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ORIGINAL ARTICLE

Integration of an evidence-based caries management approach in dental education: The perspectives of dental instructors

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Abstract

Purpose/objectives: Evidence-based caries management (EBCM) has developed into an internationally recognized tool for integration of comprehensive non-surgical caries treatment in dental education. However, uptake of the EBCM approach remains uneven across Canadian dental schools. Our project sought to understand how dental instructors perceive the challenges and solutions to the integration of the EBCM approach in undergraduate clinical education.

Methods: Using a qualitative descriptive design, we recruited a purposeful sample of clinical instructors supervising undergraduate dental students in caries-related dental care. Semi-structured, online interviews focused on the main characteristics of EBCM. Interviews were analyzed using the awareness, desire, knowledge, ability, and reinforcement (ADKAR) change management model to understand challenges with EBCM implementation in undergraduate education. The analysis process started with verbatim transcription; then, transcripts were coded deductively based on the interview guide and the ADKAR model domains, and inductively to generate emergent codes. Finally, thematic analysis was used to develop themes and subthemes.

Results: We interviewed 11 dental instructors with a wide range of clinical experience. Our results show that participants had sufficient awareness regarding the need for the EBCM approach and portrayed a strong desire to participate in bringing curricular changes. Knowledge and ability of participants depended on their training, experience, and involvement in continuing education courses. A lack of standardized caries management practices, less chairside time, and poor remuneration for instructors were major barriers in EBCM clinical implementation. Potential solutions suggested included providing continuing education courses, credits for students for non-surgical caries management, and remunerating instructors for implementation.

Sangeeth Pillai and Kimia Rohani contributed equally to this manuscript.

Conclusions: In conclusion, most participants were aware of the need for a substantive change toward EBCM and demonstrated the desire to participate and improve its implementation. Our analysis showed that to facilitate full integration of the EBCM approach into the undergraduate dental clinics, organizational focus needs to be placed on the individual's knowledge and ability, with tailored efforts toward reinforcement.

KEYWORDS
ADKAR, dental caries, EBD, evidence-based caries management, implementation, qualitative study

1 | INTRODUCTION

The conventional caries management approach, focusing on a surgical-only treatment strategy, emerged more than a century ago and was commonly supported until the 1990s.[1,2] Since then, the accumulation and synthesis of evidence in the field of cariology has accompanied a change in our understanding of the etiology and pathogenesis of the caries disease process. This new evidence has led to a paradigm shift from a surgical-only to a preventive approach to caries management. This new paradigm was named the minimum intervention philosophy, or the evidence-based caries management (EBCM) approach.[3,4] EBCM supports risk-adjusted, patient-centered management of caries disease, aims to prevent initiation and control the progression of caries through mostly non-surgical treatment; surgical interventions are applied as a last treatment option and should be minimally invasive. This approach will ultimately preserve the tooth structure, minimize surgical treatment, and maintain oral health.[4,5]

Much effort has been made in dental education and clinical practice to shift surgical management to the more conservative EBCM approach. Nevertheless, the current EBCM guidelines are still not well established in dental clinical practice globally.[6] A recent systematic review showed that dentists worldwide overuse invasive approaches for treatment of carious lesions. As a result, these lesions are being introduced into the restorative cycle unnecessarily or too early, causing harm and financial burden to patients.[7] This review highlights the need for more efficient and effective approaches to bring EBCM into dental education and clinical practice.

Undergraduate cariology education plays an essential role in establishing a foundation for future dentists' caries management practices.[8,9] In a recent survey documenting cariology education in Canadian dental schools, we identified that although current cariology concepts are being integrated into teaching curricular across Canada, there is still resistance toward the actual integration of core cariology concepts into clinical education and training.[10] Following the survey, in 2020, we initiated a 2-day inter-institutional symposium, which brought together cariology educators from all 10 Canadian dental schools to discuss aspects of cariology education and to develop a consensus regarding the core cariology curriculum that should be integrated across the dental schools in Canada.[11] Furthermore, this symposium synthesized discussions on the challenges and potential solutions regarding the implementation of the cariology curriculum. This also equipped us with knowledge and provided directions on how the outcomes discussed in the symposium can be achieved.

