



Resident perceptions of learning challenges in concussion care education

Perception des résidents quant aux difficultés d'apprentissage liées à la formation sur les soins à apporter aux victimes de commotions cérébrales

Alice Kam, Tobi Lam, Irene Chang, Ryan S Huang, Nicolas Fernandez et Denyse Richardson

Volume 15, numéro 6, 2024

URI : <https://id.erudit.org/iderudit/1115936ar>
DOI : <https://doi.org/10.36834/cmej.78016>

[Aller au sommaire du numéro](#)

Éditeur(s)

Canadian Medical Education Journal

ISSN

1923-1202 (numérique)

[Découvrir la revue](#)

Citer cet article

Kam, A., Lam, T., Chang, I., Huang, R., Fernandez, N. & Richardson, D. (2024). Resident perceptions of learning challenges in concussion care education. *Canadian Medical Education Journal / Revue canadienne de l'éducation médicale*, 15(6), 51–57. <https://doi.org/10.36834/cmej.78016>

Résumé de l'article

Contexte : Il n'existe actuellement pas de programmes d'études axés sur les résidents favorisant l'acquisition de compétences dans le domaine des soins à apporter aux victimes de commotions cérébrales. Nous avons cherché à combler cette lacune en développant et en évaluant des programmes d'études spiralés en utilisant le paradigme du constructivisme cognitif et le cadre de l'évaluation axée sur l'utilisation. Les programmes d'études fondés sur des données probantes consistaient en des demi-journées académiques et des cliniques pour les résidents de médecine familiale de première et de deuxième année. Notre première évaluation pilote a démontré quantitativement l'efficacité et l'acceptabilité, mais avait identifié des défis soutenus. Nous avons ici cherché à mieux décrire comment l'apprentissage relatif aux commotions cérébrales est vécu du point de vue des apprenants, afin de comprendre pourquoi des difficultés d'apprentissage se sont produites.

Méthodes : Une étude de cohorte qualitative interprétative a été utilisée pour explorer les perceptions des résidents sur les défis d'apprentissage relatifs aux commotions cérébrales. Les participants ont tenu un journal des cas cliniques rencontrés de façon longitudinale sur six mois afin de réfléchir à leur expérience de la commotion cérébrale. Des entretiens semi-structurés ont été menés.

Résultats : Les croyances et les perceptions des résidents quant à leur rôle ont influencé l'approche et l'organisation de leurs apprentissages. Les défis étaient liés à des lacunes concernant les connaissances déclaratives et les interconnexions de ces connaissances. Grâce à la réflexion, les résidents ont identifié leurs lacunes dans l'acquisition de compétences en matière de commotion cérébrale, ce qui a conduit à un apprentissage transformateur.

Conclusion : Cette conception intégrée en spirale a permis de créer des processus robustes pour s'interroger sur les lacunes en matière de compétences sur les commotions cérébrales. Nous avons discuté de l'état d'esprit des résidents et des facteurs qui ont entravé l'apprentissage relatif aux « commotions cérébrales » et des impacts négatifs potentiellement involontaires sur la continuité des soins aux patients. Les études futures pourraient explorer les façons permettant de tirer parti de l'expertise adaptative humaniste, de l'interdisciplinarité afin d'élaborer des programmes et l'évaluation afin de surmonter le curriculum caché et de promouvoir l'intégration de la formation et des soins aux patients.

© Alice Kam, Tobi Lam, Irene Chang, Ryan S Huang, Nicolas Fernandez et Denyse Richardson, 2024



Ce document est protégé par la loi sur le droit d'auteur. L'utilisation des services d'Érudit (y compris la reproduction) est assujettie à sa politique d'utilisation que vous pouvez consulter en ligne.

