# Use of Prescription Pain Medications Among Medical Cannabis Patients: Comparisons of Pain Levels, Functioning, and Patterns of Alcohol and Other Drug Use

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**ABSTRACT. Objective:** Management of chronic pain is one of the most common reasons given by individuals seeking medical cannabis. However, very little information exists about the concurrent use of cannabis and prescription pain medication (PPM). This study fills this gap in knowledge by systematically comparing medical cannabis users who use or do not use PPM, with an emphasis on understanding whether concurrent use of cannabis and PPM is associated with more serious forms of alcohol and other drug involvement. **Method:** Data from this study were collected from a medical cannabis clinic in southwestern Michigan (*N* = 273). Systematic comparisons were made on measures of sociodemographics, reasons for substance use, pain, functioning, and perceptions of PPM and medical cannabis efficacy. **Results:** PPM users tended to be older and reported higher levels of pain and lower levels of functioning. The overall sample exhibited higher lifetime and past-3-month rates of alcohol and other noncannabis drug use than did the general population. Approximately 40% of subjects reported combining cannabis with alcohol, but no significant difference was observed between PPM users and nonusers. PPM users and nonusers did not exhibit any difference in either lifetime or past-3-month use of other drugs, including cocaine, sedatives, street opioids, and amphetamines. PPM users rated the efficacy of cannabis higher than PPM for pain management and indicated a strong desire to reduce PPM usage. **Conclusions:** Use of PPM among medical cannabis users was not identified as a correlate for more serious forms of alcohol and other drug involvement. However, longitudinal study designs are needed to better understand the trajectories of alcohol and other drug involvement over time among medical cannabis users. (*J. Stud. Alcohol Drugs, 76,* 406–413, 2015)

POLICIES AND PRACTICES SURROUNDING medical cannabis continue to evolve and suggest a growing interest and need for researchers and clinicians to identify and understand different user groups, their demographics, perceptions of efficacy, and reasons for use. As of October 2014, 23 states and the District of Columbia had enacted laws permitting cultivation and use of medical cannabis for certain medical and mental health conditions (Bachhuber & Barry, 2014; NORML, 2014). Nearly half of these states passed medical cannabis laws during the past 5 years, and three states have pending legislation that would authorize use of medical cannabis (H. B. 153, 2014; S. B. 1182, 2014; Wilson, 2014).

Among the states with medical cannabis laws, variability exists regarding how much a person may possess, where and how the cannabis can be accessed and transported, and the specific regulations for cultivation. Variability also exists with respect to the conditions that qualify an individual for receipt of medical cannabis. However, all current laws include some provision for pain-related conditions or for the management of chronic pain (NORML, 2014).

Increasingly, medical cannabis is being presented as an alternative to opioids or as an adjunctive approach that could augment the analgesic effects of opioids (Lucas, 2012). However, cannabis may be problematic for some patients, especially those who are prescribed prescription pain medication (PPM) and use marijuana and PPM concurrently. For example, DeGeorge et al. (2013) examined PPM misuse among persons prescribed hydrocodone. Using biologically based measures, they found that patients who used cannabis were significantly more likely to be taking another nonprescribed medication than were patients who did not use cannabis. Pesce et al. (2010) also found that patients with chronic pain who used cannabis were 3.7 times more likely to test positive for other illicit drugs (e.g., methamphetamines and cocaine) than were non–cannabis users (see also Manchikanti et al., 2008). Fiellin et al. (2013) also presented evidence for cannabis as a possible gateway drug to the misuse of prescription opioids among both men and women 18–25 years of age.

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Recently, Bachhuber et al. (2014) investigated whether the availability of medical cannabis would affect PPM overdose rates, given that medical cannabis may potentially lead to increased levels of substance use through the gateway effect (Fiellin et al., 2013), or possibly alter the pharmacokinetics of opioids. Using age-adjusted opioid analgesic overdose death rates, Bachhuber et al. (2014) found the presence of state medical cannabis laws to be associated with significantly lower state-level opioid overdose rates. At the same time, inferences of causality cannot be drawn from this ecological study of state-level effects, and it remains unclear whether access to medical cannabis could influence PPM misuse (Bachhuber et al., 2014).

