



## Moving toward co-production: Five ways to get a grip on collaborative implementation of Movement Behaviour curricula in undergraduate medical education

## Vers une approche de co-conception : cinq stratégies pour la mise en place collaborative de contenu en matière de activité physique dans le programme d'études médicales prédoctorales

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Article abstract

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## Moving toward co-production: five ways to get a grip on collaborative implementation of Movement Behaviour curricula in undergraduate medical education

Vers une approche de co-conception: cinq stratégies pour la mise en place collaborative de contenu en matière de activité physique dans le programme d'études médicales prédoctorales

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### Abstract

Several “calls to action” have imposed upon medical schools to include physical activity content in their overextended curricula. These efforts have often neither considered medical education stakeholders' views nor the full complexity of medical education, such as competency-based learning and educational inflation. With this external pressure for change, few medical schools have implemented physical activity curricula. Moreover, Canada's new 24-Hour Movement Guidelines focus on the continuum of movement behaviours (physical activity, sedentary behaviour, and sleep). Thus, a more integrated process to overcome the “black ice” of targeting all movement behaviours, medical education stakeholder engagement, and the overextended curriculum is needed. We argue for co-production in curriculum change and offer five strategies to integrate movement behaviour curricula that acknowledge the complexity of the medical education context, helping to overcome our “black ice.” Our objectives were to investigate 24-Hour Movement Guideline content in the medical curriculum and develop an integrated process for competency-based curriculum renewal. Stakeholders were equal collaborators in a two-phased environmental scan of 24-Hour Movement Guideline content in the Queen's University School of Medicine. Findings and a working curriculum map highlight how new, competency-based content may be embedded in an effort to guide more relevant and feasible curriculum changes.

### Résumé

À plusieurs reprises, les facultés de médecine ont été invitées à inclure du contenu en matière d'activité physique dans leurs cursus déjà chargés. Ces appels à l'action ont souvent omis de prendre en compte les points de vue des parties prenantes de l'éducation médicale ainsi que toute la complexité de cette dernière, y compris l'approche par compétence et les contenus de cursus qui ne cessent de croître. Malgré la pression externe, peu de facultés de médecine ont mis en place des programmes d'activité physique. De plus, les nouvelles directives canadiennes en matière de mouvement sur 24 heures sont axées sur le continuum des comportements de mouvement (activité physique, comportement sédentaire et sommeil). Une approche intégrée est de mise pour négocier le terrain glissant que constitue la nécessité de cibler tous les comportements de mouvement, de solliciter les parties prenantes de l'éducation médicale et de prendre en considération le cursus chargé. Nous prônons la collaboration pour effectuer ces modifications dans les programmes d'études par le biais de cinq stratégies d'intégration de contenu sur les comportements de mouvement qui reconnaissent la complexité du contexte de l'éducation médicale. Nos objectifs étaient d'étudier le contenu des directives en matière de mouvement sur 24 heures et de créer un processus intégré pour la révision du cursus basé sur les compétences. Les parties prenantes ont collaboré sur un pied d'égalité à une analyse environnementale en deux phases du contenu des directives en matière de mouvement sur 24 heures à la Faculté de médecine de l'Université Queen's. Les résultats et le projet de programme élaboré illustrent la manière d'intégrer du contenu nouveau basé sur les compétences et d'opérer ainsi des changements pertinents et réalisables dans le cursus.

## Introduction

Years of research and several “calls to action” have pressed medical schools to include content related to the role that physical activity (PA) plays in health promotion, disease prevention, and management.<sup>1-4</sup> These calls have recommended new content and objectives to be added to existing curricula to enhance PA knowledge, skills (e.g., in counseling and prescription), and attitudes among future physicians. This literature has touted the importance of embedding PA in the curriculum without focusing on, or at least reporting, *how* to get there successfully.<sup>3-5</sup> Unsurprisingly, few medical schools in Canada have sustainably or sufficiently implemented PA in their curricula.<sup>6,7</sup> Where successful implementation has occurred, medical education stakeholders have been involved.<sup>8,9</sup> For instance, PA counseling and prescription have been integrated into the medical curriculum at the University of British Columbia with support from their curriculum leaders.<sup>8,9</sup> However, more commonly, calls to action have considered neither medical education stakeholders’ views (e.g., deans, course directors)<sup>10</sup> regarding curriculum change nor the full complexity of the context in which change must occur, such as the shift to a competency-based structure.<sup>11,12</sup> Hence, we are predominantly faced with low implementation and sustainment of PA curricula.

Verily, we are faced with an ideal time to shift our curriculum change approach as Canada no longer has national PA Guidelines, but national Movement Guidelines across four age categories.<sup>c.f.,13-16</sup> The Canadian 24-Hour Movement Guidelines (24HMG) recommend optimal daily patterns of PA, sedentary behaviour, and sleep for overall health, highlighting how these three movement behaviours interrelate.<sup>17,18</sup> Adding PA content alone now represents only one-third of the equation. Given that medical students will become physicians who have a large influence on population health behaviours,<sup>19</sup> society could benefit from an increased dialogue about movement behaviours in medicine, facilitated through medical curriculum renewal.

However, educational inflation is impeding curriculum renewal.<sup>1,2,20</sup> Each year, medical students are faced with managing the increasing expectations of the bulk of content and skills to be learned and the level of proficiency required upon graduation.<sup>20</sup> Consequently, adding movement behaviour content *on top of* existing content is unrealistic and could be perceived as overwhelming by medical students, thereby negatively impacting their

wellbeing.<sup>20</sup> To overcome the curricular “black ice” of targeting the full continuum of movement behaviours, medical education stakeholder engagement, and the overextended curriculum, an improved process for developing and implementing new curricula is needed.

