

REVIEWS, THEORETICAL PAPERS, AND META-ANALYSES

See it, Address it, Solve it” framework to support understanding and facilitate development of adaptive expertise in training and practice

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Abstract

Background: Adaptive expertise is crucial in generalist areas of medicine, where practitioners must navigate both routine and novel clinical situations daily. While adaptive expertise has been well described in the literature, there is a gap when it comes to concrete guidance for teaching and assessing adaptive expertise. This study aims to develop an evidence-guided model to support clinical educators and learners with understanding adaptive expertise so that it can be taught and assessed in the context of clinical training.

Methods: The research team used a three-stage process to develop a model of adaptive expertise. In Stage 1, a panel of experts created a concept map to describe elements of adaptive expertise in the context of the generalist clinical workplace, followed by a scoping review of the adaptive expertise literature in Stage 2. In Stage 3, the panel integrated the original concept map with the results of the scoping review to create a model of adaptive expertise in the context of the generalist clinical workplace using consensus development panel methodology.

Results: The “See it, Address it, Solve it” model illustrates how generalist practitioners move through three iterative phases: identifying gaps in knowledge or care (“See it”), engaging in innovative and context-specific problem-solving (“Address it”), and implementing and refining solutions using clinical judgement (“Solve it”).

Conclusions: The “See it, Address it, Solve it” model offers a practical resource to support both understanding of adaptive expertise in the clinical workplace, and help educators identify elements of adaptive expertise to facilitate teaching and assessment.

Le cadre « Voir, Aborder, Résoudre » pour favoriser la compréhension et faciliter le développement de l'expertise adaptative dans la formation et la pratique

Résumé

Contexte : L'expertise adaptative est essentielle dans les domaines généralistes de la médecine, où les praticiens doivent quotidiennement faire face à des situations cliniques tant courantes que nouvelles. Bien que l'expertise adaptative ait été largement décrite dans la littérature, il manque des recommandations concrètes pour son enseignement et son évaluation. Cette étude vise à développer un modèle fondé sur des données probantes afin d'aider les formateurs cliniques et les apprenants à comprendre l'expertise adaptative, de sorte qu'elle puisse être enseignée et évaluée dans le contexte de la formation clinique.

Méthodes : L'équipe de recherche a utilisé un processus en trois étapes pour développer un modèle d'expertise adaptative. Au cours de la phase 1, un groupe d'experts a créé une carte conceptuelle pour décrire les éléments de l'expertise adaptative dans le contexte du milieu de pratique clinique généraliste, suivie d'une revue de la portée de la littérature sur l'expertise adaptative au cours de la phase 2. Durant la phase 3, le groupe a intégré la carte conceptuelle initiale aux résultats de la revue de la portée afin de créer un modèle d'expertise adaptative dans le contexte du milieu de pratique clinique généraliste, en utilisant une méthodologie de panel visant à développer un consensus.

Résultats : Le modèle « Voir, Aborder, Résoudre » illustre comment les praticiens généralistes passent par trois phases itératives : identifier les lacunes dans les connaissances ou les soins (« Voir »), s'engager dans une résolution de problèmes innovante et adaptée au contexte (« Aborder »), et mettre en œuvre et affiner des solutions en s'appuyant sur le jugement clinique (« Résoudre »).

Conclusions : Le modèle « Voir, Aborder, Résoudre » offre une ressource pratique pour favoriser à la fois la compréhension de l'expertise adaptative dans le milieu clinique et aider les formateurs à identifier les éléments de l'expertise adaptative afin de faciliter l'enseignement et l'évaluation.

Introduction

The practice of medicine is filled with uncertainty, especially for those in generalist areas.¹ This uncertainty is partially due to the breadth of practice, partially due to patients presenting early in the course of disease before usual patterns of disease have evolved, and partially due to each patient's unique biopsychosocial contributors to illness.²⁻⁵ Generalist medicine requires competence in seamlessly navigating between common routine problems and

novel or uncertain ones. However, discomfort in dealing with uncertainty may be a contributing factor to why fewer medical school graduates are choosing to practice generalist medicine.⁶ Finding ways to reverse this trend is crucial, given the urgent need in Canada for generalist physicians, especially family physicians.⁷ Incorporating deliberate approaches to increase comfort with uncertainty during medical training is one potential solution.