The risk of acute toxicity from cannabis is low, and cannabis may be safer than PPMs. Although the evidence on medical cannabis for pain suggests that it might relieve pain in the short term (e.g., Berman et al., 2004; Johnson et al., 2010; Naef et al., 2003; Rog et al., 2005), the long-term benefits remain unclear (Joy et al., 1999; Ste-Marie et al., 2012; Volkow et al., 2014), making it difficult for providers and policy makers to know whether and for whom medical cannabis would be both safe and effective, in what dose, or for how long. Addressing these issues requires a strong foundation of empirical evidence using a variety of methodological designs.

To date, few studies have been conducted to understand the characteristics of persons who are seeking and using cannabis specifically for pain-related purposes. Several studies have provided descriptive data on typical medical marijuana patients and generally reflect that this is a diverse group with complicated co-occurring medical and psychiatric problems (Bonn-Miller et al., 2014; Ilgen et al., 2013; Reinarman et al., 2011). This prior work also indicates that prescription opioid use is common among those seeking medical cannabis.

The purpose of the current study is to better elucidate patterns of alcohol and other drug use, functioning, and perceived efficacy of pain treatments among medical cannabis users with and without concurrent use of PPM. By doing so, this study might help clarify whether concurrent use of medical cannabis and PPM is associated with more serious involvement of alcohol and other drugs. This study also provides comparative data to better understand the extent to which individuals seeking cannabis perceive it to be beneficial as well as their perceptions of the relative analgesic effects of cannabis and opioids. This information could help to inform the development of targeted policies and practice guidelines for medical cannabis.

## Method

### *Sampling and recruitment*

Data for this study were derived from a larger survey of persons seeking medical cannabis certification or recertification at a certification clinic in the upper Midwest (see Ilgen et al., 2013). Persons awaiting an appointment to obtain certification or recertification for medical cannabis were invited by a research staff member (not employed by the clinic) to participate in the study. Of the 370 persons invited, 94.1% ($N$ = 348) provided verbal consent to participate. This current report focuses on a subset of the subjects who endorsed using cannabis in the past month specifically for pain reduction ($N$ = 273). This study was approved by the institutional review board at the University of Michigan. Further details of the current study can be obtained in Ilgen et al. (2013).

### *Measures*

*Use of prescription pain medication.* We divided this sample into two mutually exclusive groups based on whether the subject endorsed use of PPM within the past month (PPM–Yes, $n$ = 172, 63.0%; PPM–No, $n$ = 101, 37.0%).

*Use, misuse, and efficacy of prescription pain medication.* Subjects who endorsed past-30-day PPM use were asked whether they were trying to limit their use of PPM, as follows: (a) "I am trying to use prescription pain medications for nonmedical reasons less often than I used to," and (b) "I am trying to use prescription pain medications for pain relief less often than I used to." Response options were on a 5-point Likert-type scale (1 = *strongly agree* to 5 = *strongly disagree*).

Our measurement of PPM misuse was based on items from the Current Opioid Misuse Measure (COMM; Butler et al., 2007). The scoring guidelines of the COMM were originally developed for use in pain management clinics, which are quite different from medical cannabis certification clinics. Thus, the present study used a subset of five items from the COMM, which were used to create an index of PPM misuse: (a) "How often have you taken your medications different from how they are prescribed?"; (b) "How often have you needed to take pain medications belonging to someone else?"; (c) "How often have you had to take more medication than prescribed?"; (d) "How often have you had to borrow pain meds belonging to someone else?"; and (e) "How often have you used your pain meds for nonpain symptoms?" Each of these items used a 5-point Likert-type response option (0 = *never* to 4 = *very often*). An index was created by summing across all the item scores. Thus, lower scores reflect lower levels of PPM misuse.

Subjects were also asked how helpful PPMs were in reducing pain (0 = *not at all,* 10 = *very*). For comparative purposes, subjects were also asked about how helpful cannabis was in reducing pain (0 = *not at all,* 10 = *very*).