Recent studies indicate that dental instructors are vital stakeholders in implementing a shift toward EBCM in undergraduate dental education.[11,12] Soliciting their perspectives is essential for understanding the main challenges and possible solutions for integrating EBCM in each dental institution. To date, most research concerning the implementation of EBCM in undergraduate dental education has been based on descriptive surveys focusing on specific aspects of this approach, such as communication of caries preventive strategies[13] and risk-based caries assessment.[14–17] When dental instructors have been involved as stakeholders in research, the literature has mostly focused on assessing their knowledge and attitudes regarding EBCM.[18–20] Studies suggest that practitioners experience a lack of knowledge of EBCM,[18,19] face time limitations for its implementation, deal with resistance from other practitioners, and have challenges in transitioning their current practice models.[20,21] To our knowledge, there remains limited evidence on dental instructors' perceptions on the overall implementation of EBCM in dental education. Furthermore, there is a lack of evidence on how clinical instructors experience the complex changes in the cariology curriculum. To address this gap, we designed a qualitative study to explore dental instructors' experiences with, and perceptions of, challenges and solutions to implementing EBCM in undergraduate dental education in a large Canadian city.

2 | METHODOLOGY AND METHODS

We used a qualitative descriptive study design[22] to answer the following research question: How do dental instructors perceive the challenges and solutions to the integration of the EBCM approach in the undergraduate dental clinic? We used the awareness, desire, knowledge, ability, and reinforcement (ADKAR) change management model as an analytic framework to increase the robustness of our study design; the acronym provides the five outcomes that need to be achieved for a successful change management process: ADKAR.[23] ADKAR is an outcome-oriented model based on the best change management practices.[23] It provides a framework to identify resistance points in individuals in the process of organizational change when integrating a new approach or innovation.[23] Our team includes researchers and graduate trainees with expertise in cariology, general dentistry, dental education, and qualitative research.

2.1 | Population and sample frame

The study was conducted in an undergraduate dental clinic in an urban Canadian university. We recruited a purposeful sample[24] of clinical dental instructors supervising dental students in caries-related dental care for adults at an undergraduate dental clinic, with inclusion criteria and sampling variables including: (1) experience teaching caries management; that is, instructors who self-reported that they had experience with such teaching; (2) level of instruction; that is, teaching third- or fourth-year dental students in a clinical context; and (3) location of instruction, thereby allowing comparison within the data (e.g., university multidisciplinary clinic teaching, outreach teaching, oral diagnosis clinic teaching).

Recruitment was done via an email sent by the clinic's director. All eligible instructors ($n = 33$) were included in recruitment invitation emails. Interested instructors ($n = 11$) contacted the study team directly and all were formally recruited for an interview.

2.2 | Study procedure, methods, and instruments

Our main method of data generation was online interviews with participants using a semi-structured interview guide (Appendix 1) focused on participants' experiences and perceptions regarding EBCM and its implementation in undergraduate dental education. The interviews were facilitated by two trained research assistants (RAs; S.P. and K.R.); they ranged from 50 to 60 min. The interview guide was built based on EBCM,[25,26] including: (1) understanding the EBCM approach; (2) caries lesion diagnosis; (3) caries risk assessment; (4) non-surgical treatment of caries; (5) surgical treatment of caries; and (6) follow-up and monitoring of caries risk status. For each domain, we addressed participants' perceptions and experiences regarding facilitating factors, challenges, and practical solutions related to the implementation of EBCM. In addition, we sought participants' perceptions about working collectively as a team to implement and sustain changes. The interview questions were updated based on ongoing iterative analysis of completed interviews, incorporating new topics that could enrich the data.

2.3 | Data analysis

The interviews were transcribed verbatim by two research trainees and then verified by the RAs who conducted the interviews (S.P. and K.R.). Analysis was concurrent with data generation. By the 11th interview, we determined, via team deliberation and consensus, that the data had reached informational sufficiency and that we had met our study objectives and so recruitment was closed.

For the analysis, we started by creating a code book using the deductive domains from the interview guide (EBCM) and the ADKAR model (Appendix 2). The deductive codes included the topics and subtopics covered in the interview guide, which included the major components of the EBCM approach (mentioned above). The interview transcripts were then coded by the RAs following an adapted version of SAMMSA (Summary and Analysis coding, Micro themes, Meso themes, Syntheses, and Analysis) qualitative analysis[27] as follows: a summary code was assigned to each data unit (e.g., sentence or completed thought); they were either deductive (based upon the code book) or inductive (emergent from the text). Following, analysis codes were used to group similar summary codes and reflect on their meaning vis-à-vis the research question and objectives. After the first three transcripts were analyzed, senior team members (S.T. and M.E.M.) reviewed the coding and updated the codebook to include the inductive codes. Any new inductive codes that were generated in the proceeding analysis were added to the code book iteratively. After coding was completed, all codes were manually extracted from the interviews, copied into a new text file, and then reviewed to build themes and subthemes (Table 1). Regular team meetings were held to discuss data interpretation and to refine final thematic categories and interpretation.

