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Review

# Effect of drug law enforcement on drug market violence: A systematic review

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ABSTRACT

Violence is amongst the primary concerns of communities around the world and research has demonstrated links between violence and the illicit drug trade, particularly in urban settings. Given the growing emphasis on evidence-based policy-making, and the ongoing severe drug market violence in Mexico and other settings, we conducted a systematic review to examine the impacts of drug law enforcement on drug market violence. We conducted a systematic review using Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines. Specifically, we undertook a search of English language electronic databases (Academic Search Complete, PubMed, PsycINFO, EMBASE, Web of Science, Sociological Abstracts, Social Service Abstracts, PAIS International and Lexis-Nexis), the Internet (Google, Google Scholar), and article reference lists, from database inception to January 24, 2011. Overall, 15 studies were identified that evaluated the impact of drug law enforcement on drug market violence, including 11 (73%) longitudinal analyses using linear regression, 2 (13%) mathematical drug market models, and 2 (13%) qualitative studies. Fourteen (93%) studies reported an adverse impact of drug law enforcement on levels of violence. Ten of the 11 (91%) studies employing longitudinal qualitative analyses found a significant association between drug law enforcement and drug market violence. Our findings suggest that increasing drug law enforcement is unlikely to reduce drug market violence. Instead, the existing evidence base suggests that gun violence and high homicide rates may be an inevitable consequence of drug prohibition and that disrupting drug markets can paradoxically increase violence. In this context, and since drug prohibition has not meaningfully reduced drug supply, alternative regulatory models will be required if drug supply and drug market violence are to be meaningfully reduced.



## Background

Violence is amongst the primary concerns of communities around the world, and the illegal drug trade has been identified as a key cause of violence, particularly in urban areas (Johnson, Golub, & Dunlap, 2000; Martin et al., 2009; Ousey & Lee, 2004; Romero-Daza, Weeks, & Singer, 2003). Whilst drug market violence has traditionally been framed as resulting from the effects of drugs on individual users (e.g., violence stemming from drug-induced psychosis), violence is increasingly being understood as a means used by individuals and groups to gain or maintain market share of the lucrative illicit drug trade (Blumstein, 1995; Brownstein, Crimmins, & Spunt, 2000; Donohue III & Levitt, 1998; Goldstein, Brownstein, Ryan, & Bellucci, 1989; Guerrero, 1998).

In a variety of settings, gangs or cartels that derive their primary financing from illicit drugs have been implicated in a substantial proportion of homicides (Agren, 2010; Castle, 2009; Decker, 2003; Hutson, Anglin, Kyriacou, Hart, & Spears, 1995). For instance, studies of drug gangs in Chicago have demonstrated that as much as 25% of gang activity involves violent assault and homicide (Levitt & Venkatesh, 2000), and in Vancouver, Canada, a leaked Royal Canadian Mounted Police report notes that a recent spike in gang-related homicides is the result of the expansion of drug gangs across the province of British Columbia (Rainbow, 2010). It is important to note, however, that data demonstrate that drug market violence may increase independent of street gangs, as reportedly occurred in Los Angeles in the 1990s (Klein, Maxson, & Cunningham, 1991). In some instances, responses to the illicit drug trade have contributed to increased militarization on the part of participating individuals and organizations, with a resulting increase in drug-related homicides. For instance, as a result of fighting between the Colom-

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bian military and drug cartels, in the year 1990 nearly 1 in 1000 Colombians was murdered, a rate three times that of Brazil and Mexico and ten times that of United States (Levitt & Rubio, 2005). More recently, Mexico has experienced extreme drug market violence and mortality subsequent to the 2006 launch of a massive nationwide counternarcotics campaign (Elsworth, 2006). In 2008 alone, 6,290 drug-related deaths were recorded in that country and to date over 28,000 individuals have been killed as a result of the Mexican drug war since 2006 (Agren, 2010; Associated Press, 2009).

