcement (Ritter, Hughes & Hull 2016), and two of the key law enforcement mechanisms for controlling drug use are supplier arrest and seizures (Caulkins & Reuter 2010; Kilmer & Hoorens 2010). One of the underlying assumptions of law enforcement arrest and seizure responses to drug problems is that they will deter drug crime and drug use, and thereby increase drug prices, impact purity and/or potency, and reduce drug harms more generally. Yet empirical evidence that examines the impact of supplier arrest and seizures on drug-related outcomes does not unequivocally support this basic deterrence assumption (see, for example, Mazerolle, Soole & Rombouts 2007; Reuter 2019, 1988; Wan et al. 2014). In fact, research suggests that reactive enforcement activities—such as seizures and arrests—can actually increase crime without reducing drug consumption or other harms (see, for example, Hughes et al. 2018; King & Mauer 2006). This systematic review of the impact of supplier seizure and arrest as law enforcement strategies for addressing drug crime, drug use, drug price, drug purity, and drug harms is therefore timely. It aims to provide comprehensive, clear, evidence-based guidance for Australian policy and practice.

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Method

This review uses the Global Policing Database (GPD) to capture evaluations of the impact of law enforcement arrest and/or seizure on drug crime, drug use, drug price, drug purity, and drug harm outcomes. The GPD is an online searchable database designed to capture all published and unpublished experimental and quasi-experimental impact evaluations of policing interventions conducted since 1950. It is compiled by systematically searching, retrieving and screening published and unpublished literature that reports on impact evaluations of policing interventions. There are no restrictions on the type of policing techniques, outcomes or language. A complex search string was used to search more than 60 academic databases for relevant documents (see Higginson et al. 2015 for full methodological protocol). Table 1 contains the terms used to search the GPD for research published between January 2004 and December 2018. In addition to searching the GPD, we harvested the reference lists of all included studies and previous reviews related to drug law enforcement.

Table 1: Systematic search terms			
Drug search terms		**Drug-specific law enforcement or drug market terms**	
addict*	mephedrone	bust*	interdict*
acid	methadone	buy	launder*
amphet*	meth	caution*	legali*
bath*	naloxone*	closedown*	market*
benzo*	narco*	"close down*"	network*
cannab*	opiate*	"close-down*"	operation*
cocaine	opioid*	confisc*	precursor*
"date rape"	oxy*	covert	raid*
"date-rape"	overdos*	crack*	rave*
depressant*	pharma*	dark*	referral*
drug*	poly*	deal*	sale*
ecstasy	precurs*	decrim*	saturat*
fentanyl	prescri*	delivery	smuggl*
GBL	pseudo*	deliveries	stop*
GHB	psychoactive	demand*	sting*
hallucino*	Rohypnol	depenali*	substitute*
heroin	speed	disposal*	suppl*
illicit*	spice*	disrupt*	suppress*
impair*	spik*	diver*	sweep*
inject*	steroid*	eradic*	traffick*
intoxica*	stimulant*	expiation	undercover
ketamine	substance*	farm*	
LSD	synthetic*	harm*	
marij*	tranquili*	informant*	
MDMA	weed	informer*	

Note: Terms were combined with Boolean OR to search titles and abstracts of all GPD records

Inclusion criteria

Types of interventions

The review includes any study where the intervention is either arrest of drug suppliers or seizure from suppliers (as opposed to drug users). We define 'arrest' as the act of police or law enforcement personnel taking an individual into custody. Other terms used for arrest include apprehend, restrain, capture, detain and detention. We define 'seizure' as the act of police or law enforcement personnel taking, forfeiting, confiscating, destroying or capturing an item potentially linked to a crime or illegal activity (eg drugs, precursors, stolen goods, proceeds of crime, drug-manufacturing equipment or drug paraphernalia). We included studies where the focus of the intervention—as specified by the study authors—was suppliers, or where study authors used terminology suggestive of suppliers (eg retailers, wholesale dealers).

