Contents lists available at ScienceDirect

Complementary Therapies in Medicine

journal homepage: www.elsevier.com/locate/ctim

Medical cannabis education among healthcare trainees: A scoping review

Yuval Zolotov [a], Samer Metri [b], Emily Calabria [b], Mikhail Kogan [b],*

[a] Regional Alcohol and Drug Abuse Research Center, Ben Gurion University of the Negev, Beer Sheva, Israel
[b] George Washington University, Washington, DC, USA

A B S T R A C T

Objectives: It has been previously demonstrated that healthcare professionals would like additional education on medical cannabis. However, there has not yet been a review of the status of medical cannabis curriculum for medical and allied healthcare trainees worldwide, even though future healthcare workers will be placed on the forefront of patient care and must be prepared to counsel patients. This study was designed to address this gap in knowledge.
Design: A search syntax was generated and databases PubMed, ERIC, CINAHL, and Web of Science were searched for relevant articles. A grey literature search of Google Scholar, MedEd, Medline, and the Proquest Dissertations and Theses section was also performed. All titles and abstracts were screened. Selected articles were subsequently screened using predetermined inclusion and exclusion criteria.
Results: Allied healthcare trainees lacked sufficient knowledge about medical cannabis and did not feel prepared to counsel patients on this subject. Additionally, they expressed a growing interest in medical cannabis and would like more standardized education on the topic. Finally, faculty and deans in various institutions agreed on the need to educate students on the subject, and aimed to implement courses on medical cannabis or expand their existing curricula.
Conclusions: While the medical cannabis landscape is developing, medical and allied health students are not properly educated and knowledgeable on this emerging field of clinical care. The findings suggest that the implementation of competencies-based curricula on medical cannabis is essential for medical and allied healthcare trainees to have the appropriate level of knowledge to counsel and educate their patients.

1. Introduction

The medicinal benefits of cannabis have been increasingly discussed within medicine over the past two decades.[1,2] There is a growing interest in this field and the depth of research being conducted on medical cannabis is broad, but without many concrete conclusions due to current policies, limited drug supply, and methodological limitations.[3] The limited number of double-blind clinical trials demonstrating the potential medicinal effects of cannabinoids calls for additional research questions to be explored.[4] Moreover, most studies are equivocal due to lack of standardization and quality control of the cannabis products examined.[5] Future research can be expected on the subject of medical cannabis, but how are physicians and healthcare trainees staying informed?

Previous studies have demonstrated a large gap between the public interest, current use of medical cannabis, and medical providers' ability to educate and counsel patients.[6] In other words, the use of cannabis was introduced to the field of medicine by patient inquiry rather than through extensive research.[7] Indeed, the majority of medical cannabis regulations in the United States and around the world have been implemented as a result of patient advocacy.[8] Even in some medical schools, such as the University of Vermont Larner College of Medicine, student interest drove the university to offer an elective, and furthermore integrate medical cannabis into the curriculum due to overwhelming interest.[9]

A systematic review of healthcare professionals' attitudes and knowledge on medical cannabis recently reported on a lack of self-perceived knowledge on medical cannabis across the fields of medicine, nursing, and pharmacy.[10] It further demonstrated a common desire for additional education and resources to access information about medical cannabis. In general, while several studies have shown that healthcare professionals support the use of medical cannabis in clinical practice, in particular for cancer and hospice patients, others have reported on more conservative positions.[10–13] Such a gap in attitudes and

---

```
┌─────────────────────────┐      ┌─────────────────────────┐
│ Records identified through│     │ Additional records identified│
│  database searching      │      │  through other sources   │
│      (n = 321)           │      │      (n = 91)            │
└─────────────────────────┘      └─────────────────────────┘
             │                              │
             ▼                              ▼
        ┌──────────────────────────────────────┐      ┌─────────────────────┐
        │  Records after duplicates removed     │─────▶│ Duplicates excluded │
        │            (n = 198)                  │      │      (n = 214)      │
        └──────────────────────────────────────┘      └─────────────────────┘
                          │
                          ▼
              ┌──────────────────────┐      ┌─────────────────────┐
              │   Records screened   │─────▶│  Records excluded   │
              │      (n = 198)       │      │      (n = 167)      │
              └──────────────────────┘      └─────────────────────┘
                          │
                          ▼
              ┌──────────────────────┐      ┌─────────────────────┐
              │ Full-text articles   │─────▶│ Full-text articles  │
              │ assessed for         │      │ excluded, with      │
              │ eligibility (n = 31) │      │ reasons (n = 8)     │
              └──────────────────────┘      └─────────────────────┘
                          │
                          ▼
              ┌──────────────────────┐
              │ Studies included in  │
              │ qualitative synthesis│
              │      (n = 23)        │
              └──────────────────────┘
```
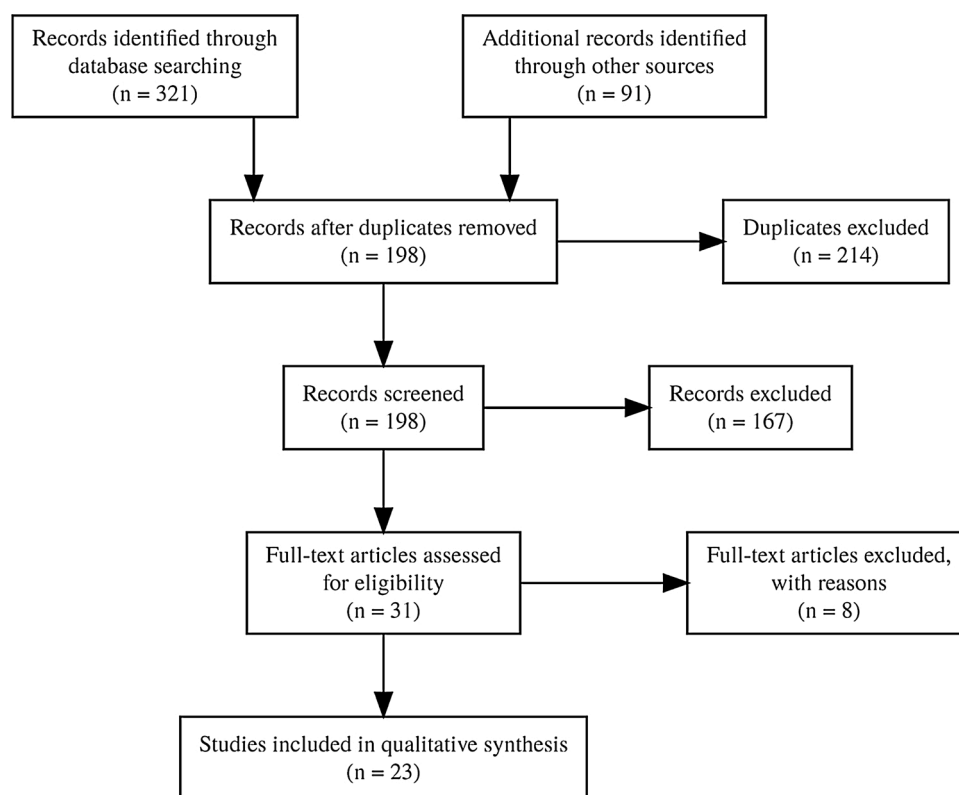
Fig. 1. PRISMA diagram.

