



## The education passport: Connecting programmatic assessment across learning and practice

## Le Passeport éducatif : relier l'évaluation programmatique à l'apprentissage et à la pratique tout au long de la formation

Eric J Warm, Carol Carraccio, Matthew Kelleher, Benjamin Kinnear, Daniel J Schumacher and Sally Santen

Volume 13, Number 4, 2022

New thinking on medical licensure in Canada  
Nouvelle réflexion sur le permis d'exercice de la médecine au Canada

URI: <https://id.erudit.org/iderudit/1092127ar>  
DOI: <https://doi.org/10.36834/cmej.73871>

[See table of contents](#)

Publisher(s)

Canadian Medical Education Journal

ISSN

1923-1202 (digital)

[Explore this journal](#)

Cite this article

Warm, E., Carraccio, C., Kelleher, M., Kinnear, B., Schumacher, D. & Santen, S. (2022). The education passport: Connecting programmatic assessment across learning and practice. *Canadian Medical Education Journal / Revue canadienne de l'éducation médicale*, 13(4), 82–91. <https://doi.org/10.36834/cmej.73871>

Article abstract

Competency-based medical education (CBME) shifts us from static assessment of learning to developmental assessment for learning. However, implementation challenges associated with CBME remain a major hurdle, especially after training and into practice. The full benefit of developmental assessment for learning over time requires collaboration, cooperation, and trust among learners, regulators, and the public that transcends each individual phase. The authors introduce the concept of an “Education Passport” that provides evidence of readiness to travel across the boundaries between undergraduate medical education, graduate medical education, and the expanse of practice.

The Education Passport uses programmatic assessment, a process of collecting numerous low stakes assessments from multiple sources over time, judging these data using criterion-referencing, and enhancing this with coaching and competency committees to understand, process, and accelerate growth without end. Information in the Passport is housed on a cloud-based server controlled by the student/physician over the course of training and practice. These data are mapped to various educational frameworks such as Entrustable Professional Activities or milestones for ease of longitudinal performance tracking. At each stage of education and practice the student/physician grants Passport access to all entities that can provide data on performance. Database managers use learning analytics to connect and display information over time that are then used by the student/physician, their assigned or chosen coaches, and review committees to maintain or improve performance. Global information is also collected and analyzed to improve the entire system of learning and care.

Developing a true continuum that embraces performance and growth will be a long-term adaptive challenge across many organizations and jurisdictions and will require coordination from regulatory and national agencies. An Education Passport could also serve as an organizing tool and will require research and high-value communication strategies to maximize public trust in the work.

© Eric J Warm, Carol Carraccio, Matthew Kelleher, Benjamin Kinnear, Daniel J Schumacher, Sally Santen, 2022



This document is protected by copyright law. Use of the services of Érudit (including reproduction) is subject to its terms and conditions, which can be viewed online.

<https://apropos.erudit.org/en/users/policy-on-use/>

## The education passport: connecting programmatic assessment across learning and practice

### Le Passeport éducatif : relier l'évaluation programmatique à l'apprentissage et à la pratique tout au long de la formation

Eric J Warm,<sup>1</sup> Carol Carraccio,<sup>2</sup> Matthew Kelleher<sup>1</sup> Benjamin Kinnear,<sup>3</sup> Daniel J Schumacher,<sup>4</sup> Sally Santen<sup>4,5</sup>

<sup>1</sup>Department of Internal Medicine, University of Cincinnati College of Medicine, Ohio, USA; <sup>2</sup>American Board of Pediatrics, North Carolina, USA; <sup>3</sup>Department of Pediatrics, University of Cincinnati College of Medicine, Ohio, USA; <sup>4</sup>Division of Emergency Medicine, Cincinnati Children's Hospital Medical Center and the University of Cincinnati College of Medicine, Ohio, USA; <sup>5</sup>Virginia Commonwealth University, Ohio, USA

Correspondence to: Eric J. Warm, warme@ucmail.uc.edu

Published ahead of issue: July 18, 2022 published: Aug 26, 2022. CMEJ 2022, 13(4) Available at <https://doi.org/10.36834/cmej.73871>

© 2022 Warm, Carraccio, Kelleher, Kinnear, Schumacher, Santen; 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

Competency-based medical education (CBME) shifts us from static assessment of learning to developmental assessment for learning. However, implementation challenges associated with CBME remain a major hurdle, especially after training and into practice. The full benefit of developmental assessment for learning over time requires collaboration, cooperation, and trust among learners, regulators, and the public that transcends each individual phase. The authors introduce the concept of an "Education Passport" that provides evidence of readiness to travel across the boundaries between undergraduate medical education, graduate medical education, and the expanse of practice.

The Education Passport uses programmatic assessment, a process of collecting numerous low stakes assessments from multiple sources over time, judging these data using criterion-referencing, and enhancing this with coaching and competency committees to understand, process, and accelerate growth without end. Information in the Passport is housed on a cloud-based server controlled by the student/physician over the course of training and practice. These data are mapped to various educational frameworks such as Entrustable Professional Activities or milestones for ease of longitudinal performance tracking. At each stage of education and practice the student/physician grants Passport access to all entities that can provide data on performance. Database managers use learning analytics to connect and display information over time that are then used by the student/physician, their assigned or chosen coaches, and review committees to maintain or improve performance. Global information is also collected and analyzed to improve the entire system of learning and care.

Developing a true continuum that embraces performance and growth will be a long-term adaptive challenge across many organizations and jurisdictions and will require coordination from regulatory and national agencies. An Education Passport could also serve as an organizing tool and will require research and high-value communication strategies to maximize public trust in the work.