Studies are included where the arrest and/or seizure intervention is based on self-report data (eg arrested yes/no) or official data (eg arrested yes/no), or where the intervention is by way of experimental design (ie district A using arrest versus district B not using arrest). Where arrest or seizure is one component of a broader intervention, studies are only included if the study authors distinguish the effects of this component of the intervention from other ineligible components of the intervention.

Types of participants and settings

This review considers the impact of arrest of suppliers or seizure from suppliers on the following:

- individuals of any age, gender or ethnicity;
- micro places (eg street corners, buildings, police beats or street segments); and
- macro places (eg neighbourhoods, communities, police districts or cities).

No limits are placed on the settings or geographical region reported on in the study. Specifically, we include high-, low- and middle-income countries in the review.

Types of outcomes

Our review includes studies where the reported outcome falls into one or more of the defined categories below. For the purposes of this review, the term 'drug' is defined as any illegal drug or a legal drug used in an illegal manner (eg fentanyl).

Drug crime

This is drug activity classified as illegal by legislation, including:

- selling, buying, manufacturing or possessing drugs or drug paraphernalia;
- public nuisance due to illicit drugs (not alcohol); and
- driving under the influence of drugs (not alcohol).

Variables suggestive of drug crime, including:

- drug-related arrests;
- drug-related fines, citations or notices;
- drug-related calls-for-service;
- drug-related convictions; and
- drug-related recidivism.

Drug use

This includes consumption of a drug for non-medical purposes, which can include different routes of ingestion (ie intravenous, oral, nasal or rectal).

Drug price

This is the monetary amount or value assigned to a drug, which may be by weight, unit or dose.

Drug purity or potency

This is a measure of the amount of the active ingredient in a drug compared with the inactive substances or substances that relate to processing or manufacturing the drug (eg a substance used to dilute or mimic a drug). Purity is sometimes used synonymously with potency, which is the measure of drug intensity—the amount required to achieve the desired drug effect.

Drug-related harms

This is the damage or injury associated with drug use. These harms can encompass the following areas:

- physical health of the user—eg physical injuries, disease, overdose or death;
- psychological health of the user and/or their significant others—eg drug-induced psychosis, diagnosis with a substance-use disorder or admission to psychiatric or rehabilitation facilities;
- social impacts of drug use at the individual level—eg injuries to user or others, stigma, homelessness, unemployment, domestic violence, family breakdown, or child abuse, maltreatment or neglect;
- social impacts of drug use at the place-based level—eg physical and social disorder or traffic accidents; and
- organisational impacts of drug use—eg use of resources or cost of dealing with drug use.

We include outcome data that is measured through self-report instruments (eg surveys and questionnaires), interviews, observations, and/or official data (eg calls-for-service, arrests, convictions and hospital admissions).

Types of research designs and comparators

Our review includes quantitative impact evaluations that use a randomised experimental design (eg a randomised controlled trial) or a quasi-experimental design with a comparison group that does not receive the intervention. We include studies where the comparison group receives either 'business-as-usual' policing, no intervention, or an alternative intervention (treatment–treatment designs).

Although not as robust as randomised controlled trials, 'strong' quasi-experiments can be used to provide causal inference when there are elements of the design that aim to minimise threats to internal validity. We therefore include the following 'strong' quasi-experimental designs in this review:

- crossover designs;
- regression discontinuity designs;
- designs using multivariate controls—for example, multiple regression;
- matched control group designs with or without pre-intervention baseline measures (propensity or statistically matched);
- unmatched control group designs without pre-intervention measures where the control group has face validity;
- unmatched control group designs with pre- and post-intervention measures which allow for difference-in-difference analysis;
- short interrupted time-series designs with control group—with less than 25 pre- and 25 post-intervention observations (Glass 1997); and
- long interrupted time-series designs with or without a control group—with 25 or more pre- and post-intervention observations (Glass 1997).

