ARTICLE DETAILS

TITLE (PROVISIONAL)	The temporal relationship between drug supply indicators: An audit of international government surveillance systems
AUTHORS	Wood, Evan; Werb, Dan; Kerr, Thomas; Nosyk, Bohdan; Strathdee, Steffanie; Montaner, Julio

VERSION 1 - REVIEW

REVIEWER	John M Corkery Research Co-ordinator Department of Pharmacy University of Hertfordshire, Hatfield, UK Please note that whilst I am unaware of any conflict of interest, that when employed by the UK Home Office I was responsible for collating, analysing and publishing the national statistics on drug seizures and offences, including price and purity data. I maintain an active interest in these and other drug indicators at a national and international (especiallu EU) level. I help to provide statistical and other informaton on UK drug epidemiology to international agencies such as the UNODC and European Monitoring Centre for Drugs & Drug Addiction for which I have been a data supplier/advisor/expert since the agency started.
REVIEW RETURNED	23-Apr-2013

THE STUDY	This study did not achieve what it claimed in its aims and conclusions. There is no description of enforcement-based supply reduction strategies contained in the paper and no attempt made to relate the findings they present to those strategies. A reasonable but limited attempt has been made to present information on the relationships between some (restricted) statistical indicators of law enforcement activities and price and purity of three grioups of illicit drugs. However, no attempt is made to estimate or even guestimate what the likely supply of these drugs is let alone what proportion is seized by law enforcement agencies (not an easy task). Therefore is not possible to to know how supply patterns may have changed in respect of volume etc. Other (proxy) measures of availability could have been looked at,e.g. drug arrests/convictions/offences such as production/cultivation, possession with intent to supply, supply,

	import/export. There is little specificity given in respect of the forms of cannabis considered. Amphetamine-type substances have been deliberately excluded despite data being available from some countries e.g. the UK.
	There are some factual inaccuracies in respect of availability of statistics, and evaluations of drug supply interventions.
RESULTS & CONCLUSIONS	As a result of the above, especially setting out what types of strategies there are in the relevant jurisdictions, the data presented do not address the research question. The data are interesting but more limited than they should be.
	If the authors wish to use the mateial presented then they need to recast their research question and commentary so that they can use the material produced to best advantage.
GENERAL COMMENTS	This are some interesting data here that deserve to be in the public domain. However, the way the paper is written means that the data do not address the posed research question. If the paper were re-written from a different perspective, i.e. looking at the relationships over time between these different drug indiactors then I think there is a viable paper here. It is hoped that the comments added to the attached script are of some help in this respect.

The reviewer also provided a marked paper which is also available from the publisher upon request.

REVIEWER	Stephen Rolles Senior Policy Analyst Transform Drug policy Foundation United Kingdom
	SR is employed by Transform Drug Policy Foundation, a non profit think tank which actively campaigns for drug policy and law reform.
	Competing interests: The author has completed the unified competing interest form at www.icmje.org/coi_disclosure.pdf (available on request from him) and declares (1) no financial relationships with commercial entities that might have an interest in the submitted work; (3) no spouses, partners, or children with relationships with commercial entities that might have an interest in the submitted work; and (4) no non-financial interests that may be relevant to the submitted work.
REVIEW RETURNED	10-May-2013

THE STUDY	One suggestion fo and additional reference: on p.6 three references are given for the sentence 'While some unintended consequences of this approach, such as record incarceration rates, have been well-documented' (14-16). One more that might usefully be added here is the UNODC World Drug Report 2008 http://www.unodc.org/documents/wdr/WDR_2008/WDR_2008_eng_web.pdf ; specifically section 2.6 p.216 which is the first formal exploration of

	'unintended consequences' by the UNODC. They are the key data source for the paper, making it particularly relevant.
GENERAL COMMENTS	in discussion it might be useful to mention not only that seizures and price/purity are proxy measures for availability, but also identify what a more meaningful availability measures would involve (most obviously involving user questionaires) and noting that (with a small number of national exceptions) there is a notable absence of systemaic data collection on such measures nationally, or at UN level (nor apparently any momentum otwards changing this situation). This absence is particularly notable given the central position of availability reduciton in the political narrative supporting resources for supply side enforcement efforts.