knowledge among healthcare professionals on this topic illustrates the need for a standardized medical cannabis education during training.

The use of medical cannabis is supported by scientific evidence for only a few conditions, such as chronic pain and chemotherapy-induced nausea and vomiting.[14] In addition, two cannabis-based pharmaceuticals have regulatory approval in many countries, namely *Nabiximols* for spasticity of multiple sclerosis patients,[15] and *Epidiolex* for refractory seizures.[16] Nevertheless, the lack of quality research due to regulatory restrictions makes it difficult for healthcare professionals to address growing questions by the public.[17,18] For example, it is important for clinicians to have sufficient knowledge of the interaction between cannabis and the novel coronavirus, SARS-CoV-2 (COVID-19). It has been stated that smoking results in airway inflammation, putting COVID-19 patients at increased risk for severe complications, including cerebrovascular dysfunction.[19–21] While inhaled cannabis was included in the previous statement, other studies currently in progress are evaluating the potential use of cannabinoids (mainly CBD) as an adjunct to antiviral treatments for patients with COVID-19.[22–24] The COVID-19 pandemic emphasizes the lack of in-depth understanding of the effects of cannabis on the human body and its therapeutic effects. It is integral to bridge this gap in knowledge, which may be possible only with proper training and education of healthcare professionals.

Some countries and states that have legalized medical cannabis require general education for recommending providers; however, the standards vary significantly.[25] This often results in superficial counseling for patients.[6] Only a handful of states have established a requirement for licensed professionals to give medical advice. For example, Connecticut requires every dispensary to have a pharmacist on staff.[26] Part of the current gap between public demand and education provided by healthcare providers is in large due to major lack of education at all levels of healthcare.[27] For example, the 2017 National Academies of Sciences, Engineering, and Medicine (NASEM) Report concluded that medical cannabis is effective for the management of chronic pain in adults.[28] However, the recommendation of medical

cannabis to patients has not been widely adopted by physicians.[12,29–33] In order to create specific educational recommendations for schools, this gap of education and mixed beliefs within healthcare education needs to be bridged. Therefore, the aim of this study was to analyze the existing literature surrounding the education of medical cannabis in allied health professional training programs worldwide. Additionally, we report the beliefs and views of trainees and faculty surrounding medical cannabis as treatment, as well as the depth of understanding of the therapeutic benefits and potential risks of medical cannabis.

2. Methods

This scoping review on medical cannabis education among medical and allied healthcare trainees was based on online database searches for peer-reviewed publications in English. The research team generated a list of search terms relevant to this topic and modeled after previous studies' search syntax and keywords.[10,34] This list was then expanded to include other common terminology and synonyms so that they could be included in the search syntax [see supplementary materials]. These terms were used to generate a syntax for searching through PubMed, ERIC, CINAHL, and Web of Science. To expand the scope of this review, relevant "grey literature" was also searched to account for non-published academic material. Finally, the search included all references of the papers selected, as well as any other articles that referenced our selection. This consisted of searching Google Scholar, MedEd, Medline, and Dissertations and Theses section of Proquest using the same search terms. The literature search took place between June 10th, 2020 and July 1st, 2020.

The search resulted in a total of 412 articles, which were imported into Covidence for duplicate removals. Two hundred and fourteen duplicate articles were removed, resulting in 198 articles for title and abstract screening. These articles were reviewed independently by two members of the team, who discussed any conflicts that arose concerning their inclusion or exclusion. Of the 198 articles, 167 were deemed out of

Table 1
Summary of the studies included in the current analysis.

