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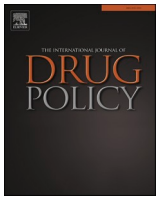

Research Paper

Clinical and public safety risks associated with cannabis legalization and frequency of cannabis use among forensic mental health patients☆

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ABSTRACT

Background: There are ongoing concerns regarding the impact of Canada's cannabis legalization and commercialization on vulnerable persons such as those with serious forms of mental illness, including persons with schizophrenia-spectrum disorders and users of forensic mental health services. The primary objective of this study was to investigate the potential harms and mental health-related impacts associated with cannabis legalization on a sample of forensic patients in Ontario ($N = 187$).

Methods: Using a pseudo-prospective design, we investigated the frequency of cannabis use over a four-year period encompassing two years preceding and two years following the legislative change. We recorded clinical and public safety outcomes (i.e., mental health deterioration, length of stay in the forensic system, rates of hospital readmission, victimization and violence) over the same period to test relationships between these variables and rates of cannabis use.

Results: We found that one-third of patients either self-reported or were discovered, via urine testing, to have used cannabis over the study period. Frequency of use was lower in the pre-legalization period, and then gradually and significantly increased after legalization. Compared to patients with no cannabis use, those with one or more instances of use were more likely to be readmitted to hospital and had higher rated static risk factors for violence. However, there were no observed differences in the actual rate of violence between patients using and not using cannabis, nor differences in the rate of violence over time. Over half of the patients who used cannabis experienced a worsening of their mental health status in the week following use.

Conclusions: Cannabis use among those with SMI is associated with adverse clinical outcomes. Results from this study suggest that the mental health burdens associated with cannabis use have risen in terms of delayed clinical recovery and progress through the forensic system since legalization.

On October 17, 2018, the Cannabis Act came into force in Canada, the fourth country in the world to legalize the recreational use and possession of cannabis. The impetus towards legalization focused on cost savings (e.g., avoiding prosecution of individuals possessing small amounts of cannabis, generation of federal tax revenues) and public safety (e.g., deterring the illegal drug trade), arguably without sufficient consideration of the potential impact on vulnerable persons such as youth and those with serious forms of mental illness (SMI; e.g., psychotic and major mood disorders). This is despite findings that cannabis use is a potent risk factor in the emergence, severity, and chronicity of psychiatric symptoms (Degenhardt & Hall, 2006; Gibbs et al., 2015; Henquet et al., 2008; Hindley et al., 2020; Mammen et al., 2018; Moore et al., 2007), as well as other adverse outcomes among those with SMI such as slowed recovery, increased rates of rehospitalization, violence and offending (Fazel et al., 2009a; Penney et al., 2018; Schoeler et al., 2016a; Volkow, 2009). While cannabis was initially legalized with restrictions

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in place, the period of market commercialization (March 2020 – present day) brought with it high THC-concentration products alongside a 16-fold increase in legal cannabis retail stores (Myran et al., 2023).

Forensic mental health services in Canada

Forensic service users are patients who have been found by a court to be either unfit to stand trial (UST) or not responsible for a criminal offense on account of mental disorder (NCRMD).[1] Their security and therapeutic needs are overseen by dispositions of the provincial Review Board (in Ontario, the Ontario Review Board [ORB]) constituted under the Canadian Criminal Code (CCC s. 672.34) (Criminal Code, RSC, 1985). Review Boards are responsible for annually reviewing the status of every forensic patient and defining the least restrictive placement of the individual (i.e., continued detention, conditional or absolute discharge). Judgments regarding progression to conditional and absolute discharge are based on decisions of significant threat to the community, defined as whether the person poses a real risk of physical or psychological harm to members of the public that is serious in the sense of going beyond the merely trivial or annoying (CCC s. 672.54).

The majority of forensic patients in Canada are male, single, and in the third or fourth decade of life. Psychotic disorders are most often the primary clinical diagnosis, and substance use comorbidity is estimated to affect between 50 and 75 % of patients admitted to forensic hospital (Chaimowitz et al., 2022; Crocker et al., 2015; Penney et al., 2019). Most forensic patients are mandated by the Review Board to abstain from all non-prescribed substances and required to undergo urine testing to verify abstinence. Despite this, significant numbers of forensic patients use substances, most commonly cannabis, with concomitant effects on their illness, rate of recovery, and risk of violence (Crocker et al., 2015; Penney et al., 2018, 2020). The prevalence of cannabis use and dependence disorders among forensic patients is estimated to be between 20 and 38 % (Cappai et al., 2017; Kivimies et al., 2012; Kraanen et al., 2012; Ogloff et al., 2004; Plant et al., 2011), significantly higher than in the general population.