Governments generally address increases in drug market violence with increases in funding for drug law enforcement interventions aimed at reducing the use and availability of illicit drugs. For the purposes of this review, drug law enforcement is defined as police-, military-, or force-based responses to illicit drugs that emphasize the imposition of criminal laws for drug use and drug-related crimes (i.e., possession, trafficking and production). Such interventions take the form of targeted crackdowns of known street drug markets (Aitken, Moore, Higgs, Kelsall, & Kerger, 2002; May & Hough, 2001), military interventions (Veillette, 2005), and legal sanctions against drug users, traffickers and producers (Drucker, 2002). These interventions increasingly resource policing efforts, and governments continue to prioritize drug law enforcement over preventive- or treatment-based responses to drug use and availability (Elovich & Drucker, 2008; Government of Canada, 2008; ONDCP, 2009; Roberts, Trace, & Klein, 2004). For example, in fiscal year 2010/11 the US government allocated approximately $10 billion USD in enforcement-based responses to drug use, including $178 million USD towards ongoing support for Plan Colombia, a military-based interdiction intervention in Colombia, and $177 million USD for the Merida Initiative, an enforcement-based assistance plan to help the Mexican government dismantle drug cartels (ONDCP, 2010). Despite the ongoing emphasis on policing as the primary means to reduce drug-related harms, however, little is known regarding the association between drug law enforcement and drug market violence. We therefore conducted a systematic review to examine the role that drug law enforcement interventions may play in reducing drug market violence. Given the widespread assumption that drug law enforcement interventions reduce drug market violence, our primary hypothesis was that the available scientific evidence would demonstrate an association between increased drug law enforcement expenditures or intensity and reduced levels of violence.

## Methods

This review involved conventional systematic searching, data extraction and synthesis methods. Specifically, a comprehensive search of the literature was undertaken using electronic databases (Academic Search Complete, PubMed, PsycINFO, EMBASE, Web of Science, Sociological Abstracts, Social Science Abstracts, PAIS International and Lexis-Nexis), the Internet (Google, Google Scholar), and article reference lists. Search terms included "violence," "drug-related violence," "drug market violence," "homicide," "prohibition," "drug law enforcement," "enforcement," "drug crime," "gangs," "drug gangs," and "gun violence". The terms were searched as keywords and mapped to database specific subject headings/controlled vocabulary terms when available. Each database was searched from its inception to its most recent update as of January 24, 2011 for English language articles.

### *Inclusion/exclusion criteria*

Studies published in peer-reviewed journals, abstracts from international conferences and reports from governments and non-governmental organizations that reported on a link between drug law enforcement, illicit drug interventions, and violence were all eligible for inclusion in the systematic review. Non-peer-reviewed sources were included in the search because preliminary searches suggested that data-driven literature on our search topic was limited and we therefore did not want to be overly conservative in our search. Editorials, advocacy articles, and studies of police violence (i.e., brutality) were excluded.

### *Data collection process*

Two investigators conducted data extraction independently, in duplicate, using standardized techniques (D.W. and G.R.). Data abstractors collected information about the study design, sample size, methods of effectiveness measurement, and outcomes (i.e., drug market violence). The data were entered into an electronic database such that duplicate entries existed for each study; when the two entries did not match, consensus was reached through discussion.

### *Data items and summary measures*

The primary outcome of interest for this review was any reported association between drug law enforcement and drug market violence. For the purposes of this review, drug market violence was defined as violence (i.e., homicides, assaults, and shootings) arising from the illicit drug market. Given the heterogeneity of the literature on drug law enforcement, in some instances proxy measures were used for both drug law enforcement (i.e., number of drug arrests, number of police officers, etc.) and drug market violence (i.e., homicide, shootings, etc.).