Common clinical situations are just that: common. Practitioners build mental models for typical

presentations for these conditions (a heuristic picture)⁸ and acquire the knowledge and skills to manage them. Management will probably change over time, requiring ongoing continuing medical education. Presentations may vary somewhat from patient to patient, but these common presentations are relatively easy to diagnose and manage. This process is the procedural fluency that starts during training and continues to grow in practice.

Novelty and uncertainty are also realities of practice. New situations, either new to the world or new to the physician, are encountered. A patient's presentation turns out to be more complex and unusual than their presenting complaint suggested, community needs change, and/or new career opportunities are embarked upon. In these situations, a physician may not have previous solutions to rely on, or what worked in the past will not work in this instance. As a result, physicians must be adaptable and flexible in their approach and able to safely navigate uncertainty. Moreover, our education must attend to both the routine and non-routine aspects of patient care to ensure that physicians are prepared for full-scope generalist practice. One way to do this is to better incorporate adaptive expertise into training.

Adaptive expertise presents a model of expert development and performance that can be incorporated into health professions education (HPE) training programs to help prepare physicians for practice where they need to be able to adapt to novelty and complexity, which can inform the supervisor's response. Adaptive expertise^{9,10} emphasizes a balance between efficiency and innovation in problem-solving situations. In response to the unknown, new knowledge and/or concepts must be learned, and new or innovative solutions—possibly including new skills—must be created or developed.¹¹ These solutions may need to be “built” *de novo* or may build on previous knowledge and skills.¹⁰ The model of adaptive expertise emphasizes that physicians need to be both efficient and innovative to safely and effectively do their daily work, with the strategies for each patient encounter falling somewhere along the “optimal adaptability corridor” (i.e., the right balance between efficiency and innovation)

described by Schwartz, Bransford, and Sears.¹² Importantly, practice in this optimal adaptability corridor requires proper discernment to determine when a clinical situation is well-suited to previously used skills and knowledge (“routine expertise”), and when (and how) a situation requires an innovative solution (“adaptive expertise”).

Integrating adaptive expertise into existing HPE training is an area of growing interest. Both the Royal College of Physicians and Surgeons of Canada (RCPSC) and the College of Family Physicians of Canada (CFPC) are in the process of incorporating adaptive expertise into their competency frameworks (respectively, CanMEDS¹³ and Skill Dimensions¹⁴). Teaching and assessing for adaptive expertise are seen as a way to ensure that graduates of HPE training programs are better prepared to safely navigate the uncertainty inherent in clinical practice. Being externally judged to be competent does not necessarily translate into internal feelings of confidence to provide safe care outside the contexts where that competence was judged. Competence during training most often has defined parameters (benchmarks) and is being assessed in the present. Competence is a known, contained entity. Explicitly teaching for adaptive expertise is expected to help learners to develop the capacity and confidence to be able to safely adapt their current competence in novel situations, if needed, and to be prepared to develop new competencies.¹⁵ Adaptive expertise is therefore a key element of preparedness for practice and future learning.

While the concept and underlying theories of adaptive expertise are well described in the HPE literature,^{9,11,16} there is a gap when it comes to concrete guidance for clinical educators and learners.^{15,17} To address this gap in the context of training for generalist family medicine, the CFPC asked members of the Certification Process and Assessment Committee (CPAC; CFPC committee responsible for defining assessment practices for family medicine training in Canada) to take on the task of articulating how to teach and assess for adaptive expertise with learners in the clinical workplace. To achieve this task, CPAC members engaged in a multi-year project to develop a model describing elements of

adaptive expertise in the clinical workplace which could be used as a practical resource by educators and learners across all specialties.

Methods

The members of CPAC developed a model of adaptive expertise in the clinical workplace using a three-stage process.

Team members' expertise: The members of CPAC form an expert panel as defined for group consensus approaches:¹⁸ all CPAC members are academic HPE researchers and practicing physicians and clinical teachers, with the exception of one PhD member who has extensive education and experience in learning and assessment. All CPAC members have held leadership roles in HPE training programs and have extensive knowledge and experience related to teaching and assessment in clinical training. Over the course of this project, a core group of five CPAC members was involved in all stages. In Stage 2, a doctoral graduate student specializing in adaptive expertise joined the panel. In Stage 3, three new members joined CPAC, resulting in a nine-member expert panel (with experience ranging from 5-40 years in practice) who engaged in a consensus development panel approach¹⁹ to create a final model.