*Pain and functioning.* The Numerical Rating Scale (NRS) was used to assess pain level on an 11-point scale

(0 = *no pain,* 10 = *severe pain*) (Farrar et al., 2001). Two questions were asked: (a) average pain over the past 30 days and (b) current pain level. The Short Form-12 Health Survey (SF-12) was used to assess functioning (Ware et al., 1995, 1996).

The mental component score (MCS) and physical component score (PCS) of the SF-12 were used for the current study. The MCS and PCS measure the perception of impact of mental health symptoms and physical problems (respectively) on one's daily activities based on a 6-point Likert-type response scale (1 = *all of the time,* 6 = *none of the time*). For both the MCS and PCS, standardized scores are computed and range from 0 to 100, with 100 representing the highest level of functioning.

*Alcohol and other drug use.* The Alcohol Use Disorders Identification Test (AUDIT) was used to assess problematic alcohol use (Babor et al., 1989). The AUDIT asks participants about quantity and frequency of alcohol use over the past year in addition to questions about potential consequences of alcohol use. Prior research has established the reliability and validity of the AUDIT (Reinert & Allen, 2002), and current guidelines recommend a cutoff of 8 or higher as the best screen for a potential alcohol use disorder (Conigrave et al., 1995).

Assessment of other noncannabis drug use involved items adapted from the World Health Organization's Alcohol, Smoking and Substance Involvement Screening Test (WHO ASSIST Working Group, 2002). Subjects were asked about lifetime and past-3-month use of cocaine, sedatives or sleeping pills, street opioids, amphetamines, hallucinogens, and inhalants. Subjects were also asked about use of cannabis combined with alcohol, other drugs, and PPMs.

### *Data analysis*

The analysis for this study involved an analysis of the overall sample of persons who had self-reported cannabis use in the past month for pain. This sample was then divided into two unique groups based on whether they reported use of PPMs within the past month (PPM users and PPM nonusers). These two user groups were compared on all the study variables using common bivariate tests of association. The measures that were relevant only to the PPM user group (i.e., PPM misuse and PPM efficacy) were analyzed using bivariate and multivariate tests of association. Poisson regression analysis was selected as the multivariate regression process, given the observed distribution of scores. Simulation procedures were performed using the Zelig package available for the statistical language R to facilitate interpretation of the coefficients from the Poisson regression model (Imai et al., 2007, 2008). Analyses were carried out using Version 3.1.0 of R (R Core Team, 2014).

## Results

### *Sample description*

The current study included 273 subjects who reported past-month cannabis use for pain-related purposes. On average, subjects in this study were approximately 40.3 years of age, male (69.2%), married or cohabitating (50.0%), and White (99.6%). The majority of subjects reported at least some education at the college level (59.0%). Of the 273 subjects, 172 (63.0%) reported using PPM within the past month for pain-related purposes (PPM users). Non–PPM users were significantly younger than PPM users ($M$ [$SD$] = 37.7 [11.7] vs. 41.9 [12.8] years; $t$ = -2.77, $p$ = .006). No other significant differences were observed across the PPM grouping variable.

### *Pain and functioning*

NRS pain rating scale scores ranged from 0 to 10, with higher scores representing higher levels of pain. PPM users reported higher levels of current pain than did PPM nonusers ($M$ [$SD$] = 6.18 [2.05] vs. 5.41 [2.28]; $t$ = -2.74, $p$ = .007), but no significant differences were observed on the measure of average pain (Table 1). PPM users also had comparably lower levels of physical functioning based on the SF-12–PCS ($M$ [$SD$] = 34.86 [8.33] vs. 38.80 [8.71], $t$ = 3.66, $p < .001$). No significant difference was observed on the SF-12–MCS.

### *Use of alcohol and other drugs*

The next stage of the analysis examined differences in levels of alcohol and other noncannabis drug involvement. AUDIT scores ranged from 0 to 40 ($M$ = 3.7, $SD$ = 4.95). Fourteen percent of the overall sample reached or exceeded the AUDIT threshold score of 8 to represent alcohol misuse. Approximately 40% of the overall sample reported using cannabis with alcohol. No significant differences were observed among PPM users and nonusers for the alcohol use measures.