#### Résumé

La formation médicale fondée sur les compétences (FMFC) nous fait passer d'une évaluation statique à une évaluation évolutive de l'apprentissage. Cependant, les défis qui accompagnent sa mise en œuvre demeurent un obstacle majeur, en particulier après la formation et dans la pratique. Pour tirer pleinement parti de l'évaluation évolutive de l'apprentissage au fil du temps, il faut une collaboration, une coopération et une confiance entre les apprenants, les organismes de réglementation et le public qui transcendent chaque phase individuelle. Les auteurs présentent le concept de « passeport éducatif » en guise de titre attestant que l'on est prêt à franchir les frontières entre la formation médicale de premier cycle, la formation postdoctorale et l'étendue de la pratique.

Dans le passeport éducatif, on utilise l'évaluation programmatique, un processus qui consiste à rassembler de nombreuses évaluations à faible enjeu provenant de sources multiples au fil du temps, dont les données sont évaluées à l'aide de critères de référence et améliorées par un encadrement et un examen par des comités de compétences afin de comprendre, de développer et d'accélérer la croissance de façon continue. Les informations contenues dans le passeport sont hébergées sur un serveur nuagique contrôlé par l'étudiant/médecin au cours de sa formation et de sa pratique. Ces données sont cartographiées en fonction de divers cadres éducatifs comme les activités professionnelles fiables ou des jalons pour faciliter le suivi longitudinal des performances. À chaque étape de la formation et de la pratique, l'étudiant/médecin accorde l'accès au passeport à toutes les entités qui peuvent fournir des données sur ses performances. Les gestionnaires de la base de données utilisent l'analyse de l'apprentissage pour recouper et afficher les informations au fil du temps, informations qui sont ensuite utilisées par l'étudiant/médecin, les coachs qu'on lui a désignés ou qu'il a choisis, et les comités d'examen pour maintenir ou améliorer les performances. Des informations globales sont également recueillies et analysées pour améliorer l'ensemble du système d'apprentissage et de soins.

L'élaboration d'un véritable continuum qui englobe la performance et la croissance constituera un défi d'adaptation à long terme pour les organisations et les provinces, et nécessitera une coordination entre instances réglementaires à l'échelle du pays. Le passeport éducatif pourrait également servir d'outil d'organisation, mais il impliquera des recherches et des stratégies de communication importantes pour maximiser la confiance du public dans ce travail.

## Introduction

Competency-based medical education (CBME) shifts us from a static assessment *of* learning to a developmental assessment *for* learning.<sup>1-3</sup> However, implementation challenges associated with CBME, in particular developing and achieving competency outcomes across transitions from undergraduate medical education (UME) to graduate medical education (GME) to practice, remain a major hurdle. The full benefit of developmental assessment *for* learning requires a foundation of collaboration, cooperation, and trust among learners, regulators, and the public that transcends each individual phase. Post-training regulatory bodies should generate processes that are developmental in nature while simultaneously measuring performance and growth

Using lessons learned from several UME and GME initiatives that involve data gathering, analytics, coaching, and handovers we introduce the concept of an “Education Passport” that provides evidence of readiness to travel across the boundaries between undergraduate medical education, graduate medical education, and the expanse of practice (Appendix A). Much of this work is grounded in programmatic assessment,<sup>3</sup> a process of collecting numerous low stakes assessments from multiple sources over time, judging these data using criterion-referencing, and enhancing this with coaching and competency committees to understand, process, and accelerate growth.

## Current state

Despite highly visible initiatives such as CanMEDS,<sup>4</sup> Competence by Design,<sup>5</sup> and the 13 Core Entrustable Professional Activities (EPAs) for entering residency,<sup>6</sup> the continuum of medical education has yet to fully adopt the changes necessary for true longitudinal CBME.<sup>6</sup> Rather, the stages of training have developed asynchronously to fill particular needs and numerous organizations now regulate a patchwork educational quilt.<sup>7,8</sup> Medical professionals progress through loosely linked experiences poorly connected to outcomes. Nearly everyone making it to the later stages of training continues into practice,<sup>9</sup> even when some should not,<sup>10-12</sup> and few mechanisms exist to reliably measure performance and growth over the length of a career.

The experience for many before medical training includes adopting performance-based mindsets<sup>13</sup> where students compete to achieve more than others to reach the next stage. Assessments of learning are rife with bias and

variation (e.g., grades, entrance exams, standardized testing),<sup>14,15</sup> and competition winnows candidates along the way. It is expected that many will fail because many *must* fail as each successive stage has fewer available slots for people to inhabit. The system incentivizes students to be “better enough” than the next person and impels institutions to rank people in order to present “the best” to the next stage. Therefore, most incentives leading to medical school embrace a culture of normative comparisons, and there is little motivation to pass anything along to the next stage except for this summation.

Once medical school begins, the pressures remain the same. Students must continue to outperform others to gain coveted residencies. Growth or the need for growth under these circumstances is viewed as negative, something to be hidden under a “cloak of competence.”<sup>16</sup> Hiding weaknesses and competing to gain the “best” residency positions are the dominant motivations within medical school, and only cursory summations of performance are communicated to the next level of training.<sup>17</sup> The same tensions continue throughout residency and fellowship, and the problem deepens. In practice, the business of medicine demands the best clinical outcomes, the highest volume, the fastest throughput, the greatest patient satisfaction, the largest knowledge base, and the most innovative discoveries. Health systems typically display only their highest-ranking metrics, usually as point prevalence data,<sup>18-20</sup> with little infrastructure or incentive to measure or report growth over time. Nearly all measurements focus on comparisons to others (norm referenced) rather than comparison to expected thresholds of performance (criterion referenced).