Article	Location	Sample Size	Healthcare Field	Summary of Findings	Notes
Balneaves & Alraja, 2019 [48]	Canada	N = 12; N = 8; N = 10	Nurse Practitioner	Most of nursing regulatory bodies had policy statements about medical cannabis. Medical cannabis was reported to be included in NP programs by 6 out of 10 program coordinators.	The study indicates a need for NP education programs to include standardized medical cannabis curriculum so that providers can give adequate patient care and counseling. Furthermore, the study highlights that there is an increased presence of NPs with authorization for medical cannabis prescription, but a lack of formal education.
Benavides et al., 2020 [49]	Washington DC, USA	N = 105	Medicine	The majority of medical students who responded to the survey reported that they did not receive any formal education about medical cannabis in their curriculum, that they have seen patients who asked about medical cannabis and that they felt unprepared to counsel them. Students generally agreed that there should be more formal education about the topic.	The survey indicated that medical students of all years lack the comfort and knowledge to counsel patients about medical cannabis but are willing and motivated to learn about the topic.
Berlekamp et al., 2019 [40]	Ohio, USA	N = 319	Pharmacy	Pharmacy students correctly responded to about half of medical cannabis knowledge questions. Students were not confident to counsel patients on dosing, side effects, and drug-drug interactions of medical cannabis and believed they did not receive much education on it.	Pharmacy students in Ohio are unprepared to counsel patients about medical cannabis use and want more education on this subject. It was inconclusive to what extent medical cannabis has been integrated into pharmacy school curriculum.
Caligiuri et al., 2018 [51]	Iowa, USA	N = 238	Pharmacy	While most students who responded could identify conditions where medical cannabis is not permitted for treatment, the majority of the students were less accurate at identifying the conditions that permitted its use. Furthermore, students indicated that they lacked confidence in counseling patients, and believed that the curriculum should focus more on medical cannabis.	Pharmacy students in Iowa indicated that they were not comfortable in their knowledge and ability to counsel patients about medical cannabis and want more formal education on the subject.
Chan et al., 2017 [52]	Colorado	N = 236	Medicine	Nearly half of the participants believe that medical cannabis can benefit physical health. The majority of students agreed that cannabis use could result in physical and/or mental harm and can be addictive. Most students believed that legal or criminal penalties for physicians recommending marijuana should be eliminated.	Students were hesitant to recommend medical cannabis to patients, which the authors speculate may be due to insufficient data about safety and/or lack of training and education.
Clark et al., 2020 [38]	Malta, Russia	N = 348	Psychology	The study found that students who reported a history of cannabis use were more likely to recommend medical cannabis as a treatment, believed in its health benefits, and were less concerned about potential risks. Additionally, secular students were more likely to recommend medical cannabis compared to religious students.	Students in both Malta and Russia reported a lack of formal education on medical cannabis.
Edelstein et al., 2020 [36]	Israel	N = 540	Medicine and Allied Health Professions	Religious students were found to have more negative attitudes about medical cannabis compared to secular students. They also were more likely to believe that cannabis use can result in serious physician and mental health risks. However, religious students showed regular or greater acceptance of the use of cannabis for certain medical conditions compared to secular students.	While religious students are less likely to use cannabis or support its legalization, they are equally likely to support it for certain medical conditions compared to secular students. Furthermore, both religious and secular students reported that they lack evidence-based knowledge about medical cannabis and that they are not prepared to counsel patients.
Elkrief et al., 2020 [55]	Canada	n = 235	Medicine	Students received low levels of cannabis education each year of medical school. Most students rated their knowledge on medical cannabis as moderate, and reported low levels of comfort with cannabis-related issues. Most students rated the school's curriculum and ability to prepare them to handle cannabis-related issues as low.	There is a lack of exposure and comfort among medical students for medical cannabis-related topics. Most students believed that didactic lectures were the most necessary form of teaching needed on medical cannabis. Low levels of exposure to medical cannabis may translate to low comfort levels among students.
Evanoff et al., 2017 [44]	USA	N = 101; N = 258*	Medicine	Most deans reported that their graduates are not prepared to prescribe medical cannabis. Almost half agreed that medical cannabis education should be included in the curriculum. The majority of residents and fellows reported receiving no education about medical cannabis in medical school or residency and believed it should be required.	There is little formal education for physicians-in-training on medical cannabis, and students are not prepared to counsel patients. There is a mismatch between legalization of medical cannabis and education gaps for physicians-in-training. Most deans agree that their graduates are not adequately prepared to counsel patients about medical cannabis.
Gritsenko et al., 2020 [37]	Russia	N = 463	Medicine	Overall, Russian Medical Students were not supportive of the use of medical cannabis. They also indicated that they lacked sufficient knowledge about medical cannabis.	
	South Africa	N = 541	Medicine		

Table 1 (*continued*)

Article	Location	Sample Size	Healthcare Field	Summary of Findings	Notes
Jain et al., 2018 [58]				Students were overall not knowledgeable of the medicinal uses of cannabis, including those who regularly use cannabis in their personal lives.	Medical cannabis was not legal in South Africa at the time of data collection.
Khamenka et al., 2019 [39]	Belarus	N = 460	Medicine	Belarusian students are less likely to recommend medical cannabis than foreign students. The majority of students believed that medical cannabis offers physical and mental health benefits, but also has potential risks and can be addictive. The majority reported a lack of formal education and clinical training, but almost half believe they're prepared to counsel patients.	Most students have positive attitudes towards medical cannabis use but have concerns about adverse effects. Most students believe more research needs to be done on this subject. Belarusian students were less likely to recommend medical cannabis, if it were to become legal, than foreign students.
Mazur et al., 2017 [60]	Poland	N = 132	Medicine, Psychology	The majority of students agreed that cannabis has medicinal properties and that it should be legalized for indicated uses.	The results are not separated by the types of students who responded.
Moeller et al., 2020 [35]	USA	N = 505	Pharmacy	Nationwide, pharmacy students were not very knowledgeable about medical cannabis adverse side effects. There was very little variation between schools in states with legal vs. illegal medical cannabis.	
Moeller & Woods, 2015 [62]	Kansas, USA	N = 311	Pharmacy	Students' knowledge about medical cannabis increased from first to third year. Students with a past history of medical cannabis use were more knowledgeable about the subject. However, the majority of students lacked sufficient knowledge about the indications of medical cannabis, as well as its adverse side effects.	Students are overall supportive of legalizing medical cannabis.
Paut Kusturica et al., 2019 [63]	Serbia	N = 316	Medicine	Students believed that they were knowledgeable about the approved indications of medical cannabis, and that cannabis should be a prescription-only drug. Students in their later years of schooling were able to recognize more indications and side effects compared to those who were just beginning their training. Students were mainly informed about the subject from extracurricular sources such as the media and workshops.	The survey highlighted that students have very little knowledge about the adverse reactions of medical cannabis. Furthermore, students believe that clear guidelines for cannabis use should be developed. Finally, the survey found that there was a strong positive self-reported correlation between self-use of cannabis and knowledge.
Pereira et al., 2020 [64]	Spain	N = 364	Nursing	Students did not know the indications for medical cannabis and wanted professors to include more information about it in lectures. Knowledge about indications was dependent on cannabis use history. There was an increase in general knowledge from year 1 to year 4 of training. Students lacked overall knowledge about side effects of medical cannabis. Students indicated that their knowledge comes from extracurriculars, not from lectures.	Students were not knowledgeable about the indications or side effects of medical cannabis. Students indicated they would want more information in their lectures. 3/4 of students agreed with legalization of medical cannabis in Spain.
Philip et al., 2017 [65]	NJ, USA	N = 51	Medicine	Overall, residents self-reported a poor level of competency regarding medical cannabis pharmacology. Internal Medicine residents reported that they were slightly more comfortable with the topic than other specialties, such as OB. There is a discrepancy in the knowledge about whether medical cannabis is an FDA approved drug, and a lack of knowledge about its category within the Controlled Substances Act.	There is poor knowledge about pharmacology of medical cannabis among resident physicians. There is grossly poor knowledge of what category medical cannabis falls under in the Controlled Substance Act.
Smithburger et al., 2019 [41]	USA	N = 68	Pharmacy	The majority of the schools that responded stated that their programs include lessons on medical cannabis in the first two years of school.	The study indicates that there is no standardized curriculum for medical cannabis across the United States. Although only less than 50 % of the schools responded to the survey, only 60 % of the respondents cover medical cannabis in their curriculum, and 23 % plan to include it within the next year.
St. Pierre et al., 2020 [67]	Canada	N = 76	Medicine	Students reported wanting about 6 hours of instruction on medical cannabis, but only received about 1.5 hours. There was a lack of knowledge in all domains of the study. Most of the medical cannabis discussion is reported to have been started by patients due to lack of knowledge of physicians.	Physicians-in-training were not comfortable discussing medical cannabis with patients due to lack of knowledge. Out of the 17 schools reached, one refused to participate, 9 did not respond despite multiple attempts, 3 required additional IRB, and only 4 schools participated.
Stojanović et al., 2017 [68]	Serbia	N = 80	Pharmacy	Most students believed medical cannabis has therapeutic effects, but only about half were familiar with potential therapeutic effects. More than half of students reported learning about therapeutic effects outside of school. Almost all respondents believed that dispensing medical cannabis in a pharmacy requires more education and knowledge by the pharmacist.	More education for pharmacy students about medical cannabis is necessary. Most students supported medical cannabis legalization, but about one-third thought that medical cannabis use could lead to abuse or cause addiction. Most students believed medical cannabis should require a prescription and should not be dispensed over-the-counter.