Lifetime use of other (noncannabis) drugs was common among the overall sample. More specifically, 37.1% of the sample reported lifetime use of cocaine, and 27.2% of the sample reported lifetime use of amphetamines (Table 2). Past-3-month use of all substances was relatively low (e.g., cocaine = 2.6% and amphetamines = 3.8%). Although no significant differences were observed in percentage of lifetime and past-3-month use of other drugs, PPM users were significantly more likely to combine use of cannabis with other drugs than were PPM nonusers. No differences in lifetime or past-3-month use of other drugs were noted across the PPM grouping variable. However, PPM nonusers were significantly less likely to combine cannabis with other drugs than were PPM users (6.9% vs. 19.2%, $p$ = .01).

TABLE 1. Comparison of medical cannabis users who used or did not use prescription pain medications (PPMs) on measures of sociodemographics, pain levels, and functioning

| Variable | Overall ($N$ = 273) | PPM nonuser ($n$ = 101) | PPM user ($n$ = 172) | Test statistics ($df$) |
|---|---|---|---|---|
| Age, in years, *M* (*SD*) | 40.3 (12.5) | 37.7 (11.7) | 41.9 (12.8) | $t(225.34) = -2.77$, $p = .006$ |
| Gender, *n* (%) | | | | |
| Male | 189 (69.2) | 74 (73.3) | 115 (66.9) | $\chi^2(1) = 1.23$, $p = .268$ |
| Female | 84 (30.8) | 27 (26.7) | 57 (33.1) | |
| Marital status, *n* (%) | | | | |
| Not married | 136 (50.0) | 49 (48.5) | 87 (50.9) | $\chi^2(1) = 0.141$, $p = .701$ |
| Married | 136 (50.0) | 52 (51.5) | 84 (49.1) | |
| Race, *n* (%) | | | | |
| Non-White | 1 (0.04) | 0 (0.0) | 1 (0.006) | $\chi^2(1) = 0.589$, $p = .442$ |
| White | 272 (99.6) | 101 (100.0) | 171 (99.4) | |
| Education, *n* (%) | | | | |
| <High school | 9 (3.0) | 3 (3.0) | 6 (3.5) | $\chi^2(2) = 0.330$, $p = .848$ |
| High school or equiv. | 102 (38.0) | 40 (39.6) | 62 (36.3) | |
| >High school | 161 (59.0) | 58 (57.4) | 103 (60.2) | |
| NRS, 0–10 scale, *M* (*SD*) | | | | |
| Current pain | 5.90 (2.16) | 5.41 (2.28) | 6.18 (2.05) | $t(188.47) = -2.74$, $p = .007$ |
| Average pain | 6.91 (1.73) | 6.69 (1.78) | 7.05 (1.69) | $t(195.93) = -1.66$, $p = .099$ |
| SF-12, 0–100 scale, *M* (*SD*) | | | | |
| Mental component | 49.18 (11.10) | 50.31 (10.73) | 48.51 (11.28) | $t(218.14) = 1.31$, $p = .189$ |
| Physical component | 36.32 (8.67) | 38.80 (8.71) | 34.86 (8.33) | $t(201.17) = 3.66$, $p < .001$ |

*Notes:* Cell values do not add up to overall sample size because of small amounts of missing data due to nonresponse. These missing data were handled using listwise deletion. Subscripts with variables represent theoretical score range. Equiv. = equivalent; NRS = Numeric Rating Scale (0 = *no pain,* 10 = *severe pain*); SF-12 = Short Form-12 Health Survey (impact on functioning, 1 = *all of the time,* 6 = *none of the time*).

TABLE 2. Comparison of medical cannabis users who used or did not use prescription pain medications (PPMs) on measures of alcohol and other drug use