TABLE 1 Coding tree.

Domains	Themes	Subthemes
Awareness	Problem	Standardization
	Challenges/barriers	Lack of guidance
		Chairside time
		Ethical dilemma
Desire	To participate	Follow EBCM in private practice
	To learn	Show and tell
	To teach	Collaboration
Knowledge	How to change/solutions	Credits (for students)
		Remuneration (for instructors)
	EBCM/components/approach	Lack of staff
		Additional lectures
		Components of EBCM
Ability	Organizational	Confidence to implement
	Individual	Educating patients
		Guidance by probing
		Physical presence (one on one)
Reinforcement	Of EBCM	Up-to-date education (instructors)
	Sustain change	Repeated exposure (students)

Abbreviation: EBCM, evidence-based caries management.

2.4 | Ethics

This study was approved by the Institutional Review Board (IRB) of McGill University (IRB study number: A10-B82-20A/20-10-034). All participants were informed about the purpose of the study and signed a consent form prior to the start of the interviews. Participation was voluntary; participants were not compensated for their participation.

3 | RESULTS

We interviewed 11 clinical instructors, including six men and five women with a mean age of 48 years and a mean clinical experience of 21.5 years. The sample demographics are provided in Table 2.

TABLE 2 Demographic characteristics of interviewed participants.

	Number of participants
Age (years)	
30–39	4
40–49	2
50–59	2
60–70	3
Gender	
Men	6
Women	5
Role in clinic	
Clinical instructors	11
Additional roles	2
Private practice status	
Group practice	8
Individual	1
Retired	2
Clinical experience (years)	
6–7	2
11–15	3
18	1
29–30	3
36–42	2

3.1 | Awareness of a need to change from conventional caries management to EBCM

In the ADKAR model, "awareness" is the first step toward change management, defined as the awareness among the individuals of the need for change. Our participants well understood the need for a change, with most conveying that there is a problem with the current caries management approach. The biggest roadblock to implementing the change mentioned above was the lack of

standardization and calibration among instructors. The extent of problems with calibration was summarized by one participant, as follows:

> "I am sure you've heard [a patient say]: 'I saw Dr. A who said I got 14 decays, and Dr. B who said I have 5, and Dr. C said 8.' So, who's right? They're probably all right. It is the way they diagnose? Is it the old fashion [traditional surgical]? Is it the new fashion [EBCM]? Are you an aggressive dentist or not? Do you think it will be good to treat the decay non-surgically or surgically? Do you want to make money over people or not? See, there's a lot of factors that are not easy to explain and to accept. For us and for the patient also."

In this quotation, we also see the issue of financial conflict of interest; we will return to this below.

Participants also raised concerns about the lack of time to properly implement EBCM. For example, the contemporary caries management approach requires more chairside time for detailed clinical examination combined with assessment of patient caries risk and more follow-ups than conventional surgical intervention. Senior participants even suggested that they need help with introducing the EBCM approach to their colleagues. One participant stressed that implementing changes would require overhauling the whole curriculum:

> "I just want to say one thing, we have to change our curriculum completely to be able to teach everything in a proper way to our students."

3.2 | Desire to be part of the EBCM change in the clinic

In our interviews, participants' desire manifested as their willingness to participate in change by either learning about or teaching and implementing EBCM concepts. Most participants showed strong willingness to support the necessary changes. Many stated they were willing to attend lectures and workshops to enhance their current knowledge and brought forward creative ways to improve the implementation of EBCM in clinics. Those participants who had previously received training on EBCM spoke of their ongoing active participation, such as how they were implementing the approach in their group private practice and teaching the students in the clinics using a "show and tell" approach. One participant operationalized their desire for change as follows:

> "Even in my private practice, there is quite a difference in how we diagnose and treat caries between clinicians. And so, I tried to standardize between everybody at the practice and tried to present the evidence at that point and you know, it wasn't really that well received. I think that everyone didn't really feel comfortable with it. But I guess I changed to be as close to the evidence as I could be, and you know, the evidence isn't 100% clear all the time, but it helped me a lot to be confident I was making the right decisions."