VERSION 1 – AUTHOR RESPONSE

Reviewer #1

Comment 1: We agree with the Reviewer that the focus on enforcement-based responses is not well-supported by the data. We have thus altered the text in the objectives section on page 4 as follows:

Some unintended consequences of this approach, such as record incarceration rates, have been well-documented.15-17 Additionally, a small number of studies assessing aspects of drug supply, measured through indicators of drug price, purity/potency and seizures, have been undertaken to describe the global relationship between these indicators over the long-term.18 However, systematic evaluation of these relationships is still needed to elucidate patterns of drug supply. The present study therefore sought to systematically identify international data from publicly available illegal drug surveillance systems to assess long-term estimates of illegal drug supply.

The conclusions section on page 12 has also been altered, as follows:

Finally, while this review focused on patterns of price and purity of selected illegal drugs, these measures are only a marker of drug supply, and do not measure other factors determining availability and concomitant rates of drug use. These limitations to assessing global drug supply using classic proxy measures such as price, purity, and, to a lesser extent, seizures, suggests that there may be a need to expand the range of measures systematically collected by governments and international bodies such as the UNODC and the European Monitoring Centre for Drugs and Drug Addiction. In particular, meaningfully incorporating measures derived from street-level questionnaires of people who use drugs may provide a more reliable metric of supply and availability. Indeed, some bodies, such as Australia's IDRS, collect such data,28 and this methodological approach should be considered by other bodies coordinating surveillance of illegal drugs.

In summary, longitudinal illegal drug surveillance systems demonstrate a general global pattern of falling drug prices and increasing drug purity and potency, alongside a relatively consistent pattern of increasing seizures of illegal drugs. Although source data have limitations and there are some exceptions to these trends, these findings should be useful given the current debates and drug policy

experimentation under way in Latin America, North America, and Europe.30-32 It is hoped that this study highlights the need to re-examine the effectiveness of national and international drug strategies that place a disproportionate emphasis on supply reduction at the expense of prevention and treatment of problematic illegal drug use.

Finally, we have updated the title of the paper to reflect these changes: "The temporal relationship between drug supply indicators: An audit of international government surveillance systems".

Comment 2: The Reviewer suggests that other proxy measures of availability could have been examined, such as arrests, convictions, and offences related to drug-related crimes. While we agree that the inclusion of such measures would be interesting, we chose to focus specifically on an indicator (e.g., seizure) that is directly related to supply, given that drug supply was the primary focus of this study. However, as noted in the response to Comment 1, suggestions have been made regarding other potentially useful metrics that may provide better indications of illegal drug supply and availability. If the Editors wish, we would be happy to attempt to expand the set of indicators to include arrests, convictions and offences related to drug-related crimes but we felt this was outside the scope of the present review.

Comment 3: The Reviewer requests further specificity on the types of cannabis reported on in the study. We have therefore ensured that all instances highlighted by the Reviewer have been addressed and now refer specifically to the type (e.g., cannabis herb). Please see revised manuscript.

Comment 4: The Reviewer suggests that patterns of supply for amphetamine-type substances be included in the study, given that data are available from select countries such as the UK. However, this study was focused on drugs for which data were available in multiple regions and given that data on amphetamine-type substances are inconsistent and/or unavailable for the study period in most of these regions, we opted to exclude this class of drugs. To further address this concern, the text in the design section on page 5 was amended as follows:

While data on amphetamine-type stimulants exist in some specific countries (e.g., the United Kingdom), this class of drugs was not included given inconsistent data collection and classification, and fluctuating surveillance periods and overall data quality.