The relationship between cannabis and psychosis

There is now a large body of evidence to support an association between cannabis use and psychosis, both in the general population (Andreasson et al., 1987; Arsenault et al., 2002; Fergusson et al., 2003; Van Os et al., 2002; Zammit et al., 2002) and among incident cases of schizophrenia and other psychotic disorders (Di Forti et al., 2019; Foti et al., 2010; Veen et al., 2004; Wheatley, 1998). Findings suggest an overall two- to three-fold increase in the relative risk for later psychosis among users of cannabis, and that this risk is heightened among those who commence using cannabis in early adolescence (Arsenault et al., 2002; Godin & Shehata, 2022; Kiburi et al., 2021; McGrath et al., 2010) as well as among users of synthetic (Kolla & Mishra, 2018) and high-potency (Di Forti et al., 2015, 2019; Petrilli et al., 2022) versions of the drug. Studies further support the temporal priority of cannabis use to the onset of psychosis in initially psychosis-free individuals (Ferdinand et al., 2005; Kraan et al., 2016), as well as a dose-response relationship between cannabis and schizophrenia while controlling for the use of other substances (Fergusson et al., 2003; Marconi et al., 2016; Van Os et al., 2002; Zammit et al., 2002). Subsequent to illness onset, continued use of cannabis is associated with symptom exacerbation (Grech et al., 2005; Marino et al., 2020; Negrete et al., 1986), a worsening course of illness (Foti et al., 2010), treatment resistance and non-adherence (Arsalan et al., 2019; Foglia et al., 2017; Schoeler et al., 2016a) and increased rates of relapse following symptom-free periods (Schoeler et al., 2016b; Zammit et al., 2008). Recent evidence places some nuance into these findings, showing, for example, that early intervention services can mitigate the negative effect of cannabis use on clinical outcomes (Wright et al., 2023). Scheffler et al. (2021) found that a sample of first-episode patients who were using cannabis did not display significantly different levels of psychopathology, social and occupational functioning, or quality of life as compared to non-users, and also showed comparable treatment response and remission rates to first-episode patients not using cannabis.

Among users of forensic mental health (FMH) services, substance use often has a major impact on illness, risk, and progress in recovery. In addition to worsening illness-related effects, substance use can significantly heighten the risk of violence when co-occurring with psychosis (Fazel et al., 2009a,b; Van Dorn et al., 2012). Importantly, however, many studies do not parse out cannabis-specific effects, but rather investigate all substances together or examine alcohol-related effects in isolation (e.g., Elbogen & Johnson, 2009; Räsänen et al., 1998). More contemporary studies have found that forensic patients with substance use disorders, most commonly of alcohol and cannabis, have more difficult trajectories of recovery and community reintegration as evidenced by more hospital readmissions and longer lengths of stay in hospital as compared to those without substance use (Penney et al., 2018). Following the granting of an absolute discharge from the Review Board system, forensic patients with relapses into substance use are re-arrested and re-hospitalized at higher rates compared to those without substance use (Hayes et al., 2014; Simpson et al., 2018).

The current study

Despite the elevated prevalence of cannabis use disorders among those with SMI, few studies have investigated the clinical and public safety related impacts of cannabis use among users of FMH services. Forensic patients represent a particularly vulnerable group whose use of cannabis can have deleterious effects on their clinical recovery and community re-integration. It is also noteworthy that, despite large increases in cannabis potency in recent years, many studies regarding the effects of cannabis on mental health and behavior draw upon data that are now more than 20 years old. With the recent legalization and market commercialization of cannabis in Canada, it is vital to quantify the frequency of cannabis use, and assess the health burden and public safety risks associated with use in this population.

The current study examines the frequency of cannabis use over a four-year period prior to and following legalization in a sample of forensic patients in Ontario, Canada. We test relationships between clinical and public safety outcome indicators (i.e., mental health deterioration, length of stay in the FMH system, rates of hospital readmission, victimization and violence perpetration) and rates of cannabis use over this same time period to estimate the potential harms and health burden associated with cannabis use in this population.

Method

Study design and participants

Data were collected from two large FMH programs in Ontario, Canada. Each hospital's program serves patients found Unfit to Stand

[1] The Canadian Criminal Code (CCC) defines UST as being "unable on account of mental disorder to conduct a defence at any stage of the proceedings before a verdict is rendered or to instruct counsel to do so, and, in particular, unable on account of mental disorder to (a) understand the nature or object of the proceedings, (b) understand the possible consequences of the proceedings, or (c) communicate with counsel" (C-46, s. 2). In practice, findings of unfitness are most commonly the result of severe intellectual disability and/or neurological impairment, often co-occurring with psychosis. In contrast, assessments of criminal responsibility are focused on the degree to which symptoms of a mental disorder rendered the person incapable of (1) appreciating the nature or consequences of their actions, or (2) knowing their legal or moral wrongfulness (CCC, 1985, C-46, s. 16). Individuals found NCRMD comprise > 85% of the Canadian forensic patient population, with psychotic disorders representing the most common clinical presentation.

Trial (UST) or Not Criminally Responsible on account of Mental Disorder (NCRMD). All forensic patients under the supervision of the ORB with an admission date between January 2010 and October 2016, and who did not have an absolute discharge prior to October 2020, were included. This included all patients who were under ORB supervision for the two years preceding and two years following legalization.

As noted, the ORB is responsible for annually reviewing the status of every person under its jurisdiction. For each annual hearing, a psychiatric report is provided and the ORB hears evidence and produces a Reasons for Disposition document. We relied primarily on these two documents to code the variables examined in this study (described below), in addition to nursing and interdisciplinary clinical notes appearing in the patient health record. A pseudo-prospective design was employed, whereby the prevalence and frequency of cannabis use were examined in relation to subsequent mental health, clinical and public safety outcome indicators. Due to the archival nature of the data, direct patient consent was not required. The study was approved by the institutional ethics review board prior to data collection.

Procedure and measures

A coding scheme was developed containing the sociodemographic, clinical, and legal/ risk-related variables investigated in this study. Variables were coded from psychiatric reports and ORB Reasons for Disposition, referenced above. These reports are comprehensive and informed by collateral (e.g., family, police) and professional (e.g., previous and current treatment providers) sources. Daily nursing and interdisciplinary clinical notes were also consulted to extract data pertaining to patient self-reports of cannabis use as well as to rate symptom severity and symptom change surrounding instances of cannabis use. Two graduate-level research analysts at each hospital were trained to use the coding form, achieving satisfactory inter-rater reliability between themselves on a subset of double-coded cases as well as with the study PI for all variables. Inter-rater reliability coefficients were calculated for those study measures necessitating clinical judgment (the Clinical Global Impression Index and the Historical, Clinical and Risk Management-20^{V3}, described below). All other variables (reflecting objective or factual data such as age, sex, incidents of cannabis use, violence and victimization) achieved perfect or near perfect agreement between raters.