3.3 | Knowledge about EBCM and about how to make curricular changes

The third building block of ADKAR is the knowledge of (1) how to change and (2) how to support the change.[23] As mentioned above, our participants were at least minimally aware of the content knowledge of EBCM. However, only a few had received extensive training. One participant with advanced knowledge described their understanding of the approach as follows:

> "So, first is understanding: why the patient got the cavities in the first place. And then determining for each specific person: Is it the juice? Is it the sugar in the chai? What is it in their habits that creates the problem and to understand if it's something punctual; if it's just COVID snacking or if it's long term. So, the caries assessment, the conversation that we have with patient is part of the non-surgical treatment for me because that targets the sugar habit."

To improve instructors' baseline knowledge, almost every participant suggested additional continuing education courses and short lectures to keep instructors up to date on evidence-based approaches. This intervention was seen as particularly important given the range of experiences in their current workforce, as described by this junior participant:

> "The other thing is that we should also educate the supervisors. Educate us as teachers in the clinic because, it's not a matter of my opinion versus other person's opinion, it's what I've learned as a student. Because I'm a new graduate, so this approach (EBCM) was already in effect. Like when I was a student, I've been told about this theory, you know,

caries management protocol. And some other dentists have graduated so many years ago, and some of them, they still have the old school of managing dental cavities."

Regarding knowledge of how to implement EBCM, the most common suggestion was to provide credits to students for applying EBCM in the clinics. For example, one participant said:

> "So, one thing they can implement is to dedicate one clinical time for that purpose (non-surgical caries management) and give student credit for the educational part (of EBCM). So, if they provide credit for that and it becomes a requirement, then implementation is much easier, and students are then willing to learn more about it because it gives them the credit. Right now, it's not part of our curriculum, it doesn't have any credit for the students and there is no clinical time and there is no real example."

Some participants focused on the lack of practical knowledge translation from preclinics to clinics to help students learn EBCM effectively. Another suggestion was to focus on improving teacher-to-student ratios, and improving remuneration and perks for instructors who already fulfilled the awareness and desire components; this could motivate them to take on leadership roles in advancing EBCM.

3.4 | Ability to make the change happen

The fourth component of ADKAR, ability, is the stage where the change actually happens; that is, when one can implement the knowledge, they are acquired through training and education.[23] Our data revealed that, among participants, a few demonstrated the ability to bring changes to caries management both at the individual level and at the students' dental clinic.

Participants who had already acquired knowledge about EBCM showed how they were already implementing it to bring actual change at the students' level. Strategies included using "show and tell" approaches, and guided discussions, as evident in the following quotation:

> "We don't have too many students. So, in our clinic it's possible to have in depth conversations, and like 'show and tell,' [and] lengthy analysis of caries."

A few instructors also showcased their ability to implement the approach in the student clinic:

> "I don't exaggerate but I think I'm kind of confident that I really know what I'm doing. So, I try to also listen to the students. Once we have the case in front of us, I start to talk, and I ask the student questions and then their answers help us to get to a final decision."

Instructors who also held additional positions, such as clinic directors or specialty dentists, spoke about how they were willing to implement EBCM at an organizational level. Yet, they were also aware of the challenges with such implementation, as revealed by the following participant:

> "I'm doing the calibration for our instructors soon with the help of the caries management group. But even finding a time and putting all the instructors at the same time in one place for them to practice and to be aware, it's very hard."

3.5 | Reinforcing the change to EBCM

The final building block in the ADKAR change management model is reinforcement, focusing on sustaining the change that has already happened.[23] Our participants demonstrated several instances of how specific changes were being sustained, both by themselves as instructors and by newly trained students. Furthermore, some mentioned that routine mandatory training should be implemented to ensure that the EBCM approach stays cemented in their clinics. For example, one participant said:

> "Something, like a pdf, could be sent to supervisors to refresh their memory on how to manage clinical cases based on EBCM."

Several participants, especially those who possessed advanced knowledge on EBCM, reflected on reinforcing this approach among the students by probing and guiding them during the caries diagnosis process:

> "When they see black fissures, they might say this needs a restoration or it's catchy or sticky because they might be poking at it. But then, when you push them to say, like, 'Look, don't poke at it, what are you doing with that? Look at this, tell me what you see.' I think they go back to their evidence-based approach, and they get the right answer most of the time."

This approach was felt to reinforce the new concepts with the students. Some participants also suggested that the students and instructors should be trained via case presentations and radiographs to give them a real-life perspective of what happens when the EBCM approach is implemented.

3.6 | Contextualizing EBCM in dentists' values and experiences

In addition to the deductive ADKAR themes above, we generated three inductive elements from our data that help to contextualize how the ADKAR framework can be maximally effective for EBCM: (1) ethical tensions, (2) experience, and (3) motivation.