| Variable | Overall ($N$ = 273) | PPM nonuser ($n$ = 101) | PPM user ($n$ = 172) | Test statistics ($df$) |
|---|---|---|---|---|
| Alcohol, AUDIT score | | | | |
| *M* (*SD*) | 3.7 (4.95) | 3.9 (5.87) | 3.5 (4.3) | $t(164.58) = 0.57$ |
| AUDIT ≥ 8, *n* (%) | 38 (13.9) | 17 (16.8) | 21 (12.4) | $\chi^2(1) = 1.05$, $p = .304$ |
| Cocaine, *n* (%) | | | | |
| Lifetime | 99 (37.1) | 36 (37.1) | 63 (37.1) | $\chi^2(1) > 0.01$, $p = .999$ |
| Past 3 months | 7 (2.6) | 2 (2.1) | 5 (2.9) | Fisher's test, $p = .71$ |
| Sedatives, *n* (%) | | | | |
| Lifetime | 66 (24.9) | 18 (18.9) | 48 (28.4) | $\chi^2(1) = 3.05$, $p = .081$ |
| Past 3 months | 23 (8.7) | 8 (8.2) | 15 (8.9) | $\chi^2(1) = 0.15$, $p = .699$ |
| Street opioids, *n* (%) | | | | |
| Lifetime | 32 (12.1) | 8 (8.2) | 24 (14.4) | $\chi^2(1) = 2.16$, $p = .142$ |
| Past 3 months | 5 (1.9) | 1 (1.0) | 4 (2.4) | Fisher's test, $p > .99$ |
| Amphetamines, *n* (%) | | | | |
| Lifetime | 72 (27.2) | 20 (20.8) | 52 (31.0) | $\chi^2(1) = 3.15$, $p = .076$ |
| Past 3 months | 10 (3.8) | 4 (4.2) | 6 (3.6) | Fisher's test, $p = .47$ |
| Cannabis combined with alcohol, *n* (%) | 109 (39.9) | 39 (37.0) | 70 (40.7) | $\chi^2(1) = 0.115$, $p = .734$ |
| Cannabis combined with other drugs, *n* (%) | 40 (14.7) | 7 (6.9) | 33 (19.2) | $\chi^2(1) = 7.64$, $p = .006$ |

*Notes:* AUDIT = Alcohol Use Disorders Identification Test.

TABLE 3. Unadjusted and adjusted associations with prescription pain medication (PPM) misuse based on Poisson regression analysis

| Variable | Unadjusted | Adjusted | Expected values *M* [95% CI] |
|---|---|---|---|
| Age | -.017*** | -.018*** | Younger age (1q = 32): 4.3 [3.9, 4.7]<br>Older age (3q = 52): 3.1 [2.8, 3.5] |
| Current pain | .03 | .037* | Low pain (1q = 5): 3.5 [3.2, 3.8]<br>High pain (3q = 8): 3.9 [3.5, 4.4] |
| SF-12–Physical component score | -.004 | .245 | N.A. |
| Perceived efficacy of PPMs | .03* | .012* | Low efficacy (1q = 3): 3.2 [2.8, 3.7]<br>High efficacy (3q = 7): 3.8 [3.4, 4.1] |

*Notes:* All covariates based on Poisson regression. Unadjusted models included only the indicated covariate with the PPM misuse score in the regression model. Adjusted models included all covariates in the model. Expected values for the first quartile (1q) and third quartile (3q) of each variable were estimated with simulation procedures using the posterior distribution of the adjusted models, while holding all other model covariates at their mean. CI = confidence interval; N.A. = not applicable; SF-12 = Short Form-12 Health Survey (impact on functioning).
*$p < .05$; ***$p < .001$.

*Perceived efficacy and misuse of prescription pain medications*

PPM users provided perceived efficacy ratings related to pain for both cannabis and PPMs (1 = *not at all helpful,* 10 = *very helpful*). Among PPM users, cannabis was perceived to be more efficacious ($M = 7.57$, $SD = 1.95$) than PPMs ($M = 5.31$, $SD = 2.56$). This was a statistically significant difference based on a pairwise *t* test, $t(160) = 9.57$, $p < .0001$. The strength of the association between these ratings was modest ($r = .21$, $p = .008$). PPM users rated the efficacy of cannabis for pain slightly lower than individuals who were non–PPM users ($M$ [$SD$] = 7.56 [1.95] vs. 8.27 [1.58]), $t(236.7) = -3.22$, $p = .001$.

PPM users reported high levels of agreement (1 = *strongly agree,* 5 = *strongly disagree*) when asked whether they were trying to reduce use of PPMs for pain ($M = 2.1$, $SD = 1.75$). Similar levels of agreement were observed regarding efforts to reduce use of PPMs for nonmedical reasons ($M = 2.65$, $SD = 2.0$). These differences were statistically significant based on a pairwise *t* test, $t(80) = -3.49$, $p < .001$.