The conclusions section on page 12 has also been altered:

Third, limitations in longitudinal data collection precluded our ability to include amphetamine-type stimulants and other emerging synthetic substances, as this data is limited to certain countries and the focus of this study was on regional trends.

Comment 4: We thank the Reviewer for their comments regarding additional data sources for drug supply statistics for production regions. The relevant text in the results section on pages 9 and 10 have been altered as follows, and new trend tests have been undertaken:

With respect to opiate seizures, the Golden Triangle includes parts of Thailand, Lao, Viet Nam and Myanmar, and according to the UNODC, this region is the second largest supplier of heroin

globally.[28] Here, trends in seizures of opium fluctuated; 3,198 kilograms of opium were seized in 1990, with a high of 12,462 kilograms seized in 2007 before a steep decline to 1,225 kilograms in 2010 (p = 0.856). Similarly, seizures of heroin fluctuated, with a decrease of more than half, from 1,337 kilograms in 1990, to 627 kilograms in 2010 (p = 0.085), and a peak of 1,565 kilograms seized in 2009. In Afghanistan, which is believed to supply over 90% of the world's opium,[28] seizures of raw and prepared opium increased by over 12,000%, from 453 kilograms in 1990 to 57,023 kilograms in 2010, and seizures of heroin increased by over 600%, from 1,256 kilograms in 1990 to 9,036 kilograms in 2010 (Note: missing data prevented a trend test for annual opium and heroin seizures in Afghanistan).

With respect to cocaine seizures, according to the UNODC, Latin America's Andean region, which includes Peru, Bolivia, and Colombia, is the primary global supplier of this drug, as coca leaf is grown exclusively in this region.[29] While seizures of cocaine in the Andean region decreased 81%, from 97,437 kilograms in 1990 to 17,835 kilograms in 2007 (p = 0.028), seizures of coca leaf increased 188% from 601,038 kilograms in 1990 to 1.73 million kilograms in 2007 (p = 0.004). During the same period, the area of coca cultivation in this region declined slightly, from approximately 210,000 hectares to 180,000 hectares (p = 0.004).

Comment 5: As suggested by the Reviewer, we have framed the research question to focus primarily on the temporal relationships. We have revised the text in the abstract on page 2 of the manuscript as follows:
Objectives: Illegal drug use continues to be a major threat to community health and safety. We used international drug surveillance databases to assess the relationship between multiple long-term estimates of illegal drug price and purity.
We have also revised the text in the introduction section on page 4 (see response to Comment #1). Finally, we have revised the text in the conclusions section on pages 10 and 11 as follows:

Longitudinal data from government surveillance systems demonstrate that over the past two decades there has been a general pattern of increased illegal drug supply as defined through lower price and higher purity of heroin, cocaine and cannabis. During the same period, patterns of drug seizures either increased or remained stable, though the trends detected in some of these indicators did not reach statistical significance. As such, we conclude, consistent with previous studies,[18] that the global supply of illicit drugs has likely not been reduced in the previous two decades. In particular, the data presented in this study suggest that the supply of opiates and cannabis, in particular, have increased, given the increasing potency and decreasing prices of these illegal commodities. These results have implications for the development of evidence-based drug policies, particularly given the interest in novel drug policy approaches in a number of settings in Latin America, North America, and Europe.[30-32]

As well as on page 13:

Although source data have limitations and there are some exceptions to these trends, these findings should be useful given the current debates and drug policy experimentation under way in Latin America, North America, and Europe.[30-32] It is hoped that this study highlights the need to re-examine the effectiveness of national and international drug strategies that place a disproportionate

emphasis on supply reduction at the expense of evidence-based prevention and treatment of problematic illegal drug use.