### *Data synthesis*

To ensure scientific rigour, the Preferred Reporting of Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used for systematic data synthesis (Moher, Liberati, Tetzlaff, & Altman, 2009). These guidelines are widely recognized as the gold standard in transparent reporting of systematic evaluations of scientific research questions.

Because studies included in this systematic review varied extensively regarding methodologies and outcomes, findings were summarized on a per-study basis and statistical data were entered into a standardized form. When reporting results from individual studies, the measures of association and *p*-values reported in the studies were cited. The heterogeneity in methodologies and outcomes also excluded the possibility of conducting a meta-analysis of the studies included in the systematic review.

### *Risk of bias across studies*

A recent commentary noted that publication bias may have prevented the publication of a number of negative studies regarding the effectiveness of school-based anti-illicit drug interventions (McCambridge, 2007). Further, scientists have been critical of government health agencies that appear not to be receptive to funding grants that may be critical of current approaches to drug policy, particularly in the United States (Pearson, 2004). It is therefore possible that studies with null findings and those that observe significant associations between higher levels of drug enforcement and higher levels of violence may be underreported reported in the literature.

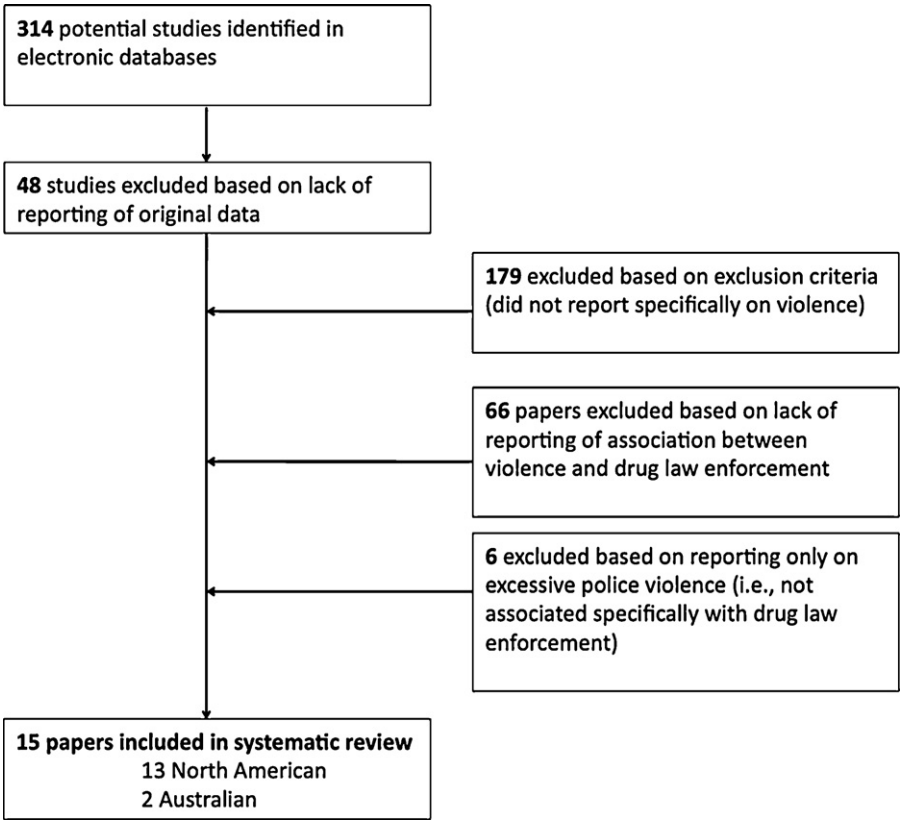


**Fig. 1.** Search process and eligible studies.

## Results

### *Study selection and study characteristics*

In the initial search, 314 potential articles were identified for inclusion in the review. Of these, 48 (15.3%) were excluded because they did not present new data (e.g., editorials). As such, 266 (84.7%) articles were retrieved for detailed examination after initial searching of keywords and abstracts. Of these, 248 (93.2%) were deemed non-relevant to the current review for the following reasons: 179 (67.3%) were excluded based on a lack of explicit mention of violence in the analysis, whilst 66 (24.8%) further studies were excluded based on a lack of reporting of drug law enforcement-related violence (i.e., they reported on levels of violence but did not report on the application of any drug law enforcement-based intervention). Finally, 6 (2.3%) papers were excluded because they reported on police violence (i.e., brutality) rather than violence associated with drug law enforcement, leaving 15 (5.6%) studies eligible for inclusion in the systematic review. The full extraction process is summarized in Fig. 1.