As previously described, a PPM misuse index was created by summing responses across a series of items derived from the COMM. In this study, the observed PPM misuse scores ranged from 0 to 18 ($M = 4.6$, $SD = 3.8$), with higher scores indicating higher levels of PPM misuse. Given the relatively small size of the PPM-user group, only a limited number of associations with other study variables were examined. Age was examined given that it exhibited significant associations with other variables in the exploratory analysis. Current pain rating, the SF-12–PCS, and perceived efficacy of PPMs were also selected given their conceptual relevance to PPM misuse.

The distribution of the PPM misuse score was consistent with the distribution of count-based measures; therefore, the associations were examined using Poisson regression analysis. Table 3 provides unadjusted and adjusted associations between each study variable and the PPM misuse. Age and perceived efficacy of PPMs were significantly associated with PPM misuse in both the unadjusted and adjusted models. Current pain was significant only in the adjusted model, and the SF-12–PCS was not significant in either model.

To facilitate the interpretation of the adjusted model, expected values were estimated with simulation procedures using the posterior distribution of the adjusted models. Expected values were estimated for the first and third quartile (i.e., 25th and 75th percentile rank) for each variable, while holding the other variables at their mean. These analyses showed that age exhibited the strongest effect with respect to PPM misuse. Younger adults (first quartile = 32 years of age) had an expected PPM misuse score of 4.3 (95% CI [3.9, 4.7]), whereas older adults (third quartile = 52 years of age) had an expected score of 3.1 (95% CI [2.8, 3.5]). Although current pain and perceived efficacy of PPMs were statistically significant, the effect sizes were not practically significant (Table 3).

## Discussion

The laws and policies surrounding medical cannabis have changed rapidly over the past 10 years, but the research on the characteristics and needs of persons who are seeking medical cannabis is limited. The purpose of this study was to provide descriptive data on the characteristics of persons who are seeking and using cannabis specifically for pain-related purposes. Pain as a presenting problem is commonly endorsed by adults seeking medical cannabis, and medical cannabis is often presented as a viable alternative (or adjunctive agent) to PPMs that have risks in terms of misuse and potential adverse outcomes (e.g., Berman et al., 2004; Johnson et al., 2010; Lucas, 2012; Naef et al., 2003; Rog et al., 2005). This study is the first to make systematic compari-

sons among medical cannabis users who use and do not use PPMs.

Among this sample of medical cannabis users, those who used PPMs tended to be older and exhibited slightly higher levels of pain and lower levels of physical functioning. However, no other differences with respect to sociodemographics and functioning were observed. One of the concerns of medical cannabis relates to the psychoactive properties of the substance and the possibility of it leading to more serious levels of drug involvement, particularly in the context of receiving PPMs. This is especially important because pain clinics face increasing pressures to monitor prescription opioids and other drugs (Manchikanti et al., 2008) and because the interaction between cannabinoids and PPMs is not well understood (Abrams et al., 2011). Although the overall sample exhibited higher lifetime and past-3-month rates of use of alcohol and other drugs than did the general population, no differences were observed between PPM users and nonusers in terms of rates of co-occurring substance use. These data provide preliminary results that use of PPMs among cannabis users might not be a reliable risk indicator for more serious forms of drug involvement. At the same time, this claim needs to be examined using a longitudinal research design.

It is important to highlight that approximately 40% of the overall sample reported combining cannabis with alcohol—no differences were observed among PPM users and nonusers. The interaction between cannabis and alcohol is not well understood and remains a crucial gap in the cannabis research.

Swartzwelder et al. (2012) provide preliminary evidence for the combined effects of these substances, with a significant age–drug interaction on working memory. Shillington and Clapp (2001) also examined the relation between college student alcohol and cannabis use. Polysubstance use—that is, combining alcohol and cannabis—was associated with more substance-related problems than alcohol-only use. However, most prior research was based on recreational users of alcohol and cannabis, and more work is needed to understand the co-use of these substances among adults who report medical cannabis use for pain management.