These efforts are associated with significant harm across the continuum including burnout,<sup>21-24</sup> shame,<sup>25,26</sup> and even suicide.<sup>27</sup> Clinical quality trails the enormous investments many nations make.<sup>28</sup> Poor behaviors such as professionalism issues often continue unchecked through the system.<sup>10,11,29</sup> Unfortunately, remedies such as CBME (e.g., CanMeds, ACGME Milestone project), advances from accreditation and licensing bodies, or myriad burnout mitigation efforts have yet to change these outcomes.<sup>30</sup>

## Moving to a developmental process

Multiple interrelated educational approaches may provide guidance in addressing these questions. The Dreyfus model,<sup>31</sup> representing a series of stages from novice to advanced beginner to competent to proficient to expert and master, lends itself to an educational continuum from

first day of school to the last day of practice. Experts are not static entities that reach a destination. Instead, experts “step back from their first, oversimplistic interpretation of a problem or situation and question their own knowledge.”<sup>32</sup> In growth mindset, individuals believe their abilities can be developed through hard work, strategy, and help from others.<sup>13</sup> Failure is critical to learning, and when learners cannot do a task, they frame it as not being able to do it yet.<sup>13</sup> In master adaptive learning, a concept derived specifically for the medical professions, learners plan, learn, assess and *adjust*.<sup>33,34</sup>

This developmental model must start with entry into medical school, if not before, with intentional training, feedback, and reinforcement. It necessitates changes in grading with a focus on the ability of the trainee to engage in informed self-assessment and learning. Entry into practice also has the *potential* to reinforce growth mindset. In the US, the Joint Commission mandates a process of onboarding into practice (Focused Professional Practice Evaluation) and continued monitoring (Ongoing Professional Practice Evaluation). In reality, these practice evaluations are mostly checkboxes that do not influence performance, but in concept these processes could further engage practitioners in improvement and growth. In Canada, the example of the College’s Physician Peer Review might also support growth mindset if the conditions were right: a continual trajectory of improvement as described above of stepping back, questioning, continuous hard work, and adjusting *that has no end*.

## Creating a true medical education continuum

At present, the medical education ‘continuum’ consists of many performance ‘ends’ including graduations, board exams, and licensing procedures. Growth occurs within each of these defined periods, but it is generally not well-communicated between stages. However, measuring and reporting both performance *and* growth under one umbrella is inherent in the levels of the Dreyfus Model,<sup>31</sup> the challenges and triumphs of growth mindset,<sup>13</sup> and the *learning* and *assessing* stages in master adaptive learning.<sup>33</sup> Each of these concepts acknowledges and measures the distance travelled by the learner (growth) and the present state of the learner (performance). Real life examples of simultaneously measuring and reporting growth and performance can be found in the Educating Physician Across the Continuum (EPAC) project<sup>35</sup> and the Observable

Practice Activity (OPA) system of residency training.<sup>36</sup> In EPAC, a broad coalition of educational leaders identified and developed a standard set of tools that complemented local assessment efforts to inform decisions about transition from UME to GME to fellowship or practice.<sup>35</sup> These educators monitored entrustment trajectories through frequent review by a clinical competency committee (CCC, a concept first developed in GME).<sup>37</sup> CCCs aggregate feedback on direct observations and assessments from myriad sources to chart developmental paths in order to adjust or create new learning opportunities *and also* to make judgements regarding transitions between educational phases.<sup>38</sup> EPAC guaranteed residency spots to medical students *when they were ready* (which in many cases turned out to be faster than average), removing a powerful incentive for performance mindset and greatly incentivizing growth-minded behaviors. Licensing and regulatory bodies should look for similar incentives and disincentives in the structures and policies they oversee. In the OPA system, educators collect thousands of data points over time from multiple sources, plot these on a dashboard using learning analytics,<sup>39</sup> and pair these plots with narrative assessment.<sup>36,40,41</sup> A CCC then reviews these data to create learning plans for residents and their coaches to consider, *and* to make summary judgements about advancement, promotion, and graduation.<sup>36</sup> As in EPAC, residents are incentivized to get information about their performance because this data helps them create plans for improvement.

## Building a record of programmatic assessment from training to practice

Truly successful CBME projects occur at the local level with intense evaluation of relevant downstream outcome measures that inform the entire process going forward.<sup>35,42</sup> Learners and program designers receive ongoing guided feedback to continuously measure and improve outcomes. These programs follow the major tenants of programmatic assessment, an approach in which “routine information about the learner’s competence and progress is continually collected, analyzed and, where needed, complemented with purposively collected additional assessment information, with the intent to both maximally inform learners and their mentors.”<sup>3</sup> EPAC and OPAs offer a possible blueprint for regulatory bodies to follow as they consider a developmental approach to accrediting and licensing while also determining who can continue and/or progress in practice.

## Traveling across the continuum: education passports

Can we imagine then, an overarching “Education Passport” initiated at the beginning of medical school that provides evidence of readiness to travel across the boundaries between UME, GME, and the expanse of practice (Appendix A). An Education Passport could be housed on a cloud-based server that the student/physician could have access to from the first day of learning to the last day of practice (akin to a cell phone number that one may keep throughout life). At each stage of education and practice the student/physician would grant access to all entities that could provide data on performance. Using learning analytics,<sup>39,43,44</sup> database managers would connect and display information over time that could be used by the student/physician and their assigned or chosen coaches and review committees. Each level of training and practice would consist of the data relevant for that level (e.g., tests for medical students, case logs for residents, quality outcomes and patient satisfaction for attending physicians), with each element mapped to an organizing principle such as CanMeds roles,<sup>4</sup> EPAs<sup>6,45-47</sup> or milestones<sup>48</sup> for longitudinal performance tracking over time.<sup>41</sup> In this way, the Education Passport could include all of the primary data, but also an easily digestible set of summary display options that can be quickly and succinctly reviewed.