Table 1 (*continued*)

Article	Location	Sample Size	Healthcare Field	Summary of Findings	Notes
Tang et al., 2020 [42]	Canada	N = 10	Pharmacy	9/10 programs stated they included some content about medical cannabis. Most of the programs included medical cannabis as a small topic within a bigger lecture about other information. Many schools indicated that they are considering expanding their curriculum about medical cannabis in the near future.	Information on medical cannabis is brief, illustrated by the average teaching time of 4 hours in each school, lack of uniform curriculum, and many gaps in curriculum. Schools and school leaders want to expand on medical cannabis in the curriculum soon.
Vujcic et al., 2017 [70]	Serbia	N = 418	Medicine	Students were overall supportive of legalizing medical cannabis in Serbia. They also indicated that the majority of their existing knowledge about cannabis was obtained from extracurricular sources. While the students with prior use of cannabis were familiar with some of its side effects, the majority of students lacked knowledge about the indications and adverse side effects of cannabis.	Students indicated that their knowledge about medical cannabis was obtained from extracurricular sources, and that they wanted to learn more through formal education.

scope of this study and were excluded. The remaining 31 articles were then assessed with a full text review, and 8 publications were subsequently excluded. The exclusion criteria consisted of findings that were not based on an empirical study, examined populations outside the scope of this review, or studied substance use or misuse among students. The full text screening was done by multiple members of the research team independently, so that each study was examined by a minimum of three members. The data of the included studies were analyzed, extracted, and categorized by healthcare field, study design, study location, and important outcomes. The process of data search and extraction is presented in a PRISMA diagram in Fig. 1.

3. Results

A summary of the 23 studies that were included for the current analysis is presented in Table 1. The vast majority of studies assessed attitudes, beliefs, and knowledge about medical cannabis among trainees or faculty using a survey that included Likert scales to rate levels of agreement with various statements. In contrast, the 2020 study by Moeller et al. administered a quiz to pharmacy students to determine student knowledge about medical cannabis. The results demonstrated that most students do not feel knowledgeable and did not receive a passing score for adverse effects and approved indications.[35] Notably, four studies used the same instrument (in different languages),[36–39]

which was developed by the Regional Alcohol and Drug Abuse Research (RADAR) Center at Ben Gurion University of the Negev (Israel).

The search strategy resulted in data from ten countries: The United States, Canada, Serbia, Russia, Israel, Spain, South Africa, Malta, Belarus, and Poland. As shown in Table 2, which summarizes the distribution of studies by country and discipline, the largest number of studies (n = 9) took place in the United States where the legalization of medical cannabis varies by state. Furthermore, medical cannabis is not legal in all of the remaining countries examined. Twelve studies out of the 23 examined, in eight of the ten countries, focused on the field of medicine, and examined the education of medical cannabis in the medical school curriculum. Pharmacy was the second most common field of study making up seven out of the 23 studies and was examined in three countries. Finally, two studies examined the topic in the field of nursing, two articles focused on the field of psychology, and one study surveyed nurse practitioner programs.

In general, it was found that there was no structured curriculum or competencies on medical cannabis in most schools. Four studies revealed that students receive most of their education on medical cannabis from extracurriculars and sources outside of school. We also found that this aligns with the belief commonly expressed among students that they lack adequate education, mentorship, and guidance on this subject. In the studies assessed, students overwhelmingly reported that they do not feel knowledgeable or comfortable to counsel patients

Table 2
Country and discipline distribution of studies.