Weaker quasi-experimental designs can be used to demonstrate the magnitude of the relationship between an intervention and an outcome. However, we will exclude the following weaker quasi-experimental designs due to their limited ability to establish causality:

- raw unadjusted correlational designs where the variation in the level of the intervention is compared to the variation in the level of the outcome; and
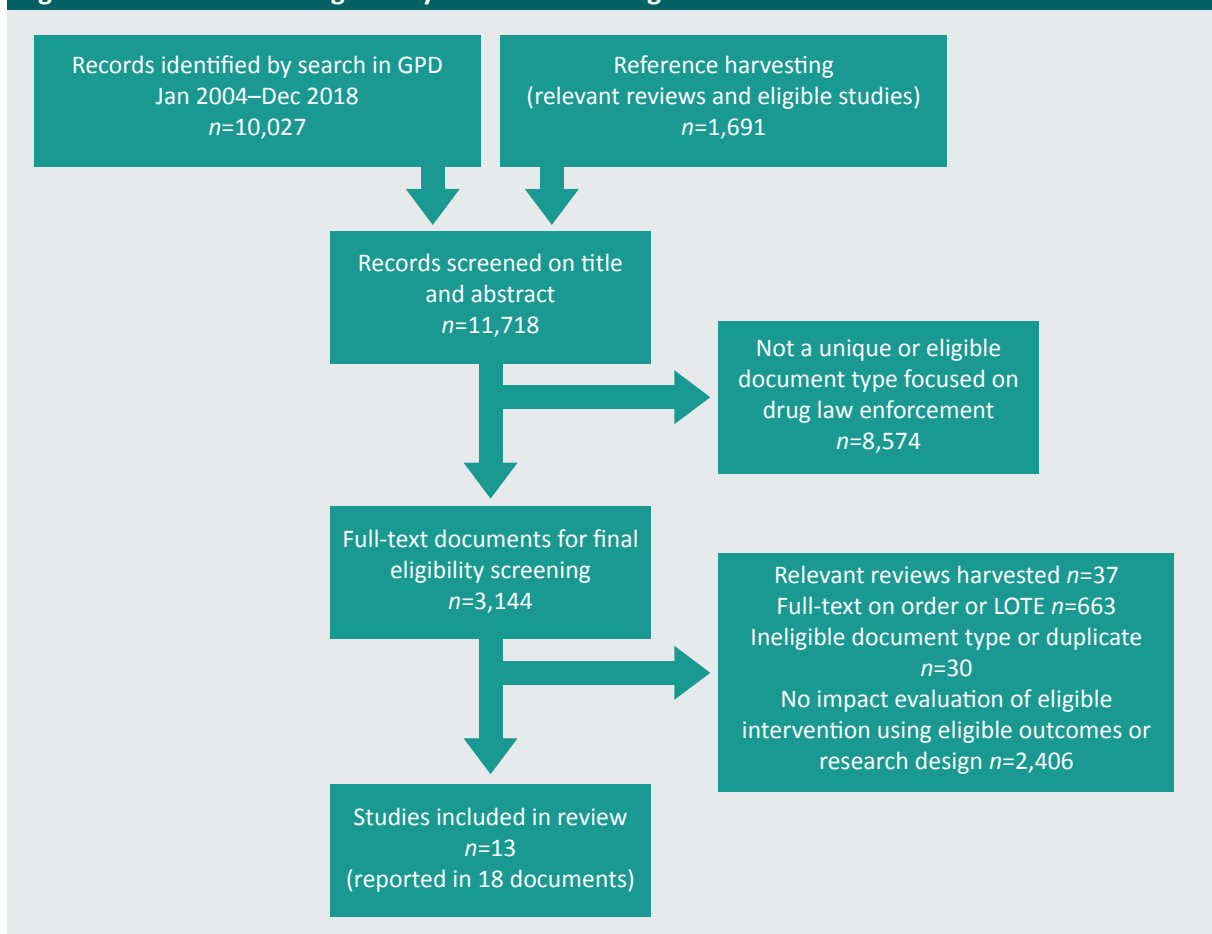- single group designs with pre- and post-intervention measures.

Results

Search and screening

The systematic search within the GPD identified 75,005 records (citations gathered from over 60 databases and research repositories). Of these, 10,027 had been full-text screened as reporting or potentially reporting on a quantitative impact evaluation of an intervention pertaining to police or policing. These records were then processed within SysReview review management software (Higginson & Neville 2014) to determine their eligibility for the current review. In addition, we harvested and processed potentially eligible studies from the reference lists of 37 reviews relevant to the topic area and from all studies found eligible for this review. Figure 1 provides a flowchart illustrating the attrition of records through the systematic screening stages according to the Preferred Reporting for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al. 2009).