Imagine a collaborative process, where curricular gaps can be identified and subsequently targeted without overloading existing time-constraints and the ever-expanding expectations of medical trainees. Consider what might happen if we stop urging medical schools to take action and started collaborating with them on how to navigate the process of feasible, sustainable curriculum change. Compared to Exercise is Medicine® and lifestyle medicine approaches, which have advocated for the inclusion of one or two movement behaviours in medical education,<sup>6,21,22</sup> we are using integrated knowledge translation (iKT) to inform the co-production and implementation of content on all 24HMG behaviours in the Queen’s University School of Medicine curriculum. The objectives of our iKT research were to glean a comprehensive view of the presence or lack of 24HMG content in the undergraduate medical curriculum and to develop and apply an integrated process for competency-based curriculum renewal. Herein, we expound on five strategies that comprise an integrated process for curriculum renewal, to step away from endorsing *what* to embed in the curriculum and toward having a conversation about *how* to get there.

## How to get a grip on implementing movement behaviour curricula

### 1. Use an iKT approach

iKT is the collaboration between researchers and stakeholders to optimize how knowledge is disseminated and implemented.<sup>23</sup> Much research in health care and health promotion has used iKT to guide collaborations on “knowledge products” that address evidence-practice gaps and to subsequently implement this knowledge into practice.<sup>24</sup> Efforts to renew medical curricula should apply iKT to engage medical education stakeholders in decision-making from project inception.<sup>24,25</sup> In support, a recent article has recommended early engagement of stakeholders.<sup>12</sup> Doing so may improve our ability to address implementation barriers, such as educational inflation,<sup>20</sup> and enhance implementation enablers, such as stakeholder ownership,<sup>10,26,27</sup> to improve the specificity and relevancy of curriculum changes to each medical school’s local context.<sup>24,28</sup>

Using iKT, we (researchers in kinesiology and health promotion and the educational developer in the School of Medicine) have engaged with stakeholders (10 faculty and three medical student representatives in the School of Medicine) as equal collaborators since the outset of our research. Stakeholders came from multiple areas of

medicine that were deemed as relevant to the 24HMG, including population health, geriatrics, and endocrinology (see list of included courses in Tables 1 and 2). We conducted a two-phased curriculum scan (Table 1 abridged version) and subsequent curriculum mapping process (Table 2, in-progress abridged version).

Table 1. (abridged). Results from phases one and two of the curriculum scan for 24-Hour Movement Guideline content in the Queen’s University Undergraduate Medical Education 2019-2020 curriculum.

Content related to the Canadian 24-Hour Movement Guidelines for Adults					Queen’s Competency Framework <sup>31</sup>	
Learning Event Objectives	Learning Event Title: Description (Format)	Assessment Type: (Duration)	Course (Term, Semester, Year)	Existing Instruction Time	Queen’s Outcomes	Queen’s Competencies
Understand the types of evidence on the utility of exercise <sup>a</sup> to reduce risk and associated cardiometabolic risk factors.	<i>PROACTIVE Trial Critical Appraisal:</i> Critical appraisal on a randomized controlled trial manuscript (DIL)	<i>Formative:</i> Critical appraisal worksheet small group assignment	MEDS123: Population Health <sup>b</sup> (Term 2, W2020)	50 mins	Health Advocate 1.1.5	#7
Understand the types of evidence on the utility of exercise <sup>a</sup> to reduce risk and associated cardiometabolic risk factors.	<i>Exercise<sup>a</sup> in Medicine:</i> PowerPoint slides on the utility of PA to manage obesity-related health risk (LEC)	N/A	MEDS123: Population Health (Term 2, W2020)	120 mins	Scholar 1.3.7	#10
Consider effective strategies for health promotion at the individual, group, and community level and how to promote health in a 1:1 encounter.	<i>Introduction to Health Promotion:</i> Module on health promotion, prevention, and behaviour change, including exercise <sup>a</sup> , PA, and avoidance of sedentary behaviours (LEC + SGL)	<i>Summative:</i> Exam (20 mins, 5 questions)	MEDS123: Population Health (Term 2, W2020)	110 mins	Health Advocate 1.1.5	#7
					Health Advocate 2.1.1, 2.1.2	#8
					Health Advocate 3.1.1	#9
Prescribe exercise <sup>a</sup> to older adults using the FITT principle and discuss strategies to help older adults address barriers to exercise <sup>a</sup> .	<i>Exercise<sup>a</sup>/Falls in Older Adults:</i> Reading and PowerPoint slides on prescribing exercise <sup>a</sup> in older adults (SGL)	<i>Summative:</i> Exam (45 mins, questions on one mandatory reading)	MEDS126: Principles of Geriatrics, Oncology, and Palliative Care (Term 2, W2020)	120 mins	Medical Expert 1.1.1	#1
					Medical Expert 2.1.3, 2.2.1, 2.2.2, 2.2.5	#2
					Health Advocate 1.1.5, 1.1.2	#7
Explore the normal response to exercise <sup>a</sup> and the impact of cardio-respiratory disease on exercise <sup>a</sup> function.	<i>Exercise<sup>a</sup>:</i> Module on exercise <sup>a</sup> and cardio-respiratory-metabolic function (SGL)	<i>Formative:</i> Question and small group activity worksheet <i>Summative:</i> Exam (120 mins, portion of questions)	MEDS110: Human Structure and Function (Term 1, F2019)	110 mins	[Outcomes to be added and mapped to learning event]	[Competencies to be added and mapped to learning event]
N/A	PA for patients in chest pain, back pain, prevention, screening, depression, and anxiety sessions	N/A	MEDS115: Family Medicine (Term 1, F2019)	Varies	N/A	N/A
Instances Embedded in Learning Events to Promote Medical Students’ Participation in Healthy Movement Behaviours						
N/A	HIIT and stretching during 10 minute break	N/A	MEDS115: Family Medicine (Term 1, F2019)	10 mins	N/A	N/A
N/A	Facilitating standing breaks anytime a video is shown	N/A	Multiple (ongoing)	Varies	N/A	N/A

