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Prescribing Competence of Canadian Medical Graduates: National Survey of Medical School Leaders

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Abstract: Suboptimal knowledge of clinical pharmacology, therapeutics, and toxicology (CPT) and poor-quality prescribing are threats to patient safety. Our previous national survey of medical faculty identified limited confidence in medical student graduates' ability to safely prescribe, as well as an interest in a national prescribing competence assessment. Given the in-person challenges posed by the restrictions related to the COVID-19 pandemic, we aimed to re-evaluate opinions and gauge the interest in e-learning resources and assessments. Using public sources, a sampling frame of medical school leaders from all 17 Canadian medical schools, including deans, vice-deans, and program directors for clerkship, residency, and e-learning, were invited to participate in a cross-sectional survey. Survey questions were finalized after several rounds of testing, and analyses were descriptive. Of 1448 invitations, 411 (28.4%) individuals reviewed the survey, and, among them, 278 (67.6%) completed at least one survey question, with representation from all schools. While more than 90% of respondents agreed that medical students should meet a minimum standard of prescribing competence, only 17 (7.9%) could vouch for their school meeting objectives in CPT, and many had significant concerns about their own or other schools' recent graduate prescribing abilities. Given the lack of local CPT e-curricula resources, there was strong interest in a national online course and assessment in CPT. Our national survey results suggest an ongoing inadequacy of medical trainees' prescribing competence, and also provide a strong endorsement for both a national online CPT course and assessment during medical school.

Keywords: prescribing competency; medical education; survey; Canada; medication safety

1. Introduction

The discipline of clinical pharmacology, therapeutics, and toxicology (CPT) covers basic human pharmacology, therapeutics, toxicology, drug regulation knowledge, as well as prescribing and therapeutic monitoring skills [1]. Physicians must be competent in CPT, no matter their specialty, as prescribing is the most common act of treatment in

medicine. A lack of competence correlates with medication errors, patient harm, and medicolegal risk [2–4]. There is well-documented evidence that knowledge and the appropriate prescribing of medication reduces patient mortality and disability and improves the cost-effectiveness and sustainability of the healthcare system [5]. Our group has previously demonstrated that fewer than half of final-year medical students in Ontario, Canada passed early versions of the Canadian Prescribing Safety Assessment, and medical schools both across the country and internationally struggle to ensure prescribing competence [6–9]. Ideally, CPT knowledge and prescribing skill objectives are longitudinally integrated into medical education, beginning in early medical school and continuing through post-graduate training and ongoing professional development. By the time of graduation, medical students should be able to safely prescribe and monitor commonly used medications on the relevant Essential Medications list and maintain a strong learning plan through training and their career to increase their scope of expertise [10]. However, medical school curricula are increasingly crowded as medical knowledge and public expectations of health care expand. Our previous survey of medical school leaders across Canada found a lack of confidence in many graduating medical students' prescribing competence and identified great interest among faculty for the creation of a standardized CPT curriculum and assessment prior to licensing exams [11].

Currently, CPT-related e-curricula resources and online assessments hold appeal since there are very few CPT faculty, there is a lack of reliable open-access CPT e-resources available, and because the pandemic has demonstrated the value of quality online medical education resources [6,12,13]. The most well-established English-language e-curricula products for CPT at present are the Australian National Prescribing Curriculum and the British Pharmacology Society's e-Curriculum (the latter restricted to Britain at present) [14–16]. While these resources may be useful for teaching the general principles of CPT, such as safe prescribing, establishing a drug history, or calculating appropriate dosing, these resources may be limited in their usefulness when describing specific therapeutics or toxicology for learners not based in those countries due to potential regional differences. For example, medications used to treat or self-treat conditions may vary depending on differences in the disease burden, both regulated and unregulated medical supplies, approval from governmental health regulatory agencies, and the availability of public funding [17–19]. In addition, the need for high quality online CPT resources that addressed country-specific priorities was amplified during the COVID-19 pandemic due to the restrictions placed on in-person educational opportunities for students. During the pandemic, medical education was disrupted, with many institutions moving to online modes of delivering education and replacing clinical placements with simulations or role-playing [20]. Many medical schools reported being able to navigate these challenges and created online learning environments that trainees approved of with minimal impacts to their learning, providing evidence that a CPT e-curriculum may be feasible for the pandemic and beyond [20–23].