3.6.1 | Ethical tensions

Although some standardized protocols and guidelines exist in EBCM practice, the specifics within the treatment plan will necessarily depend on the decisions made by the practitioner in charge. These decisions will be based upon their own training, their treatment philosophies, and the constraints and affordances of their work environments. In the undergraduate teaching clinic where this study was based, patients are admitted for care only if they have several cavitated caries lesions; that is, priority is given to patients who can provide ample "hands on" training for the students. Importantly, this care is fee-for-service; that is, patients pay for treatment from insurance or their own pockets. Clearly, in dental education, learning how to restore teeth is of primordial importance; furthermore, fee-for-service care provides the financial assistance to maintain the educational environment by keeping the clinic running.

The clinician can thus be caught in an ethical dilemma: treating caries with a preventative, non-surgical approach brings in less revenue for the operational budget. This tension surfaced in many interviews, while participants clearly sided with the need to advance the best evidence-based care for patients, they were still mindful of the pressures—on both instructors and students—to maximize revenues.

3.6.2 | Experience

An important variable we found in our data was how the participants' years of clinical experience inversely related to experience with EBCM. Our participants ranged from having less than 10 to more than 40 years of experience. Importantly, those more recently graduated showed higher level of knowledge of EBCM compared to the senior participants. It is important to reflect on how experience and success can act as a barrier for paradigm shifts such as is required by EBCM.

3.6.3 | Motivation

Finally, in our conversations with participants we found a bridging factor that seems to lie between the awareness and desire components of ADKAR: the "motivation" to abide by the change practices. While our participants had awareness of EBCM and exhibited a desire to participate in the change (e.g., by leaning, by teaching), participants also expressed how motivation plays a major role in inculcating and sustaining desire. Although the clinicians actively showed their readiness to participate in the change by teaching students and by investing time to implement the EBCM approach, they were concerned that without tangible "perks" (e.g., acknowledgment, training opportunities), instructors would lose motivation to maintain high-quality education.

Finally, we have distilled our results into "readiness factors" required for implementing EBCM in undergraduate dental education (see Figure 1). Furthermore, Table 3 outlines the major barriers and solutions to implementation.

4 | DISCUSSION

The EBCM approach is a major paradigm shift from the conventional surgical caries management approach. To gain a first-hand knowledge of how clinical instructors perceive their own understanding regarding this shift, we used the ADKAR change management model. The ADKAR change model is built upon the notion that organizational change occurs only when individuals change.[23] Utilizing this model, we were able to identify the main domains that require focus among our clinical instructors to appropriately and feasibly integrate the EBCM approach in undergraduate dental education. To facilitate the full change process, our results suggest that focus needs to be placed on the final three components of ADKAR: knowledge, ability, and reinforcement.

The awareness factor is seen to be crucial to understand the level of preparedness in individuals before they can be evaluated on the subsequent ADKAR model domains.[23] In 2020, we conducted a symposium to bring a consensus among Canadian cariology educators regarding the core cariology curriculum to successfully implement EBCM in undergraduate training.[11] Then, the participants showed strong awareness regarding the ongoing paradigm in caries

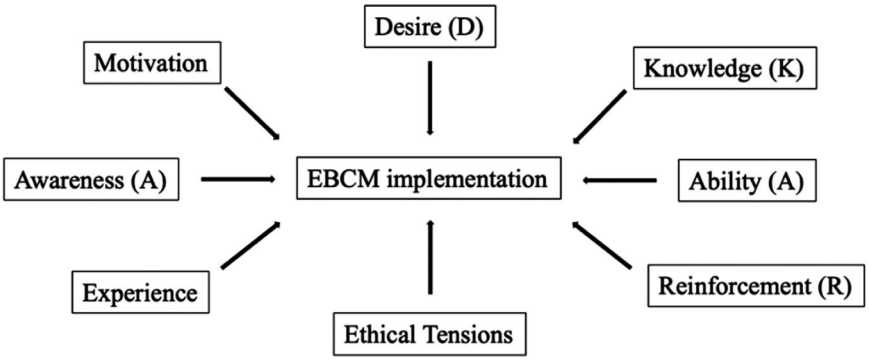

FIGURE 1 Readiness factors influencing the implementation of evidence-based caries management (EBCM) in undergraduate dental education.

TABLE 3 Barriers and solutions to supporting the implementation of evidence-based caries management (EBCM) in undergraduate dental education.