DIL = directed independent learning; FITT principle = frequency, intensity, type, time; HIIT = high-intensity interval training; LEC = lecture; PA = physical activity; SGL = small group learning

Note: The curriculum scan was performed for the 2019-2020 academic year. Learning events related to sleep disorders were identified in the curriculum scan; however, as this falls outside the scope of the 24-Hour Movement Guidelines (which pertain to sleep recommendations for health promotion), these learning events were excluded. No content related to sleep for health promotion was identified in the curriculum scan, therefore learning events presented in Table 1 only content related to physical activity, exercise, or sedentary behaviour.

<sup>a</sup> The term “exercise” is used throughout Table 1 (rather than “physical activity”, which is the language consistent with the 24-Hour Movement Guidelines) as this is the current language used in the curriculum.

<sup>b</sup> Only learning events in first year courses were identified in the curriculum scan.

The full versions of Tables 1 and 2 are provided in Appendix A. In our curriculum scan, we: (i) strategically searched the UGME learning management system for formal learning events (e.g., lectures), then (ii) purposively recruited faculty and medical student representatives to complete an online survey to confirm the learning events found in phase one and list any additional formal or informal (e.g., movement breaks) learning events. Ethics clearance from our institution was given prior to commencing phase two of our scan (i.e., participant recruitment). Notably, our scan predominantly identified PA content in the curriculum with only one mentioning of sedentary behaviour and no mentioning of sleep content for health promotion. Search terms used in phase one of the scan are provided in Appendix B. By engaging relevant staff, faculty, and student representatives from outset, we hope to improve communication and commitment to movement behaviour curriculum change.<sup>10</sup>

Engaging both medical education faculty and medical student representatives can offer a more holistic view of curriculum change feasibility and may enhance the uptake of movement behaviour curricula.<sup>12</sup> Similar to faculty, medical student representatives can provide a recollection of content taught in the curriculum. However, medical student leaders may also advocate for student concerns and foster effective communication and transparency of the change to the student body.<sup>26</sup> McKimm and Jones<sup>27</sup> have advised not to undervalue the complexity of curriculum change, especially given the influence of ‘soft’ elements (i.e., people, rituals) who are active agents in the change process. Indeed, individuals adopt change at different rates,<sup>29</sup> and emotions and personal interest may influence resistance or adaptation to change.<sup>27</sup> However, planning for change collaboratively with those who will be affected by the change can help steer implementation while alleviating resistance.<sup>27</sup> These benefits of developing stakeholder partnerships are the basis for why we have applied a co-production model of change in our curriculum scan and map.

## 2. Integrate new content within a CBME framework

Canadian Undergraduate Medical Education (UGME) is shifting to a competency-based structure,<sup>11,12</sup> thus new curricular content must be competency-based. Competency-Based Medical Education (CBME) is centered on the four principles of (i) outcomes-based learning, (ii) the achievement of abilities, (iii) learner-centered education, and (iv) a de-emphasis on time-based training.<sup>30</sup> CBME ensures that, upon graduation, medical students

exemplify the set of values and behaviours required of a medical professional to meet the health needs of society.<sup>31</sup> To develop curricula that facilitate medical students’ achievement of these pre-specified competencies, medical schools have applied the CanMEDS framework, which explains the seven roles that are required of physicians.<sup>32</sup> As implementation of CBME may vary between schools,<sup>33</sup> the competency framework of the host institution should be used when available.

Using the curriculum scan findings and stakeholder input, we have begun developing our curriculum map (Table 2, in-progress) that works within the competency-based structure and limitations of overcrowded curricula by aligning new content within the existing Queen’s University UGME Competency Framework,<sup>31</sup> which is shaped by the CanMEDS roles. In this mapping process, the first author retrieved syllabi and course materials for all learning events identified in the curriculum scan, to determine if any adjustments could be made to strengthen existing content in line with the 24HMG, and has been manually searching the learning management system for other candidate courses where 24HMG content could be embedded, either through small additions to existing content and instruction time (i.e., +5-10 minutes) or by replacing existing content (i.e., in a net zero approach).

This working map shows how movement behaviour curricula should follow the four tenets of CBME. Curricula should include learning events covering PA, sedentary behaviour, and sleep that build off one another across all years of UGME<sup>30</sup> and facilitate the achievement of competencies and program outcomes. Curricula should facilitate medical students in ‘scaffolding’ from developing basic knowledge to more complex concepts to developing skills in PA, sedentary behaviour, and sleep topics (e.g., Table 2, column 1 and row 6),<sup>30,34</sup> and topics should address societal health needs.<sup>31</sup> Given that competency is context-dependent, multifaceted, and cannot be measured at a single point in time,<sup>33</sup> multiple points of formative and summative assessment conducted by multiple assessors in different settings can ensure this progression of abilities.<sup>31,33</sup> A transparent vision of how medical students are expected to achieve PA, sedentary behaviour, and sleep competencies should also be present in curricula.<sup>30</sup> Learner-centered instructional methods have been recommended<sup>35,36</sup> and could consist of active learning, small group sessions, case studies, personal reflections, and self-directed learning on movement behaviour promotion, and simulations on PA (e.g., Table 1, row 4),

sedentary behaviour, and sleep counseling for health promotion (e.g., with volunteer community members; Table 2, row 6). Finally, competency-focused instruction for movement behaviour curricula should support unique learning curves, where medical students may learn the

appropriate knowledge, skills, and attitudes in PA, sedentary behaviour, and sleep topics at their own pace.<sup>37</sup> For instance, self-directed study blocks where students can interact in clinical settings could be recommended where further hands-on learning is needed.<sup>36</sup>

Table 2. (abridged). Integrated curriculum map (in-progress) of aligned, competency-based 24-Hour Movement Guideline content in the Queen's University Undergraduate Medical Education curriculum.