<https://apropos.erudit.org/fr/usagers/politique-dutilisation/>

Resident perceptions of learning challenges in concussion care education

Perception des résidents quant aux difficultés d'apprentissage liées à la formation sur les soins à apporter aux victimes de commotions cérébrales

Alice Kam,¹ Tobi Lam,² Irene Chang,³ Ryan S Huang,³ Nicolas Fernandez,⁴ Denyse Richardson⁵

¹Division of Physical Medicine and Rehabilitation, Department of Medicine, University of Toronto, Ontario, Canada; ²The Institute for Education Research, University Health Network, Ontario, Canada; ³Temerty Faculty of Medicine, University of Toronto, Ontario, Canada; ⁴Department of Family and Emergency, Université de Montréal, Québec, Canada; ⁵Department of Physical Medicine and Rehabilitation, Queen's University, Ontario, Canada
Correspondence to: Alice Kam MD MScCH FRCPC, Toronto Western Hospital, University Health Network, 399 Bathurst St, Toronto, Ontario, M5T 2S8; email: alice.kam@uhn.ca

Published ahead of issue: Feb 19, 2024; published: Dec 31, 2024. CMEJ 2024, 15(6) Available at <https://doi.org/10.36834/cmej.78016>

© 2024 Kam, Lam, Chang, Huang, Fernandez, Richardson; licensee Synergies Partners. This is an Open Journal Systems article distributed under the terms of the Creative Commons Attribution License. (<https://creativecommons.org/licenses/by-nc-nd/4.0>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is cited.

Abstract

Background: Resident-focused curricula that support competency acquisition in concussion care are currently lacking. We sought to fill this gap by developing and evaluating Spiral Integrated Curricula (SIC) using the cognitive constructivism paradigm and the Utilization-Focused Evaluation (UFE) framework. The evidence-based curricula consisted of academic half-days (AHDs) and clinics for first- and second-year family medicine residents. Our first pilot evaluation had quantitatively demonstrated effectiveness and acceptability but identified ongoing challenges. Here we aimed to better describe how concussion learning is experienced from the learners' perspective to understand why learning challenges occurred.

Methods: A qualitative interpretative cohort study was utilized to explore resident perceptions of concussion learning challenges. Participants completed six monthly longitudinal case logs to reflect on their concussion exposure. Semi-structured interviews were conducted.

Results: Residents' beliefs and perceptions of their roles influenced their learning organization and approaches. Challenges were related to knowledge gaps in both declarative knowledge and knowledge interconnections. Through reflection, residents identified their concussion competency acquisition gaps, leading to transformative learning.

Conclusion: This Spiral Integrated Design created vigorous processes to interrogate "concussion" competency gaps. We discussed resident mindsets and factors that hindered "concussion" learning and potentially unintentional negative impacts on the continuity of patient care. Future studies could explore how to leverage humanistic adaptive expertise, cross-disciplines for curriculum development, and evaluation to overcome the hidden curriculum and to promote integrated education and patient care.

Résumé

Contexte : Il n'existe actuellement pas de programmes d'études axés sur les résidents favorisant l'acquisition de compétences dans le domaine des soins à apporter aux victimes de commotions cérébrales. Nous avons cherché à combler cette lacune en développant et en évaluant des programmes d'études spiralés en utilisant le paradigme du constructivisme cognitif et le cadre de l'évaluation axée sur l'utilisation. Les programmes d'études fondés sur des données probantes consistaient en des demi-journées académiques et des cliniques pour les résidents de médecine familiale de première et de deuxième année. Notre première évaluation pilote a démontré quantitativement l'efficacité et l'acceptabilité, mais avait identifié des défis soutenus. Nous avons ici cherché à mieux décrire comment l'apprentissage relatif aux commotions cérébrales est vécu du point de vue des apprenants, afin de comprendre pourquoi des difficultés d'apprentissage se sont produites.

Méthodes : Une étude de cohorte qualitative interprétative a été utilisée pour explorer les perceptions des résidents sur les défis d'apprentissage relatifs aux commotions cérébrales. Les participants ont tenu un journal des cas cliniques rencontrés de façon longitudinale sur six mois afin de réfléchir à leur expérience de la commotion cérébrale. Des entretiens semi-structurés ont été menés.

Résultats : Les croyances et les perceptions des résidents quant à leur rôle ont influencé l'approche et l'organisation de leurs apprentissages. Les défis étaient liés à des lacunes concernant les connaissances déclaratives et les interconnexions de ces connaissances. Grâce à la réflexion, les résidents ont identifié leurs lacunes dans l'acquisition de compétences en matière de commotion cérébrale, ce qui a conduit à un apprentissage transformateur.