Comment 6: The Reviewer suggests changing the wording of 'criminalization' and describing in detail alternative drug policy models in the introductory section. We have thus altered the text in the introduction section on page 4 as follows:

In response to the health and social concerns associated with illegal drug use, several UN conventions were created to control the possession, consumption, and manufacture of illegal drugs.9-11 As a result, over the last several decades, most national drug control strategies have prioritized drug law enforcement interventions to reduce drug supply, despite recent calls by experts to explore alternative models of drug control such as systems of drug decriminalization and legal regulation.12-14

Comment 7: As requested by the Reviewer, we have changed the word 'patterns' to 'data' to improve clarity in the design section on page 5.

Comment 8: The Reviewer requests further detail on the search strategy. The following section on page 5 has thus been amended:

An online search of surveillance systems monitoring illicit drugs using two a priori defined inclusion criteria was carried out.

As well, the following sentence in the design section on page 6 was altered as follows:

Data were obtained through systematic searches of registries of surveillance systems (e.g., governmental websites, United Nations databases), governmental reports, and peer-reviewed publications, as well as through data requests to relevant organizations including the UNODC.

Comment 9: The Reviewer suggests acknowledging that European data may be biased as a result of the undue influence of the United Kingdom and Spain. The following sentence was therefore inserted into the conclusions section on page 11:

Nevertheless, the long-term trends in increasing purity and decreasing price presented here likely reflect overall trends in many regions, though it should be noted that in some regions (e.g., Europe), indicators of price and purity may have been strongly influenced by a few countries such as the United Kingdom and Spain.

Comment 10: We agree that a discussion of the Australian heroin drought is warranted. The following section has been inserted into the results section on page 8:

Specifically, after adjustment, the price of heroin decreased by 49%, from approximately $460 USD per gram to approximately $235 per gram (p < 0.001), despite the well described heroin 'drought' of 2001,26 which saw a reduction in the supply and availability of heroin in Australia. Additionally, the price of cocaine decreased 14% from approximately $255 AUD per gram to $220 AUD per gram (p =

0.477), and the price of cannabis decreased 49% from approximately $25 AUD per gram to $13 AUD per gram (p < 0.001).27

The following section was also inserted into the conclusions section on page 12 of the manuscript:

Additionally, some exceptions in the trends were observed. Australia for instance, while experiencing a significant decrease in the prices of both heroin and cannabis, did not experience a significant decrease in the price of cocaine, which may reflect the geographic isolation of the region or other market factors. It is also of note that Australia's 'heroin drought',35 which saw a sudden drop in measures of the supply and availability of heroin, appears to have had a limited long-term impact on supply, though some experts suggest that it may have resulted in higher levels of polysubstance use among Australian heroin injectors.36

Comment 11: We agree with the Reviewer that contextualizing the section on seizures in production regions with data on overall production would strengthen the manuscript. The following text was therefore inserted into the results section on page 9 of the manuscript:

With respect to opiate seizures, the Golden Triangle includes parts of Thailand, Lao, Viet Nam and Myanmar, and according to the UNODC, this region is the second largest supplier of heroin globally, though production has declined throughout the last decade, with opium production decreasing by approximately 60% and 90% in Myanmar and Lao, respectively.30

Comment 12: The Reviewer requests clarification on the areas of major illegal cannabis cultivation. The following text in the results section on page 10 was therefore amended as follows:

Finally, according to the UNODC, major areas of cannabis cultivation exist in North Africa, Afghanistan, and North America.

Comment 13: We agree with the Reviewer that indoor cannabis cultivation should be characterized as a particular challenge for efforts to curtail drug production. The text on page 12 in the conclusions section was revised as follows:

It is noteworthy in this regard that the production of synthetic substances – as well as indoor cannabis cultivation – present particular challenges for supply reduction strategies, given that these drugs can be mass produced in clandestine locations regardless of climate or other factors that limit traditional drug production.19, 37

Comment 14: We agree that a brief, further delineation of how this data may be valuable for policymakers and other stakeholders is warranted. The following passage has been amended in the conclusions section on page 13 of the manuscript:

Although source data have limitations and there are some exceptions to these trends, these findings should be useful given the current debates and drug policy experimentation under way in Latin America, North America, and Europe.31-33

Reviewer #2

Comment 1: We thank the Reviewer for their suggestion for an additional reference regarding the unintended consequences of enforcement-based drug policies, and we have incorporated the additional reference into the manuscript.