Barriers perceived	Plausible causes	Consequences	Suggested solutions
• Unstandardized approaches among instructors	• Lack of continuing education courses • Experience-based approaches • Resistance to change among senior dentists	• Patients experience confusion regarding treatment options • Students experience confusion regarding treatment options • The patient receives inadequate care; is under- or over-treated; this adversely affect their oral health	• Continuing education courses on a regular basis • Educational tools (e.g., PDF to refresh instructors and students' memory on EBCM concepts)
• Lack of incentives among students	• Students do not gain degree credits for providing non-surgical treatments (credit- based education) • Students are required to gain certain "technical" skills in a relatively short period of time to obtain their degrees	• Students are motivated to perform surgical treatments and gains "hard skills" and "degree credits" to graduate on time and enter the job market	• Emphasis on non- surgical treatments in the curriculum • Providing credits for non-surgical treatments
• Lack of incentives among instructors	• Instructors feel underpaid • Instructors who practice EBCM are not acknowledged for their innovative care approach	• Dental schools find it challenging to hire motivated clinical instructors	• Higher salaries for clinical instructors • Purposely seek instructors with EBCM training
• Dental education has both time and financial constraints.	*Time constraints*: Implementation of EBCM is time consuming Students' dental clinics are understaffed *Financial constraints*: Dental schools cannot charge patients for non-surgical treatments • A large proportion of a dentist's salary comes from surgical treatment of caries • Government insurance is not covering non- surgical treatments	• Lack of enriching discussion over clinical cases, which prevents students from deeply learning EBCM approaches • Dental practice is guided by the business side of dentistry rather than the evidence-based decision making	• Increasing the instructor-to-student ratio to facilitate discussions over clinical cases • Training students on the benefits of EBCM • Structural change (e.g., on a systems level, evidence-based practices should be supported by governments and insurance companies)
There is a gap between research/ideal world and daily dental	• Treating patients is not solely technical; a variety of factors affect a patient's oral health status	• Full implementation of EBCM in the day-to-day dental practice is very challenging and might not be possible	• Research teams and preclinical instructors could communicate better and plan together

management approaches and voiced a consensus on the need for a change from traditional approaches. In this study, most clinical instructors demonstrated awareness regarding the change that was happening in conventional caries management either because they were already part of the change, or they experienced it as a part of their interactions with fellow instructors. Within their awareness was also the awareness of roadblocks to change. Many participants itemized multiple barriers to implementing EBCM within the clinic. Participants explained that there is a lack of understanding about EBCM among both students and instructors. They mentioned how challenging it is to convince their fellow instructors and how essential it is, given what is at stake for training students. The lack of acceptance of the EBCM approach by clinical instructors and giving less value to the non-surgical caries management approach by the students compared with other competencies in clinic has been reported in previous research.[12]

The desire component of ADKAR focuses on the decision of an individual, who is already aware of the need for a change to support and participate in the change.[23] It must not be assumed that having an awareness naturally leads to desire.[23] Our participants who were already aware of the problem showed a positive desire to be part of the change. In addition, the extent of their awareness was reflected in their desire to participate in the study and provide crucial suggestions on how others can be motivated to inculcate desire. Using the experiences of individuals within organizations who portray high levels of desire because they believe in the need for change can be beneficial to creating new desire among other individuals or co-workers.[28]

In our data, knowledge manifested both as content knowledge of EBCM and as well as knowledge about how to bring forward curricular changes in the clinic. Many of our participants reported that there is a lack of knowledge among clinical instructors regarding the EBCM approach and emphasized the importance of keeping instructors up to date through continuity education training. This important aspect of educating the teaching faculty is well acknowledged in the literature.[6,29] Regarding how to bring about the change, our participants suggested that non-surgical caries treatment credits could be given to students for applying EBCM in the clinics. This idea is logical since dental students inevitably have to focus on the credits that they must fulfill. In addition, it is crucial to implement a rubric to assess student's performance in using the EBCM protocol, and grade them accordingly. These ideas are in agreement with other studies on cariology education.[11,12]

In our study, clinical instructors who were previously exposed to EBCM training demonstrated an ability to participate in the change process, using show and tell approaches and guided discussions with students. Nevertheless, limited chairside time and setting-up of multiple follow-up appointments in the teaching clinic seemed to limit their ability to fulsomely teach EBCM. Lack of time has been mentioned as one of the main barriers to implementation of Evidence-Based Dentistry (EBD) in other studies.[11,30]