Reflexivity: The team engaged in active strategies to practice reflexivity. The diverse experiences of the core team created a culture where regular discussions occurred to explicitly identify potential biases and pre-existing assumptions held by team members. As the framework developed, the team engaged in open discussions to incorporate individual team members' experiences into the framework, while also ensuring the incorporation of theoretical findings into the framework. When the team expanded in Stages 2 and 3, new team members actively led discussions intended to identify where the framework may have been influenced by potential bias or preconceived ideas by member(s) of the original core team. The team continuously reflected on how their professional backgrounds, leadership positions, and theoretical orientations shaped their interpretation and decision-making, aiming to mitigate potential biases and foster a balanced,

comprehensive conceptualization of adaptive expertise that incorporated theory and experience.

Stage 1: *Identifying elements of adaptive expertise to articulate how it can be taught and assessed in HPE programs:* Discussion took place at three CPAC meetings between September 2019 and March 2020. Initial discussions combined rapid reviews of the adaptive expertise literature²⁰⁻²³ with personal experiences from family medicine practice and teaching. These discussions resulted in an initial concept map to show the relationships between the elements identified in the group discussions.

Stage 2: *Review of the literature:* The team carried out a scoping review of adaptive expertise in health professions education (HPE) between May and October 2021 in collaboration with a subject librarian and a doctoral graduate student specializing in adaptive expertise.⁹ This scoping review provided a thorough description of how adaptive expertise is defined in the HPE literature and it identified how HPE training programs can support the development of adaptive expertise.

Stage 3: *Determining consensus on the elements of the model:* The CPAC members used consensus development panel methodology^{18,19} to create a final model. The team integrated findings from the scoping review with the preliminary concept map at a CPAC meeting in October 2021. Individual members created variations of the model using the new evidence-integrated concept map as a common starting point, and shared these models for discussion during the virtual January 2022 CPAC meeting, resulting in a new iteration of the concept map that incorporated literature findings and front-line clinical and teaching experience. CPAC members contributed comments and suggestions for turning the concept map into a practical model using an online collaborative concept mapping software program (Mural; Tactivos Inc). At a face-to-face meeting in May 2022, the CPAC members reviewed the model being developed and made revisions over two days. The team reached consensus when all CPAC members agreed on a final version that integrated theory and findings from the literature with clinical and teaching experiences of the expert panel.

Results

In developing a practical model of adaptive expertise to support teaching and assessment in clinical training, we sought to identify the key elements of adaptive expertise that allow physicians to efficiently and creatively go about their work and, depending on the situation at hand, respond safely to patient and community needs through adapting

existing competencies or learning new ones. The model articulates the contributing conditions and factors that facilitate thinking outside the box, acknowledging if and when there is a lack of knowledge and expertise, and having the confidence, courage, and capacity to tackle new situations. In describing this model (Figure 1), we begin with a clinical case example where adaptive expertise would be needed.

