Guidelines for Public Health and Safety Metrics to Evaluate the Potential Harms and Benefits of Cannabis Regulation in Canada

Stephanie Lake, Thomas Kerr, Daniel Werb, Rebecca Haines-Saah, Benedikt Fischer, Gerald Thomas, Zach Walsh, Mark A. Ware, Evan Wood, and M-J Milloy

West Vancouver Community Centres Society Forum on Cannabis

November 6, 2018
Background

OPEN LETTER:

A Call for A Reprioritization of Metrics to Evaluate Illicit Drug Policy

TO: UN Member States Delegations
    Mr. Ban Ki-Moon, Secretary-General, United Nations
    Mr. Mogens Lykketoft, President of the UN General Assembly
    Mr. Arghaoyt Shamsaou, Chair of the Commission on Narcotic Drugs
    Mr. Yury Fedotov, Executive Director, United Nations Office on Drugs and Crime
    Dr. Margaret Chan, Director-General, World Health Organization
    Dr. Michel Sidibé, Executive Director, Joint United Nations Programme on HIV/AIDS
    Mr. Anthony Lake, Executive Director, UNICEF
    Ms. Helen Clark, Administrator, UN Development Program
    Mr. Dainius Pūras, UN Special Rapporteur on the Right to Health

JANUARY 21, 2016
Objectives

1) Recommend a set of population indicators that could be used to assess the public health and safety impacts of cannabis regulation in Canada

2) Summarize preliminary evidence of short-term impacts in nearby jurisdictions that have regulated cannabis
Methods

What are current public health and safety issues relevant to cannabis use or cannabis policy?
- Searched 5 academic databases using broad terms (e.g., “cannabis”, “public health”)
- Articles screened and sorted into topic categories (e.g., road safety)
- Indicators generated from topic categories (e.g., number and rate of motor vehicle crash fatalities)

What do we know about the impact of legal cannabis on each indicator?
- Academic/non-academic database search
- Snowball search methods (e.g., hand searching reference lists of articles from indicator selection)

What data sources can be used to evaluate indicator shift?
- Consultation with health science librarian
Metrics: 28 indicator areas under 5 themes

- Public Safety
  - Cannabis-impaired driving
  - Cannabis-related motor vehicle injuries and fatalities
  - Alcohol-impaired driving
  - Alcohol-related motor vehicle injuries and fatalities
  - Dating and intimate partner violence
  - Cannabis-related workplace injuries overall and across work sectors
  - Violent and property crime

- Cannabis Use Trends
  - Cannabis use initiation among youth
  - Cannabis use rates among youth
  - Cannabis use disorder
  - Unregulated cannabis product use
  - Cannabis use among expectant and breastfeeding mothers
  - Trends in cannabis use products and practices
  - Cannabis-related health care utilization
  - Cannabis-related poison center calls
  - Cannabis-attributable burden of disease

- Other Substance Use Trends
  - Medical and non-medical opioid use and use disorders
  - Fatal and non-fatal drug overdoses
  - Illicit stimulant use and use disorders
  - Alcohol use and use disorders
  - Tobacco use and use disorders

- Cardiovascular & Respiratory Health
  - Respiratory problems including COPD and lung cancer
  - Cardiovascular problems including MI, cardiac arrest, and ischemic stroke

- Mental Health & Cognition
  - Psychosis and psychotic disorders
  - Depression and anxiety
  - Attempted and completed suicide
  - Cognitive functioning and educational achievement among youth
Metrics: Public Safety

Public Safety
- Cannabis-impaired driving
- Cannabis-related motor vehicle injuries and fatalities
- All-cause motor vehicle injuries and fatalities
- Alcohol-impaired driving
- Alcohol-related motor vehicle injuries and fatalities
- Dating and intimate partner violence
- Cannabis-related workplace injuries overall and across work sectors
- Violent and property crime

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Other Substance Use Trends
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- Alcohol use and use disorders
- Tobacco use and use disorders

Cardiovascular & Respiratory Health
- Respiratory problems including COPD and lung cancer
- Cardiovascular problems including MI, cardiac arrest, and ischemic stroke

Mental Health & Cognition
- Psychosis and psychotic disorders
- Depression and anxiety
- Attempted and completed suicide
- Cognitive functioning and educational achievement among youth

Violent and property crime
Preliminary Evidence – Road Safety

Washington state

Figure 1. Quarterly average proportion of drivers involved in fatal crashes who were positive for THC and modeled seasonally-adjusted linear trend before and after Washington Initiative 502 took effect on 6 December 2012 legalizing recreational use of marijuana for adults aged 21 years and older, Washington, 2010 – 2014.