Overall, the 15 eligible studies included 13 (87%) studies from North America (Benson, Leburn, & Rasmussen, 2001; Benson & Rasmussen, 1998; Brumm & Cloninger, 1995; Burrus, 1999; Caulkins, Reuter, & Taylor, 2006; Goldstein et al., 1989; Levitt & Venkatesh, 2000; Miron, 1999, 2001; Rasmussen, Benson, & Sollars, 1993; Resignato, 2000; Riley, 1998; Shepard & Blackley, 2005), and 2 (13%) studies from Australia (Maher & Dixon, 1999, 2001). Thirteen (87%) used quantitative study designs and 2 (13%) used qualitative study designs. One study used a mixed method (i.e., quantitative and qualitative techniques) design. Of the 13 studies that employed quantitative techniques, 11 (85%) conducted regression analyses of real world data and 2 (15%) presented theoretical models of drug market dynamics. The individual studies are described in Table 1.

### *Results of individual studies*

The 11 studies that conducted longitudinal quantitative analyses of empirical data included violence, violent crime, or homicide as a primary independent variable of interest, and used measures of drug law enforcement as dependent variables of interest. All studies were published in peer-reviewed academic journals. These studies used a variety of proxy variables to quantify drug law enforcement, drug arrests as a proportion of total arrests, police expenditure, number of police officers, and drug seizure rates. All 11 longitudinal quantitative analyses used sophisticated regression analyses in their investigation of the impact of drug law enforcement on drug market violence, and data analysed were of high quality. Contrary to our original hypothesis, in 10 (91%) of these studies that analysed empirical data, a significant association was observed between drug law enforcement and violence (Benson et al., 2001; Benson & Rasmussen, 1998; Goldstein et al., 1989; Levitt & Venkatesh, 2000; Miron, 1999, 2001; Rasmussen et al., 1993; Resignato, 2000; Riley & O'Hare, 1998; Shepard & Blackley, 2005). That is, studies found that an increase in drug law enforcement intensity was associated with an increase in drug market violence. Only 1 (9%) study reported no significant association between drug law enforcement and drug market violence (Brumm & Cloninger, 1995). The 2 mathematical models of drug market dynamics, which modelled the potential future impact of law enforcement, reached divergent conclusions: one concluded that increased law enforcement would decrease violence (Burrus, 1999), whilst the other concluded that increased law enforcement would increase violence (Caulkins et al., 2006).