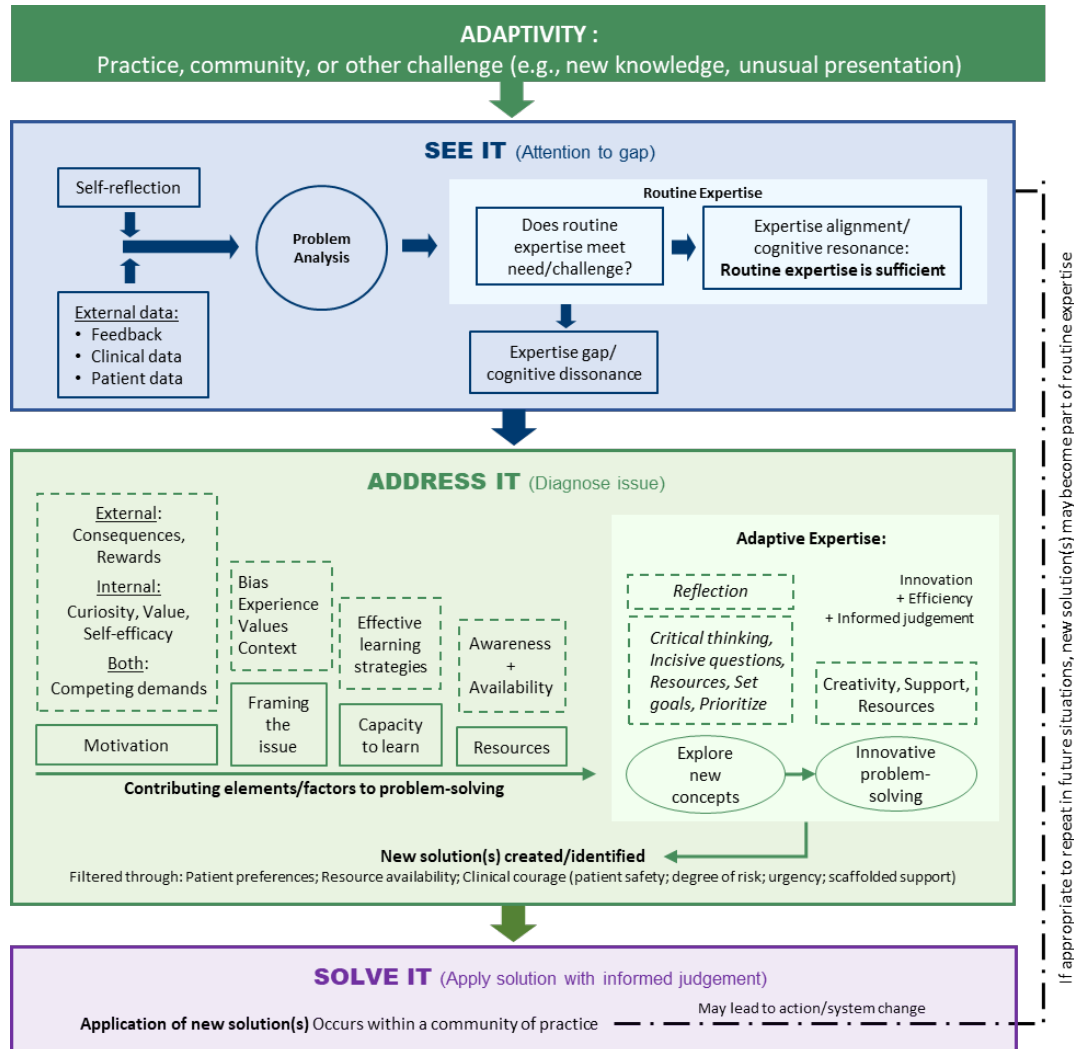


Figure 1. A practical model of elements contributing to adaptive expertise in clinical practice. This model integrates theory and experts' experiences to describe what contributes to adaptive expertise, and articulates individual components to foster understanding of adaptive expertise for learners and educators in HPE training programs.

Case example Part 1:

Dr. Z works as a rural full-scope family physician, often with a resident. Dr. Z's practice includes

outpatient family medicine clinic, shifts in the rural emergency department, and inpatient hospitalist work. During orientation with a new resident, Dr. Z set expectations for the rotation, including letting the resident know that there will be times when the resident is unsure of next steps with a patient and

that Dr. Z will partner with the resident on working through those situations. Dr. Z likes to emphasize this with all new residents, because as is common in many rural contexts, there are no specialists working in Dr. Z's community, so complex cases fall to Dr. Z and fellow family physicians.

Three weeks after the resident has started working with Dr. Z, they are called to see a profoundly ill patient whose condition is quickly deteriorating. Supervising closely, Dr. Z has the resident start management, letting the resident know that Dr. Z will step in if the patient deteriorates and/or the resident hits the limits of their personal expertise. When the resident asks for help, Dr. Z initiates usual strategies for stabilizing the patient, consults some point-of-care online resources, and calls a specialist colleague to confirm a plan for the next steps. Once the patient was stabilized, if you were Dr. Z, how would you debrief with the resident?