Country	Is medical cannabis legal?	# of Studies	General Beliefs and Findings	Fields studied
United States[40,41,46,49,62,44,52,51,65]	Legal in 33 states as of July 2020	9	Students had a favorable attitude towards the use of medical cannabis in their future careers. However, they indicated very limited structured educational resources, and therefore felt that they lacked the knowledge to counsel patients in the future.	Medicine, Pharmacy
Canada[42,48,55,67]	Yes	4	Students receive little formal education about medical cannabis and do not feel prepared to counsel patients. The need for expanded and standardized curriculum to increase student comfort on this subject was highlighted.	Medicine, Nurse Practitioner, Pharmacy,
Serbia[63,68,70]	No	3	Students want more education on medical cannabis and are generally supportive of legalization.	Medicine, Pharmacy
Russia[37,38]	No	2	Students were divided on their perception of the medicinal uses of cannabis, but uniformly reported a lack of education about the subject.	Psychology, Medicine
Israel[36]	Yes	1	Students reported a lack of knowledge about medical cannabis and felt unprepared to counsel patients about the topic.	Medicine & Allied Health Professions
Spain[64]	No	1	Students indicated that they lacked knowledge about medical cannabis and indicated that they would like courses that cover the topic.	Nursing
South Africa[58]	Yes, but not at the time the study was conducted	1	Students were not knowledgeable about medical cannabis.	Medicine
Malta[38]	Yes	1	Students reported a lack of formal education about medical cannabis.	Psychology
Belarus[39]	No	1	In general, students viewed medical cannabis positively, but with concerns about adverse effects. Students want more research to be done in this field.	Medicine
Poland[60]	Yes, but not at the time the study was conducted	1	Most students believed cannabis should be legal for certain medical indications and sold as a prescription drug.	Medicine, Psychology

on medical cannabis, mostly due to a lack of evidence-based knowledge. However, students' beliefs about the efficacy of medical cannabis varied depending on culture, religion, location, and prior personal use. For example, one study in Israel reported that religious students were more likely to have negative attitudes about medical cannabis.[36] In addition, a study in Malta and Russia found that secular students were more likely to recommend medical cannabis than religious students.[38] Students in several studies also cited prior personal use as a factor influencing knowledge, where it was determined that, in general, these students had more knowledge on this subject and were more likely to recommend medical cannabis to patients.

Faculty perspectives were also considered in five of the studies analyzed. Three of these studies focused on pharmacy curriculum, and in all three studies, the faculty described that medical cannabis was included in their curriculum. In a study based in Ohio, over half of the faculty surveyed from multiple states with legalized medical cannabis stated that medical cannabis was incorporated in the curriculum either as an elective or required course.[40] Another study from the same year concurred with these findings, reporting that over half of the respondents claimed that medical cannabis education is included in the first two years of school.[41] The third study from Canada described that medical cannabis is taught, but there is limited teaching time to about 4 h and there is no standardized curriculum.[42] The results of these studies also indicated that some schools are hoping to expand upon or include medical cannabis into their curriculum if not already present. The two additional studies including faculty focused on the fields of nurse practitioners and medicine, and there was agreement that trainees require more education on medical cannabis and are unprepared to counsel patients on this topic with the current education they are receiving.[43,44]

4. Discussion

Cannabis is recently emerging as a potential therapeutic agent in many places, and regulatory frameworks are accordingly evolving around the world. Therefore, the objective of this study was to identify and assess the current literature about medical cannabis education among trainees and faculty of health professions, and to examine their prominent beliefs and views related to their competency to integrate cannabis into their clinical work once graduated. Overall, trainees in all health disciplines reported on low levels of perceived knowledge on medical cannabis and lack of formal education on this topic. Correspondingly, they expressed feeling unprepared to counsel patients on appropriate use of medical cannabis. Studies that have surveyed curriculum/education deans at academic institutes affirmed the lack of structured and standardized education. These results disclose the large gap between the need of guidance on medical cannabis by patients and the professional capacity of healthcare providers to deliver such guidance.[17]

The beliefs reported by trainees align with those reported by certified healthcare professionals. Specifically, cannabis was perceived to potentially benefit certain conditions, but was additionally considered to cause physical or mental harms as an addictive substance. These views reflect the innate conundrum of cannabis, as being a potential therapeutic agent but also a substance of abuse.[45] Although cannabis has been used for medical purposes throughout history, only in recent years is it being reintroduced as an optional part of modern pharmacopeia. Nonetheless, the legal status of medical cannabis varies among states and countries, and the relevant legal frameworks differ considerably. However, major differences were not observed between studies conducted in places where medical cannabis is legal as opposed to where it is not (e.g., Serbia and Spain). Indeed, despite the fact that our scoping review revealed a limited amount of research done to assess attitudes and knowledge of medical and allied healthcare trainees about medical cannabis, there appears to be a uniform lack of education and desire to learn more about this field, regardless of its legal status.

Students are not merely educated in medical schools, but are also being indoctrinated to adhere to professional norms and conceptions. While the biomedical model of medicine is a dominant paradigm in healthcare, it, in fact, clashes with the integration of cannabis into the medical practice, similar to herbal medicines as well as to other complementary practices. Ostensibly, trainees' attitudes and perceived knowledge may be influenced from various factors, which are not necessarily related to the current state of scientific evidence. For example, one study pointed to religion as a factor which may influence perceptions about medical cannabis,[36] and another study suggested that personal experience may be associated with more perceived knowledge on medical cannabis.[46] Finally, a considerable amount of students reported getting their information about medical cannabis from non-scientific sources, and previous studies suggest that sources such as the online sources may have an impact on attitudes towards medical cannabis.[47] Inevitably, there is a tangible mismatch between the reported beliefs of trainees and the current evidence-base as outlined in the 2017 NASEM report.

Clearly, the lack of education on medical cannabis ought to be addressed. Currently, however, academic programs for health professions lack any structured and uniform curriculum, and previous research points to resistance among academic administrators to such additions to the core curriculum.[44] Moreover, the Accreditation Council for Graduate Medical Education (ACGME) or equivalent regulatory bodies worldwide offer no guidance for how to tackle the current educational gap. As a result, only sporadic institution-level efforts are being made to incorporate medical cannabis into the curriculum. For example, the Lerner College of Medicine in the University of Vermont has created an online course on medical cannabis, which has drawn more students than expected, but this is a non-credit course that is not integral to the medical education program.[9]

Furthermore, there is currently no standardized resource ('textbook') to facilitate proper evidence-based education on medical cannabis. Future studies should not only clarify specific knowledge gaps but suggest ways to address them. Given the scarcity of formal curricula within academic centers, establishing a set of ACGME-approved competencies appears to be a high priority that can aptly facilitate the development of medical cannabis education.