Conclusion : Cette conception intégrée en spirale a permis de créer des processus robustes pour s'interroger sur les lacunes en matière de compétences sur les commotions cérébrales. Nous avons discuté de l'état d'esprit des résidents et des facteurs qui ont entravé l'apprentissage relatif aux « commotions cérébrales » et des impacts négatifs potentiellement involontaires sur la continuité des soins aux patients. Les études futures pourraient explorer les façons permettant de tirer parti de l'expertise adaptative humaniste, de l'interdisciplinarité afin d'élaborer des programmes et l'évaluation afin de surmonter le curriculum caché et de promouvoir l'intégration de la formation et des soins aux patients.

Introduction

More patients are now seeking concussion care, particularly in primary care settings.¹⁻³ Concussions are complex; timely assessment and accurate diagnosis are required as patients present with nonspecific symptoms and require patient-specific, multidisciplinary approaches of management.³ Despite reformed concussion guidelines and educational campaigns aimed to improve concussion management practices,⁴ concussion education gaps have been reported within family medicine training programs.^{5,6} Thirty two percent of family medicine residents believed that seeing a physician was not essential for concussion care, and 12% reported having no training in concussion management.⁵

In 2021, at the University of Toronto's Family Medicine residency program, a concussion curriculum using a Spiral Integrated Curricular (SIC) approach was developed and subsequently evaluated with Patton's Utilization-Focused Evaluation Framework (UFE)^{5,7}am. We selected Patton's UFE method due to its emphasis on judging evaluations based on utility and actual use,⁷ addressing our goal of creating an actionable and resident-focused concussion curriculum in response to identified gaps in competency. Initial evaluation results from our pilot study showed 12% increase in knowledge and described positive behavior changes⁸; but chronic concussion care was identified as a challenging topic.⁹ Using a learner-centered UFE process, we pursued a more in-depth understanding for curriculum development beyond individual-level learning¹⁰ to investigate what systems barriers may be hindering concussion learning.

Our current qualitative study aimed to describe concussion care challenges from the learners' perspective to identify education system gaps. We focused on describing learners' perceptions of, and experiences with concussion care following their participation in a concussion curriculum.¹ Our insights inform integrated curriculum design, within a clinical topic, to align educational system gaps with healthcare system barriers.

Methods

We utilized a qualitative interpretative cohort study approach.

Educational context

Postgraduate year one (PGY1) and two (PGY2) family medicine residents were able to participate in the SIC and completed: Flipped Classroom (asynchronous self-learning,

followed by synchronous interactive case-based learning), Peer teaching, Guided Reflective workplace learning and coaching, and Reflective Longitudinal Case Logs (full protocol available at <https://doi.org/10.1111/tct.13707>). During the case logs, participants recorded the types of concussion cases they encountered over six months. The learning objectives were to develop competencies with:

- Diagnosis of concussion with specific diagnostic criteria, ruling out other co-morbidities
- Management of concussion symptoms and support returning to activities for patients with non-complex concussions
- Utilization of resources and initiation of early referrals to specialist care for complex concussions

Data collection and participants

The University of Toronto research ethics board (REB#40656) approved the study. We conducted semi-structured interviews (Appendix A) with curriculum participants at six months, recorded, de-identified, and transcribed verbatim. Case logs were analyzed to track the types and numbers of concussion cases the participants encountered. To elicit context-specific responses on their learning process and application of knowledge, clinical experiences and cases from the participants' Case Logs were used as interview prompts for reflection of learning experiences.

Data analysis

We conducted qualitative interpretative content analysis to identify concussion competency acquisition challenges. Braun & Clarke's framework was used to guide our coding and thematic analysis.¹² Each transcript was first inductively coded by two members of the research team (AK, IC; AK, RH) using NVivo (Lumivero). We then identified utterances from the participants that reflected prevailing concepts and ideas, examining how participants' experiences and realities influence their learning. Constructivism, as a framework for knowledge building, was applied for deductive conceptual analysis.^{12,13} We achieved thematic saturation after no new themes were uncovered.

Results

Respondent characteristics

Six family medicine residents participated in semi-structured interviews (Table 1).