Data: Washington Traffic Safety Commission, 2010 – 2014. Drivers positive for THC based on results of blood toxicological tests. Results imputed 10 times when driver was not tested or test results were unknown; results reflect averages from 10 imputed values for each driver. Model-based predictions are from binomial regression model with identity link function, indicator variables for seasons, and a linear spline with change in slope on 5 September 2013 (39 weeks after effective date of Initiative 502).

Crash Fatality Rates After Recreational Marijuana Legalization in Washington and Colorado

Jayson D. Aydelotte, MD, Lawrence H. Brown, PhD, Kevin M. Luftman, MD, Alexandra L. Mandock, BA, Pedro G. R. Teixeira, MD, Ben Coppswood, MD, and Carlos V. R. Brown, MD

Conclusions. Three years after recreational marijuana legalization, changes in motor vehicle crash fatality rates for Washington and Colorado were not statistically different from those in similar states without recreational marijuana legalization. Future studies over a longer time remain warranted. (Am J Public Health. 2017;107:1329–1331. doi: 10.2105/AJPH.2017.303848)
Medical Marijuana Laws, Traffic Fatalities, and Alcohol Consumption

D. Mark Anderson  Montana State University
Benjamin Hansen  University of Oregon
Daniel I. Rees  University of Colorado Denver

Table 10
Medical Marijuana Laws and Traffic Fatalities by Sex

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>MML</td>
<td>-.114</td>
<td>-.072</td>
</tr>
<tr>
<td>R²</td>
<td>.974</td>
<td>.960</td>
</tr>
</tbody>
</table>

Note. The dependent variable is equal to the natural log of fatalities per 100,000 people. Regressions are weighted using the relevant state-by-sex populations. Standard errors, corrected for clustering at the state level, are included. Year fixed effects, state fixed effects, state-specific trends, and state-specific trends are included in all specifications. Statistically significant at the 10% level.

Table 9
Medical Marijuana Laws and Traffic Fatalities by Age

<table>
<thead>
<tr>
<th></th>
<th>15–19</th>
<th>20–29</th>
<th>30–39</th>
<th>40–49</th>
<th>50–59</th>
<th>60+</th>
</tr>
</thead>
<tbody>
<tr>
<td>MML</td>
<td>-.022</td>
<td>-.132</td>
<td>-.175</td>
<td>-.094</td>
<td>-.038</td>
<td>-.048</td>
</tr>
<tr>
<td>R²</td>
<td>.915</td>
<td>.940</td>
<td>.943</td>
<td>.939</td>
<td>.874</td>
<td>.921</td>
</tr>
</tbody>
</table>

Note. The dependent variable is equal to the natural log of fatalities per 100,000 people. Regressions are weighted using the relevant state-by-age populations. Standard errors, corrected for clustering at the state level, are included. Year fixed effects, state fixed effects, state covariates, and state-specific trends are included in all specifications. Statistically significant at the 5% level.

Table 7
Medical Marijuana Laws and Traffic Fatalities: The Role of Alcohol

<table>
<thead>
<tr>
<th></th>
<th>Fatalities (No Alcohol)</th>
<th>Fatalities (BAC &gt; 0)</th>
<th>Fatalities (BAC ≥ .10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Year of law change</td>
<td>-.075 (.062)</td>
<td>-.141 (.077)</td>
<td>-.168 (.082)</td>
</tr>
<tr>
<td>1 Year after MML</td>
<td>-.071 (.068)</td>
<td>-.103 (.068)</td>
<td>-.162 (.088)</td>
</tr>
<tr>
<td>2 Years after MML</td>
<td>-.071 (.068)</td>
<td>-.103 (.068)</td>
<td>-.142 (.086)</td>
</tr>
<tr>
<td>3 Years after MML</td>
<td>-.071 (.068)</td>
<td>-.103 (.068)</td>
<td>-.152 (.086)</td>
</tr>
<tr>
<td>4 Years after MML</td>
<td>-.071 (.068)</td>
<td>-.103 (.068)</td>
<td>-.162 (.088)</td>
</tr>
<tr>
<td>5+ Years after MML</td>
<td>-.071 (.068)</td>
<td>-.103 (.068)</td>
<td>-.172 (.088)</td>
</tr>
<tr>
<td>Joint significance of lags (p-value)</td>
<td>.964 (.964)</td>
<td>.905 (.905)</td>
<td>.906 (.906)</td>
</tr>
</tbody>
</table>