Much of this infrastructure is already present in UME and GME, but not yet in practice, Post-training regulatory bodies will need to create the conditions of programmatic assessment (e.g., collecting peer assessment, clinical outcomes, and knowledge-based testing, etc.) to generate the data needed for learning trajectories and judgements. This information, housed in the cloud-based Education Passport, could serve as the infrastructure for individual learning plans (ILPs) guided by practice coaches, as well as the framework judgments made by peer review committees based on the concept of CCCs.

## Stepping stones: extending growth and development into practice and licensure

Echoes of the concept of an Education Passport exists in other high risk, yet safe, industries such as aviation and nuclear power where pilots<sup>49</sup> and engineers<sup>50</sup> are monitored and tracked over time for continuing training and performance against clear criterion. In medicine, a critical first step in this direction will be to develop shared

mental models<sup>51</sup> of actual skill sets required for unsupervised practice (Appendix A). Current work on EPAs, CanMEDs and Milestones can serve as examples of this work.<sup>4-6</sup> A key second step will be to determine how to interpret growth trajectories and set thresholds of competence. Third, regulatory bodies will need to determine how best to develop and/or approve peer assessment bodies modeled after CCCs. The fourth step will be to determine support structures for particular skills sets that should be worked on in practice. For example, the ability to engage in quality improvement is critical for upholding our commitment to the public as a self-regulating profession, but it is often poorly developed at the time of GME completion. This should not necessarily keep a trainee from completing a program if direct patient care skills are at a level of competence. If using the Education Passport and ILP, this information would be given by the graduate to those at the next stage involved in assessing these skills in practice (an educational handover<sup>52</sup>). One may even consider graduating a resident who has more than one need for non-critical improvement. The combination of skill level and approach (humility, knowing limitations, self-awareness) would inform these decisions as well as the need for specific coaching within the practice setting. Even those who perform at a competent level for all EPAs should be expected to systematically work towards proficiency and expertise over time.

Once the infrastructure of data collection, coaching, and review are created in practice, the message from accrediting and regulatory bodies could be as follows:

- After review of the information in your Education Passport, we agree you need to demonstrate continued progress in X to reach the desired threshold for unsupervised practice.
- We want to work with you to continue to develop this skill
- We have activities that you can choose from to develop your skill in this cycle of maintenance of certification, or you can work with your coaches to develop an approach of your choosing
- These activities represent a continuous effort to develop your skills and abilities as part of your individual learning plan

- You will continue to be assessed at your local site, and we will use these measures as well as patient outcomes to re-evaluate you at X time in the future

Finally, accrediting and regulatory bodies will need to determine how to best facilitate transparency, trust, and communication of this information in safe and productive ways. Groups like EPAC have achieved this by deliberately planning and executing the first steps in this process: developing a shared mental model of skills, setting thresholds for trajectories and competence determination, and creating CCCs as promoters of growth *and* performance. The secret ingredient for the success of EPAC, which is just as relevant here, is a cultural revolution in which physicians become self-directed assessment seekers, who want the constructive feedback that will help them to improve.<sup>53</sup> Imagine if accrediting and regulatory bodies asked physicians to report failures and gaps in knowledge instead of the number of hours spent learning. If practicing physicians could be obsessed with their own gaps and failures, perhaps we could start chipping away at performance mentality.

We offer a ‘blue sky’ example of a longitudinal developmental framework driven by the specific and global needs of learners, educational institutions, accrediting, certifying, and licensing bodies, and the public (Appendix B). As expected, the figure acknowledges the process of training and licensing is complex. We highlight three key points. First, the training of physicians starts before medical school and extends into practice until retirement. Focusing on growth mindset should start as early as possible with the goal of engaging in master adaptive learning through plan-learn-assess-adjust cycles continuing throughout physicians’ careers. The process includes feedback on performance aligned with coaching. Second, performance outcomes need to feedback to trainees as part of master adaptive learning but there must also be a process to provide feedback to organizations for systems improvement. This occurs longitudinally to ensure integration and alignment of summative assessment and training. Finally, the top panel of Appendix B highlights that the competency domains might include communication, knowledge, and technical skills (among others) that grow from college to retirement with specific measurement points along the way. At each transition there will be summative assessment, but also a re-test of knowledge to ensure retention and transfer. There is expected growth over the continuum but there is also “forgetting” so that skills must be maintained. Therefore, once in practice,

learning, assessment, and certification must continue to grow as medicine changes. Examples like this will need to be tested for efficacy, and adjustments made as cycles of learning proceed without end.

## Possible consequences

Accrediting and regulatory bodies may have a significant challenge in bringing these issues forward. Can the public understand the nuance of continual growth trajectories in their personal physicians when centuries of precedent promote the opposite, or will they see physicians who are always trying to improve as not meeting performance expectations? Can medical education make the transition to time variable, fixed outcome structures that will almost certainly result from these efforts? Do licensing bodies have the reach to influence and the willingness to collaborate with other organizations across all the steps in the pipeline? If we fail to address these questions, practitioners may come to distrust a new developmentally minded process, resent feedback opportunities, and demand yet another system change.<sup>54,55</sup>

Critics of CBME, the bedrock of what we are proposing, argue that supporters have yet to offer solid empirical evidence for the work.<sup>56</sup> While some initial pilot CBME descriptions are robust, authors often frame limitations around implementation and interpretation.<sup>35,42,57,58</sup> Indeed, we believe one common failure of CBME and other trajectory-based learning strategies is that we treat implementation as a technical problem rather than an adaptive challenge. We should avoid this trap. As defined, technical problems are easily identified, lend themselves to quick and easy solutions, can be solved by authorities or expertise, and require change within relatively small organizational boundaries.<sup>59-61</sup> Technical solutions are implemented and solved quickly, often by edict.<sup>59-61</sup> Adaptive challenges, on the other hand, are difficult to identify and require adjustments in values, beliefs and roles. Adaptive challenges require change in numerous places, often across organizational boundaries, and must involve local people to solve the problems faced there. Success requires multiple tests of change, takes a long time to implement, and cannot be settled by edict.<sup>59-61</sup> Creating an Education Passport for a developmentally minded licensing process rooted in a culture that values continual growth over time is clearly an adaptive challenge.