Table 1. Respondent demographic characteristics

Demographic Categories	Respondents (n = 6)
<i>Gender</i>	
Men	2
Women	4
<i>Year of Residency Training</i>	
PGY1	3
PGY2	3
<i>Institution of Undergraduate Medical Education</i>	
McMaster University Michael G. DeGroot School of Medicine	2
University of Toronto Faculty of Medicine	2
University of British Columbia Faculty of Medicine	1
Dalhousie University Faculty of Medicine	1
<i>Personal Concussion Experience</i>	
Never experienced a concussion previously	5
Prefer not to say	1
<i>Prior Clinical Encounters with Different Concussion Types in Residency*</i>	
Seen patient with concussion in acute phase on the field	1
Seen patient with concussion in acute phase within one hour of concussion	2
Seen patient with concussion in acute phase within one week of concussion	4
Seen patient with concussion in acute phase within one to eight weeks of concussion	3
Seen patient with concussion with persistent symptoms 8-12 weeks post-concussion	2
Seen patient with concussion with persistent symptoms more than 12 weeks post-concussion	2
<i>Number of concussion cases seen by resident during six-month case log</i>	
None	2
1 case	2
2 cases	1
3 cases	1

*This section denotes how many of the six residents have seen each type of concussion patient. Residents are able to indicate prior encounters with more than one type of concussion patient.

Findings

We identified three main themes on concussion competency acquisition challenges: 1) learners' beliefs and values influencing learning, 2) declarative knowledge gaps and 3) knowledge interconnection challenges (Table 2). Participants identified their process of learning through reflection and described challenges with chronic concussion care.

Beliefs and values influencing learning

When describing and reflecting on SIC experiences, residents focused on learning the "red flags" of concussion.

After seeing which questions were answered incorrectly on their knowledge surveys, participants realized what was important to know and the limits to their learning. Participants described what they failed to learn, what they had forgotten, and the challenge of remembering what they learned. This reflection process informed how their beliefs changed their learning approach: "... the reason I got it wrong is because I felt it's not important for the management... so I guess I didn't pay attention to that..." (P2). Participants focused their attention on their clinical interests: "...my interest...they kind of lie in emergency or like acute care... so all my knowledge level is limited after first line interventions. I think with a lot of chronic patients I'm kind of stuck sometimes as to what the next step in care would be" (P1). Residents went through a process of self-determining what information in the curriculum was most pertinent for their practice as family physicians, separating need-to-know basis from more specialized knowledge. "Is this something that I need to know for my practice or is this just interesting research stuff ...or is it actually clinically relevant to me?" (P5). These foci of filtering for relevancy were influenced by the residents' clinical interests and perception of the boundaries of family practice.

Declarative knowledge gaps and missing interconnection

While focused on "red flags," the reflection process also identified knowledge gaps pertaining to uncertainty with concussion symptoms, diagnosis, management, and situations where decision-making was unclear. "Symptoms can be quite vague... and to really narrow it down as most likely a concussion" (P4) was challenging. When applying what they learned, participants realized the clinical knowledge interconnection was missing. They questioned their management approaches and realized their limitations when they reflected on their curriculum learning experience on a clinical encounter. Participants described how feedback from clinical supervisors allowed them to learn how to adapt examinations to patient context.