Our findings also suggest that the reinforcement of the change to EBCM needs more focus and effort within the institutional environment, which agrees with the previous literature.[29] Additional individual factors affecting instructors' readiness to participate in change surfaced in our data, namely, their motivation, and their philosophy for navigating ethical dilemmas. While we found that participants with less clinical experience (more recently graduated) showed a better knowledge of, and ability to implement EBCM, more experienced dentists were more likely to follow conventional approaches rooted in their professional experiences. In this regard, O'Donnell et al. interviewed private-practice dentists to assess the barriers to the use of evidence-based clinical recommendations for non-cavitated carious lesions. Their results report that "personal clinical experience" was the key determinant for dentist decisions for the treatment of non-cavitated lesions.[31]

Our data also pointed to a conflict of interest that instructors experienced when implementing EBCM. The surgical treatment of caries generates more profit and financial incentives than EBCM; EBCM requires non-surgical procedures and multiple follow-up appointments, which are often not covered by insurance companies. Concurrent with private dental practice,[32] dental education in Canada tends to reproduce the business model of dentistry; thus, EBCM runs counter to financial incentives. Our findings are concurrent with the other studies focused on individual components of EBCM. Schwendicke et al. conducted a study with dentists from New Zealand, USA, and Germany regarding management of non-cavitated proximal caries lesions and reported similar concerns from practitioners regarding financial pressure and lack of reimbursement.[33]

According to our participants, students in the dental clinic also struggle with the same conflict of interest. For students, the ethical tension manifests as having to choose between gaining treatment-based credits versus performing non-surgical caries treatments. Dental education is heavily focused on technical skills and the number of surgical treatments[11]; therefore, it seems that the teaching clinic is not well set up to motivate students to learn and master non-surgical treatment approaches.

As in most dental training environments in Canada, our participants spend most of their work week as private practice dentists. Thus, their expression of the need for continuing education courses and training and action-

able, standardized clinical guides are important. Such a gap between academic concepts and everyday dental practice has been previously reported in the literature.[6,7,10,33] To tackle this issue, dental schools need to maintain regular faculty development activities to ensure that all instructors involved in cariology teaching are well trained and can adequately teach EBCM. The successful implementation of the EBCM approach demands dedication, perseverance, and responsibility on the part of healthcare providers. To integrate this approach into clinical practice, the entire dental care system must undergo significant adaptation and become a staunch supporter of prevention-oriented dental care rather than exclusively focusing on restorative measures. It should foster a culture that encourages dental care teams to prioritize non-surgical treatments over surgical ones. Acknowledging that behavioral interventions may not consistently yield positive results and that patients' compliance can be challenging, EBCM emphasizes the use of evidence-based approaches of behavior change and the necessity for a risk-based treatment strategy. Caries management should be tailored to each patient's individual compliance level and the feasibility of modifying their risk factors.[2,3]

While our study provides innovative findings, there are limitations to be considered. First, our study is only focused on one dental school. This choice was deliberate, given the pilot funding that supported the study and the background work we had already done at this institution; together, these elements justify our current focus as a logical "next step" in our research process. This singular location, however, leads to the second limitation: while our findings are transferable to other Canadian institutions given the similarities across educational environments, the specifics (e.g., individual instructor characteristics; organization cultures) at each location need to be explored in future studies to present a fulsome national portrait of the challenges and solutions to EBCM uptake. Moreover, the EBCM implementation models may vary and be unique for each dental school. Finally, our study focuses on clinical instructors; additional work is needed to canvass the views of other stakeholders, including learners, administrators, and educational policy makers.

5 | CONCLUSION

Our study revealed that the majority of our dental instructors were aware of the need for change toward EBCM approaches and showed the desire to participate in the change. Importantly, their level of knowledge regarding EBCM approaches and their ability to implement it clinically were limited, influenced by their own caries management training, years of experience in the field, and their level of participation in EBCM continuing education sessions. Our results also demonstrate that individual factors, including ethics and self-motivation, play a crucial role in an individuals' progress through the different phases of individual change management. The results of our study can be used to support stakeholders (e.g., academic deans, clinic directors, cariology educators, and clinical instructors) to act, support and participate in bringing forward the urgent need to change to EBCM. Further research should be conducted at a multi-school level to both understand underlying challenges unique to each dental school and to derive potential solutions to integrating EBCM in undergraduate students' dental clinics across the country.

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CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

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APPENDIX 1: INTERVIEW GUIDE

- How do you feel about the "EBCM approach"?
- Do you apply this approach, or any of its elements, in your private practice?
- Let us talk about overall feasibility of the implementation of the EBCM approach in the students' dental clinics. We will talk about particular important points of the caries management approach and their integration in the clinic.