Canadian 24-Hour Movement Guidelines for Adults content					Queen's Competency Framework <sup>31</sup>	
Learning Event Objectives	Learning Event Title: Description (Format)	Assessment Type: (Duration)	Course (Term, Semester, Year)	Added Instruction Time	Queen's Outcomes <sup>a</sup>	Queen's Competencies <sup>b</sup>
Describe the benchmarks for promoting health via PA, sedentary behaviour, and sleep in accordance with the 24HMG	<i>Introduction to Health Promotion<sup>c</sup>:</i> Module slides on the 24HMG (LEC), compare and contrast prevention in each 24HMG age category (SGL)	<i>Summative:</i> Exam (20 mins, 5 questions)	MEDS123: Population Health (Term 2)	+5 mins	Health Advocate 1.1.5	#7
					Health Advocate 2.1.1, 2.1.2	#8
					Health Advocate 3.1.1	#9
Discuss appropriate PA, sedentary behaviour, and sleep interventions to promote health and prevent disease	<i>Social &amp; Structural Determinants of Health:</i> Module section on accessibility of PA, sedentary behaviour, and sleep interventions (DIL)	<i>Formative:</i> Module completion <i>Summative:</i> Exam (75 mins, portion of questions)	MEDS117: Health Determinants (Term 1)	+10 mins	Health Advocate 1.1.1, 1.1.2	#7
Give examples of recommended preventive care interventions on PA, sedentary behaviour, and sleep across age ranges at primary, secondary, and tertiary levels of prevention	<i>Prevention:</i> 3 slides on T2D prevention strategies: 1 <sup>e</sup> prevention: 24HMG program for teens 2 <sup>e</sup> prevention: 24HMG screening with risk assessment in adults 3 <sup>e</sup> prevention: 24HMG programs for adults with T2D (LEC)	<i>Summative:</i> Exam (60 mins, portion of questions)	MEDS115: Family Medicine (Term 1)	Net zero (replace 3 slides with example of COPD prevention strategies in 60 min lecture)	Medical Expert 1.1.3, 1.1.1	#1
					Medical Expert 2.1.5	#2
Explain the evidence behind the integration of PA, sedentary behaviour, and sleep in preventive care	<i>Prevention:</i> Video explaining the integrated nature of PA, sedentary behaviour, and sleep and the 24-hour paradigm (LEC)	<i>Summative:</i> Exam (60 mins, portion of questions)	MEDS115: Family Medicine (Term 1)	Net zero (replace 10 min video)	Medical Expert 1.1.3, 1.1.1	#1
					Medical Expert 2.1.5	#2
Develop a non-pharmacological management plan for type 2 diabetes using the 24HMG recommendations	<i>Introduction to Management of T2D:</i> Slides on T2D management through PA, reduction of sedentary behaviour, and sleep (LEC)	<i>Formative:</i> Optional quiz, 1 question on Reading Assessment Test	MEDS231: Endocrine and Renal (Term 3)	+5 mins	Medical Expert 2.2.1	#2
Learn how to teach diabetes self-care skills (including PA, sleep, and limiting sedentary behaviour) using MI and BAP	<i>Diabetes Expo:</i> Station on 24HMG promotion for diabetes self-care in a simulated scenario (Demo)	<i>Formative:</i> Midterm (60 mins) <i>Summative:</i> Final exam (180 mins)	MEDS231: Endocrine and Renal (Term 3)	Net zero (modify one existing expo station)	Medical Expert 2.2.1, 2.1.4, 2.2.2, 2.1.6	#2
					Health Advocate 1.1.2, 1.1.5	#7
Determine risks for age and sex-specific conditions to guide history, physical examination, screening, and counselling on the 24HMG	<i>Mandatory Encounter on Preventative Care:</i> Log an encounter involving 24HMG history, screening, and counselling (clerkship rotation)	<i>Formative:</i> case reflection <i>Summative:</i> Four case reflections, community reflection	MEDS446: Family Medicine (Clerkship term)	Net zero (becomes mandatory encounter for MCC Presentation #74)	Medical Expert 2.1.3, 2.1.4, 2.2.1	#2
					Communicator 1.1.4	#3
					Health Advocate 1.1.5	#7

1<sup>e</sup>, 2<sup>e</sup>, 3<sup>e</sup> = primary, secondary, tertiary; 24HMG = 24-Hour Movement Guidelines; BAP = brief action planning; DIL = directed independent learning; LEC = lecture; MCC = Medical Council of Canada; MI = motivational interviewing; PA = physical activity; SGL = small group learning; T2D = type 2 diabetes

<sup>a</sup>Only the CanMEDS roles that were deemed as relevant to the proposed 24HMG content are listed in Table 2. As the curriculum map is in-progress, it is possible that linkages to other CanMEDS roles could be identified and listed in the final curriculum map.