**Table 1**
Eligible studies on violence and prohibition.

| Author/year | Location | Total *N* | Study design | Study period | Main findings |
|---|---|---|---|---|---|
| Goldstein, 1989 | New York City, US | 414 homicide events | Longitudinal observational study | March 1, 1988–October 31, 1988 | 39% of all homicide events were 'systemic', i.e., a result of prohibition/enforcement effects. |
| Rasmussen, 1993 | Florida, US | 67 Florida counties | Longitudinal observational study | 1989 | The model presented suggests that increased drug enforcement will increase the size of a drug market in an adjoining jurisdiction, resulting in a higher violent crime rate. |
| Brumm, 1995 | US | 57 US cities | Longitudinal observational study | 1985 | No significant association between drug arrests and violence was observed. |
| Benson, 1998 | Florida, US | 67 Florida counties | Longitudinal observational study | 1983–1987 | Measures of drug law enforcement were significantly and positively associated with Index I crime (violent and property crime) in Florida, despite adjustment for confounders. Drug arrests were associated with an almost fivefold risk of violent and property crime (Drug arrest Relative Risk = 4.63, $p < 0.05$). |
| Riley, 1998 | 6 US cities | Not reported | Longitudinal observational study, qualitative | 1995 | Increased enforcement efforts against crack markets were associated with increased homicide rates in 4 cities and decreased homicide rates in 2 cities. |
| Burrus, 1999 | NA | NA | Predictive model | NA | Theoretical model implies that law enforcement decreases territorial returns and the marginal benefit of violence decreases, and violence decreases. |
| Maher, 1999 | Sydney, Australia | 143 | Qualitative | February 1995–February 1997 | As dealers leave the market, those willing to work in a high-risk environment move in. Street dealing becomes more volatile and violent. |
| Miron, 1999 | US | NA | Longitudinal observational study | 1900–1995 | Enforcement variables account for more than half of the variation in the homicide rate over the study period ($R^2$: .53). |
| Levitt, 2000 | Chicago, US | Not reported | Longitudinal observational study | Four year period in the 1990s (anonymized for confidentiality) | Lack of formal dispute resolution mechanisms in illicit drug trade and drug law enforcement pressure caused a high level of violence amongst drug gang studied; as a result, violent conflict made up approximately 25% of gang activities during study period. |
| Resignato, 2000 | United States | 24 US cities | Longitudinal observational study | October 1992–September 1993 | In 4 regression analyses, the drug enforcement proxy variable (ratio of drug arrests to total arrests), was positively and significantly associated with violence. |
| Benson, 2001 | Florida, US | 67 Florida counties | Longitudinal observational study | 1994–1997 | Increases in the rate of drug arrests were associated with a twofold risk of violent and property crime across counties Adjusted Relative Risk for change in drug arrests: 2.20 ($p < 0.01$). |
| Maher, 2001 | Sydney, Australia | Not reported | Qualitative | 1995–2001 | Violent disputes associated with the drug market contributed to a number of murders and the substantial rise in non-fatal shootings with handguns in NSW in 1995–2000. |
| Miron, 2001 | US | Not reported | Longitudinal observational study | 1993–1996 | In a regression analysis of the homicide rate, and using nine different drug seizure rates (prohibition proxy variables), 6 drug seizure rates were significantly and positively related to the homicide rate. |
| Shepard, 2005 | New York State, US | 62 counties | Longitudinal observational study | 1996–2000 | In regression analyses, drug arrests were not significantly negatively associated with crime (i.e., do not decrease crime). Increases in total per capita drug arrests are accompanied by higher rates of crime. Additionally, arrests for manufacture and sale of hard drugs is associated with higher levels of all crimes, including assault (Relative Risk for assault by hard drug arrest = 0.35, $p < 0.05$). |
| Caulkins, 2006 | NA | NA | Predictive model | NA | Theoretical model implies that increasing the severity of penalties associated with dealing drugs raises the stakes for all dealers, especially for the marginal dealers, who are the most likely to be apprehended. The remaining dealers command a higher market price. If favourable positions are secured by use of violence, violence may increase. |

The 2 qualitative studies included in this systematic review both reported on health harms amongst illicit drug users in an open air illicit drug market located in Sydney, Australia (Maher & Dixon, 1999, 2001). In these studies, the authors observed that, as dealers exit the illicit drug market, those willing to work in a high-risk environment enter, and that street dealing thereby becomes more volatile (Maher & Dixon, 1999). Further, the authors noted that the increased volatility associated with street dealing has resulted in a higher number of violent disputes, which have contributed to an increase in murders and non-fatal shootings amongst individuals involved in the illicit drug trade (Maher & Dixon, 2001).