Step one: See it. Each patient encounter requires analysis and self-examination. The clinician needs to identify what is going on and if the situation matches with something they already know. They determine whether they can safely and effectively manage the patient's problem. In analyzing a clinical issue, the practitioner seeks alignment with what is already known and considers the path forward. They consider whether the visit is a simple follow-up with no complications or whether it is a new presentation that aligns well with their heuristic for this constellation of signs and symptoms. They identify if there is a management plan that is known to them and acceptable to the patient. If these elements are the case, we respond with an efficient and safe path forward (particularly if we have also employed deliberate consideration of potentially dangerous diagnoses to avoid early closure, confirmation bias, and other potential errors).²⁴ When a previous solution does not meet the needs for this patient's presentation, then the adaptive practitioner must pay attention to and respond to that misalignment. Cognitive dissonance is defined in several ways but can be thought of as the discomfort that occurs when thoughts or beliefs don't align with the situation at hand.²⁵ The adaptive expert uses that discomfort as a tool to stop

pushing forward with the prior solution and consider new possibilities. Paying attention to discomfort and pausing has been termed as 'creating epistemic distance': distancing one's current beliefs from the problem at hand^{16,26} to support slowing down, thinking more about the problem and employing additional resources to solve the problem, including collaboration with other healthcare providers. Certain internal and external factors will facilitate or inhibit the adaptive response to problem-solving. These are outlined on the left-hand side of the second box, *Address it*.

Step 2: Address it. Both internal and external factors either facilitate or inhibit our adaptability. External factors impacting a mindful response to cognitive dissonance primarily include competing demands and the availability of resources (point of care resources, equipment, other health care practitioners). You can imagine the scenario where there are multiple demands (many patients, other health care practitioners and learners asking questions or making requests) with limited resources (no available equipment, no colleagues for a second opinion, no point-of-care information tools). In that moment the doubt/cognitive dissonance about a diagnosis or management plan may be suppressed. Other external factors, such as a shame/blame-based organization, may also suppress attention to cognitive dissonance. Internal factors priming us to pay attention to cognitive dissonance include our sense of responsibility to the patient, capacity to focus on the problem at hand, willingness to embrace uncertainty, curiosity, humility, mindful attention to biases, and sense of being able to solve the problem (self-efficacy based on experience, effective learning strategies, and awareness of resources and how to use them). On the other hand, a desire to appear certain, to be "right", or feeling the pressure of time—may lead to pushing forward and ignoring cognitive dissonance.

Ideally, cognitive dissonance should act as a prompt to start exploring new concepts and invoke innovative problem-solving skills. Again, there are external and internal elements that facilitate or inhibit this exploration and innovation. Externally, resources (equipment, personnel, support) and a just

culture²⁷ facilitate exploration and innovation. On a personal level is our capacity for critical thinking, distilling information to inform decisive questions, prioritizing situations, setting goals, and being creative and open new diagnostic and/or management possibilities. With those in hand and using wise judgment, the adaptive expert, in consultation with the patient, then works to solve the problem at hand.

Step 3: Solve it. Judgement, availability of resources, and patient preferences will dictate different paths in a clinical situation, either action or watchful waiting. Judgement becomes increasingly important as both the need for action and the risk of active treatment increase, as illustrated in Figure 2. Low-Need, Low-Risk situations (quadrant 1) require some judgement, primarily about whether to employ watchful waiting or engage in a low-risk treatment. Neither strategy puts the patient at significant risk, and action primarily comes down to patient and practitioner preferences and/or availability of treatment resources. Low-Need, High-Risk situations (quadrant 2) would almost always make watchful waiting the best option. High-Need, Low-Risk situations (quadrant 3) would usually make intervention the best option. Quadrant 4, High-Risk, High-Need, is the most challenging of all situations. This is the case where the need for adaptive expertise, facilitated through internal and external factors, is may be particularly important to ensure the best possible outcome. The case example at the beginning of this section illustrates a situation where there is a need for intervention, but that intervention goes beyond the practitioner’s routine expertise alone and is risky. A critical element for the practitioner in this situation is the decision of who is in the best position to treat the patient, considering the context and availability of resources.