This scoping review is inherently restricted by the limitations of the studies which were included in our analysis. Indeed, poor and inconsistent methodologies have been applied in most of the studies reviewed, which have used cross-sectional designs to survey non-representative samples; moreover, sample sizes were not justified and consisted of low response rates. In addition, the instruments which were used are not validated or uniform, and such flaws clearly undermine the ability to adequately draw comparisons between the findings and form robust conclusions. Indeed, a validated and uniform instrument is warranted in order to facilitate the generation of reliable information. In this context, the instrument developed by the RADAR Center in Israel is noteworthy, as it has already been used in several studies worldwide.[36–39] An additional limitation is that we only searched for literature in English. However, we assume that studies around the world are generally published in peer-reviewed literature in English. Notwithstanding its limitations, this novel study sheds light on the current status of medical cannabis education, and it may serve to direct the developments of future studies and academic endeavors alike.

Since modern health care education is normally based on competencies, we suggest that a formal set of competencies related to medical cannabis should be established in order to guide the formation of curricular inclusion. This would dictate the scope of courses that are needed for providing adequate education, which may vary across healthcare disciplines. Although curricula are indeed horrendously overloaded, we argue that this should not serve as a reason for excluding medical cannabis from healthcare curricula. Academic education on medical cannabis may only be feasible with the support of governmental granting agencies, such as the NIH, in order to avoid potential biases and

conflicts of interest if such programs were to be sponsored by the industry.

In conclusion, while the medical cannabis landscape is developing, medical and allied health students are not properly educated and knowledgeable on this emerging field of clinical care. This appears to be common across disciplines and countries. Given the massive gap between public interest in medical cannabis and lack of qualified practitioners offering balanced guidance, it is essential that future providers are trained appropriately and enter the workforce well equipped with knowledge based on a set of approved medical cannabis competencies.

Declaration of Competing Interest

None.

Acknowledgements

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ctim.2021.102675.

References

1 Whiting PF, Wolff RF, Deshpande S, et al. Cannabinoids for medical use: A systematic review and meta-analysis. *JAMA*. 2015;313(24):2456–2473. https://doi.org/10.1001/jama.2015.6358.

2 Bostwick JM. Blurred boundaries: The therapeutics and politics of medical marijuana. *Mayo Clin Proc*. 2012;87(2):172–186. https://doi.org/10.1016/j.mayocp.2011.10.003.

3 Montero-Oleas N, Arevalo-Rodriguez I, Nuñez-González S, Viteri-García A, Simancas-Racines D. Therapeutic use of cannabis and cannabinoids: An evidence mapping and appraisal of systematic reviews. *BMC Complement Med Ther*. 2020;20. https://doi.org/10.1186/s12906-019-2803-2.

4 Kleckner AS, Kleckner IR, Kamen CS, et al. Opportunities for cannabis in supportive care in cancer. *Ther Adv Med Oncol*. 2019;11. https://doi.org/10.1177/1758835919866362.

5 Russo EB. Current therapeutic Cannabis controversies and clinical trial design issues. *Front Pharmacol*. 2016;7. https://doi.org/10.3389/fphar.2016.00309.

6 Ziemianski D, Capler R, Tekanoff R, Lacasse A, Luconi F, Ware MA. Cannabis in medicine: A national educational needs assessment among Canadian physicians. *BMC Med Educ*. 2015;15:52. https://doi.org/10.1186/s12909-015-0335-0.

7 Azcarate Pm, Zhang Aj, Keyhani S, Steigerwald S, Ishida Jh, Cohen Be. Medical reasons for marijuana use, forms of use, and patient perception of physician attitudes among the US population. *J Gen Intern Med*. 2020;35(7):1979–1986. https://doi.org/10.1007/s11606-020-05800-7.

8 Medical Marijuana Initiative Qualifies For November Ballot - NORML. Accessed July 23, 2020. https://norml.org/news/1996/06/06/medical-marijuana-initiative-qualifies-for-november-ballot.

9 Rubin R. Medical marijuana is legal in most states, but physicians have little evidence to guide them. *JAMA*. 2017;317(16):1611–1613. https://doi.org/10.1001/jama.2017.0813.

10 Gardiner KM, Singleton JA, Sheridan J, Kyle GJ, Nissen LM. Health professional beliefs, knowledge, and concerns surrounding medicinal cannabis - A systematic review. *PLoS One*. 2019;14(5). https://doi.org/10.1371/JOURNAL.PONE.0216556.

11 Costantino RC, Felten N, Todd M, Maxwell T, McPherson ML. A survey of hospice professionals regarding medical Cannabis practices. *J Palliat Med*. 2019. https://doi.org/10.1089/jpm.2018.0535. Published online May 16, 2019:jpm.2018.0535.

12 Braun IM, Wright A, Peteet J, et al. Medical oncologists' beliefs, practices, and knowledge regarding marijuana used therapeutically: A nationally representative survey study. *J Clin Oncol*. 2018;36(19):1957–1962. https://doi.org/10.1200/JCO.2017.76.1221.

13 Fitzcharles M-A, Ste-Marie PA, Clauw DJ, et al. Rheumatologists lack confidence in their knowledge of cannabinoids pertaining to the management of rheumatic complaints. *BMC Musculoskelet Disord*. 2014;15(1):258.

14 Abrams DI. The therapeutic effects of Cannabis and cannabinoids: An update from the National Academies of Sciences, Engineering and Medicine report. *Eur J Intern Med*. 2018;49:7–11. https://doi.org/10.1016/j.ejim.2018.01.003.

15 Keating GM. Delta-9-Tetrahydrocannabinol/Cannabidiol oromucosal spray (Sativex®): a review in multiple sclerosis-related spasticity. *Drugs*. 2017;77(5):563–574. https://doi.org/10.1007/s40265-017-0720-6.

16 Abu-Sawwa R, Scutt B, Park Y. Emerging use of epidiolex (Cannabidiol) in Epilepsy. *J Pediatr Pharmacol Ther*. 2020;25(6):485–499. https://doi.org/10.5863/1551-6776-25.6.485.

17 Kondrad EC, Reed AJ, Simpson MJ, Nease DE. Lack of communication about medical marijuana use between doctors and their patients. *J Am Board Fam Med*. 2018;31(5):805–808. https://doi.org/10.3122/jabfm.2018.05.170462.