Clinical variables

Clinical variables included current psychiatric diagnoses, substance use and personality disorders. Diagnoses are rendered by the attending psychiatrist, and informed by the patient's self-report together with collateral information (coming primarily from family and previous treatment providers). Dependence or abuse of alcohol and/or drugs was coded as present when there was a formal diagnosis of alcohol or substance abuse appearing in the patient's health record. In 12 cases, abuse of cannabis was coded as present in the absence of a formal diagnosis but where it was evident that substance use had been chronic and impairing of the person's socio-occupational function.

Baseline illness severity was defined as the duration of illness prior to entering the forensic system, as well as evidence of treatment-resistant symptoms (i.e., prior or current treatment with electroconvulsive therapy [ECT]). The patient's course in hospital was coded for the four-year study window (i.e., time spent as an inpatient versus outpatient), and included the presence of any readmissions from the community and associated reasons. Lastly, problems with medication adherence or responsiveness over this period were coded from the health record, operationalized as any initiation of long-acting injections secondary to concerns regarding compliance, or clozapine use.

Cannabis use

We coded the number of times cannabis was used by patients over the study window, as measured by the number of positive urine drug screens (UDS) for cannabis or any synthetic cannabinoid. All patient self-reports of cannabis use appearing in the health record (i.e., within the nursing and/or interdisciplinary notes) were also counted as an instance of use, whether or not there was a corresponding positive UDS. Although not the primary focus of this study, the same coding procedure was adopted for any other non-prescribed (licit or illicit) substance appearing in the health record. The outcome used in the analyses presented below was the proportion of positive cannabis tests among all UDS tests administered. Monthly raw proportions of positive tests were also examined. We had two independent variables: (1) time of the UDS test, centered at legalization (Oct 17, 2018), and (2) legalization (assuming value 0 before legalization and 1 at and after legalization). Time was calculated in days from legalization but modeled in years (see model description below).

Of note, UDS are only mandated by the ORB when there is a clinical justification to do so, for example in patients with a history of substance misuse, and/or previous offending where substance use played a role. However, even in the absence of a requirement to conduct UDS testing, clinical teams will canvas this issue with patients through observation and conversations about substances where it is relevant. Patients without any UDS administered over the study are primarily those without any (or very restricted/supervised) community access, and where the opportunity to access cannabis would be very limited, and/or those judged to be at low risk for substance use based on history and current clinical presentation. For these reasons, we have assumed that such patients represented non-users of cannabis, or very infrequent users. These patients also did not have any self-reports or clinical documentation of actual or suspected cannabis use.

Mental health indicators

Symptom severity and changes in symptoms were rated by trained research analysts using the Clinical Global Impression (CGI; Guy & Bonato, 1970) rating scales. The CGI consists of three domains: Global Severity (CGI-S), Global Improvement (CGI-I), and Therapeutic Index. The Global Severity domain is a single overall rating of illness severity, rated on a seven-point scale rated from "*no mental disorder*" to "*among the most severely ill patients*". There are also two rating scales for Global Improvement (rater's impression of symptom change) and Therapeutic Index (rater's impression of treatment efficacy). This study utilized the first two indices measuring symptom severity and symptom change. Consistent with how the CGI is used in practice, ratings of symptom severity and symptom change were based upon documented symptoms, behavior, and function in the past seven days. For the purposes of this study, the CGI-S was rated for the week prior to, and the week following, all discovered incidents of cannabis use, while the CGI-I was rated in the week following. If there were two or more instances of cannabis use near each other, they were treated as a single "cluster" for the purposes of coding symptoms and mental status changes in the week preceding and following use. Inter-rater reliability was satisfactory for both the CGI-S and CGI-I ratings (Table 1).

Violence and victimization

Incidents of violence perpetration and victimization were measured by the MacArthur Violence Risk Assessment Instrument (MAC-VI; Monahan et al., 2001). The MAC-VI is an expanded version of the Conflict Tactics Scale (Straus et al., 1996), and evaluates whether the individual has engaged in or been the victim of eight categories of aggression during a given time period: i) pushing, grabbing, or shoving; ii) kicking, biting, or choking; iii) slapping; iv) throwing an object; v) hitting with a fist or object; vi) sexual assault; vii) threatening; and viii) using a weapon. All incidents of violence and victimization occurring during the study observation period and appearing in the health record were coded and dated. We used the Historical, Clinical and Risk Management-20^{V3} (HCR-20^{V3}; Douglas et al., 2013), a widely-used and validated structured professional judgment tool, to estimate violence risk. It consists of 10 risk factors relating to historical variables (e.g.,

Table 1
Inter-rater reliability coefficients.