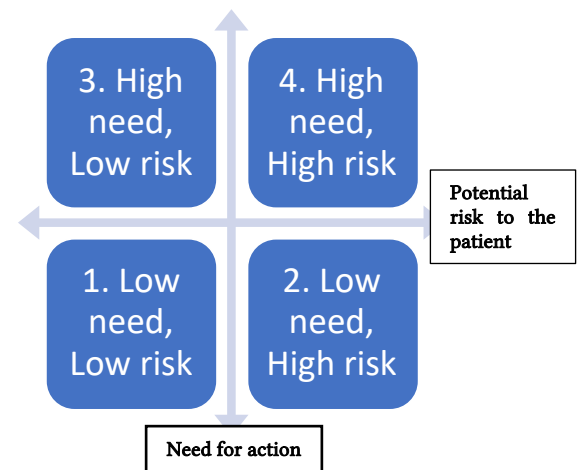


Figure 2. Influences on decision-making when a novel or challenging situation requires a practitioner to demonstrate adaptive expertise.

Whenever adaptive expertise is called into play, the outcome(s) should prompt reflection on the approach, outcome, and learning for future practice.²⁸ If it worked well, the adaptive expertise prompted by what was a novel situation may in time become routine when similar circumstances occur (dotted line on the right side of Figure 1). A debrief for circumstances in Quadrant 4—what worked well, what was a near miss, what is needed for next time?—should be part of being an adaptive expert working in an adaptive system. This is illustrated in Part 2 of our case example.

Case Example Part 2

When there was a quiet moment in the day, Dr. Z sat down with their learner to review the patient. Dr. Z first explored with the learner their takeaways from that encounter (encouraging reflection) and then provided feedback to them about their initial management of the patient. They asked them what they would have done if they hadn’t had Dr. Z to turn to in the moment. As the learner reflected on possible management plans Dr. Z guided them beyond their initial thoughts (into their “zone of proximal development”).²⁹ Dr. Z asked for things such as a more extensive differential diagnosis, if other things should be on the list and if not why, what a more expanded treatment plan might be, and posed “what if?” questions to change the scenario slightly. In doing so Dr. Z also pushed the learner up Bloom’s taxonomy of learning from simple answers to more

nuanced explanations,³⁰ ultimately pushing into areas of uncertainty and encouraging critical thinking. When the learner got to the point when they didn't know and couldn't reason out next steps, Dr. Z deliberately commended them on being able to say I don't know, acknowledging that uncertainty and lack of knowing everything is a reality of practice (positively spotlighting the importance of humility). This praise was followed by "and how will you find out"

Dr. Z then discussed with the learner their own reasoning and reactions during the management of the patient (making the "implicit explicit").³¹ Dr. Z added some elements to the resident's initial diagnosis and management plan, pushing the resident to move up Bloom's taxonomy from simple answers to explanations for why this diagnosis was part of a differential diagnosis and this one wasn't, why this management plan seemed appropriate or not. Dr. Z also talked about the point Dr. Z had personally hit their own wall of uncertainty, role modeling this as a part of Family Medicine,³² what that felt like, what Dr. Z weighed in their mind for next steps (risk/benefit Figure 2), what tipped them to using point-of-care tools, and why they called a colleague (illuminating the concept of cognitive dissonance and what to do with it). This was followed by a discussion of what went well and what could be improved, and the next steps of learning for both Dr. Z and the resident (role modeling continuous quality improvement and humility) and when Dr. Z and the resident would find time to talk about those.

In documenting the assessment of this learner, Dr. Z explicitly identified and labelled elements of adaptive expertise that this learner had demonstrated, from being able to identify when a patient's presentation was not following a usual course, slowing down and rethinking the diagnosis and/or management plan. Dr. Z noted positively the learner's ability to admit when they didn't know, ask thoughtful questions, and be innovative in using resources, including references and other team members to problem-solve. Later, Dr. Z did another assessment noting the resident's conscientiousness in further reading and demonstration of new skills with a subsequent patient.

Dr. Z discussed with the program director the value of using such a case presentation, where the initial plan was uncertain, to create a simulation case³³ or OSCE³⁴ where the objective of the case was managing uncertainty.