## Recommendations

Using these ideas as a starting place we offer the following recommendations for accrediting and regulatory bodies and others to consider in creating a developmentally minded licensing process.

1. Reorient the work of accrediting and regulating to be developmentally minded, fostering continual growth mindset and master adaptive learning
2. Create an Education Passport housed on a cloud server controlled by the student/physician over the course of training and practice
3. Develop streams of programmatic assessment for the Education Passport that capture valuable competencies over time
4. Map the primary data in the Education Passport to overarching frameworks such as CanMeds roles, EPAs, or milestones and use learning analytics for ease of display and analysis
5. Set clear criterion and expectations for performance over time
6. Provide coaching to practicing physicians for reflection on the data in the Education Passport
7. Form clinical review committees for practicing physicians that resemble developmentally minded CCCs, and share summary recommendations with physicians and their coaches for further learning
8. Collate global performance information for feedback to the entire system of learning and care
9. Establish a public communication strategy that manages the polarity between measuring growth and certifying performance to maximize public trust in the work
10. Approach the issue of introducing development as part of the accrediting and regulatory processes as an adaptive challenge

We believe that continual development after training is possible and necessary, and we hope these concepts will spur thinking and research in this area.

**Conflicts of Interest:** None reported

**Funding:** None

## References

1. McGaghie WC, Miller GE, Sajid AW, Telder TV. Competency-based curriculum development on medical education: an introduction. *Public Health Pap.* 1978;(68):11-91.
2. Frank JR, Snell LS, Cate OT, et al. Competency-based medical education: theory to practice. *Med Teach.* 2010;32(8):638-45. <https://doi.org/10.3109/0142159X.2010.501190>
3. van der Vleuten CP, Schuwirth LW, Driessen EW, Govaerts MJ, Heeneman S. 12 Tips for programmatic assessment. *Med Teach.* Nov 2014:1-6. <https://doi.org/10.3109/0142159X.2014.973388>
4. Frank JR, Danoff D. The CanMEDS initiative: implementing an outcomes-based framework of physician competencies. *Med teach.* 2007;29(7):642-647. <https://doi.org/10.1080/01421590701746983>
5. Edgar L, Roberts S, Holmboe E. Milestones 2.0: a step forward. *JGME.* 2018;10(3):367. <https://doi.org/10.4300/JGME-D-18-00372.1>
6. Englander R, Flynn T, Call S, et al. Toward defining the foundation of the md degree: core Entrustable Professional Activities for entering residency. *Acad Med.* Oct 2016;91(10):1352-1358. <https://doi.org/10.1097/acm.0000000000001204>
7. Coalition for Physician Accountability. *Initial summary report and preliminary recommendations of the undergraduate medical education to graduate medical education review committee (UGRC).* <https://physicianaccountability.org/wp-content/uploads/2021/04/UGRC-Initial-Summary-Report-and-Preliminary-Recommendations-1.pdf> [Accessed May 15, 2021].
8. Santen SA, Foster KW, Hemphill RR, Christner J, Mejicano G. Simplifying the interconnected alphabet soup of medical education. *Acad Med.* 2022;97(5)
9. Gingerich A, Sebok-Syer SS, Larstone R, Watling CJ, Lingard L. Seeing but not believing: insights into the intractability of failure to fail. *Med Educ.* Dec 2020;54(12):1148-1158. <https://doi.org/10.1111/medu.14271>
10. Papadakis MA, Teherani A, Banach MA, et al. Disciplinary action by medical boards and prior behavior in medical school. *N Engl J Med.* Dec 2005;353(25):2673-82. <https://doi.org/10.1056/NEJMs052596>
11. Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during internal medicine residency training and subsequent disciplinary action by state licensing boards. *Ann Intern Med.* Jun 2008;148(11):869-76. <https://doi.org/10.7326/0003-4819-148-11-200806030-00009>
12. Jonker G, Ochtman A, Marty AP, Kalkman CJ, Ten Cate O, Hoff RG. Would you trust your loved ones to this trainee? Certification decisions in postgraduate anaesthesia training. *Br J Anaesth.* Nov 2020;125(5):e408-e410. <https://doi.org/10.1016/j.bja.2020.07.009>
13. Dweck CS. *Mindset: The new psychology of success.* Random House Digital, Inc; 2008.
14. Lucey CR, Hauer KE, Boatright D, Fernandez A. Medical education's wicked problem: achieving equity in assessment for medical learners. *Acad Med.* Dec 2020;95(12S Addressing harmful bias and eliminating discrimination in health