A total of 13 studies (reported in 18 documents) were deemed eligible for the review. Only three of these studies contained sufficient data to calculate effect sizes, and these studies used different outcome variables to measure the impact of seizure or supplier arrest. As a result, quantitative synthesis via meta-analysis was not possible. In the following section, we provide a qualitative summary of the included studies.

Figure 1: PRISMA flow diagram: Systematic screening of records

Records identified by search in GPD
Jan 2004–Dec 2018
n=10,027

Reference harvesting
(relevant reviews and eligible studies)
n=1,691

Records screened on title and abstract
n=11,718

Not a unique or eligible document type focused on drug law enforcement
n=8,574

Full-text documents for final eligibility screening
n=3,144

Relevant reviews harvested *n*=37
Full-text on order or LOTE *n*=663
Ineligible document type or duplicate *n*=30
No impact evaluation of eligible intervention using eligible outcomes or research design *n*=2,406

Studies included in review
n=13
(reported in 18 documents)

Summary of eligible studies

Supplier arrest or seizure: Drug crime

Three studies (represented in five documents) examined the impact of supplier seizure on drug crime, with no studies found that examined the impact of supplier arrest on drug crime (see Table 2). These three studies found that supplier seizures do not unequivocally reduce drug crime.

Table 2: Studies examining impact of supplier arrest or seizure on drug crime			
Study name, document type, location	**Intervention, participants, research design**	**Outcome measured**	**Study results**
Giommoni, Aziani & Berlusconi 2017 Peer-reviewed journal article Multiple (European and non-European countries in the heroin trade network)	Intervention: Quantity of heroin seizures per 100,000 population. Participants: Macro places (countries). Research design: Design with multivariate controls.	Heroin trafficking between European and non-European countries (official report)	More heroin seizures associated with a greater number of connections within the trafficking network.
Bishopp & Worrall 2009 Peer-reviewed journal article United States (multiple states)	Intervention: Four levels of forfeiture laws: 100% of proceeds to law enforcement; over 80% to law enforcement; less than 80% and more than 0% to law enforcement; 0% to law enforcement. Also examines past forfeiture activities per state. Participants: Macro places (states). Research design: Design with multivariate controls	Drug manufacturing and sale arrests per 10,000 population	Asset forfeiture laws not associated with the drug arrest rate. A small but positive effect of the <80% >0% law on arrests
Wan et al. 2016, Wan et al. 2014a, Wan et al. 2014b Peer-reviewed journal article & government reports Australia (NSW)	Intervention: Number and weight of drug seizures (supplier-side) Participants: Citizens. Research design: Design with multivariate controls	Number of monthly arrests for use and possession of narcotics (heroin, amphetamines, and cocaine)	Increased seizure enforcement did not have an effect on decreasing the number of arrests for use and possession of cocaine, heroin, or amphetamines

Supplier arrest or seizure: Drug use

One study examined the impact of supplier arrest or seizure on drug use (see Table 3). This report found that, while drug use declined in the intervention and comparison locations, it was relatively equivalent at both sites at the post-intervention time point.

Table 3: Studies examining impact of supplier arrest or seizure on drug use			
Study name, document type, location	**Intervention, participants, research design**	**Outcome measured**	**Study results**
Braun & Berger 2011 Technical report Switzerland (Zurich and Bern)	Intervention: Increased suppression via arrest for supplying or dealing heroin and seizure for distribution heroin (Bern) versus treatment-as-usual law enforcement activities (Zurich) Participants: Individuals (publicly visible heroin users) Research design: Design with multivariate controls	Self-report monthly consumed amount of heroin	Drug use declined over time in both locations but remained higher in the treatment location

Supplier arrest or seizure: Drug price

Three studies examined the impact of supplier arrest or seizure on drug price (see Table 4), with mixed results as to whether increased supplier arrest and/or seizure impacts drug price.