Table 2. Illustrative quotes (n = 6) were identified as P1-6

Learning Challenges: Learners' beliefs and values influence learning	
Resident's perception & preferences	"It's really the epidemiology like what are the risk factors, that I don't really like to, I guess, focus on in emergency or in family settings." (P2) "I think the reason I got it wrong is because I felt like it's not important for the management." (P2)
Resident's interests	"I think that acute cases are the most interesting because my interests... they kind of lie in emergency or acute care. So, all my knowledge level is limited after first line interventions." (P1)
Resident's organization with a focus on ruling out red flags	"I think I really focus on what physical examination findings I need to look for, like what are the red flags, as opposed to overall progress." (P2) "I think some of the challenges are wanting to rule out more serious injuries in the context of like emergency before labelling something as concussion." (P4)
Learning Challenges: Missing knowledge hinders learning	
Missing declarative knowledge hinders learning	
Knowing diagnosis	"I guess I don't know that much about concussion, at least from the perspective of specific criteria." (P5)
Knowing management	"I didn't start the pharmacological management so part of that. But I just felt like...but it's not like an issue with the guide itself. It's kind of just the medicine itself but there's not much I can rec all from my end." (P2) "So that might kind of be at the brink of my knowledge and understanding because I'm not really sure how I'd tailor my medications or like who else or what other strategies I could involve here." (P1)
Missing knowledge interconnections hinder learning	
Chronic cases with vague symptoms	"Symptoms can be quite vague, you know, irritability or nausea or headache, and to really narrow it down as most likely a concussion can be challenging." (P4) "The chronic cases are a little less clear cut, so those ones were a bit harder." (P5)
Chronic cases with multiple complains and less clear management plan	"I would say it's the chronic concussion cases that I have the most difficulty with because I find these to have multiple chief complaints that the patients present with, making it hard to choose treatments." (P1) "...in terms of like management, I think it's the chronic that I was kind of touching upon, where someone has persistent symptoms, that's where it gets complicated." (P5)
Reflective Learning Impact: Understanding learning facilitates future learning	
Realizing old knowledge is wrong	"With one case, I was over-inclusive because I added the standard mini mental exam when it shouldn't have been included." (P1) "Before I was just kind of shooting from the hip being like oh do you have headaches, so I realize that approach is wrong" (P1)
Realizing knowledge gaps	"I definitely realized what gaps there were in terms of the knowledge." (P2) "I feel like it revealed that I have a basic competency, but there's definitely knowledge gaps and things I still need to learn" (P3)
Changing perception and approach	"So, before I guess I had seen some more concussions and they are more benign and sometimes the patients know what to do. So, my reaction is maybe they don't need to see a physician. The ideal way is that they should all be seen." (P3) "I feel like I'm probably more succinct in my history taking. Have a bit of a stronger approach to what things on physical exam are going to be helpful. When, after now seeing a number of head injury/concussion type cases, so have definitely kind of noticed a change in that." (P4)

Learning Through reflection

With case reflection, respondents described slowly discovering how to learn, consolidate and integrate their competency acquisition: "I learn about the topic and then I encounter a patient case where I can actually apply it... was very helpful in solidifying some of the didactic and then my clinic experience ... also made me aware of a number of other resources" (P5). The spiral process allowed participants to "go back, practice it and come back with defined objectives or questions" (P6), which they found helpful for developing competency. The integrated curriculum allowed for transformative learning when participants reflected on the outcomes of their learning. "Before I was just kind of shooting from the hip being like 'oh, do you have headaches? so I realize that approach is wrong" (P5). The reflective practice changed perceptions of medical management, "So, before I had seen some more concussions, and they are more benign... my reaction is

maybe they don't need to see a physician. The ideal way is that they should all be seen" (P3).

Discussion

Our learner-centric evaluation highlighted concussion knowledge translation challenges at the system level. The SIC improves learning efficiency,¹⁴ enabling a shift from a fragmented education delivery approach to a synthesized delivery of competency as a unit with a spiral-deepening learning experience.¹⁴ With a UFE framework,¹⁰ this curricular approach facilitates robust, timely, and purposeful curricular evaluation to iteratively identify gaps and improvements.¹⁰ Our study identified themes related to learners' perceived beliefs and values, gaps in declarative knowledge and clinical interconnection, and learners' abilities to reflect on learning. Our current study used constructivism knowledge building to describe the

learning challenges experienced by learners in the curriculum.

Our results were similar to previously identified knowledge gaps in concussion diagnosis and management, namely: the non-specificity and vagueness of symptoms, lack of formal diagnostic criteria, patient compliance with management, and counselling patients with respect to return to activity.⁵ We expanded on these themes through residents' perspective of why these knowledge gaps may be occurring and how we might address them.

It is important to pinpoint the attributes of the SIC approach that were particularly influential. The SIC model facilitated a layering of complexity in clinical problem-solving, which allowed residents to build upon their previous knowledge in a structured yet dynamic manner. This iterative process ensured that residents' understanding deepened, mirroring the spiral learning path from basic concepts to advanced clinical application. The SIC aligns with competency learner-centric framework which posits self-regulated experiential learning and the important relevance of the content to their work. Residents identified their learning needs through reflection on their clinical experiences and sought out relevant knowledge in a just-in-time manner. The integration likely contributed to the observed increase in both confidence and competence in managing concussion cases.

The Case Logs revealed that residents had few experiences with concussion management. There were extended intervals without any concussion encounters, and when they did occur, the cases were primarily acute (within 1-12 weeks of symptom onset). Marginalized patient populations are known to have less access to concussion care.¹⁵ Relying on chance clinical experiences for learning limits knowledge to only patient populations who have access to care. Consequently, learners may find it challenging to progress to more complex cases. To address this issue, we suggest the deliberate use of case scenarios, standardized patients, or simulations.