In 2021, the Medical Council of Canada (MCC) added specific Prescribing Practices objectives, which highlighted the expectations that medical schools teach safe prescribing and monitoring skills [24]. The combination of explicit directives in CPT for medical schools, the deficiency of any national clinical pharmacology knowledge and prescribing skills textbook, and the added strain of the COVID-19 pandemic and its aftermath on medical education have all created an urgent need to address medical students' prescribing competence, especially considering the aging Canadian population, where patients are presenting with more comorbidities and with increasingly complex health concerns.

The objective of the present study was to survey all faculty who held medical education positions at Canadian medical schools regarding their views on the current prescribing competency of undergraduate medical trainees, changes in education since COVID-19, their school's use of CPT e-curricula, and their interest in a national CPT curriculum and assessment.

2. Methods

2.1. Settings, Participants, and Ethical Considerations

This study was a cross-sectional survey administered from August to November 2022 in English via LimeSurvey, an open-source, online survey platform [25]. Survey distribution and data collection were conducted electronically. The LimeSurvey platform was chosen due to its data security, ease of use for researchers, and availability of technological support [25].

Using publicly available sources, researchers gathered contact information for all educational leaders at Canada's 17 medical schools; specifically leaders in the following roles: deans, vice-deans, or assistant deans involved in medical education and program directors for clerkship, residency, or e-learning. Residency in Canada means post-graduate medical education where trainees transition to their disciplines—family medicine, internal medicine, surgery, etc., and their prescriptions do not need to be co-signed by their attendings. Clerkship in Canada is the final year or two of undergraduate medical school training where the student is almost full time in clinical rotations, and their prescriptions must be co-signed by a qualified physician supervisor. Participant names, emails, and roles were gathered from websites, faculty lists, institutional directories, and administration personnel for Dalhousie University, McGill University, McMaster University, Memorial University of Newfoundland, the Northern Ontario School of Medicine, Queen's University, the University of Alberta, the University of British Columbia, the University of Calgary, the University of Manitoba, the University of Ottawa, the University of Saskatchewan, the University of Toronto, Western University, l'Université Laval, l'Université de Montréal, and l'Université de Sherbrooke. For representativeness, the final invitee number at each individual medical school was weighted by class size following consultation with a health science statistician. All survey participants were anonymized via the automated assignment of a unique token ID that was sent via an email invitation and allowed only a single complete response per participant. The survey was sent to participants on 9 August 2022 and stayed open for exactly 14 weeks until 15 November 2022. Reminders were sent out weekly to biweekly, and these were restricted to participants who were non-responders or had incomplete/unsubmitted surveys. Each non-responder received at least seven reminders to complete the survey.

This project was reviewed and approved by the Hamilton Integrated Research Ethics Board (HiREB) prior to commencement of the study (HiREB #13806). To maintain confidentiality, survey responses were anonymized via token IDs and stored securely on the LimeSurvey platform.

2.2. Survey Overview

Survey questions were designed in consultation with the senior author, a clinical pharmacologist and internal medicine specialist who has extensive experience and expertise in the field of CPT and medical education, in order to gather information related to the following themes:

Perceptions of the prescribing competence of local medical students and incoming early junior residents and the ability of their school to meet MCC Prescribing Practices objectives.

- The impact of the COVID-19 pandemic on clinical placements and rotations, and its educational impact on the prescribing competence of medical trainees.
- e-Learning resources used for the Clinical Pharmacology and Prescribing Competence curriculum.
- Current knowledge of non-Canadian CPT e-Curriculum resources.
- Interest in a CPT e-curriculum and online prescribing skills e-assessment.

Questions were reviewed and refined among investigators and volunteers for clarity, based on four rounds of survey pre-testing. The survey was designed to be short and succinct in order to maximize participation, with a planned maximum of ten minutes

completion time. We asked nine content questions centered around the following content domains: (1) opinion on the importance of standardized CPT training in Canada, (2) perception of prescribing skills among their own medical students and incoming junior residents, (3) opinion on the importance of a CPT e-curriculum in Canada, and (4) opinion on the impact of COVID-19 on CPT education among medical students. The development of the content questions was guided, in part, by the questionnaire from a previous survey study conducted before the COVID-19 pandemic. [10] The present survey also includes five demographic questions that collected information regarding the participants' age, gender, role, institutional affiliation, and number of years on medical faculty. Seven out of nine content questions used a five-point Likert-rating scale to ensure that a nuanced perspective could be gathered [26]. The first nine survey questions could not be bypassed without a response, but included a "prefer not to answer" option, while the demographic questions were not mandatory for participants to complete. The analysis of the survey results was descriptive, and the Equator Network's Consensus-Based Checklist for Reporting of Survey Studies (CROSS) was used to guide survey development [27].