Table 4: Studies examining impact of supplier arrest or seizure on drug price			
Study name, document type, location	**Intervention, participants, research design**	**Outcome measured**	**Study results**
Braun & Berger 2011 Technical report Switzerland (Zurich and Bern)	Intervention: Increased suppression via arrest for supplying or dealing heroin and seizure for distribution heroin (Bern) versus treatment-as-usual law enforcement activities (Zurich) Participants: Individuals (publicly visible heroin users) Research design: Design with multivariate controls	Consumer price for heroin and small-scale dealer purchase price for heroin	Price decreased in treatment location (Bern); treatment and comparison condition not significantly different at post-intervention
Freeborn 2009 Peer-reviewed journal article United States (191 counties in 37 states)	Intervention: Varying rates of arrest of cocaine dealers across counties in the United States Participants: Macro places (county-level data) Research design: Design with multivariate controls	Pure-gram cocaine price for consumers	No significant relationship between dealer arrest rates and pure-gram heroin price
Keefer, Loayza & Soares 2008 Working paper (Bolivia, Columbia, Ecuador, Peru, Australia, Norway & Singapore)	Intervention: Weight of heroin and cocaine seizures (kg per 1,000 population) Participants: Macro place (country-level data) Research design: Design with multivariate controls	Cocaine and heroin prices in US$ per gram	Greater seizures were associated with greater heroin and cocaine prices

Supplier arrest or seizure: Drug purity or potency

One study examined the impact of supplier arrest or seizure on drug purity or potency (See Table 5) and found that increased seizures predicted a portion of the variance of street-level purity of heroin in the twelve months following the seizures.

| Table 5: Studies examining impact of supplier arrest or seizure on drug purity or potency			
Study name, document type, location	**Intervention, participants, research design**	**Outcome measured**	**Study results**
Smithson, McFadden & Mwesigye 2005 Peer-reviewed journal article Australia (ACT)	Intervention: Increases in heroin seizures made by the Australia Federal Police (AFP) at federal level Participants: Macro places (country) Research design: Design with multivariate controls	Street-level heroin purity in the year following	Increases in heroin seizures accounted for 10–20% variance in street-level heroin purity

Supplier arrest or seizure: Drug harms

Six studies (represented in 11 documents) examined the impact of supplier arrest or seizure on drug harms (see Table 6), with mixed results. Two studies suggest that increased seizures are associated with decreased mortality, decreased ambulance call-outs, and increased help-seeking for substance use (Kennedy-Hendricks et al. 2016; Smithson, McFadden & Mwesigye 2004). The other four studies suggest that supplier arrests or seizures tend to increase drug-related harms, including law enforcement budgetary spending, drug-related deaths, presentation to emergency departments for drug-related health issues, and drug-related violence (Baicker & Jacobson 2007, 2004; Osorio 2015, 2014, 2013; Toprak & Cetin 2009; Wan et al. 2014a, 2014b, 2016).