Discussion

We have described the personal and system factors that impede or facilitate adaptive expertise, and have presented a model of adaptive expertise 'in action' to help teachers and learners to be able to better understand this concept in the context of clinical workplace teaching and assessment. Figure 1 can also form a framework to consider curricular factors to support the development of adaptive expertise, thinking about the elements of developing "deep conceptual understanding, exposure to meaningful variation, an emphasis on productive struggle, and discovery and metacognitive strategizing."^{15,17} While previous literature has identified the importance of adaptive expertise as a theoretical framework to support generalist practice,⁴ our model offers an important contribution through the explicit operationalization of how adaptive expertise looks in generalist training and practice. This operationalization is an important consideration for supporting educators tasked with teaching and assessing adaptive expertise in their specific context. Moreover, our model incorporates strategies to explore the different professional behaviours and dispositions that can support adaptive expertise in training and practice (i.e self-efficacy). This perspective is often overlooked: while notions of preparedness—and broader conversations in medical education—often equate competence with knowledge and skills, we highlight the internal and external factors which support efficient and innovative use of this knowledge in response to emerging patient problems. It is important to note that foundational to each step of the model are attributes of cognitive flexibility,³⁵ humility,³⁶ self-efficacy,³⁷ and clinical courage.³⁸ In Table 1, we describe some of the factors identified in the literature that support development of, and engagement in, adaptive expertise in training and practice.

Table 1. Supporting the development of adaptive expertise in training and in practice.

	In training	In practice
Promote self-reflection	Preceptors trained to role-model self-reflection, how to deal with uncertainty, ³⁹ what cognitive dissonance feels like and adaptive responses to that Preceptors ask for learner's thoughts and reactions before providing answers	Continuing medical education and faculty development builds in time and uses the same strategies as for learners for self-reflection Institutional review process promotes self-reflection
Promote productive struggle	Preceptors ask for learner's thoughts and reactions before providing answers Preceptors push learners into their "zone of proximal development" ²⁹ (e.g. just past the limits of their knowledge) by: -Asking questions that push for deeper understanding ³⁰ -Adding variation to questions ("what if" questions)	Continuing medical education and faculty development builds in time for productive struggle. using the same strategies as for learners.
Motivation-consequences	System follows a "just culture" ²⁷ where exploration of errors does not focus on blame but a review of the systems issues that contributed to the error and expectations are set that misses and near-misses undergo a review as part of a professional duty	
Self-efficacy	Learners provided with increasingly sophisticated uncertain presentations, initially didactically, then through simulation ³³ and subsequently in clinical situations, with instruction on how to deal with uncertainty safely Preceptors explicitly discuss and challenge the notion that uncertainty indicates incompetence ³⁴ In assessment (e.g. OSCEs), cases without an obvious answer are used, assessing for dealing with uncertainty ³⁴	
Competing demands	Time is built into the curriculum for reflection	Where situations demand heightened reflection and focus, strategies are enacted to decrease competing demands ³⁸
Bias	Training in recognizing bias and ways to mitigate it is provided ²⁴	
Resources	Access to point-of-care tools, and the supervisor as needed	Access to point-of-care tools, experts (both locally and distant) with clear pathways for contact, targeted faculty development to deal with new circumstances (community need, new epidemic/pandemic)
Critical thinking	Instruction in clinical reasoning and critical thinking in settings of uncertainty ⁴¹	
Evaluation	Instruction in quality improvement strategies ⁴²	Access to data to inform evaluation; identified QI directors to address issues.

It should be noted that integrating adaptive expertise into HPE training and practice will take more than just developing a teaching module or offering some faculty development sessions. Rather, there needs to be cultural and system changes to reach the goal of developing clinical practitioners who are adaptive experts. A practice environment of "just culture" (non-shame/non-blame based)²⁷ with available resources and time for reflection/debriefing supports adaptive expertise in clinical practice. Similarly, establishing an educational environment that incorporates "just culture" will support learners in their development of adaptive expertise. Deliberate attention to curriculum and assessment elements (Table 1) that promote and/or nurture intrinsic elements such as a sense of self-efficacy, clinical

humility, and engagement in self-reflection and critical thinking will support the development of learners who are both competent and confident, and prepared to practice to their full scope.

Conclusion

Physicians must be adaptive experts. Most situations will call for routine problem-solving, but everyone will face novel situations. In that context of challenge or novelty, the adaptive practitioner must use the discomfort of cognitive dissonance to engage their internal and external resources to effectively explore new concepts and problem solve to manage the new situation, such as through

engaging in adaptive expertise with judgement. Residency training and clinical practice systems need to be aware of the elements making up and supporting the development and deployment of adaptive expertise. These systems need to deliberately train and support physicians as they integrate this expertise in their training and practice.

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