3. Results

A total of 1448 survey invitations were sent by email with 411 (28.4%) faculty receiving and reviewing the email invitation. Out of the 411 who interacted with the email-based survey invitation, at least one survey response was submitted by 278 (67.6%) participants, with 206 (50.1%) completing the entire survey, including all demographic questions. The survey was closed 4 months after release. The mean total time spent completing the survey was 5.6 (SD 12.4) minutes.

Faculty representation from all 17 Canadian medical schools was present. Most respondents were between 40–49 years of age, and 97 (46.4%) identified as female. A detailed breakdown of participant characteristics is found in Table 1. There were 109 (52.7%) residency program directors, 25 (12.1%) clerkship directors, and 18 (8.7%) in a deanery role (dean/vice dean/assistant dean of medicine or undergraduate medical education). The remaining 55 (26.6%) respondents were a mix of e-Learning directors, did not disclose their specific role, or listed their role as "other". The most common "other" roles were reported as previous program directors, current clinical preceptors, associate program directors, or clinical professors. A detailed summary of respondent characteristics is shown in Table 1.

Table 1. Participant characteristics.

Age, n (%)	
20–29	0 (0.0)
30–39	38 (18.2)
40–49	88 (42.1)
50–59	54 (25.8)
>60	16 (7.7)
Prefer not to answer	13 (6.2)
Gender, n (%)	
Female	97 (46.4)
Male	96 (45.9)
Prefer not to disclose	14 (6.7)
Other	2 (1)
Role, n (%)	
Residency program director	109 (52.7)
Clerkship director	25 (12.1)
Assistant/vice/dean of medicine or undergraduate medicine	18 (8.7)
e-Learning directors or leads	2 (1.0)
Prefer not to answer	15 (7.2)
Other	38 (18.6)

Table 1. Cont.

University affiliation, n (%)	
Dalhousie University	17 (8.2)
McGill University	12 (5.8)
McMaster University	21 (10.1)
Memorial University of Newfoundland	8 (3.9)
Northern Ontario School of Medicine	5 (2.4)
Queen’s University	9 (4.3)
University of Alberta	16 (7.7)
University of British Columbia	10 (4.8)
University of Calgary	11 (5.3)
University of Manitoba	4 (1.9)
University of Ottawa	15 (7.2)
University of Saskatchewan	15 (7.2)
University of Toronto	17 (8.2)
University of Western Ontario	13 (6.3)
Université Laval	9 (4.3)
Université de Montréal	15 (8.2)
Université de Sherbrooke	6 (2.9)
Prefer not to answer	4 (1.9)

Detailed responses to each survey question are shown in Table 2.

Table 2. Participant Responses.

Study Consent and Preamble						
Q1. Study preamble and consent to participate (n = 278).	Proceed to survey 258 (92.8%)					No 20 (7.2%)
Main survey content questions						
Q1. It is important for graduating medical students in Canada to meet a common threshold of prescribing competence by the end of their undergraduate training. (n = 252)	Strongly Agree 185 (73.4%)	Somewhat Agree 47 (18.7%)	Neutral 7 (2.8%)	Somewhat Disagree 0 (0.0%)	Strongly Disagree 13 (5.2%)	
Q2. Thinking of all of the medical students who graduated from your school over the past 3 years, please rate their average knowledge of clinical pharmacology, therapeutics, and toxicology, and their prescribing skills at the time of graduation. (n = 238)	Excellent 3 (1.3%)	Good 60 (25.2%)	Satisfactory 129 (54.2%)	Poor 44 (18.5%)	Very Poor 2 (0.8%)	
Q3. Thinking of the early postgraduate Year 1 residents you have encountered in the past 3 years (who could be graduates of other medical schools), what proportion required close supervision for safe prescribing? (n = 225)	<10% 37 (16.4%)	10–33% 61 (27.1%)	34–50% 49 (21.8%)	>50% 68 (30.2%)	None 10 (4.4%)	
Q4. How well does your medical school’s current curriculum meet the Medical Council of Canada’s new Objectives on Prescribing Practice? Specifically, how many of these MCC objectives are met at an acceptable standard? (n = 217)	None 0 (0.0%)	A few 9 (4.1%)	Approximately half 30 (13.8%)	Most objectives 54 (24.9%)	All objectives 17 (7.9%)	Do not know 107 (49.3%)

Table 2. Cont.