HCR-20^{V3}	$ICC_{A,1}$ / K_W
Historical scale	.84
Clinical scale	.60
Risk management scale	.69
Total score	.91
SRR: Case prioritization / future violence	.72
SRR: Serious physical harm	.86
SRR: Imminence	1.0
GI: Global Severity scale (CGI-S)	
# ratings of 4 ('moderately ill') or higher	.74
# ratings of 5 ('markedly ill') or higher	.82
CGI: Global Improvement scale (CGI-I)	
# ratings of 5 ('minimally worse') or higher	.73
# ratings of 6 ('much worse') or higher	.86

Note. ICC $_{A,1}$ = intraclass correlation coefficient, absolute agreement (single measure). K_W = weighted kappa coefficient. HCR-20^{V3} = Historical, Clinical, Risk Management-20, Version 3. SRR = summary risk rating. CGI = Clinical Global Impression rating scales. The CGI-S ranges from 1 (*Normal / no mental disorder*) to 7 (*Severely ill*). The CGI-I ranges from 1 (*Very much improved*) to 7 (*Very much worse*).

previous violence, past problems with substance use or employment, trauma history), 5 items describing current clinical concerns (e.g., insight, active symptoms of major mental illness, current treatment compliance), and 5 items describing areas for future risk management (e.g., future plans for housing or employment, presence of social supports). Each item may be scored on a three-point scale as 0 (not present), 1 (possibly or partially present), or 2 (definitely present). Summary risk ratings (for future violence/case prioritization, as well as the seriousness and imminence of harm) are then presented as low, moderate, or high. Inter-rater reliability was adequate for each of the HCR-20^{V3} subscales as well as the total score. A weighted kappa coefficient revealed acceptable rater agreement for the ordinal summary risk ratings (Table 1).

Data analysis

We present descriptive frequencies to document the prevalence of cannabis use among patients in the 24 months preceding the legalization of cannabis and compare this to the prevalence of use in the 24 months following. An interrupted time series (ITS) approach was used to examine changes in rates of cannabis use over calendar time and in relation to legalization. The ITS model aims to fit a trend before legalization and another after legalization, in the same model, so that the prevalence of positive UDS tests can be tested for changes at legalization and the time trend before and after legalization can be compared. Segmented regression was used with linear and quadratic functional forms to allow for non-linear time trends, and generalized estimating equation (GEE) to estimate the unconditional (i.e., population level) effect of the legalization policy rather than individual variations of this effect (as would be estimated by mixed effect models with random intercepts and slope of time). The GEE model used sandwich robust standard errors and AR1 (autoregressive of order 1) working correlation structure, which accounts for the dependence in the longitudinal data and results in unbiased estimates even under mis-specification of the working correlation structure.

Given significant restrictions in community access effected at the start of the COVID-19 pandemic, we ran a secondary ITS after removing those data points occurring after March of 2020. Examination of the scatterplots revealed a significant drop in the frequency of UDS testing occurring from March – October 2020 (the end of the study observation period), reflecting pandemic restrictions and supporting the decision to examine time trends in the absence of these data points.

A cross-sectional comparison of cannabis users (at any point in the study window) and non-users was conducted to examine group differences on demographic and clinical variables. Here, we examined whether users versus non-users varied in terms of age, sex, or ethnicity, as well as with respect to diagnosis, type of index offense, duration of stay in the FMH system, and rates of violence and victimization. All analyses were conducted using IBM SPSS Version 29.0.1.0 and R version 4.3.1.

Results

Sample descriptives

The sample comprised all 187 inpatients and outpatients under the supervision of the ORB as of May 2020 across two large forensic programs in Ontario. Patients were primarily male (87.7 %) with a mean age of 35.43 (SD = 11.78) at the time of admission to forensic care. Breakdown in terms of ethnicity was as follows: 35.3 % Caucasian, 32.1 % Black, 15.5 % Asian, 7.5 % Middle Eastern, and 9.6 % 'other'.

The most frequent primary diagnosis was schizophrenia (65.2 %, and 88.2 % had any psychotic disorder), and 60.4 % were diagnosed with a substance use disorder. Just under one-third (29.4 %) had a current cannabis use disorder (61.0 % by history and/or in sustained remission). Personality disorders were present in 12.8 % (most commonly antisocial or borderline). Only 7.5 % of the sample was diagnosed with bipolar disorder (n = 12) or major depression (n = 2). As of the study's end date (October 2020), the average length of time spent under forensic supervision was approximately 7 years (M = 82.84 [months]; SD = 24.51).

Prevalence of cannabis use

Over the four-year study observation period, there were 3552 UDS tests administered to 129 patients (58 patients had no urine tests; as noted, urine testing is only required by the ORB when there is a clinical justification to do so). Of these, 34.0 % (n = 1206) were positive for cannabis or synthetic cannabinoids. Cocaine, alcohol, and opiates were detected in 7.7, 5.4, and 1.4 % of UDS tests, respectively. Sixty-five patients (34.8 %) had at least one recording of cannabis use (self-reported, detected via urine, or both) over the study window. In all of these cases, the use of cannabis represented a breach of the conditions set out in the patient's ORB disposition. Sixty patients (32.1 %) self-reported using cannabis on one or more occasion, and 60 patients (32.1 %) had one or more positive UDS for cannabis. These were overlapping groups, with only five patients self-reporting cannabis use but without any corresponding positive UDS. A small group of patients (n = 19) was responsible for the majority of the positive UDS (i.e., having 20 or more positive results each). There was also an elevated prevalence of dilute urine samples (n = 1080; 30.4 %), suggesting that there may be a number of cases where efforts were made to obscure the presence of substances.

Patients with one or more positive UDS were tested more frequently (M = 41.17, SD = 30.88) as compared to those without any positive test results (M = 15.48, SD = 22.00), $F(1, 128) = 30.16$, $p < .001$. Further, a majority (81.7 %) of patients with a positive UDS had one or more subsequent positive results; put otherwise, it was uncommon for patients to have just one single positive UDS for cannabis. This may partially be a reflection of the prolonged detectability of cannabis in some individuals, which could result in multiple positive UDS from a single instance of cannabis use if those tests are administered in close proximity. Clinical teams also often administer more frequent UDS in the time period following a positive result.