Based on our findings, we provide recommendations for improving concussion education through medical education cultural changes. Foremost, we advocate for programs overcoming hidden curriculum factors that determine residents' beliefs and prioritization of red flags. Going beyond red flags to explore patients' complex needs and incorporating counselling for symptom management.

We believe that cross-discipline inputs support residents' consolidation of knowledge to better integrate complex

cases. We described how residents' knowledge is consolidated not only within a curriculum but across other disciplines and experiences such as teaching, case studies and clinical experiences. Prior knowledge, such as red flags, could also be a source of misconceptions and negative interference.⁵ The emerging benefits¹⁶ of contextualized reflective competence through additional sub-specialty learning experiences will benefit from further exploration. Reflection within the proper context drives metacognitive development and self-regulated life-long learning.¹⁷ Our findings suggest that supervisor feedback to guide critical reflectivity and consolidation may help surmount challenges with learning integration caused by healthcare or education system gaps.

There are limitations to our study. There are approximately 500 family medicine residents across Canada.¹⁸ Our participants represent only a narrow subset of this demographic and was conducted within one program, that of the University of Toronto. Our study's findings may not be transferrable to other family medicine training programs, given variations in curricula and practice settings. Additionally, the study was conducted during a six-month follow-up period with low number of cases and, may have limited the development of competencies and concussion experiences.

Conclusions

Our SIC design in a concussion education context matched system-based competency expectations with residents' perceived learning challenges. This curricular design aligns health care system goals with postgraduate competency educational goals to integrate patient care. Our study used a learner-centric approach to identifying system challenges through curricular evaluation. Although limited to a single institution, participant learning insights were rich, valuable, and informative for enhancing curricular design. Findings may be useful to other schools aiming to strengthen integrated care pathways within clinical education contexts.

Conflicts of Interest: There are no conflicts of interest to disclose for the authors.

Funding: No funding was obtained for the study.

Edited by: Cindy Schmidt (senior section editor); Marcel D'Eon (editor-in-chief)

Acknowledgements: The authors would like to thank faculty and staff of the Dalla Lana School of Public Health (Health Practitioner Teacher Education Program) and the University of Toronto Department of Family and Community Medicine staff members, administrators, residents, and the participation of all Year 1 & 2 family medicine residents for their tremendous support of this project. The authors also would like to thank the full team who supported the first iteration of the UFE evaluation. The work of the first survey-based evaluation has been accepted for publication in *The Clinical Teacher*. This current iteration has not received any financial support; however, we would like to express our heartfelt thank you to Dr. Aisha Husain for facilitating residents' academic half days and providing feedback for resident research participants, Occupational Therapist Ms. Stephanie McFarland for teaching the pediatric portion of the curriculum, Ms. Alyson Summers for data collection and Ms. Ching-Lung Huang for the project coordination.