<sup>b</sup>24HMG curricula were aligned with existing competencies at the Queen's University UGME Competency Framework either by ensuring that the competencies associated with existing learning events that we modified remained applicable or by linking new 24HMG curricula to existing competencies that we deemed were most applicable. Additionally, 24HMG content will fill gaps within newer MCC presentations in preventive care, which will be incorporated into existing assessment plans. Questions will be developed for the MCC Qualifying Examinations Part I and II section on Health Promotion and Illness Prevention.

<sup>c</sup>The learning events in Table 2 are a combination of (i) existing learning events in the Queen's University 2019-2020 UGME curriculum that related to the 24HMG and have been modified by the authors (e.g., row 1, modified from row 3 of Table 1) and (ii) new learning events that have been developed by the authors as short pieces of content that can either be added to existing learning events or traded for content within existing learning events not related to the 24HMG.

### 3. Integrate across competencies and outcomes to ensure curriculum alignment

The concept of curriculum alignment stems from the nexus of two dominant threads in the educational literature: constructivist learning theory and instructional design.<sup>35</sup> Curriculum alignment occurs when curricular content and assessment methods are aligned, such that the learning objectives that are taught are synonymous with the learning objectives that are measured and assessed.<sup>35</sup> Hence, 24HMG content should be developed and integrated as building blocks to existing competencies and outcomes with existing assessment methods used as-is or modified.<sup>33</sup> This is exemplified in Table 2, whereby competencies are explicitly outlined (last column), instructional methods provide specific opportunities for medical students to progress toward these competencies (second column), and assessment captures instances of observed competencies (third column).<sup>10</sup> The benefits of aligned curricula include an integration of foundational and clinical knowledge, a more holistic, competency-based student performance standard,<sup>36</sup> and greater achievement of institutional goals.<sup>10</sup> Ensuring alignment supports a smooth progression of learning<sup>38</sup> and enables medical graduates to better meet accreditation standards.<sup>33,39</sup>

### 4. Integrate movement behaviours within a single learning event

The 24-hour paradigm specifies that PA, sedentary behaviour, and sleep all impact one another and health outcomes. To achieve greater health benefits, sedentary time should be traded for more light PA and light PA should be traded for more moderate-to-vigorous PA while conserving sleep.<sup>13,14</sup> Given such overlap, we recommend discussing content on one movement behaviour wherever one or both of the other behaviours are taught. In our scan, we identified existing content on PA promotion across population health, geriatrics, human structure and function, and family medicine courses (Table 1). This content could be revised to speak to the integration of PA, sedentary behaviour, and sleep with minimal added burden to instructors. For instance, PA behaviour change is currently taught in population health and could be supplemented or replaced with a brief small group learning activity to compare and contrast the PA, sedentary behaviour, and sleep recommendations per each 24HMG age category (Table 2, row 1).

### 5. Integrate new content within existing instructional time

Designing courses can be burdensome and cost-intensive;<sup>40</sup> therefore, existing courses should be examined for areas where movement behaviour content could be readily integrated in a manner that supports curriculum alignment. This integration could be achieved, for instance, via customizable lecture slides, teaching notes, and exam questions.<sup>40</sup> Further, existing competencies and program outcomes likely already bear relevance to 24HMG promotion (e.g., Health Advocate 1.1.5 and the associated competency in Table 2, row 1). Thus, content should align with the competencies and outcomes of the host institution rather than with entirely new competencies, which would likely be labour-intensive to implement. To overcome the barrier of the overextended curriculum, our competency-based map integrates movement behaviour content within existing learning events to minimally disrupt instructional time and avoid curricular creep. For example, levels of prevention may be taught in family medicine using the 24HMG rather than the existing example, for type 2 diabetes prevention, resulting in a net zero change to instruction time (Table 2, row 3).

## A way forward

We have proposed a process for integrated curriculum renewal that addresses the lack of integrated movement behaviour curricula in UGME and considers the full complexity of the medical education context, thereby achieving our objectives. We presented a working, integrated curriculum map that was informed by CBME,<sup>30</sup> constructive alignment,<sup>35</sup> the Queen's University UGME Competency Framework<sup>31</sup> and an iKT approach.<sup>24</sup> Our process was not without challenges, predominantly being the time burden on medical education stakeholders' engagement during the school year, amidst a pandemic. However, by adapting curriculum renewal to the medical education context, we hope to produce more feasible, relevant, and sustainable changes.<sup>24</sup> This process may be applied by others seeking to integrate content on topics beyond Movement Behaviour guidelines within overcrowded curricula. We hope to encourage others to surpass urging medical schools to supplement their curriculum based on a pie-in-the-sky paragon and to embrace collaboration, on-the-ground work, and innate challenges. Now is the time to move toward co-production of integrated curriculum changes.



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## Appendix A. Full-length versions of the two-phased curriculum scan (Table 3) and working curriculum map (Table 4).