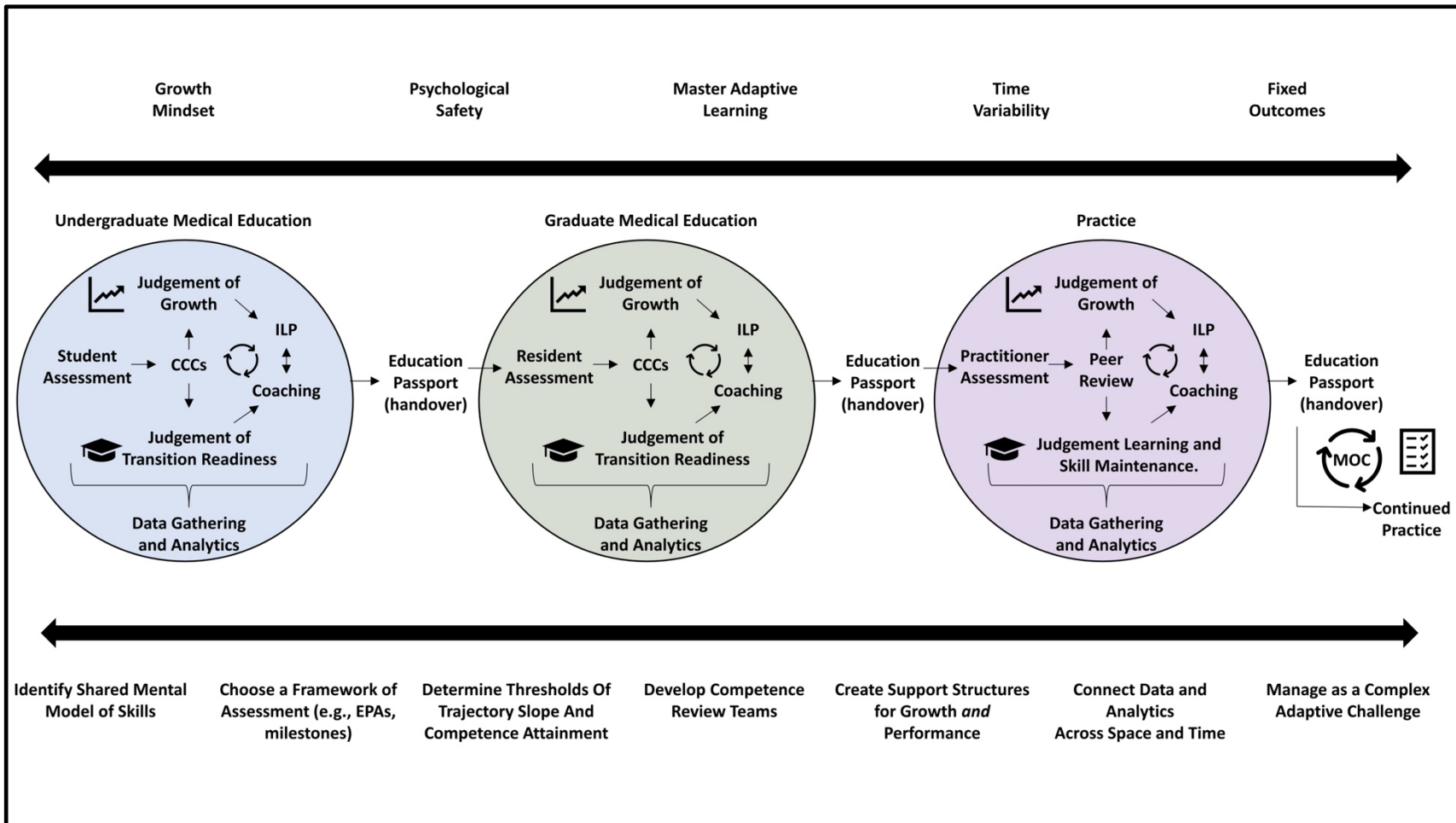
- professions learning environments):S98-s108.  
<https://doi.org/10.1097/acm.0000000000003717>
15. Low D, Pollack SW, Liao ZC, et al. Racial/ethnic disparities in clinical grading in medical school. *Teach Learn Med.* Oct-Dec 2019;31(5):487-496.  
<https://doi.org/10.1080/10401334.2019.1597724>
  16. Williams RG, Klamen DA, McGaghie WC. Cognitive, social and environmental sources of bias in clinical performance ratings. *Teach Learn Med.* 2003;15(4):270-92.  
[https://doi.org/10.1207/S15328015TLM1504\\_11](https://doi.org/10.1207/S15328015TLM1504_11)
  17. Warm EJ, Kinnear B, Pereira A, Hirsh DA. The residency match: escaping the prisoner's dilemma. *J Grad Med Educ.* Oct 2021;13(5):616-625. <https://doi.org/10.4300/jgme-d-21-00477.1>
  18. Mendu ML, Kachalia A, Eappen S. Revisiting US news & world report's hospital rankings-moving beyond mortality to metrics that improve care. *J Gen Intern Med.* 2021:209-210. vol. 1.  
<https://doi.org/10.1007/s11606-020-06002-x>
  19. Ried LD, Ried DB. Predicting the 2016 US News & world report rankings using a reputation and prestige model. *Curr Pharm Teach Learn.* Feb 2021;13(2):91-101.  
<https://doi.org/10.1016/j.cptl.2020.09.011>
  20. Newsweek. *Best Hospitals 2021 - Canada.* 2021.  
<https://www.newsweek.com/best-hospitals-2021/canada> [Accessed May 9, 2021].
  21. Fang DZ, Young CB, Golshan S, Moutier C, Zisook S. Burnout in premedical undergraduate students. *Acad Psych.* 2012;36(1):11-16.
  22. Ishak W, Nikraves R, Lederer S, Perry R, Ogunyemi D, Bernstein C. Burnout in medical students: a systematic review. *Clin Teach.* Aug 2013;10(4):242-5.  
<https://doi.org/10.1111/tct.12014>
  23. Prins JT, Gazendam-Donofrio SM, Tubben BJ, van der Heijden FM, van de Wiel HB, Hoekstra-Weebers JE. Burnout in medical residents: a review. *Med Educ.* Aug 2007;41(8):788-800.  
<https://doi.org/10.1111/j.1365-2923.2007.02797.x>
  24. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. *J Intern Med.* Jun 2018;283(6):516-529. <https://doi.org/10.1111/joim.12752>
  25. Bynum WEt, Artino AR, Jr., Uijtdehaage S, Webb AMB, Varpio L. Sentinel emotional events: the nature, triggers, and effects of shame experiences in medical residents. *Acad Med.* Jan 2019;94(1):85-93.  
<https://doi.org/10.1097/acm.0000000000002479>
  26. Bynum WEt, Varpio L, Lagoo J, Teunissen PW. 'I'm unworthy of being in this space': the origins of shame in medical students. *Med Educ.* Feb 2021;55(2):185-197.  
<https://doi.org/10.1111/medu.14354>
  27. Albuquerque J, Tulk S. Physician suicide. *Cmaj.* May 6 2019;191(18):E505. <https://doi.org/10.1503/cmaj.181687>
  28. Schneider EC, Sarnak DO, Squires D, Shah A, Doty MM. *Mirror Mirror 2017.* Commonwealth Fund New York; 2017.
  29. McDonald FS, Duhigg LM, Arnold GK, Hafer RM, Lipner RS. The American board of internal medicine maintenance of certification examination and state medical board disciplinary actions: a population cohort study. *J Gen Intern Med.* Aug 2018;33(8):1292-1298. <https://doi.org/10.1007/s11606-018-4376-z>
  30. Naji L, Singh B, Shah A, et al. Global prevalence of burnout among postgraduate medical trainees: a systematic review and meta-regression. *CMAJ Open.* Jan-Mar 2021;9(1):E189-e200.  
<https://doi.org/10.9778/cmajo.20200068>
  31. Dreyfus SE. The five-stage model of adult skill acquisition. *Bulletin of science, technology & society.* 2004;24(3):177-181.  
<https://doi.org/10.1177/0270467604264992>
  32. Dunning D. The Dunning-Kruger effect: On being ignorant of one's own ignorance. *Advances exper soc psychol.* Elsevier; 2011:247-296. <https://doi.org/10.1016/B978-0-12-385522-0.00005-6>
  33. Cutrer W, Pusic M, Gruppen LD, Hammoud MM, Santen SA. *The Master Adaptive Learner.* Elsevier Health Sciences; 2019.
  34. Cutrer WB, Miller B, Pusic MV, et al. Fostering the development of master adaptive learners: a conceptual model to guide skill acquisition in medical education. *Acad Med.* Jan 2017;92(1):70-75. <https://doi.org/10.1097/acm.0000000000001323>
  35. Andrews JS, Bale JF, Jr., Soep JB, et al. Education in pediatrics across the continuum (EPAC): first steps toward realizing the dream of competency-based education. *Acad Med.* Mar 2018;93(3):414-420.  
<https://doi.org/10.1097/acm.0000000000002020>
  36. Warm EJ, Held JD, Hellmann M, et al. entrusting observable practice activities and milestones over the 36 months of an internal medicine residency. *Acad Med.* Oct 2016;91(10):1398-1405. <https://doi.org/10.1097/acm.0000000000001292>
  37. Hauer KE, Chesluk B, Iobst W, et al. Reviewing residents' competence: a qualitative study of the role of clinical competency committees in performance assessment. *Acad Med.* Aug 2015;90(8):1084-92.  
<https://doi.org/10.1097/acm.0000000000000736>
  38. Hauer KE, Edgar L, Hogan SO, Kinnear B, Warm E. The science of effective group process: lessons for clinical competency committees. *J Grad Med Educ.* Apr 2021;13(2 Suppl):59-64.  
<https://doi.org/10.4300/jgme-d-20-00827.1>
  39. Thoma B, Warm E, Hamstra SJ, et al. Next steps in the implementation of learning analytics in medical education: consensus from an international cohort of medical educators. *J Grad Med Educ.* Jun 2020;12(3):303-311.  
<https://doi.org/10.4300/jgme-d-19-00493.1>
  40. Warm EJ, Mathis BR, Held JD, et al. Entrustment and mapping of observable practice activities for resident assessment. *J Gen Intern Med.* Aug 2014;29(8):1177-82.  
<https://doi.org/10.1007/s11606-014-2801-5>
  41. Schauer DP, Kinnear B, Kelleher M, Sall D, Schumacher DJ, Warm EJ. Developing the expected entrustment score: accounting for variation in resident assessment. *J Gen Intern Med.* Apr 4 2022; <https://doi.org/10.1007/s11606-022-07492-7>
  42. Nousiainen MT, Mironova P, Hynes M, et al. Eight-year outcomes of a competency-based residency training program in orthopedic surgery. *Med teach.* 2018;40(10):1042-1054.  
<https://doi.org/10.1080/0142159X.2017.1421751>
  43. Chan T, Sebok-Syer S, Thoma B, Wise A, Sherbino J, Pusic M. Learning analytics in medical education assessment: the past, the present, and the future. *AEM Educ Train.* Apr 2018;2(2):178-187. <https://doi.org/10.1002/aet2.10087>
  44. Thoma B, Caretta-Weyer H, Schumacher DJ, et al. Becoming a deliberately developmental organization: using competency