References

- Langer L, Levy C, Bayley M. Increasing Incidence of Concussion: True Epidemic or Better Recognition? *J Head Trauma Rehabil*. 2020 Jan;35(1):E60-6. <https://doi.org/10.1097/HTR.0000000000000503>
- Zemek RL, Grool AM, Rodriguez Duque D, et al. Annual and seasonal trends in ambulatory visits for pediatric concussion in Ontario between 2003 and 2013. *J Pediatr*. 2017 Feb;181:222-228.e2. <https://doi.org/10.1016/j.jpeds.2016.10.067>
- Ellis MJ, Bauman S, Cowle S, Fuselli P, Tator CH. Primary care management of concussion in Canada. *Paed Child Health*. 2019 May 15;24(3):137-42. <https://doi.org/10.1093/pch/pxy171>
- Stoller J, Carson JD, Garel A, et al. Do family physicians, emergency department physicians, and pediatricians give consistent sport-related concussion management advice? *Can Fam Physician*. 2014 Jun;60(6):548, 550-2.
- Mann A, Tator CH, Carson JD. Concussion diagnosis and management: Knowledge and attitudes of family medicine residents. *Can Fam Physician*. 2017 Jun;63(6):460-6.
- Boggild M, Tator CH. Concussion knowledge among medical students and neurology/neurosurgery residents. *Can J Neurol Sci*. 2012 May;39(3):361-8. <https://doi.org/10.1017/S0317167100013524>
- Patton MQ. *Utilization-focused evaluation*. 4th ed. Thousand Oaks: Sage Publications; 2008. 667 p.
- Kam ASH, Zhao G, Huang C, et al. Residency spiral concussion curriculum design. *Clin Teach*. 2023 Nov 30;e13707. <https://doi.org/10.1111/tct.13707>
- Kam ASH, Zhao G, Khan F, et al. *Impact on resident competency acquisition: near-peer teaching in a spiral curriculum*. The 2023 American Educational Research Association (AERA) Annual Meeting; 2023 May 4. <https://doi.org/10.3102/2007097>
- Rojas Gualdron D, Parker K. Evaluation in health professions education: Enhancing utility and supporting innovation. *Clin Teach*. 2021 Dec;18(6):621-6. <https://doi.org/10.1111/tct.13416>
- Cupido N, Ross S, Lawrence K, et al. Making sense of adaptive expertise for frontline clinical educators: a scoping review of definitions and strategies. *Adv in Health Sci Educ*. 2022 Dec; 27(5):1213-43. <https://doi.org/10.1007/s10459-022-10176-w>
- Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006 Jan; 3(2):77-101. <https://doi.org/10.1191/1478088706qp063oa>
- Ambrose SA, editor. *How learning works: seven research-based principles for smart teaching*. 1st ed. San Francisco, CA: Jossey-Bass; 2010. 301 p. (The Jossey-Bass higher and adult education series).
- Brauer DG, Ferguson KJ. The integrated curriculum in medical education: AMEE Guide No. 96. *Med Teach*. 2015 Apr 3;37(4):312-22. <https://doi.org/10.3109/0142159X.2014.970998>
- Johnson LW, Diaz I. Exploring the Social Determinants of Health and Health Disparities in Traumatic Brain Injury: A Scoping Review. *Brain Sci*. 2023 Apr 23;13(5):707. <https://doi.org/10.3390/brainsci13050707>
- Lane AS, Roberts C. Contextualised reflective competence: a new learning model promoting reflective practice for clinical training. *BMC Med Educ* [Internet]. 2022 Dec [cited 2023 Jul 6];22(1):71. Available from: <https://bmcmmeduc.biomedcentral.com/articles/10.1186/s12909-022-03112-4> <https://doi.org/10.1186/s12909-022-03112-4>
- Sandars J. The use of reflection in medical education: AMEE Guide No. 44. *Med Teach*. 2009 Aug;31(8):685-95. <https://doi.org/10.1080/01421590903050374>
- CaRMs. *2023 Family medicine/enhanced skills match*. Available from: <https://www.carms.ca/wp-content/uploads/2023/03/fmes1e.pdf> [Accessed on Aug 29, 2023 Aug 29].

Appendix A. Semi-structured interview guide

Tell me about how the curriculum helped to change how you have approached any concussion cases

- Were there any particular changes, when you say changes to practice, in terms of history taking or referring initial referrals?

How did you find the self-reflective knowledge check-in?

- How do you feel like you did on it?
- How did you do 6 months ago with the same check-in?
- What we want to do with the results is see where you may have gone wrong the first time, second time. Where you may have gotten questions right, and then why ...any trends any patterns to that. Just talking about that, having the chance to reflect with me.

Tell me about your learning experiences with respect to the concussion cases that you've seen in residency. Use the TIDieR framework approach

How many cases of concussion did you see in the clinic?

- What type of cases were they?
- What was your level of autonomy?
- How confident did you feel when you were handling these cases?

Which concussion case would you say was the most challenging experience? Why?

What kind of learning worked for you? Why? So when I say learning I mean did you rely on any particular methods or techniques or textbooks, external sources...?

- How did you find ... to be? In terms of usefulness, material, structure?

Did you receive any type of feedback or criticism that you then used to improve on?

What components of the curriculum do you feel contributed most to your competency? Why? So the components would be the academic half-day, the half-day clinic, and the self-study guide.

- How do you feel like the curriculum materials and resources specifically supported your competency?

How confident are you in your diagnosis and management in patients with concussion now?

- Overall do you feel more confident going into cases now?

Do you have any recommendations for changes to the curriculum