Table 3. Results from phases one and two of the curriculum scan for 24-Hour Movement Guideline content in the Queen's University Undergraduate Medical Education 2019-2020 curriculum

Content related to the Canadian 24-Hour Movement Guidelines for Adults					Queen's Competency Framework <sup>31</sup>	
Learning Event Objectives	Learning Event Title: Description (Format)	Assessment Type: (Duration)	Course (Term, Semester, Year)	Existing Instruction Time	Queen's Outcomes	Queen's Competencies
Understand the types of evidence on the utility of exercise <sup>a</sup> to reduce risk and associated cardiometabolic risk factors.	<i>PROACTIVE Trial Critical Appraisal:</i> Critical appraisal on a randomized controlled trial manuscript (directed independent learning)	<i>Formative:</i> Critical appraisal worksheet small group assignment	MEDS123: Population Health <sup>b</sup> (Term 2, W2020)	50 minutes	Health Advocate 1.1.5 (Provide examples of disease prevention and the promotion of healthy behaviours in clinical practice)	7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment
Understand the types of evidence on the utility of exercise <sup>a</sup> to reduce risk and associated cardiometabolic risk factors.	<i>Exercise<sup>a</sup> in Medicine:</i> PowerPoint slides on the difference between types of evidence and how findings support the utility of physical activity to manage obesity-related health risk (lecture)	N/A	MEDS123: Population Health (Term 2, W2020)	120 minutes	Scholar 1.3.7 (Assess the validity of evidence regarding diagnosis, prognosis, therapy, and harm and of evidence summaries)	10. Demonstrates proficiency in the steps of evidence-based medical practice
Consider effective strategies for health promotion at the individual, group, and community level and how health may be promoted to individuals accessing care in a 1:1 encounter, as a group in clinical practice, and to a community.	<i>Introduction to Health Promotion:</i> Module on health promotion, prevention, and behaviour change, including exercise <sup>a</sup> , physical activity, and avoidance of sedentary behaviours (lecture and small group learning)	<i>Summative:</i> Exam (20 minutes, 5 questions)	MEDS123: Population Health (Term 2, W2020)	110 minutes	Health Advocate 1.1.5 (Provide examples of disease prevention and the promotion of healthy behaviours in clinical practice)	7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment
					Health Advocate 2.1.1 (Identify the health needs of a community or population)	8. Identifies and communicates about community resources to promote health, prevent disease and manage illness in the communities and populations that will impact their practice
					Health Advocate 2.1.2 (Identify the availability of and access to resources for a community or a population)	
Be able to prescribe exercise <sup>a</sup> to older adults using the FITT (frequency, intensity, type, time) principle and discuss strategies to help older adults address barriers to exercise <sup>a</sup> .	<i>Exercise<sup>a</sup>/Falls in Older Adults:</i> Reading and PowerPoint slides on prescribing exercise <sup>a</sup> in older adults including using the FITT principle and discussing strategies to barrier management (small group learning)	<i>Summative:</i> Exam (45 minutes, questions on one mandatory reading)	MEDS126: Principles of Geriatrics, Oncology, and Palliative Care (Term 2, W2020)	120 minutes	Health Advocate 3.1.1 (Describe the role of physicians [individually and as represented by their organizations] to be socially accountable by advocating for individual and population health)	9. Is able to identify and engage opportunities to demonstrate social responsibility and service
					Medical Expert 1.1.1 (For each major organ system, explain normal human structure [location, macroscopic and microscopic structure] and development, and demonstrate the ability to apply this knowledge to relevant clinical presentations)	1. Articulates and utilizes the basic sciences to inform disease prevention, health promotion and the assessment and management of patients presenting with clinical illness

						<p>Medical Expert 2.1.3 (Elicit a history that is relevant to the specific patient encounter)                  Medical Expert 2.2.1 (Develop and implement an appropriate management plan for the clinical presentation, including prescribing non-pharmacologic, pharmacologic and interventional options)                  Medical Expert 2.2.2 (Integrate preventive measures and health promotion relevant to a given clinical presentation)                  Medical Expert 2.2.5 (Provide a rationale for any diagnostic/therapeutic procedures indicated)</p>	<p>2. Is able to perform a complete and appropriate clinical assessment of and provide initial management for patients presenting with clinical illness</p>
						<p>Health Advocate 1.1.5 (Provide examples of disease prevention and the promotion of healthy behaviours in clinical practice)                  Health Advocate 1.1.2 (Identify obstacles to health care and access with a patient and family, and work toward solutions, respecting the diversity of the patient population)</p>	<p>7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment</p>
Explore the normal response to exercise <sup>a</sup> in health and the impact of cardio-respiratory disease on exercise <sup>a</sup> function.	<i>Exercise</i> <sup>a</sup> : Module on exercise <sup>a</sup> and integrating cardio-respiratory-metabolic function (small group learning)	<i>Formative</i> : Question and discussion point worksheet small group activity (reviewed in class) <i>Summative</i> : Exam (120 minutes, portion of included questions)	MEDS110: Human Structure and Function (Term 1, F2019)	110 minutes	[Outcomes to be added and mapped to learning event]	[Competencies to be added and mapped to learning event]	
N/A	Physical activity for patients in chest pain, back pain, prevention, screening, depression, and anxiety sessions	N/A	MEDS115: Family Medicine (Term 1, F2019)	Varies	N/A	N/A	
<b>Instances Embedded in Learning Events to Promote Medical Students' Participation in Healthy Movement Behaviours</b>							
N/A	High-intensity interval training and stretching during the 10 minute break	N/A	MEDS115: Family Medicine (Term 1, F2019)	10 minutes	N/A	N/A	
N/A	Facilitating standing breaks anytime a video is shown in-session	N/A	Multiple (ongoing)	Varies	N/A	N/A	

Note: The curriculum scan was performed for the 2019-2020 academic year. Learning events related to sleep disorders were identified in the curriculum scan; however, as this falls outside the scope of the 24-Hour Movement Guidelines (which pertain to sleep recommendations for health promotion), these learning events were excluded. No content related to sleep for health promotion was identified in the curriculum scan, therefore learning events presented in Table 1 only content related to physical activity, exercise, or sedentary behaviour.

<sup>a</sup> The term "exercise" is used throughout Table 1 (rather than "physical activity", which is the language consistent with the 24-Hour Movement Guidelines) as this is the current language used in the curriculum.

<sup>b</sup> Only learning events in first year courses were identified in the curriculum scan.