PPM users reported combining cannabis with other drugs at a significantly higher rate than non–PPM users. Because these data were based on a pilot study, our measurement was not granular enough to determine the types of drugs that were combined. Clearly, improved measures are needed, but nonetheless, very little research has been conducted to understand the combined use of cannabis and other substances. Despite the limitations in measurement and study design, these findings suggest a need to provide greater patient education regarding substance misuse when patients are seeking certification or recertification for medical cannabis. Such patient education can also be provided at cannabis dispensaries where certified cannabis users access this substance.

A number of general indicators of problems associated with PPMs were observed in this study. For example, PPM users rated the efficacy of cannabis for pain management higher than that of PPMs, which suggests that PPM users may have pain-related needs that are not being sufficiently addressed by their PPMs. PPM users provided high levels of agreement on questions related to efforts to reduce use of PPMs for pain and nonmedical reasons. Although this finding implies that the PPM users believe they are taking too many PPMs for both pain and nonpain purposes, more information is needed about their motivations. More specifically, additional research is necessary to understand the perspective of the individual user to better identify whether the efforts to reduce use are for purposes of safety (e.g., to avoid becoming dependent), side effects of the medication, or some other reason. This is an opportunity for qualitative research to better understand the user experience.

The majority of PPM users endorsed some form of PPM misuse—a finding that was consistent with the full sample of the parent study (see Ilgen et al., 2013). The high rates of PPM misuse in this sample highlight the extent to which these participants are at elevated risk for PPM-related problems such as the development of an opioid use disorder and/or other opioid-related adverse outcomes such as overdose, accidents, etc. As previously mentioned, the recent work of Bachhuber et al. (2014) showed that states with medical cannabis laws had a 24.8% lower mean annual opioid overdose mortality rate. This suggests that medical cannabis could be a safer alternative to PPMs, but further research is needed to illuminate the underlying causal relationships.

In this study, we used items adapted from the COMM as an index to identify factors associated with PPM misuse. Although a few variables were identified as significant in the multivariate model (i.e., younger age, lower physical functioning, higher perceived efficacy of PPMs), the simulation procedures suggest that these factors have minimal practical significance. One of the obvious limitations is that the constructed index needs further development to establish a stronger base of reliability and validity. Our selection criteria also relied on any past-month use of medical cannabis for chronic pain, but we were unable to quantify the actual amount. Moreover, the extent to which cannabis use represents medical or recreational use is unknown. Based on the state's certification laws, patients in this study were able to legally grow and possess cannabis and use it at their own discretion. No formal prescription exists to specify the specific indication, dose, or timing of use. Consequently, differentiating medical versus nonmedical use following certification is not possible. In all likelihood, significant variability exists both between and within participants in the degree to which each instance of use was motivated by factors related to medical or other nonmedical reasons.

Future research is needed to develop standardized measures of cannabis use, preferably measures that could be

used to triangulate self-reports. Recently, Phillips et al. (2014) provided evidence of the feasibility of using text messaging as an ecological momentary assessment method for measuring cannabis use among college students. Although they reported findings that suggested this is a promising direction, it is unclear whether samples of medical cannabis users recruited from community-based certification centers are regular users of this technology.

It is also important to note that this study uses data derived from a single medical marijuana certification center, and the majority of subjects were White. At present, no information is available regarding the number of certification centers, their locations, and the demographics of persons seeking certification or recertification. The absence of these data necessarily limits the generalizability of the current study and points to the need for more research related to medical cannabis certification.

Overall, this study provides much needed information to understand the population of medical cannabis users, particularly in the context of use of PPMs. The findings of this study need to be considered within the context of the study limitations, several of which have been identified previously in this discussion. Advancing this line of research necessarily requires improvements in both study design and measurement.

Regarding study design, a longitudinal approach is needed to better understand the trajectories of substance use among medical cannabis users (Ilgen et al., 2013), with ongoing comparisons among persons using and not using PPMs. The improvement of measurements also is essential for building this knowledge base—e.g., motivations and reasons for use of medical cannabis, perceived efficacy of cannabis and PPMs, and PPM misuse. This line of research should be considered a priority in the studies of alcohol and other drugs, given the rapidly changing landscape of medical cannabis laws and policies.

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