Table 6: Studies examining impact of supplier arrest or seizure on drug harms

Study name, document type, location	Intervention, participants, research design	Outcome measured	Study results
Baicker & Jacobson 2004, 2007 Peer-reviewed journal article United States (Arizona, California, Florida, New York & Pennsylvania)	Intervention: Monetary value of drug seizures made Participants: Macro places (counties within US states) Research design: Design with multivariate controls	Budgetary allocations made to police by the county ('budgetary offsetting')	Increased seizures associated with decrease in county-allocated budgets for police in the year following
Kennedy-Hendricks et al. 2016 Dissertation & peer-reviewed journal article United States (North Carolina & Florida)	Intervention: Supplier seizure versus treatment as usual (standard law enforcement) Participants: Macro places (states) Research design: Unmatched comparison group design with pre-intervention measures	Mortality over time (overdoses)	Decrease in mortality over time
Osorio 2013, 2014 & 2015 Peer-reviewed journal article, dissertation & working paper Mexico	Intervention: Drug trafficker arrests and number of seizures for drugs and drug-related assets Participants: Macro places (municipalities) Research design: Design with multivariate controls	Violence between drug trafficking organisations (weekly)	Arrests and seizures associated with an increase in violence between drug trafficking organisations
Smithson, McFadden & Mwesigye 2004 Peer-reviewed journal article Australia (ACT)	Intervention: Number and weight of heroin seizures and number of amphetamine seizures made by the Australia Federal Police (AFP) at the state level between 1996 and 2002 Participants: Citizens Research design: Design with multivariate controls	Number of ambulance call-outs per month for heroin and non-heroin overdoses; Monthly methadone treatment enrolments	Increased seizures associated with increased enrolment in methadone treatment and decreased ambulance call-outs
Toprak & Cetin 2009 Peer-reviewed journal article Turkey (Istanbul)	Intervention: Number and weight of drug seizures (monthly) Participants: Macro place (Istanbul) Research design: Design with multivariate controls	Number of heroin-related deaths	Number and weight of heroin seizures predicted number of heroin-related deaths: increases in number and weight of seizures associated with increased number of heroin-related deaths
Wan et al. 2016, Wan et al. 2014a, Wan et al. 2014b Peer-reviewed journal article & government reports Australia (NSW)	Intervention: Number and weight of drug seizures (supplier-side) Participants: Citizens Research design: Design with multivariate controls	Number of monthly presentations at hospital emergency departments for cocaine, amphetamines and heroin	Increased seizure enforcement did not have an effect on the number of emergency department presentations for cocaine, heroin, or amphetamines

Figure 2: Evidence and gap map: Studies on impact of drug seizures and supplier arrests
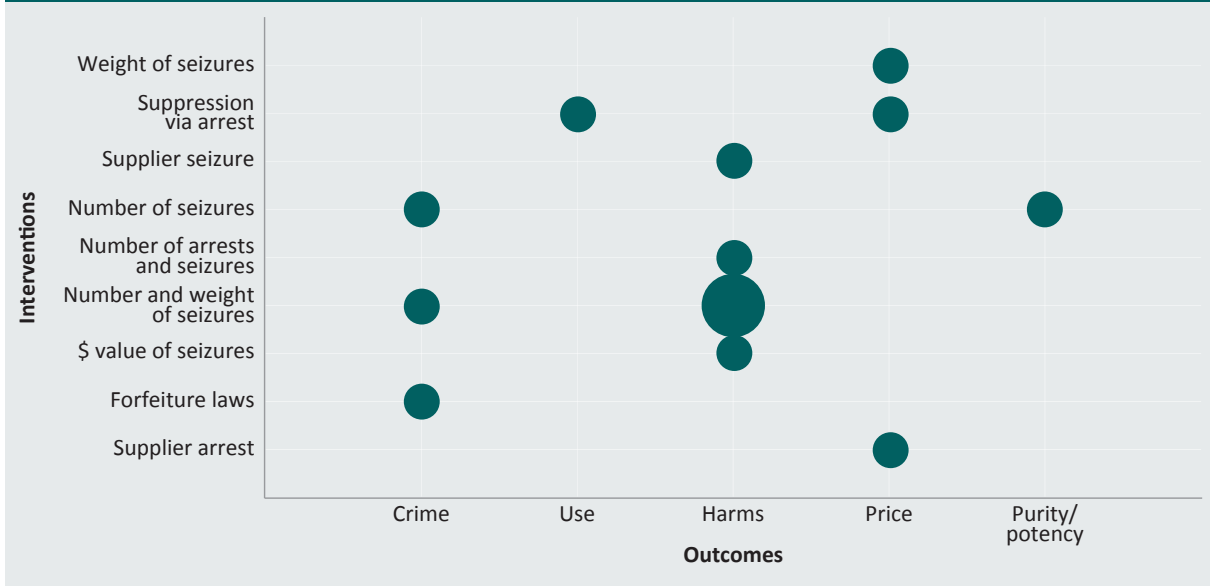
Research evidence and gap map

Figure 2 provides an evidence and gap map for eligible studies that measure the impact of supplier arrest and/or seizure on drug crime, use, harm, price, and purity and/or potency. Evidence and gap maps systematically and visually present research evidence on a particular topic via a matrix that maps the state of the evidence, including identifying where evidence is missing (Snilstveit et al. 2016).