18 Kiel C. *Why doctors know almost nothing about the health effects of marijuana*. Published November 2019. Accessed September 9, 2020. Association of American Medical Colleges; 2019. https://www.aamc.org/news-insights/why-doctors-know-almost-nothing-about-health-effects-marijuana.

19 Archie SR, Cucullo L. Cerebrovascular and Neurological Dysfunction under the Threat of COVID-19: Is There a Comorbid Role for Smoking and Vaping? *Int J Mol Sci*. 2020;21(11). https://doi.org/10.3390/ijms21113916.

20 Abuse NI on D. *COVID-19: Potential implications for individuals with substance use disorders*. National Institute on Drug Abuse; 2020. Published April 6, 2020. Accessed July 17, 2020 https://www.drugabuse.gov/about-nida/noras-blog/2020/04/covid-19-potential-implications-individuals-substance-use-disorders.

21 CNN SL. *Smoking weed and coronavirus: Even occasional use raises risk of Covid-19 complications*. Accessed July 17. CNN; 2020. https://www.cnn.com/2020/04/10/health/smoking-weed-coronavirus-wellness/index.html.

22 Byrareddy SN, Mohan M. SARS-CoV2 induced respiratory distress: Can cannabinoids be added to anti-viral therapies to reduce lung inflammation? *Brain Behav Immun*. 2020;87:120–121. https://doi.org/10.1016/j.bbi.2020.04.079.

23 Wang B, Kovalchuk A, Li D, Ilnytskyy Y, Kovalchuk I, Kovalchuk O. *In search of preventative strategies: Novel anti-inflammatory High-CBD Cannabis sativa extracts modulate ACE2 expression in COVID-19 gateway tissues*. 2020. https://doi.org/10.20944/preprints202004.0315.v1. Published online April 19, 2020.

24 Hill KP. Cannabinoids and the coronavirus. *Cannabis Cannabinoid Res*. 2020;5(2):118–120. https://doi.org/10.1089/can.2020.0035.

25 Sideris A, Khan F, Boltunova A, Cuff G, Gharibo C, Doan LV. New York physicians' perspectives and knowledge of the state medical marijuana program. *Cannabis Cannabinoid Res*. 2018;3(1):74–84. https://doi.org/10.1089/can.2017.0046.

26 Bonner L. In Connecticut, medical cannabis must be dispensed by pharmacists. *Pharm Today*. 2015;21(6):58–59. https://doi.org/10.1016/S1042-0991(15)30304-2.

27 Carlini BH, Garrett SB, Carter GT. Medicinal Cannabis: A survey among health care providers in Washington State. *Am J Hosp Palliat Care*. 2017;34(1):85–91. https://doi.org/10.1177/1049909115604669.

28 Committee on the Health Effects of Marijuana, National Academies of Sciences, Engineering, and Medicine. The Health Effects of Cannabis and Cannabinoids: The Current State of Evidence and Recommendations for Research. National Academies Press; 2017. Accessed January 24, 2017. https://www.nap.edu/catalog/24625.

29 Luba R, Earleywine M, Farmer S, Slavin M. Cannabis in end-of-Life care: Examining attitudes and practices of palliative care providers. *J Psychoactive Drugs*. 2018;50(4):348–354. https://doi.org/10.1080/02791072.2018.1462543.

30 Kondrad E, Reid A. Colorado family physicians' attitudes toward medical marijuana. *J Am Board Fam Med*. 2013;26(1):52–60. https://doi.org/10.3122/jabfm.2013.01.120089.

31 Karanges EA, Suraev A, Elias N, Manocha R, McGregor IS. Knowledge and attitudes of Australian general practitioners towards medicinal cannabis: A cross-sectional survey. *BMJ Open*. 2018;8(7):e022101. https://doi.org/10.1136/bmjopen-2018-022101.

32 Oldfield K, Braithwaite I, Beasley R, Eathorne A, Newton-Howes G, Semprini A. Medical cannabis: Knowledge and expectations in a cohort of North Island New Zealand general practitioners. *N Z Med J*. 2020;133(1508):12–28.

33 St-Amant H, Ware MA, Julien N, Lacasse A. Prevalence and determinants of cannabinoid prescription for the management of chronic noncancer pain: A postal survey of physicians in the Abitibi-Temiscamingue region of Quebec. *CMAJ Open*. 2015;3(2):E251–E257. https://doi.org/10.9778/cmajo.20140095.

34 Brooks E, Gundersen DC, Flynn E, Brooks-Russell A, Bull S. The clinical implications of legalizing marijuana: Are physician and non-physician providers prepared? *Addict Behav*. 2017;72:1–7. https://doi.org/10.1016/j.addbeh.2017.03.007.

35 Moeller KE, McGuire JM, Melton BL. A nationwide survey of pharmacy students' knowledge and perceptions regarding medical cannabis. *J Am Pharm Assoc*. 2020;60(1):218–224. https://doi.org/10.1016/j.japh.2019.08.008. e3.

36 Edelstein OE, Wacht O, Grinstein-Cohen O, Reznik A, Pruginin I, Isralowitz R. Does religiosity matter? University student attitudes and beliefs toward medical cannabis. *Complement Ther Med*. 2020;51. https://doi.org/10.1016/j.ctim.2020.102407.

37 Gritsenko V, Konstantinov V, Reznik A, Isralowitz R. Russian Federation medical student knowledge, attitudes and beliefs toward medical cannabis. *Complement Ther Med*. 2020;48, 102274. https://doi.org/10.1016/j.ctim.2019.102274.

38 Clark M, Gritsenko V, Bonnici JS, Marinova T, Reznik A, Isralowitz R. Psychology student attitudes and beliefs toward Cannabis for mental health purposes: A cross national comparison. *Int J Ment Health Addict*. 2020. https://doi.org/10.1007/s11469-020-00280-6. Published online 2020.

39 Khamenka N, Skuhareuski A, Reznik A, Isralowitz R. Medical Cannabis pain benefit, risk and effectiveness perceptions among belarus medical students. *Int J Ment Health Addict*. 2019. https://doi.org/10.1007/s11469-019-00152-8. ublished online 2019.