- based assessment data for organizational development. *Med Teach*. May 25 2021:1-9. <https://doi.org/10.1080/0142159x.2021.1925100>
45. Ten Cate O, Graafmans L, Posthumus I, Welink L, van Dijk M. The EPA-based Utrecht undergraduate clinical curriculum: development and implementation. *Med Teach*. May 2018;40(5):506-513. <https://doi.org/10.1080/0142159x.2018.1435856>
  46. Choe JH, Knight CL, Stiling R, Corning K, Lock K, Steinberg KP. Shortening the miles to the milestones: connecting epa-based evaluations to ACGME milestone reports for internal medicine residency programs. *Acad Med*. Jul 2016;91(7):943-50. <https://doi.org/10.1097/acm.0000000000001161>
  47. Wagner LM, Dolansky MA, Englander R. Entrustable professional activities for quality and patient safety. *Nurs Outlook*. May - Jun 2018;66(3):237-243. <https://doi.org/10.1016/j.outlook.2017.11.001>
  48. Kelleher M, Kinnear B, Wong SEP, O'Toole J, Warm E. Linking workplace-based assessment to ACGME milestones: a comparison of mapping strategies in two specialties. *Teach Learn Med*. Apr-May 2020;32(2):194-203. <https://doi.org/10.1080/10401334.2019.1653764>
  49. Gerstle CR. Parallels in safety between aviation and healthcare. *J Pediatr Surg*. May 2018;53(5):875-878. <https://doi.org/10.1016/j.jpedsurg.2018.02.002>
  50. Borrelli RA. Reflections on developing an identity for the third generation nuclear engineer in the post-Fukushima society. *Reflections on the Fukushima Daiichi Nuclear Accident*. Springer, Cham; 2015:353-365. [https://doi.org/10.1007/978-3-319-12090-4\\_19](https://doi.org/10.1007/978-3-319-12090-4_19)
  51. Jonker CM, Riemsdijk M, Vermeulen B. Shared mental models. Springer; 132-151. [https://doi.org/10.1007/978-3-642-21268-0\\_8](https://doi.org/10.1007/978-3-642-21268-0_8)
  52. Warm EJ, Englander R, Pereira A, Barach P. Improving Learner Handovers in Medical Education. *Acad Med*. Jul 2017;92(7):927-931. <https://doi.org/10.1097/acm.0000000000001457>
  53. Eva KW, Regehr G. "I'll never play professional football" and other fallacies of self-assessment. *J Contin Educ Health Prof*. Winter 2008;28(1):14-9. <https://doi.org/10.1002/chp.150>
  54. Ikizler TA, Berns JS. Transformation of ABIM and What the Changes Mean to Nephrologists. *Clin J Am Soc Nephrol*. 2018;13(1):164-166. <https://doi.org/10.2215/CJN.05700517>
  55. Teirstein PS. Boarded to death--why maintenance of certification is bad for doctors and patients. *N Engl J Med*. Jan 8 2015;372(2):106-8. <https://doi.org/10.1056/NEJMp1407422>
  56. Boyd VA, Whitehead CR, Thille P, Ginsburg S, Brydges R, Kuper A. Competency-based medical education: the discourse of infallibility. *Med Educ*. Jan 2018;52(1):45-57. <https://doi.org/10.1111/medu.13467>
  57. Murray KE, Lane JL, Carraccio C, et al. Crossing the gap: using competency-based assessment to determine whether learners are ready for the undergraduate-to-graduate transition. *Acad Med*. Mar 2019;94(3):338-345. <https://doi.org/10.1097/acm.0000000000002535>
  58. Heath JK, Wang T, Santhosh L, et al. Longitudinal milestone assessment extending through subspecialty training: the relationship between acgme internal medicine residency milestones and subsequent pulmonary and critical care fellowship milestones. *Acad Med*. May 18 2021; <https://doi.org/10.1097/acm.0000000000004165>
  59. Heifetz RA, Laurie DL. The work of leadership. *Harvard business review*. 1997;75:124-134.
  60. Heifetz R, Linsky M. *Leadership on the line, with a new preface: Staying alive through the dangers of change*. Harvard Business Press; 2017.
  61. Groupsmith. *Technical Problems vs. Adaptive Challenges*. 2021. [https://www.sgaumc.org/files/files\\_library/technical\\_vs\\_adaptive\\_challenges.pdf](https://www.sgaumc.org/files/files_library/technical_vs_adaptive_challenges.pdf) [Accessed May 9, 2021].