The proportion of UDS positive for cannabis occurring prior to and following legalization were significantly different, and demonstrated an increase in the incidence of positive tests in the post-legalization period ($z = -2.73$, p = .006). Specifically, 1807 UDS tests were conducted in the pre-legalization period, of which 575 (31.8 %) returned positive for

cannabis among 41 patients. Post-legalization, 1745 tests were administered, of which 631 (36.2 %) returned positive for cannabis among 43 patients. As will be elaborated below, given that the last six months of our post-legalization period included the beginning of COVID-19, with significant restrictions on community access, the above numbers are likely an underestimate of the actual increase in use.

Results from an interrupted time series analysis (Table 2) found a significant rise in the proportion of positive UDS results (among all UDS test results) for cannabis in the post-legalization period. There was no change in level (i.e., a change in the proportion of positive tests for cannabis at the exact point of legalization), but a significant change in slope (i.e., the directionality and gradient of each line segment at post- versus pre-legalization) as evidenced by the significant Time x Legal interaction term. Prior to legalization, the odds of a positive UDS for cannabis was observed to drop by 43 %, on average, per year; in contrast, in the period following legalization there was an almost 3-fold increase in the odds of a positive UDS per year. This is consistent with the suggestion that the legalization effect was not immediate, but rather was associated with a gradual increase in use over time. Fig. 1 displays the linear model graphically, using the aggregated monthly proportion of positive UDS for cannabis.

Association between cannabis use and clinical indicators

As seen in Table 3, patients with one or more instances of cannabis use (self-reported or detected via UDS) were, on average, younger (M = 39.00, SD = 8.69), as compared to those without any cannabis use (M = 44.11, SD = 12.82), $F(1, 185) = 8.28$, $p = .004$. They were also more likely to be of African, Caribbean, or 'Other' ethnicity, and less likely to be of Asian descent (χ^2 [1, N = 187] = 16.33, $p < .001$). Patients with one or more instances of cannabis use were more likely to have a substance use disorder as part of their diagnostic profile (χ^2 [1, $N = 187$] = 43.58, $p < .001$), and were also more likely to have a history of cannabis abuse in adolescence (χ^2 [1, N = 146] = 24.82, $p < .001$) and in adulthood (χ^2 [1, N = 180] = 54.06, $p < .001$), preceding forensic admission. Other variables examined (i.e., sex, the presence of a personality disorder, type of index offense, length of forensic hospitalization) showed no significant differences across patients with and without cannabis use. With respect to the duration of forensic hospitalization, because we included only those patients with an admission date after January 2010, we would not have captured very long stay patients, some of whom will have had issues with cannabis use.

Seventy-two patients were readmitted to inpatient forensic care on one or two ($n = 53$) or multiple ($n = 19$) occasions, representing 51.1 % of patients who had some amount of community tenure during the study. Patients with cannabis use were more likely to have one or more hospital readmissions from the community (χ^2 [1, $N = 141$] = 10.88, p = .001). In 42.5 % of readmissions, there was a positive UDS result for cannabis and/or another prohibited substance in the days prior. Related to this finding, in those patients using cannabis, 39 (60 %) evidenced more overt symptoms of their mental disorder in the week following at least one instance of use. In 23 of these cases, the change in mental status was categorized as severe. At the same time, as seen in Table 4, many patients using cannabis also experienced no significant changes in symptoms in the week following use, and a CGI-I rating of 'no change' was most often tendered (representing 69.5 % of all CGI-I ratings). However, a substantial minority experienced changes classified as clinically significant, with 22.5 % of all CGI-I ratings indicating modest to severe changes in mental status. The average symptom severity score (CGI-S) likewise indicated a significant increase when examined in the week preceding versus following cannabis use, $t(625) = 5.84$, $p < .001$. This pattern of results was similar when CGI ratings were examined separately for the periods preceding and following legalization.

We observed an elevated prevalence of medication non-compliance, either on a single occurrence (16.0 %) or multiple occurrences (29.4 %) in the sample as a whole. Patients using cannabis were more likely to have recurring problems with medication compliance ($z = -1.98$, p = .02), and patients with recurring medication non-compliance, in turn, were more frequently readmitted to hospital from the community (χ^2 [1, $N = 141$] = 8.18, $p = .02$). Finally, patients with documented cannabis use were less likely to have a history of ECT (χ^2 [1, $N = 187$] = 3.30, p = .06) and previous or current treatment with clozapine (χ^2 [1, $N = 187$] = 5.39, $p = .02$).

Table 2
Coefficient estimates for GEE models after removing outlying data points.

Predictors	Linear Model			Quadratic Model		
	Odds Ratios	95 % CI	p	Odds Ratios	95 % CI	p
(Intercept)	0.30	0.14 – 0.61	**0.001**	0.36	0.15 – 0.85	**0.02**
Time	0.57	0.31 – 1.05	0.07	1.18	0.10 – 14.70	0.90
Legal	0.69	0.29 – 1.67	0.41	0.79	0.28 – 2.20	0.65
Time × Legal	5.00	1.26 – 19.87	**0.02**	0.70	0.02 – 19.36	0.82
Time^2				1.59	0.34 – 7.47	0.56
Legal × Time^2				1.56	0.16 – 15.49	0.71
$N_{participants}$	114			114		
N_{UDS}	2776			2776		

Note. GEE = generalized estimating equations. 'Legal' = estimated change at legalization, interpreted as the odds of positive cannabis UDS test. 'Time' = the pre-legalization slope for the linear model. 'Time X Legal' = the change in slope at post-legalization compared with pre-legalization, for the linear model. Following the removal of data points occurring after March 2020, there was no evidence that a quadratic model was needed.