40 Berlekamp D, Rao PSS, Patton T, Berner J. Surveys of pharmacy students and pharmacy educators regarding medical marijuana. *Curr Pharm Teach Learn*. 2019;11(7):669–677. https://doi.org/10.1016/j.cptl.2019.03.006.

41 Smithburger PL, Zemaitis MA, Meyer SM. Evaluation of medical marijuana topics in the PharmD curriculum: A national survey of schools and colleges of pharmacy. *Curr Pharm Teach Learn*. 2019;11(1):1–9. https://doi.org/10.1016/j.cptl.2018.09.022.

42 Tang G, Schwarz J, Lok K, Wilbur K. Cannabis content in Canadian undergraduate pharmacy programs: A national survey. *Can Pharm J*. 2020;153(1):27–31. https://doi.org/10.1177/1715163519890629.

43 Balneaves LG, Alraja AA. "Guarding their practice": A descriptive study of Canadian nursing policies and education related to medical cannabis. *BMC Nurs.* 2019;18(1):66. https://doi.org/10.1186/s12912-019-0390-7.

44 Evanoff AB, Quan T, Dufault C, Awad M, Bierut LJ. Physicians-in-training are not prepared to prescribe medical marijuana. *Drug Alcohol Depend.* 2017;180:151–155. https://doi.org/10.1016/j.drugalcdep.2017.08.010.

45 Zolotov Y, Vulfsons S, Zarhin D, Sznitman S. Medical cannabis: An oxymoron? Physicians' perceptions of medical cannabis. *Int J Drug Policy.* 2018;57:4–10. https://doi.org/10.1016/j.drugpo.2018.03.025.

46 Moeller KE, Woods B. Pharmacy students' knowledge and attitudes regarding medical marijuana. *Am J Pharm Educ.* 2015;79(6). Accessed October 8, 2015 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4584377/.

47 Lewis N, Sznitman SR. Engagement with medical cannabis information from online and mass media sources: Is it related to medical cannabis attitudes and support for legalization? *Int J Drug Policy.* 2019, S0955395919300131. https://doi.org/10.1016/j.drugpo.2019.01.005. Published online February 2019.

48 Balneaves LG, Alraja AA. "Guarding their practice": A descriptive study of Canadian nursing policies and education related to medical cannabis. *BMC Nurs.* 2019;18(1):66. https://doi.org/10.1186/s12912-019-0390-7.

49 Benavides A, Gregorio N, Gupta P, Kogan M. Medical students are unprepared to counsel patients about medical cannabis and want to learn more. *Complement Ther Med.* 2020;48, 102237. https://doi.org/10.1016/j.ctim.2019.102237.

51 Caligiuri FJ, Ulrich EE, Welter KJ. Pharmacy student knowledge, confidence and attitudes toward medical Cannabis and curricular coverage. *Am J Pharm Educ.* 2018;82(5):6296. https://doi.org/10.5688/ajpe6296.

52 Chan MH, Knoepke CE, Cole ML, McKinnon J, Matlock DD. Colorado medical students' attitudes and beliefs about marijuana. *J Gen Intern Med.* 2017;32(4):458–463. https://doi.org/10.1007/s11606-016-3957-y.

55 Elkrief L, Belliveau J, D'Ignazio T, Simard P, Jutras-Aswad D. Assessing the current state of medical education on cannabis in Canada: Preliminary findings from Quebec. *Paediatr Child Health.* 2020;25(Supplement_1):S29–S33. https://doi.org/10.1093/pch/pxaa015.

58 Jain R, Chang CC, Koto MA, Geldenhuys AN, Nichol RJ, Joubert G. Cannabis use and knowledge among medical students at the University of the Free State, Bloemfontein, South Africa. *J Child Adolesc Ment Health.* 2018;30(1):19–26. https://doi.org/10.2989/17280583.2018.1438291.

60 Mazur R, Masternak S, Pająk M, Parszewska K, Skórzyńska-Dziduszko K. Polish students' opinion about medicinal Cannabis. *Taiikugaku Kenkyu.* 2017;7(9):233–242. https://doi.org/10.5281/ZENODO.894710.

62 Moeller KE, McGuire JM, Melton BL. A nationwide survey of pharmacy students' knowledge and perceptions regarding medical cannabis. *J Am Pharm Assoc.* 2020;60(1):218–224. https://doi.org/10.1016/j.japh.2019.08.008. e3.

63 Paut Kusturica M, Tomas A, Sabo A, Tomić Z, Horvat O. Medical cannabis: Knowledge and attitudes of prospective doctors in Serbia. *J Saudi Pharm Soc.* 2019;27(3):320–325. https://doi.org/10.1016/j.jsps.2018.11.014.

64 Pereira L, Núñez-Iglesias MJ, Domínguez-Martís EM, López-Ares D, González-Peteiro M, Novío S. Nursing students' knowledge and attitudes regarding medical marijuana: A descriptive cross-sectional study. *Int J Environ Res Public Health.* 2020;17(7). https://doi.org/10.3390/ijerph17072492.

65 Philip NA, Cardinale M, Yegneswaran B. Knowledge and Perception of Medical Cannabis Among Physicians in Training: Are We Prepared? *CHEST.* 2017;152(4):A577. https://doi.org/10.1016/j.chest.2017.08.607.

67 St. Pierre M, Matthews L, Walsh Z. Cannabis education needs assessment among Canadian physicians-in-training. *Complement Ther Med.* 2020;49. https://doi.org/10.1016/j.ctim.2020.102328.

68 Stojanović MS, Tomas AD, Paut-Kusturica MM, et al. Pharmacy students' knowledge and attitudes regarding Cannabis for medical purposes a. *Hosp Pharmacol - Int Multidiscip J.* 2017;4(3):559–567. https://doi.org/10.5937/hpimj1703559S.

70 Vujcic I, Pavlovic A, Dubljanin E, Maksimovic J, Nikolic A, Sipetic-Grujicic S. Attitudes toward medical Cannabis legalization among serbian medical students. *Subst Use Misuse.* 2017;52(9):1225–1231. https://doi.org/10.1080/10826084.2017.1302959.