## Discussion

In this systematic review, all available English language studies that evaluated the association between drug law enforcement and violence were reviewed. Whilst the number of studies was limited, they included a diverse array of literature including longitudinal analyses involving up to 6 years of prospective follow-up, regression analyses, qualitative analyses, and mathematical predictive models. Contrary to our primary hypothesis, amongst studies that systematically evaluated this question using real world data, 91% found a significant association between levels of drug law enforcement and levels of drug market violence.

The present systematic review demonstrates that drug law enforcement interventions are unlikely to reduce drug market violence. Instead, and contrary to the conventional wisdom that increasing drug law enforcement will reduce violence, the existing scientific evidence base suggests that drug prohibition likely contributes to drug market violence and increased homicide rates and that increasingly sophisticated methods of disrupting illicit drug distribution networks may in turn increase levels of violence.

The association between increased drug law enforcement funding and increased drug market violence may seem paradoxical. However, in many of the studies reviewed here, experts delineated certain causative mechanisms that may explain this association. Specifically, research has shown that by removing key players from the lucrative illegal drug market, drug law enforcement has the perverse effect of creating new financial opportunities for other individuals to fill this vacuum by entering the market (Maher & Dixon, 1999; Rasmussen et al., 1993). Classic historical examples of this phenomenon are embodied in the steep increase in gun-related homicide that emerged under alcohol prohibition in the United States (Miron, 1999), and after the removal of Columbia's Cali and Medellin cartels in the 1990s (Levitt & Rubio, 2005). In this second instance, the destruction of the cartels' cocaine duopoly led to the emergence of a fractured network of smaller cocaine producing cartels that increasingly used violence to protect and increase their market share (Bagley, 2001). In this context, violence may be an inevitable consequence of drug prohibition when groups compete for massive profits without recourse to formal non-violent negotiation and dispute resolution mechanisms (Miron, 1999; Resignato, 2000). Additionally, 'target hardening', wherein vulnerable entities become increasingly militarized in the face of risk of attack (Newton, Rogerson, & Hirschfield, 2008), has occurred amongst drug organizations facing increased drug law enforcement. In particular, the escalating militarization of drug cartels in the face of government enforcement operations has been documented in Mexico, where the emergence of the Zetas, former Mexican special forces soldiers, as criminal players in the drug market has resulted in increased violence and homicides (Sullivan & Elkus, 2008). In terms of indirect effects of drug law enforcement, experts have noted that violence may exist in many forms, including structural (i.e., political and economic inequity) (Farmer, 2010), interpersonal (i.e., the normalization of 'everyday' violence) (Scheper-Hughes, 1996), and symbolic (the ideological or cultural oppression of one group of individuals) (Bourgois, 1998). Whilst fully exploring these forms of violence is beyond the scope of this review, they nevertheless represent pervasive sources of harm amongst drug dependent populations and in communities affected by drugs. Whilst all three forms of violence differ, they are all distally related to the application of drug law enforcement against drug users.

Whilst not a central focus of this review, prior reviews have concluded that, in addition to violence, drug prohibition has produced several other unintended consequences. One key concern driving the introduction of new players into the illicit drug market is the existence of a massive illicit market that has resulted in response to the prohibition of illicit drugs, estimated by the United Nations to be worth as much as US$320 billion annually (UNODC, 2005). These massive drug profits are entirely outside the control of governments and, based on the findings of the present review, likely fuel crime, violence, and corruption in countless urban communities. Further, these profits have destabilized entire countries across the world, such as Colombia, Mexico, and Afghanistan, and have contributed to serious instability in West Africa (Cornwell, 2008; Destrebecq & Leggett, 2007; Felbab-Brown, 2005; Morris, 2003). In North America, profits from the cannabis trade constitute a major source of potential corruption and instability. In British Columbia, Canada, the cannabis market was recently estimated to be worth approximately $7 billion Canadian dollars annually, and a ferocious gang war has recently been waged over the control of these profits (British Columbia Statistics, 2009; Castle, 2009). In the United States, cocaine is used at least annually by approximately 5.8 million people, and control of this market has long been characterized by gang violence (Blumstein, 1995; Goldstein et al., 1989; Johnson et al., 2000; UNODC, 2009). In southeast Asia, a burgeoning illicit methamphetamine trade is intimately tied to regional instability, where the minority Wa and Shan groups fund an insurgency against the Burmese military junta through manufacture and wholesale distribution of methamphetamine and opium to Thailand, China, and other neighbouring countries (Cornell, 2007). In West Africa, entire countries such as Guinea-Bissau are at risk of becoming 'narco-states', as Colombian cocaine traffickers employ West African trade routes to distribute cocaine into destination markets in Europe, Russia, and the Middle East (Destrebecq & Leggett, 2007). Estimates now suggest that 27% of all cocaine destined for Europe is transited through West Africa, and is worth over $1.8 billion USD annually wholesale and as much as ten times as much at the retail level (Destrebecq & Leggett, 2007).