Association between cannabis use, risk, and public safety indicators

Patients using cannabis had higher risk scores on the historical/static risk factor subscale of the HCR-20^{V3} ($F_{1,185} = 11.95$, $p < .001$). There were no group-based differences on the dynamic, clinical indicators of violence risk, and no differences on the overall summary risk estimates yielded from the HCR-20^{V3} (i.e., risk of future violence, risk of serious physical harm, risk of imminent violence). The rate of actual violence over the 4-year study observation period (140 events by 46 patients) did not differ across groups with and without cannabis use (F[1, 185] = 0.61, p = .81), nor did it differ in the time periods preceding (50.4 % of all events) and following (49.6 %) legalization. The most frequently documented acts of violence were minor and involved hitting, pushing, or shoving another person. Reported experiences of victimization (60 events experienced by 39 patients) were also of low severity and did not significantly differ across groups with and without cannabis use (F[1, 185] = 2.43, p = .12). However, more incidences of victimization were observed to occur in the post-legalization period (66.1 %) as compared to the pre-legalization period (33.9 %).

Discussion

Unauthorized substance use continues to be a pressing concern among forensic patients in Canada and internationally, with studies demonstrating significant adverse effects of cannabis use on psychiatric symptoms and clinical recovery for persons with serious forms of mental illness (e.g., Penney et al., 2018; Schoeler et al., 2016a; Volkow, 2009). In Ontario, the prevalence of substance use disorders among forensic patients has risen significantly over the past 25 years (Penney et al., 2019), making it an important clinical target with implications for risk management and community reintegration. The advent of legalization in Canada in 2018 made it a major priority to investigate the association between cannabis use and specified mental health and clinical outcomes

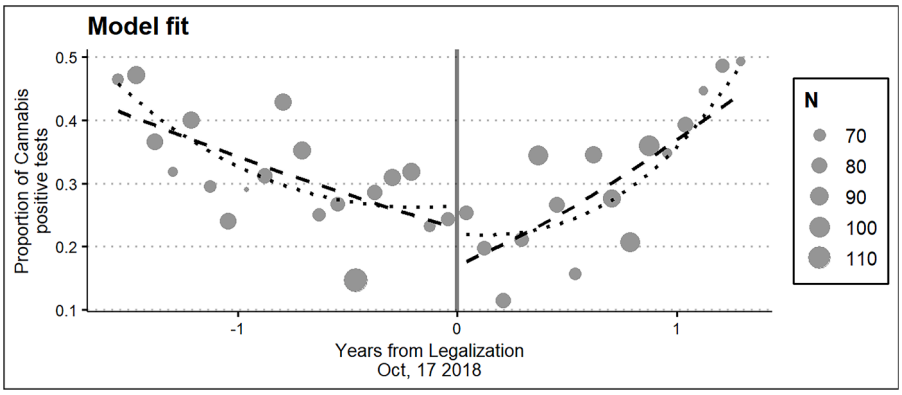

Fig. 1. *Proportion of positive cannabis tests aggregated monthly*
Note. Model-predicted means were used to graph the trend and the legalization effect. The graph also used monthly raw proportions of positive UDS tests to display the trend in the data to which the model was overlaid.

Table 3
Sociodemographic and clinical characteristics of patients with and without cannabis use.

	No cannabis use ($n = 122$)	≥ 1 cannabis use ($n = 65$)	
	M (SD) / *n* (%)		F / χ^2 (p)
Age	37.25 (12.65)	32.02 (9.08)	8.73 (0.004)
Sex (male)	107 (87.7)	57 (87.7)	.00 (0.58)
Ethnicity			
Caucasian	46 (37.7)	20 (30.8)	16.33 (0.001)
African / Caribbean	32 (26.2)	28 (43.1)	
Asian	27 (22.1)	2 (3.1)	
Other	17 (13.9)	15 (23.1)	
Diagnosis			
Any psychotic disorder	105 (86.1)	60 (92.3)	1.59 (0.15)
Any personality disorder	12 (9.8)	12 (18.5)	2.82 (0.08)
Any substance use disorder	53 (43.4)	60 (92.3)	42.35 (0.00)
Forensic hospital readmission (Y)	36 (29.5)	36 (55.4)	10.88 (0.001)
Medication non-compliance (recurring)	30 (24.6)	25 (38.5)	3.53 (0.05)
History of ECT treatment (Y)	13 (10.7)	2 (3.1)	3.30 (0.06)
History of Clozapine treatment (Y)	61 (50.0)	21 (32.3)	5.39 (0.02)
Duration of illness prior to forensic care (years)	9.06 (9.57)	6.81 (8.12)	2.36 (0.13)
Violence risk estimates: HCR-20^{V3}			
Historical scale	12.82 (3.50)	14.49 (2.37)	11.95 (0.001)
Clinical scale	4.35 (2.41)	3.78 (2.29)	2.45 (0.12)
Risk management scale	4.04 (2.00)	4.37 (1.55)	1.33 (0.25)
Total score	21.21 (5.76)	22.65 (3.83)	3.25 (0.07)
Summary risk estimate (case prioritization / future violence)			
Low	23 (18.9)	10 (15.4)	.38 (0.83)
Moderate	91 (74.6)	51 (78.5)	
High	8 (6.6)	4 (6.2)	
# violent incidents	0.75 (2.02)	0.68 (1.37)	.06 (0.81)
# victimization incidents	0.26 (0.64)	0.43 (0.81)	2.43 (0.12)

Note. HCR-20^{V3} = Historical, Clinical, Risk Management-20, Version 3. CGI = Clinical Global Impression rating scales.