Note. The dependent variable is equal to the natural log of fatalities per 100,000 people. Regressions are weighted using state populations. Standard errors, corrected for clustering at the state level, are included. Year fixed effects, state fixed effects, state covariates, and state-specific trends are included in all specifications. MML = medical marijuana law. N = 1,071.

-13.2% (p>0.1)
-15.5% (p<0.05)
-16.7% (p<0.05)
-16.1% (p<0.1)
Metrics: Cannabis Use Trends

Public Safety
- Cannabis-impaired driving
- Cannabis-related motor vehicle injuries and fatalities
- All-cause motor vehicle injuries and fatalities
- Alcohol-impaired driving
- Alcohol-related motor vehicle injuries and fatalities
- Dating and intimate partner violence
- Cannabis-related workplace injuries overall and across work sectors
- Violent and property crime

Other Substance Use Trends
- Medical and non-medical opioid use and use disorders
- Fatal and non-fatal drug overdoses
- Illicit stimulant use and use disorders
- Alcohol use and use disorders
- Tobacco use and use disorders

Cardiovascular & Respiratory Health
- Respiratory problems including COPD and lung cancer
- Cardiovascular problems including MI, cardiac arrest, and ischemic stroke

Mental Health & Cognition
- Psychosis and psychotic disorders
- Depression and anxiety
- Attempted and completed suicide
- Cognitive functioning and educational achievement among youth

Cannabis Use Trends
- Cannabis use initiation among youth
- Cannabis use rates among youth
- Cannabis use disorder
- Unregulated cannabis product use
- Cannabis use among expectant and breastfeeding mothers
- Trends in cannabis use products and practices
- Cannabis-related health care utilization
- Cannabis-related poison center calls
- Cannabis-attributable burden of disease
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BRITISH COLUMBIA CENTRE ON SUBSTANCE USE
Preliminary Evidence – Youth usage trends

Figure 2. Marijuana Use Before and After Legalization in Colorado, Washington, and States Without Recreational Marijuana Laws (RML)

- + 2%
- + 4%

The solid lines indicate the adjusted prevalence of past-month marijuana use before and after RML in Colorado, Washington, and non-RML states by grade. Error bars indicate 95% CIs.
Preliminary Evidence – Youth usage trends

Medical cannabis legalization

Figure 3  Fixed-effects meta-analysis: pre–post medical marijuana law (MML) change in past-month marijuana prevalence within MML states

MTF = Monitoring the Future Study; NLSY = National Longitudinal Survey of Youth; NSDUH = National Survey on Drug Use and Health
YRBS = Youth Risk Behavior Survey; FE = fixed-effects. FE model: $\hat{\theta} = \sum_{i=1}^{11} w_i \theta_i / \sum_{i=1}^{11} w_i$, where $\hat{\theta}$ corresponds to the final fixed-effects estimate, $\theta_i$ corresponds to the $i^{th}$ study’s standardized estimate and $w_i$ corresponds to the inverse of the variance of the $i^{th}$ study’s standardized estimate.
Preliminary Evidence – Unintentional Poisonings

+ 34% per year in Colorado
+ 19% per year in USA

Comparison of unintentional marijuana exposure rates between Colorado and the remainder of the United States excluding Colorado per 100,000 population in children 0 to 9 years and younger between 2009 and 2015. The Colorado rate = 100,000 × e^{9.589 - 0.290 × time} and the United States rate = 100,000 × e^{31.45 + 0.1732 × time}, where time is -6 in 2009, -5 in 2010, -4 in 2011, -3 in 2012, -2 in 2013, -1 in 2014, and 0 in 2015. The rate difference was significant (P = .04). PC indicates poison center.
Metrics: Other Substance Use Trends