Study Consent and Preamble					
Q5. COVID-19 removed many clinical placements and rotations for medical students, with attempts to substitute online learning equivalents. How did this change influence the prescribing competence of your final year medical students? (<i>n</i> = 214)	Strongly Positive 0 (0.0%)	Positive Change 5 (2.3%)	Neutral 131 (61.2%)	Negative change 68 (31.8%)	Strongly Negative 10 (4.7%)
Q6. Does your medical school use specific e-learning resources to teach Clinical Pharmacology and Toxicology? (<i>n</i> = 214)	Yes 16 (7.5%)		No 26 (12.2%)	Do not Know 172 (80.4%)	
Q7. There is currently no national Canadian Clinical Pharmacology knowledge or Prescribing Skills curricula or eLearning resource. Our systematic review found the most relevant to be Australia's National Prescribing Curriculum and the British Pharmacology Society's e-Curriculum (the latter is restricted to UK at present). Multiple options can be selected.	Familiar with the Australian NPC and would recommend it <i>n</i> = 4	Familiar with the Australian NPC but would not recommend it <i>n</i> = 1	Familiar with the BPS eCurriculum and would recommend it <i>n</i> = 7	Familiar with the BPS eCurriculum but would not recommend it <i>n</i> = 3	Not familiar with either resource <i>n</i> = 199
Q8. A Canadian online prescribing skills competence assessment (e.g., mix of multiple-choice questions, prescription writing scenarios, and virtual OSCE stations) would improve the clinical performance of graduating medical students in Canada. (<i>n</i> = 209)	Strongly Agree 63 (30.1%)	Somewhat Agree 106 (50.7%)	Neutral 29 (13.9%)	Somewhat Disagree 7 (3.3%)	Strongly Disagree 4 (1.9%)
Q9. A Canadian online course which included the main learning priorities for clinical pharmacology, therapeutics, toxicology, and prescribing skills for medical students would offer a significant improvement in education for your school's medical students. (<i>n</i> = 209)	Strongly Agree 62 (29.7%)	Somewhat Agree 97 (46.4%)	Neutral 34 (16.3%)	Somewhat Disagree 11 (5.3%)	Strongly Disagree 5 (2.4%)

A total of 232 (92.1%) respondents agreed or strongly agreed that it is important for graduating medical students in Canada to meet a common threshold of prescribing competence by the end of their undergraduate training. When asked to think about medical students who graduated from their own school in the past 3 years, 46 respondents (19.3%) rated their students' CPT knowledge and prescribing skills as less than satisfactory. Additionally, 117 respondents (52.0%) specified that close supervision of prescribing was needed for more than one-third of their first-year residents, trainees who could have graduated from any medical school.

Regarding whether their medical school curriculum meets the MCC objectives on Prescribing Practices, approximately half of the respondents (49.3%) were unsure, with an additional 39 (17.3%) respondents reporting that fewer than half of the MCC objectives were currently met at their institution. Only 17 (7.9%) faculty were fully confident that all MCC objectives were met in their school's curriculum. Most respondents (61.2%) thought that the COVID-19 pandemic had a neutral effect on the prescribing competence of final year students, but 78 (36.4%) reported that COVID-19 had a negative effect on student prescribing skills.

Few participants (17, 7.5%) were aware of the specific e-learning resources used to teach CPT at their school. Only 10 (4.8%) respondents, were familiar with either the Australian National Prescribing Curriculum or the British Pharmacological Society e-Curriculum resources. Those familiar with these resources viewed them as trusted sources as they displayed a resemblance to Canadian medical standards or because they were aware of the involvement of Canadian CPT leaders who supported the resource. For those not recommending either resource, reasons included a lack of time in the current curriculum and concerns related to the use of externally developed curricula.

Lastly, 169 (80.9%) respondents agreed or strongly agreed with the idea that a national online prescribing skills competence assessment would improve the clinical performance of graduating medical students in Canada, and 159 respondents (76.1%) believed that an online course including the main learning priorities for clinical pharmacology, therapeutics, and prescribing skills for medical students would significantly improve students' medical education.