Table 4
CGI ratings of symptom severity and symptom change in the week following cannabis use.

	# patients (% of all patients using cannabis, $n = 65$)	# ratings (% of all CGI-I ratings, $n = 626$)	Average symptom severity score (CGI-S) – week prior	Average symptom severity score (CGI-S) – week following	Average symptom change score – week following
CGI-I ratings in the week following cannabis use			M (SD), Mode – Clinical Descriptor		
Very much improved	0 (0)	0 (0)	1.87 (1.07), 1 – 'Normal'	2.09 (1.22), 1 – 'Normal'	4.20 (0.57), 4 – 'No change'
Much improved	1 (1.5)	1 (0.2)			
Minimally improved	11 (16.9)	49 (7.8)			
No change	54 (83.1)	435 (69.5)			
Minimally worse	30 (46.2)	107 (17.1)			
Much worse	22 (33.9)	33 (5.3)			
Very much worse	1 (1.5)	1 (0.2)			

Note. Percentages sum to greater than 100 % as more than one CGI rating is often present for a single patient, reflecting more than one instance of cannabis use. The CGI-S can range from 1 (*Normal / no mental disorder*) to 7 (*Severely ill*). The CGI-I ranges from 1 (*Very much improved*) to 7 (*Very much worse*).

within a forensic context.

Prevalence of cannabis use and the effects of legalization

Consistent with other national reports (Chaimowitz et al., 2022; Crocker et al., 2015; Penney et al., 2019), patients in this sample were primarily young men with a psychotic illness and an elevated prevalence of cannabis use and cannabis use disorders. Over one-third of patients had one or more instances of cannabis use over a four-year observation period, contrary to the conditions of their ORB disposition orders. Further, 34 % of all completed UDS tests ($N = 3552$) were positive for cannabis. In the majority (81.7 %) of cases, patients had multiple rather than single occurrences of cannabis use, suggesting that use was ongoing despite clinical efforts to reduce or cease use. At the same time, it must be acknowledged that some tests occurring in close proximity will reflect a single instance of use given the prolonged detectability of cannabis in certain individuals. Clinical teams will also often test patients more

frequently following a positive UDS, resulting in more "opportunities" to detect repeated instances of cannabis use.

When the proportion of urine screens positive for cannabis was examined as a function of legalization, results showed a significant increase in the incidence of positive tests in the post-, as compared to pre-, legalization period. Results from an interrupted time-series analysis supported this finding, demonstrating an almost three-fold increase in the odds of a positive UDS per year in the post-legalization period. This suggests that legalization was associated with a gradual increase in use, rather than relating to a change in the frequency of use at a discrete point in time. This is intuitive and consistent with the notion that societal attitudes and permissiveness surrounding cannabis use continue to evolve, both as policies surrounding the drug have shifted and the corresponding commercialization and availability of cannabis has intensified (Government of Canada, 2022, 2024; Myran et al., 2023).

The reasons underlying the observed decrease in cannabis use in the months preceding legalization are less clear. This may have reflected a general trend towards recovery and increased compliance with ORB dispositions, which would align with our program's recent implementation of a new forensic Model of Care, intended to optimize service delivery, standardize care, and advance the development of assessment and treatment standards. These efforts could all have conceivably had significant impacts on curbing illicit substance use in our patient population. In contrast, the reversal observed in the post-legalization period may reflect the sociopolitical reasons articulated above as well as the salience of having visible triggers (e.g., cannabis dispensaries and storefronts) in such close proximity.

The variables driving change in cannabis consumption in the general population will also likely be distinct from those associated with changes in consumption observed in a forensic patient sample. For one, despite that recreational cannabis use is legal in Canada, it continues to be monitored closely and prohibited for many forensic patients. Further, despite the sharp increase in cannabis retail outlets, including many in close proximity to the forensic hospitals studied here, few forensic patients are purchasing cannabis from these outlets as it is higher cost than street available cannabis. Patients are disinclined to change the way they obtain cannabis, which, from our clinical experiences, has come primarily from informal social networks such as groups of friends, family members or acquaintances.

Patient characteristics associated with cannabis use

Patients with one or more instances of cannabis use, when compared to those without any use, were found to be younger and with a noted history of problematic cannabis use. They were also more likely to be of African, Caribbean, or 'Other' ethnicity, and less likely to be of Asian descent. With respect to this latter finding, studies drawing on U.S. data have suggested that racialized communities may be more likely than White populations to experience negative consequences of drug legalization, including increased cannabis use and a higher prevalence of cannabis use disorders (Adinoff & Reiman, 2019; Martins et al., 2021). Recent population-based surveys have shown that higher-frequency cannabis use is more common among young and racial minority populations, as well as in men, and specifically, that individuals who engaged in daily cannabis use were disproportionately Black or Native American, while Asian and Hispanic cannabis consumers tended to be infrequent users (Hasin et al., 2019; Jeffers et al., 2021).