Comment 2: We agree with the Reviewer that a discussion of indicators of drug supply and availability potentially more meaningful than seizures is warranted. We have therefore inserted the following text in the conclusions section on page 12 of the manuscript (consistent with response to Reviewer #1, Comment #1):

These limitations to assessing global drug supply using classic proxy measures such as price, purity, and, to a lesser extent, seizures, suggests that there may be a need to expand the range of measures systematically collected by governments and international bodies such as the UNODC and the European Monitoring Centre for Drugs and Drug Addiction. In particular, meaningfully incorporating measures derived from street-level questionnaires of people who use drugs may provide a more reliable metric of supply and availability. Indeed, some bodies, such as Australia's IDRS, collect such data,28 and this methodological approach should be considered by those coordinating surveillance of illegal drugs. Other bodies have prioritized emphasizing measures of community health including reduced HIV infections, reduced drug-related violence and reductions in numbers of individuals incarcerated.39, 40

VERSION 2 – REVIEW

REVIEWER	John M. Corkery Research Co-ordinator, Department of Pharmacy University of Hertfordshire, UK & Programme Manager, National Programme on Substance Abuse Deaths International Centre for Drug Policy St George's University of London, UK
REVIEW RETURNED	11-Jun-2013

| THE STUDY | Although all the major points raised have now been adequately dealt with by the authors and the paper is of publishable quality, there are still 3 points that have not been responded to fully.

Page 6, lines 36 - 38 - "annualized estimates" - this term has not been defined in terms of how the estimation was done.

Page 6, line 45 - "online search" - we still do not how this was done in detail , e.g. search terms, inclusion/exclusion criteria

Page 7, line 7 "systematic searches" - again, what does this mean?

Subject to these queries being dealt with satisfactorily, then |

	publication should go ahead.
GENERAL COMMENTS	I think this is a much tighter paper now.

VERSION 2 – AUTHOR RESPONSE

Evan Wood, MD, PhD ABIM FRCPC
Professor of Medicine, University of British Columbia
Director, Urban Health Research Initiative
BC Centre for Excellence in HIV/AIDS
CANADA
Reviewer #1

Comment 1: We are pleased that the Reviewer felt that all major points were adequately dealt with in the first round of revisions. As requested, we have provided the following definition for the derivation of estimates on Page 5 in the methods section:

Linear by linear association trend tests were carried out on annual estimates of all outcomes of interest. Price and purity estimates represent median values for each year, while estimates for seizures represent crude totals of quantity seized. All price estimates are expressed in 2011 USD and are, where possible, adjusted for purity.23

Comment 2: As requested by the Reviewer, we have provided a more robust definition of the online search. The relevant passage on Page 5 in the methods section now reads as follows:

Search terms included: drugs, illicit, illegal, price, purity, potency, surveillance system, government data, longitudinal, annual, estimate. Inclusion/exclusion criteria were as follows: only surveillance systems that included continuous longitudinal assessments of these outcomes of interest for at least 10 years were included because we specifically sought to assess the long-term impact of enforcement-based supply reduction strategies on illegal drug price and purity/potency. Finally, data extraction was restricted to 1990 and onwards to focus on patterns of supply during recent decades.

Comment 3: As requested by the Reviewer, we have revised the wording around 'systematic searches' to more specifically explain the search process. The relevant passage on Page 6 in the methods now reads as follows:

Data were obtained through online searches of registries of surveillance systems (e.g., governmental websites, United Nations databases), governmental reports, and peer-reviewed publications, through referrals from experts in the field, and through data requests to relevant organizations including the UNODC.