4. Discussion

The present survey points to a common perception among medical school leadership that medical students in Canada are not learning sufficient CPT knowledge and do not have adequate prescribing skills at graduation. We found that approximately one-third of respondents believe that the alterations in medical teaching and learning related to the pandemic have adversely affected students' prescribing competence. Despite a relatively new emphasis on CPT knowledge and skills brought about by specific learning objectives mandated by the national medical school curriculum regulator (MCC), only a very small number of faculty could positively vouch that their school met all of the MCC objectives. Our findings are similar to investigations regarding CPT knowledge among medical students internationally. For example, a systematic review conducted in 2018 evaluating studies of prescribing competence among final year medical students internationally found a general lack of knowledge and skills, as well as a lack of confidence in their ability to prescribe safely [9]. In the 2019 Preparedness for Internship survey conducted by the Australian Medical Council and Medical Board of Australia, they noted that prescribing "remains a relatively low rated clinical skill in terms of perceived preparedness." [28]. Our survey also reconfirms and expands perceptions from our 2015 survey that Canadian medical education leaders believe a common national threshold of competence in CPT knowledge and prescribing skills is important [11]. However, results also confirm that schools need support in CPT curriculum development as there is no national resource [11]. This impression was present pre-COVID-19 but has increased post-pandemic. For example, the proportion of faculty who specified the close supervision of prescribing was needed for more than 33% of their first-year residents increased from 44.8% in the 2015 survey to 52.0% presently [11]. However, it is unclear why faculty felt a greater proportion of trainees currently required supervision, although it is likely because students had fewer in-person opportunities for clinical experiences and prescribing during the pandemic.

The perceived lack of medical trainee prescribing competence is likely related to a lack of teaching and assessment in CPT, as well as a lack of experience in prescribing and monitoring medications during undergraduate medical education [8,29,30]. The knowledge requirements for CPT are arguably the most daunting of all medical specialties, given the thousands of prescription medications, over-the-counter drugs, unregulated substances, and drugs of abuse that physicians must know about in order to serve the population [31]. At the same time, as CPT clinical content and expertise requirements expand, the medical school curriculum attention paid to CPT is declining due to the very small number of CPT specialists available to advocate for this fundamental training in the face of competing, arguably less crucial, content [32,33]. It is likely that CPT education can be delivered effectively by non-CPT experts as long as explicit objectives, relevant resources, and high-quality educational activities and assessments are provided.

The COVID-19 pandemic impacted many aspects of medical training that had traditionally been carried out in person; however, this adjustment may have had somewhat of a 'silver lining' in that it accelerated the interest in and the comfort when using e-curricula and online assessment methods [34,35]. This transition has proved particularly useful as widespread shortages of physicians who can provide direct patient care make the provision of extensive faculty presence for educational events difficult to manage.

Strengths and Limitations

Strengths of the study include the wide representation of respondents, particularly residency program directors who are well-placed to comment on graduating students' knowledge and skills. All medical schools in the country are represented in this survey, improving the generalizability of the results nationally. Moreover, the survey topic and results remain completely novel in North America in terms of their exploration of CPT education and prescribing skills amongst medical students in the modern era, where they are so critical to provider competence and patient safety [11,36,37]. As such, these results add an important dimension to the ongoing international concern about the lack of training in CPT knowledge and prescribing skills [18]. However, this study also has limitations. Our survey may have had imperfect role representation, as there is no curated list of medical school leaders. Obtaining the list that we used required many weeks to complete. We are also unable to ascertain whether the difference between surveys sent versus opened was due to emails never reaching their intended respondent, since the LimeSurvey platform did not identify the number of emails that may have bounced. The survey response rate was relatively low as is common with surveys of active physicians, despite multiple targeted reminders. This may have led to some response bias. Additionally, our survey results, by definition, are self-reported opinions, resulting in a description-based analysis which lacks external validation. Lastly, we also recognized that in our attempt to send out the invitation as broadly as we did, some recipients would assume that other members of their faculty would be in a more suitable position to respond knowledgeably. We attempted to mitigate these limitations by ensuring our large list of participants was representative of educational leaders and decision makers, was proportional to the size of the program, and prioritized survey security and privacy with the use of the LimeSurvey platform.

5. Conclusions

Our national survey highlights ongoing concerns of medical school faculty about the prescribing competency of graduating medical students and junior residents in Canada, with resultant interest in a national CPT e-curriculum and assessment process.

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Institutional Review Board Statement: This project was reviewed and approved by the Hamilton Integrated Research Ethics Board (HiREB) prior to commencement of the study (HiREB #13806).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be available upon reasonable request.

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