## Appendix A. Example of an Education Passport.

An education passport initiated at the beginning of medical school could provide evidence of readiness to travel across the boundaries between UME, GME, and the expanse of practice. In this model, assessment of learners generates data for clinical competency committees (CCC) to review to make judgements about both growth and performance. This information is then passed to coaches to help learners develop individualized learning plans in an iterative fashion until such time the competency committee determines the learner is ready for the next stage. Data are then transmitted into an Education Passport to be reviewed immediately upon entry into the next phase in the continuum, serving as the first next step in assessment. The entire cycle repeats itself with the Education Passport serving as a connector between phases of the continuum. Maintenance of Certification (MOC) once in practice should be determined by the data collected in the Education Passport. Overarching elements describing the necessary steps in creating the Education Passport system are listed at the bottom of the figure, and necessary conditions for all of this to happen are listed at the top. Abbreviations: CCC = clinical competency committee, ILP = individualized learning plan, MOC = maintenance of certification.



## Appendix B. A ‘blue sky’ example of the planning stage of ‘planning, learning, assessing and adjusting’<sup>38</sup> for licensing bodies of the future.

The example here is a longitudinal developmental framework driven by specific and global needs informed by a preceding interconnected growth-based training continuum. The top section highlights that the training of physicians starts before medical school and extends into practice until retirement. Training and licensure must focus on growth mindset and master adaptive learning that includes feedback on performance aligned with coaching. The next section highlights that certification and accreditation trainee performance outcomes also include feedback to organizations for systems improvement. The bottom panel highlights that the competency domains might include communication, knowledge, and technical skills (among others) that grow from college to retirement with specific measurement points along the way. At each transition there will be summative assessment, but also a re-test of knowledge to ensure retention and transfer.