Table 4. Integrated curriculum map (in-progress) of aligned, competency-based 24-Hour Movement Guideline content in the Queen's University Undergraduate Medical Education curriculum.

Canadian 24-Hour Movement Guidelines for Adults content					Queen's Competency Framework <sup>31</sup>	
Learning Event Objectives	Learning Event Title: Description (Format)	Assessment Type: (Duration)	Course (Term, Semester, Year)	Added Instruction Time	Queen's Outcomes <sup>a</sup>	Queen's Competencies <sup>b</sup>
Describe the benchmarks for promoting health via physical activity, sedentary behaviour, and sleep in accordance with the 24HMG	<i>Introduction to Health Promotion:</i> Customizable module slides to introduce the 24HMG (lecture) and instructions to compare and contrast different prevention strategies per the recommendations of each age category (small group learning)	<i>Summative:</i> Exam (20 minutes, 5 questions)	MEDS123: Population Health (Term 2)	+5 minutes	Health Advocate 1.1.5 (Provide examples of disease prevention and the promotion of healthy behaviours in clinical practice)	7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment
					Health Advocate 2.1.1 (Identify the health needs of a community or population)	8. Identifies and communicates about community resources to promote health, prevent disease and manage illness in the communities and populations that will impact their practice
					Health Advocate 2.1.2 (Identify the availability of and access to resources for a community or a population)	
Be able to discuss appropriate physical activity, sedentary behaviour, and sleep interventions to promote health and prevent disease	<i>Social &amp; Structural Determinants of Health:</i> Added module section on accessibility of physical activity, sedentary behaviour, and sleep interventions for all socioeconomic backgrounds (directed independent learning)	<i>Formative:</i> Module completion grade <i>Summative:</i> Exam (75 minutes, portion of included questions)	MEDS117: Health Determinants (Term 1)	+10 minutes	Health Advocate 3.1.1 (Describe the role of physicians [individually and as represented by their organizations] to be socially accountable by advocating for individual and population health)	9. Is able to identify and engage opportunities to demonstrate social responsibility and service
					Health Advocate 1.1.1 (Apply knowledge of the determinants of health to a patient's health needs and challenges respecting the importance of diversity)	
Give examples of recommended preventive care interventions on physical activity, sedentary behaviour, and sleep across age ranges at primary, secondary, and tertiary levels of prevention	<i>Prevention:</i> 3 customizable slides on type 2 diabetes prevention strategies using the 24HMG: Primary prevention: Movement behaviour change program for teens Secondary prevention: Movement behaviour screening with risk assessment in adults Tertiary prevention: Movement behaviour change programs for adults with type 2 diabetes (lecture)	<i>Summative:</i> Exam (60 minutes, portion of included questions)	MEDS115: Family Medicine (Term 1)	Net zero (replace 3 slides with example of COPD prevention strategies in 60 minute lecture)	Health Advocate 1.1.2 (Identify obstacles to health care and access with a patient and family, and work toward solutions, respecting the diversity of the patient population)	1. Articulates and utilizes the basic sciences to inform disease prevention, health promotion and the assessment and management of patients presenting with clinical illness
					Medical Expert 1.1.3 (Identify the consequences of structural variability and/or damage or loss of tissues and organs associated with genetic variation and pathophysiological processes including, but not limited to, inflammation, infection, neoplasia, atherosclerosis, hematological disorders and trauma)	
					Medical Expert 1.1.1 (For each major organ system, explain normal human structure [location, macroscopic and microscopic structure] and development, and demonstrate the ability to apply this knowledge to relevant clinical presentations)	2. Is able to perform a complete and appropriate clinical assessment of
					Medical Expert 2.1.5 (Select and prioritize medically appropriate	

					diagnostic tests depending on the urgency of the patient's condition, with consideration of risks, benefits and costs)	and provide initial management for patients presenting with clinical illness
Be able to explain the evidence behind the integration of physical activity, sedentary behaviour, and sleep in preventive care interventions	<i>Prevention:</i> Video on "The Whole Day Matters", explaining the integrated nature of physical activity, sedentary behaviour, and sleep and the 24-hour paradigm (lecture)	<i>Summative:</i> Exam (60 minutes, portion of included questions)	MEDS115: Family Medicine (Term 1)	Net zero (replace 10 minute video, "23 ½ Hours" by Dr. Mike Evans)	Medical Expert 1.1.3 (Identify the consequences of structural variability and/or damage or loss of tissues and organs associated with genetic variation and pathophysiological processes including, but not limited to, inflammation, infection, neoplasia, atherosclerosis, hematological disorders and trauma) Medical Expert 1.1.1 (For each major organ system, explain normal human structure [location, macroscopic and microscopic structure] and development, and demonstrate the ability to apply this knowledge to relevant clinical presentations)	1. Articulates and utilizes the basic sciences to inform disease prevention, health promotion and the assessment and management of patients presenting with clinical illness
					Medical Expert 2.1.5 (Select and prioritize medically appropriate diagnostic tests depending on the urgency of the patient's condition, with consideration of risks, benefits and costs)	2. Is able to perform a complete and appropriate clinical assessment of and provide initial management for patients presenting with clinical illness
Develop a non-pharmacological management plan for type 2 diabetes using the 24HMG recommendations	<i>Introduction to Pharmacological [and Non-Pharmacological] Management of Type 2 Diabetes:</i> Customizable slides on approaches to type 2 diabetes management through physical activity, reduction of sedentary behaviour, and sleep (lecture)	<i>Formative:</i> Optional non-graded quiz, 1 added question on Reading Assessment Test	MEDS231: Endocrine and Renal (Term 3)	+5 minutes	Medical Expert 2.2.1 (Develop and implement an appropriate management plan for the clinical presentation, including prescribing non-pharmacologic, pharmacologic and interventional options)	2. Is able to perform a complete and appropriate clinical assessment of and provide initial management for patients presenting with clinical illness
Learn how to teach diabetes self-care skills (including promoting physical activity and sleep and limiting sedentary behaviour) using motivational interviewing and brief action planning	<i>Diabetes Expo:</i> One of seven stations on diabetes self-care skills devoted to 24HMG promotion, taught by diabetes nurse educators and dietitians, with practice on applying motivational interviewing techniques to assess readiness and use appropriate 24HMG promotion strategies in a simulated scenario (Demo)	<i>Formative:</i> Midterm (60 minutes) <i>Summative:</i> Final exam (180 minutes)	MEDS231: Endocrine and Renal (Term 3)	Net zero (modify one existing expo station)	Medical Expert 2.2.1 (Develop and implement an appropriate management plan for the clinical presentation, including prescribing non-pharmacologic, pharmacologic and interventional options) Medical Expert 2.1.4 (Perform a focused and complete physical examination that is relevant to the specific patient encounter) Medical Expert 2.2.2 (Integrate preventive measures and health promotion relevant to a given clinical presentation) Medical Expert 2.1.6 (Correctly interpret diagnostic tests)	2. Is able to perform a complete and appropriate clinical assessment of and provide initial management for patients presenting with clinical illness