In terms of additional unintended consequences, in the United States, mandatory minimum sentencing policies for drug offenders have resulted in a massive growth in the prison population and place an enormous burden on the US taxpayer (Harrigan, Study Group Members AMC, Reiss, & Lange, 2000; National Center on Addiction and Substance Abuse at Columbia University, 2001). Most notably, the incarceration of drug offenders in the United States has generated substantial racial disparities in incarceration rates (Caulkins, Rydell, Schwabe, & Chiesa, 1997; Gaskins, 2004; Mascharka, 2000; Meierhoefer, 1992). For instance, based on data from 2007, one in eight African-American males in the age group 25–29 is incarcerated on any given day in the US, despite the fact that ethnic minorities consume illicit drugs at comparable rates to other subpopulations in the US (Sabol & Couture, 2008).

Whilst increased drug market violence might be acceptable to the general public under the scenario whereby drug law enforcement substantially reduces the flow of illegal drugs, prior research has clearly demonstrated that law enforcement efforts have not achieved a meaningful reduction in drug supply or use in settings where demand remains high (Degenhardt et al., 2008). In the United States, despite annual federal drug law enforcement budgets of approximately $15 billion USD and higher since the

1990s, illegal drugs – including heroin, cocaine, and cannabis – have become cheaper and drug purity has increased, whilst rates of use have not markedly changed (Manski, Pepper, & Petrie, 2001; ONDCP, 2009; UNODC, 2008). In Russia, despite a strong emphasis on drug law enforcement, evidence suggests that illicit drug use is widespread (British Columbia Statistics, 2009). Specifically, recent United Nations estimates suggest that over 1.6 million Russians use illicit opiates annually, though experts caution that the true number of Russian illicit opiate users could be as high as 5 million (UNODC, 2009).

In the face of the strong evidence that drug law enforcement has failed to achieve its stated objectives of reducing the supply and use of illicit drugs, and considering that our review suggests that this approach likely contributes to increases in drug market violence (Miron, 1999; Resignato, 2000; UNODC, 2008), policy-makers must consider alternatives. Indeed, some experts have begun to call for the regulation of certain currently illegal drugs. In the United Kingdom, researchers recently released a report delineating potential regulatory models for currently illegal drugs (Rolles, 2009). In California, a recent fiscal deficit has prompted the State Board of Equalization to prepare estimates of the potential revenue from a regulated cannabis market (Rolles, 2009). The State Board estimated that annual revenues of approximately $1.4 billion USD could result from the imposition of a regulatory framework (Ingenito, 2009). Additionally, recent results from an evaluation of Portugal's drug decriminalization policy suggests that this approach may reduce both illicit drug use and its related harms (Greenwald, 2009). Portugal's drug control framework as well as that proposed by researchers in the UK both prioritize public health responses to drug users, resourcing efforts towards treatment (i.e., methadone maintenance therapy), harm reduction interventions (i.e., sterile syringe distribution and medically supervised injecting facilities), and the prevention of illicit drug use. In Portugal, where such a model has been implemented since 2001, data suggest that rates of drug use have not increased and levels of drug-related harm, including the transmission of HIV amongst drug users, have decreased significantly (Hughes & Stevens, 2007). However, it is of note that the decriminalization of illicit drugs may not significantly reduce levels of drug market violence given that production and trafficking of drugs would remain unregulated under such a model. Given the absence of legal dispute resolution mechanisms in the regulation of a decriminalized market, violence may remain high.