While the ethnoracial composition in Ontario is distinct from many U.S. jurisdictions, it is clear that more data is required at this juncture to better evaluate the impact of Canadian legalization policies as a function of race and ethnicity, as well as for identifying groups in heightened need of intervention, for example, through the provision of more equitable and culturally-responsive substance use prevention and treatment resources (Martins et al., 2021). Also needed are additional pre- and post-legalization study designs to fully quantify the prevalence of cannabis use across different FMH contexts, especially in light of the fact that racialized and other marginalized groups are overrepresented in forensic settings in Canada (Penney et al., 2020) and internationally (e.g., Bulla et al., 2018; Gabrielsen & Kramp, 2009; Leese et al., 2006; Morgan & Hutchison, 2010).

Clinical and public safety implications of cannabis use

Results from this study supported an association between cannabis use and patients' psychiatric stability, finding that approximately half of all patients with cannabis use experienced significant worsening of their mental health status in the days surrounding their use. Given the literature showing a robust relationship between cannabis use and psychosis, coupled with the fact that most forensic patients have a primary psychotic disorder diagnosis, we would argue that this finding is generalizable to other non-forensic, clinical populations. Also related to this finding was the observation that patients using cannabis were more likely to be readmitted to hospital, and that, indeed, readmissions were a common occurrence in this sample as a whole (51.1 % of the 141 patients with some duration of community living). This is consistent with the suggestion that cannabis use, coupled with significant changes in mental status, are factors that frequently precede readmission to forensic inpatient care. Prior studies have similarly found that psychiatric decompensation, substance use, and treatment non-adherence are critical factors prompting re-hospitalization among community-dwelling forensic patients (Melnychuk et al., 2009; Penney et al., 2018).

Rates of more seriously adverse outcomes in the domains of interpersonal violence and victimization were low, but less hazardous forms of violence and victimization were more frequently observed (e.g., hitting and shoving, being hit or shoved). The finding that rates of hospital readmission are consistently higher in forensic patient samples, including this one, as compared to rates of community violence or re-offending (e.g., Charette et al., 2015) suggests that returns to inpatient forensic care are used prophylactically by clinical teams, and as part of a patient's overall risk management plan. Notably, despite a modestly higher level of static/historical risk factors for violence for the cannabis-using group, rates of violence perpetration were not found to differ across patient groups with and without cannabis use, nor across time. And while this does not diminish the clinical import of the behavioral incidents that did occur in this sample, it does suggest that the public safety risks associated with cannabis use among forensic patients have not materially changed with the advent of legalization in Canada. Rather, clinical teams intervened before safety risks arose, resulting in a burden on service provision rather than public safety.

Limitations included that this was an archival-based study, in which we relied on health record information and urine toxicology reports. That said, the reports and documentation contained in patient files are typically comprehensive, including reports from collateral sources (e.g., family, police), previous treatment records, multi-disciplinary clinical notes and detailed psychiatric reports prepared for the provincial Review Board. There are also limitations associated with the UDS data from which we coded the prevalence and timing of substance use. For one, there is a potentially confounding relationship between the likelihood of discovered substance use with the frequency of urine testing. The number of tests, and therefore the proportion of positive findings, depends in part on variations in clinical team practice. Positive urine results will also often result in increased restrictions (e.g., in the form of reduced or more intensively supervised community access), thereby potentially suppressing the frequency of continued use. Importantly, we do not have any reason to believe that these clinical practices would have changed materially in the period preceding versus following legalization, and thus should not have impacted one specific part of the study observation period over another. It is also often not possible to reliably quantify the amount or potency of the product consumed (i.e., % THC) from the urine, which in turn has implications for the risk associated with consumption on psychiatric and behavioral stability (Di Forti et al., 2015, 2019; Petrilli et al., 2022).

Another limitation had to do with the timing of the COVID-19 lockdown and restrictions in Ontario, which coincided with the beginning stages of cannabis market commercialization, making it difficult to parse out effects. We needed to remove data points from the last six months of our study observation period (March – October 2020) as the number of administered UDS tests dropped significantly, reflecting the highly restricted community access and visitor prohibitions in place at this time. A longer follow-up period would be beneficial to capture the full impact of market commercialization on forensic patients post-COVID, when community access privileges were re-instated, and to more robustly estimate the impact of legalization on rates of cannabis use. Finally, although the demographic and clinical characteristics of this sample appear similar to the larger population of Canadian forensic service users, it is unknown to what degree findings from this sample are generalizable to other jurisdictions internationally.

This is the first Canadian study to examine the impact of cannabis use and legalization in a large sample of forensic patients and quantify the mental health burden and public safety risks associated with cannabis in this population. Considering the elevated and increasing cannabis consumption among forensic patients, findings also question the effectiveness of the abstinence-based model currently espoused by the Canadian FMH system and provincial Review Boards. A qualitative project undertaken by our team will examine the impact of cannabis legalization on perceptions of risk associated with use among forensic patients, and perceptions of changing clinical and legal practices (e.g., by the Review Board) as time from legalization has elapsed. This information will provide an important context and depth of understanding to the quantitative results surrounding changing patterns of cannabis use in forensic patients.

Ethics approval

The authors declare that they have obtained ethics approval from an appropriately constituted ethics committee/institutional review board where the research entailed animal or human participation.

Centre for Addiction and Mental Health Research Ethics Board, Protocol #2020/044.

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CRediT authorship contribution statement

Stephanie R. Penney: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Roland M. Jones:** Writing – review & editing, Funding acquisition, Conceptualization. **Treena Wilkie:** Writing – review & editing, Conceptualization. **Cory Gerritsen:** Writing – review & editing, Conceptualization. **Sumeeta Chatterjee:** Writing – review & editing, Conceptualization. **Gary A. Chaimowitz:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization. **Alexander I.F. Simpson:** Writing – review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

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

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