					Health Advocate 1.1.2 (Identify obstacles to health care and access with a patient and family, and work toward solutions, respecting the diversity of the patient population)	7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment
Determine risks for age and sex-specific conditions to guide history, physical examination, screening, and counselling on physical activity, sedentary behaviour, and sleep	<i>Mandatory Encounter on Preventative Care (MCC Presentation #74: Periodic health encounter/Preventive health advice):</i> Log the role played, date, location, and practice setting of an encounter involving history, screening, and counselling on the 24HMG (clerkship rotation)	<i>Formative:</i> One case reflection <i>Summative:</i> Four case reflections, one community reflection	MEDS446: Family Medicine (Clerkship term)	Net zero (becomes the one mandatory logged encounter for MCC Presentation #74)	Medical Expert 2.1.3 (Elicit a history that is relevant to the specific patient encounter)	2. Is able to perform a complete and appropriate clinical assessment of and provide initial management for patients presenting with clinical illness
					Medical Expert 2.1.4 (Perform a focused and complete physical examination that is relevant to the specific patient encounter)	
					Medical Expert 2.2.1 (Develop and implement an appropriate management plan for the clinical presentation, including prescribing non-pharmacologic, pharmacologic, and interventional options)	
					Communicator 1.1.4 (Respect diversity and difference and communicate effectively with individuals regardless of their social, cultural or ethnic backgrounds)	3. Effectively communicates with colleagues, other health professionals, patients, families and other caregivers
					Health Advocate 1.1.5 (Provide examples of disease prevention and the promotion of healthy behaviours in clinical practice)	7. Responds to the individual patient's health needs by advocating (supporting and speaking up) with the patient within and beyond the clinical environment

24HMG = 24-Hour Movement Guidelines; MCC = Medical Council of Canada

<sup>a</sup>Only the CanMEDS roles that were deemed as relevant to the proposed 24HMG content are listed in Table 2. As the curriculum map is in-progress, it is possible that linkages to other CanMEDS roles could be identified and listed in the final curriculum map.

<sup>b</sup>24HMG curricula were aligned with existing competencies at the Queen's University UGME Competency Framework either by ensuring that the competencies associated with existing learning events that we modified remained applicable or by linking new 24HMG curricula to existing competencies that we deemed were most applicable. Additionally, 24HMG content will fill gaps within newer MCC presentations in preventive care, which will be incorporated into existing assessment plans. Questions will be developed for the MCC Qualifying Examinations Part I and II section on Health Promotion and Illness Prevention.

<sup>c</sup>The learning events in Table 2 are a combination of (i) existing learning events in the Queen's University 2019-2020 UGME curriculum that related to the 24HMG and have been modified by the authors (e.g., row 1, modified from row 3 of Table 1) and (ii) new learning events that have been developed by the authors as short pieces of content that can either be added to existing learning events or traded for content within existing learning events not related to the 24HMG.

# Appendix B. 24-Hour movement guidelines for adults UGME curriculum scan

January 2021

Search of academic year 2019-2020 (most recent complete year)

Primary Search Terms	Physical activity "1" LE	Sedentary behaviour "0"	Sleep "17" but focused on disorders and physiology, not sleep hygiene	Movement "28" but none related to exercise; e.g. "movement disorders" or anatomy or neurology related to movement
Secondary Search Terms	Physically active "0"	Sedentary "0"	Rest "16" but none relevant (confounded term)	Movement behaviours "0"
	Activity *	Sitting "3" but not relevant (position of patient during Breast exam, cardiac exam, respiratory exam)	Sleep guideline "0"	
	Exercise *	Seated "14" but all in instructions to "stay seated" during online proctored exams.		
	Physical exercise "0"	Inactive "0"		
	Aerobic physical activity "0"	Inactivity "0"		
	Aerobic exercise "0" Searched "aerobic"***			
	Strength training "0"			
	Physical activity guideline "0"			
	Exercise guideline "0"			

\* Can't search these terms, because of alternative usage, e.g. "you will complete this activity"

\*\* Search for simply "aerobic" turned up one result, but it was about pneumonia and "aerobic, anaerobic and non-bacterial infection"