### *Limitations*

This study has a number of limitations. First, because the majority of studies included in this systematic review were longitudinal observational studies, and because no randomized control trials were included in the review, it is important to note that we cannot assume causality for such a complex phenomenon as drug market violence. Second, publication bias may have skewed the availability of studies investigating the role of violence and drug law enforcement as a result of political sensitivities in organizations funding research on drug policy. Specifically, research funders have traditionally been unsympathetic to critical evaluations of the 'war on drugs' (Pearson, 2004; Saunders, 2007). However, it is noteworthy that the only paper to describe drug law enforcement having a positive effect on reducing drug market violence was based on a theoretical model (Burrus, 1999), and was inconsistent with the empirical evidence presented in the data-driven studies (Benson et al., 2001; Benson & Rasmussen, 1998; Brumm & Cloninger, 1995; Goldstein et al., 1989; Levitt & Venkatesh, 2000; Maher & Dixon, 1999; Maher & Dixon, 2001; Miron, 1999, 2001; Rasmussen et al., 1993; Resignato, 2000; Riley & O'Hare, 1998; Shepard & Blackley, 2005) and in the popular media (Agren, 2010; CBC, 2010). Third, we were limited by the lack of peer-reviewed published research on the effect of drug law enforcement on drug market violence, and were therefore restricted to a sample size of 15 studies. The fact that 13 (87%) of these studies were from North America also limits the generalizability of our findings to other settings. Fourth, because the analysis was restricted only to studies investigating the effect of drug law enforcement on drug market violence, studies that reported on levels of police violence against drug users were excluded. Finally, there are instances, such as the recent outbreak of violence in Mexico, where there is widespread agreement that law enforcement efforts sparked drug market clashes (Agren, 2010; Laski, 2009), but this has not been evaluated in a scientific study. As such, the association between drug law enforcement and drug market violence that we identified in the literature is most likely an underestimate.

### *Conclusions*

Based on the available English language scientific evidence, the results of this systematic review suggest that an increase in drug law enforcement interventions to disrupt drug markets is unlikely to reduce drug market violence. Instead, from an evidence-based public policy perspective and based on several decades of available data, the existing scientific evidence suggests drug law enforcement contributes to gun violence and high homicide rates and that increasingly sophisticated methods of disrupting organizations involved in drug distribution could paradoxically increase violence. In this context, and since drug prohibition has not achieved its stated goals of reducing drug supply, alternative regulatory models for drug control will be required if drug market violence is to be substantially reduced.

## Contributors

Evan Wood had full access to all the data in the study and had final responsibility for the decision to submit for publication. DW and GR conducted the systematic search. DW and EW drafted the manuscript. GG and TK revised the systematic review and meta-analysis methodology. TK, JM and GG revised the manuscript substantially. All authors have seen and approved the final version.

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The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript.

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## Conflict of interest statement

Dan Werb, Greg Rowell, Gordon Guyatt, Thomas Kerr and Evan Wood have no competing interests to declare. Julio Montaner has received grants from, served as an ad hoc adviser to, or spoken at events sponsored by Abbott, Argos Therapeutics, Bioject Inc., Boehringer Ingelheim, BMS, Gilead Sciences, GlaxoSmithKline, Hoffmann-La Roche, Janssen-Ortho, Merck Frosst, Panacos, Pfizer

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