The evidence and gap map in Figure 2 maps the outcome measures of the 13 eligible studies to nine intervention categories:

- weight of seizures;
- suppression via arrest;
- supplier seizure;
- number of seizures;
- number of arrests and seizures;
- number and weight of seizures;
- monetary value of seizures;
- forfeiture laws; and
- supplier arrest.

This evidence and gap map illustrates that all outcome measures have been captured by studies in our review. The greatest volume of evidence relates to drug harms, followed by drug crime and drug price. A smaller number of studies have examined drug use and drug purity and/or potency. More specifically, the map shows that there is significant evidence describing the effect of the number and weight of supplier arrests and seizures on drug harms. While this map does not depict the impact of this intervention on drug harms, it does indicate that a greater portion of the research has explored this relationship. The map also shows that researchers have studied the impact on drug harms of supplier seizure, number of arrests and seizures, and the monetary value of seizures.

The evidence regarding drug crime outcomes focuses mostly on the number and/or weight of supplier seizures and forfeiture laws. No research was identified that examined the relationship between drug crime and supplier arrest, whether alone or combined with seizure. This presents a gap in the evidence relating to drug crime outcomes. The evidence regarding drug price outcomes, conversely, has been assessed using both arrest and seizure interventions (although not in combination), while some studies have examined the effectiveness of supplier arrest, suppression via arrest, and the weight of seizures on drug price.

The map shows that fewer authors have studied drug use and drug purity and/or potency as outcome measures. Indeed, while some research has been conducted into the impact of suppression via arrest on drug use, and into the number of seizures on drug purity and/or potency, other types of supplier arrest and/or seizure interventions have not examined these particular outcomes. This presents another gap in the evidence.

In terms of the types of interventions that have been studied, more research has examined the use of number and weight of seizures as a predictor of drug outcomes. Research into the effectiveness of seizures on drug outcomes appears more prevalent than research relating to arrest or forfeiture laws, while few studies have examined the combined effect of supplier arrests and seizures from suppliers.

Discussion

The results of this review demonstrate that there is limited high-quality scientific evidence that can be used to examine the impact of the law-enforcement mechanisms of supplier arrest and seizure on a range of drug-related outcomes. The locations of the eligible studies vary, and most of the studies examine increased drug law enforcement seizures rather than supplier arrest. In addition, study findings vary, with only three studies reporting sufficient data to calculate effect sizes. Given these variations in the included studies, it was not possible to quantitatively synthesise the reported data to consider the overall impact of supplier arrest or seizure on drug-related outcomes. These mixed findings and the inability to quantitatively synthesise the evaluation evidence have important implications. For instance, the existing evidence does not allow us to definitively conclude that arresting suppliers and seizing from suppliers will lead to desired outcomes such as reducing drug crime, drug use and other drug harms.

Our review provides brief qualitative summaries of the included studies, but we caution against a simple counting of the number of positive and negative findings studies to determine the overall effectiveness of supplier arrests or seizures. This counting approach is not recommended by either of the Campbell or Cochrane collaborations—the two global collectives who disseminate 'gold standard' systematic reviews of interventions—because it does not take into consideration methodological variations or other differences in the studies in the same way as meta-analysis. Instead, we recommend that the findings of each study are carefully considered in light of the data synthesised (eg geographical location) and the nature of local problems. We also note that the review is limited to research conducted between 2004 and 2018, which means that potentially eligible research conducted prior to 2004 is not included.

In sum, we make two key recommendations. First, we strongly recommend that future research rigorously examines the impact of drug supplier arrest and seizures, with a particular focus on collecting high-quality longitudinal data to permit sophisticated analysis that can answer nuanced questions with implications for policing practice (see eg Singleton et al. 2018); for example, the seizure and arrest thresholds that are required to disrupt drug markets and sustain those disruptions. Second, we recommend that policymakers, funding bodies and practitioners consider the use of proactive law enforcement initiatives that are place-focused and problem-focused, which have a stronger evidence base (eg see Mazerolle, Soule & Rombouts 2007; Mazerolle, Eggins & Higginson 2020).

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