Public Safety
- Cannabis-impaired driving
- Cannabis-related motor vehicle injuries and fatalities
- Alcohol-impaired driving
- Alcohol-related motor vehicle injuries and fatalities
- Dating and intimate partner violence
- Cannabis-related workplace injuries overall and across work sectors
- Violent and property crime

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Cardiovascular & Respiratory Health
- Respiratory problems including COPD and lung cancer
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Mental Health & Cognition
- Psychosis and psychotic disorders
- Depression and anxiety
- Attempted and completed suicide
- Cognitive functioning and educational achievement among youth
Preliminary Evidence – Opioids

Medical Cannabis Laws and Opioid Analgesic Overdose Mortality in the United States, 1999-2010

Marcus A. Bachhuber, MD; Brendan Saloner, PhD; Chinazo O. Cunningham, MD, MS; Colleen L. Barry, PhD, MPP

Do Medical Marijuana Laws Increase Hard-Drug Use?

Yu-Wei Luke Chu
Victoria University of Wellington

Medical marijuana policies and hospitalizations related to marijuana and opioid pain reliever

Yuyan Shi
Department of

The effect of medical marijuana laws on adolescent and adult use of marijuana, alcohol, and other substances

Hefei Wen, Jason M. Hockenberry, Janet R. Cummings

State Medical Marijuana Laws and the Prevalence of Opioids Detected Among Fatally Injured Drivers

June H. Kim, MPH, MHS, Julian Santana-Torres, DVM, MS, Christine Mauro, PhD, Julia Wrob, MS, Magdalena Cerdà, DrPH, Katherine M. Keyes, PhD, Deborah Hasin, PhD, Silvia S. Martins, PhD, and Caoshua Li, MD, DrPH
Preliminary Evidence – Opioids

Passage of medical cannabis law associated with significant decreases in opioid-related overdose fatalities
Preliminary Evidence – Opioids

Passage of medical cannabis law not associated with changes in opioid-related overdose deaths, treatment admissions for OUD, self-reported non-medical use of pharmaceutical opioids, legal distribution of pharmaceutical opioids

Significant decreases in opioid overdose deaths and OUD treatment admissions if state allowed for operational dispensaries

Do medical marijuana laws reduce addictions and deaths related to pain killers?²

David Powell¹, Rosalie Liccardo Pacula¹,², Mireille Jacobson¹,²

¹ RAND, Santa Monica, United States
² KIRSK, Cambridge, MA, United States
³ University of California, Irvine, United States
Preliminary Evidence – Opioids

Recreational Cannabis Legalization and Opioid-Related Deaths in Colorado, 2000–2015

Melisa D. Livingston, PhD, Tracey E. Barnett, PhD, Chris Delcher, PhD, and Alexander C. Wagenaar, PhD

Note. Change in opioid-related deaths per month following legalization = −0.68 (95% confidence interval = −1.34, −0.03; P = .043). Change in model-estimated opioid-related deaths was robust to covariate control of opioid-related deaths in all comparison states. Change in model-estimated opioid-related deaths was robust to whether the prescription drug monitoring program (PDMP) covariate was modeled at the beginning of implementation or at full implementation of the 2014 PDMP change.

FIGURE 1—Changes in Monthly Opioid-Related Deaths Following Recreational Cannabis Legalization in Colorado, 2000–2015
Now that cannabis is legal, let’s use it to tackle the opioid crisis
Metrics: Cardiovascular & Respiratory Health

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Mental Health & Cognition
• Psychosis and psychotic disorders
• Depression and anxiety
• Attempted and completed suicide
• Cognitive functioning and educational achievement among youth
Metrics: Mental Health & Cognition

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Discussion/Conclusions

• The unprecedented transition from cannabis prohibition to regulation in Canada provides a valuable opportunity to study the health impacts of cannabis use and cannabis regulation.

• We established a set of priority metrics to evaluate the public health and safety impact of legalization in Canada:
  – Overall, and between provincial/territorial jurisdictions.

• Preliminary evidence from US jurisdictions with non-medical and/or medical cannabis reveals potential challenges and possible unintended benefits to public health and safety:
  – High degree of heterogeneity between regulatory frameworks.

• A comprehensive and evidence-informed public health and safety evaluation will require consideration of both harms and benefits.
THANK YOU

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