Components within EBCM approach

A. Caries lesion diagnosis
   - Early detection (non-cavitated), is it a focus?
   - Lesion severity assessment (non-cavitated, micro-cavitated, cavitated)
   - Lesion activity assessment (only active lesions need treatment)
   - Radiography as an adjunct method, not the main method
     - How do you perceive your ability to implement this diagnostic approach?
     - How do you perceive it works in the students' clinic?

- What would you say are the barriers that might affect the successful implementation?
- What would you say are the facilitating factors and practical solutions that could help with a successful implementation?

B. Caries risk assessment; non-surgical treatment at the patient level
   - Identifying risk factors and evaluating caries risk
   - Diminishing/elimination risk factors: behavioral changes, several follow-ups
   - Re-assessment of the risk: is it sustainable?
     - How do you perceive your ability to implement the approach?
     - How do you perceive it works in the students' clinic?
     - What would you say are the barriers that might affect the successful implementation?
     - What would you say are the facilitating factors and practical solutions that could help with a successful implementation?

C. Non-surgical treatment of active caries lesions (e.g., plaque control, fluorides, sealants, Silver Diamine Fluoride (SDF)
   - Several follow-ups
   - Re-assessment of lesion activity
   - Final outcome: active lesions become inactive
     - How do you perceive your ability to implement the approach?
     - How do you perceive it works in the students' clinic?
     - What would you say are the barriers that might affect the successful implementation?
     - What would you say are the facilitating factors and practical solutions that could help with a successful implementation?

D. Surgical treatment
   - Clinical threshold (frank cavitation into dentine, lesion is active and not cleansable)
   - Radiographic threshold (a middle or inner one-third of dentin)
   - Moderate lesions (e.g., selective removal of dentine to firm)
   - Deep lesions (e.g., selective removal of dentine to soft)
     - How do you perceive your ability to implement the approach?
     - How do you perceive it works in the students' clinic?
     - What would you say are the barriers that might affect the successful implementation?
     - What would you say are the facilitating factors and practical solutions that could help with a successful implementation?

E. Follow-ups
   - Short-term follow-up: re-assessment of lesion activity + risk factors
   - Long-term follow-up: non-modifiable risk factors; modifiable risk factors; caries-inactive patients
     - How do you perceive your ability to implement the approach?
     - How do you perceive it works in the clinic?
     - What would you say are the barriers that might affect the successful implementation?
     - What would you say are the facilitating factors and practical solutions that could help with a successful implementation?

- How can we work together as a faculty to ensure these solutions?

APPENDIX 2: ADKAR MODEL AND DEDUCTIVE CODEBOOK

Awareness

- An understanding of why a change is needed.

Desire

- Making a personal decision to support and participate in the change.

Knowledge

- Clinician's knowledge about the EBCM approach.
- The information, training, and education necessary to know how to change.

Ability

- Is the stage where the change actually occurs. An individual demonstrating the required changes, such that overall expected performance results are achieved.

Reinforcement

- Sustaining a change: the mechanisms and approaches so that the new way stays in place.

The deductive codebook

1. EBD approach
   - Use up-to-date best evidence for caries management + clinicians experience + patient's clinical status, values, preferences
2. Private practice caries management

3. Caries diagnosis
   - Early detection
   - Lesion severity assessment
   - Lesion activity assessment
   - Radiographic diagnosis and its role in treatment decisions
4. Caries risk assessment
   - Identifying risk factors and assessing caries risk
   - Planning treatment intensity based on caries risk
5. Non-surgical treatment
   - Threshold for treatment
   - Behavior changes related to plaque control, diet, etc.
   - Fluorides, sealants, SDF
6. Surgical treatment
   - Threshold for surgical interventions: clinical threshold, radiographic threshold
   - Dentine removal: selective removal, complete removal
7. Follow-up
   - Short term
   - Long term
8. An outdated caries diagnosis and management approach
   - Looking only for cavities
   - No lesion activity assessment
   - Threshold for restorative treatment: any lesion into dentine on radiograph
   - Sharp explorer use: stickiness of the tooth surface as a main sign of lesion detection
   - Heavily relying on radiography
   - Complete dentine removal instead of selective removal
   - Follow-up every 6 months for all patients
9. What works/is implemented in clinic regarding the EBCM approach
10. Challenges in the implementation
11. Solutions to facilitate the implementation
12. Undergraduate clinic's facilitating set up