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Precision surgical education

Educación quirúrgica de precisión

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ABSTRACT

Information and data are accelerating the implementation of competency-based medical education. The adoption of precision education can contribute to this purpose. This article discusses the extent to which precision surgical education can be used in assessing the minimum reliability standards of future surgeons — given the advent of Entrustable Professional Activities — and as an option to strengthen the career trajectory of residents.

Keywords: Medical education; surgery; teaching; learning; evaluation; curriculum.

RESUMEN

La información y los datos están acelerando la implementación de la educación médica basada en las competencias. La adopción de la educación de precisión puede contribuir a este propósito. Este artículo analiza los alcances de la educación quirúrgica de precisión para la evaluación del desempeño de los futuros cirujanos en sus estándares mínimos de confiabilidad -ante el advenimiento de las actividades profesionales confiables -, y como alternativa para fortalecer la trayectoria profesional de los residentes.

Palabras clave: educación médica; cirugía; evaluación; enseñanza; currículo.

INTRODUCTION

Competency-based medical education (CBME) has rapidly expanded worldwide. The field of surgery is not an exception. CBME was defined as "education for the medical profession that is targeted at a fixed level of proficiency in one or more medical competencies" (1). Within this definition, the meaning of competence differs in the plural or singular. The former denotes a set of interdependent pieces (for example, communication, knowledge, leadership) that constitute — in the singular — the full spectrum of medical competence, that is, the comprehensive ability to practice the profession.

CBME has its roots in the mid-20th century concept of *outcome-based education* (OBE), adapted to the field of medicine as *outcome-based medical education* (OBME) during the 1970s (1). OBE, in turn, was built on three premises: education must systematically focus on *learning outcomes* rather than the generationally evolved tradition; education must be flexible and individualized — since not all students master learning at the same time; and education *requires instructional design* (1,2). It was not long before *competencies* and *personalized education* became the holy grail to face up to these challenges. However, they have been insufficient

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to foster CBME (1). The first aim of this article is to describe the limitations of *competencies and personalized education* as means to nurture CBME in surgery. The second is to discuss the role of precision education in overcoming these limitations. Finally, we introduce the concept of *precision surgical education* to operationalize CBME.

CURRENT CHALLENGES OF CBME IN SURGICAL TRAINING

To start with, competency-based curricular frameworks have been used to enumerate and specify different attributes that future doctors must demonstrate as they prepare to face the complexity of professional practice. A general surgery resident, for instance, must demonstrate scientific knowledge, operative skill, medical reasoning, decision making and integrity, among other competencies. Under this curricular rationale, these attributes are essential to perform a wide range of operative procedures, from laparoscopic appendectomy to liver transplant or laryngectomy. However, the main problem behind this logic is that competencies are usually detached from reality and practice. In many contexts, liver transplant and laryngectomy are not part of the daily work of general surgeons, who most probably are not all reliable to perform these procedures.

Therefore, if they are to be consistent with the real world, residency programs should be accountable in terms of the level of expertise to which they commit in the training future surgeons in specific procedures, in accordance with their individual competencies. More specifically, the challenge is to focus their training efforts on basic procedures — and a few intermediate complexity operations — regularly performed by different groups of specialists, while assigning advanced complexity procedures to subspecialties and fellowships. These endeavors can avoid problems for patients, surgeons, institutions, and health systems, as they ultimately create coherence between education and surgical care.

However, surgical training in intermediate complexity procedures remains problematic. A laparoscopic gastrectomy or a right colectomy, for instance, can be reliably performed by general, gastrointestinal, oncology and colorectal surgeons in different contexts. Thus, there is a need for specialists and training programs, as part of their social accountability, to negotiate and reach an agreement regarding who is to be responsible for training the next generation of surgeons in these procedures. Furthermore, workplace-based learning (WPBL) requires individual and organizational resources to ensure progressive and effective transfer of autonomy, gradually reducing resident supervision, in order to strengthen their reliability and readiness for independent practice. This begs the question of whether this is the sole responsibility of general, gastrointestinal, oncology or colorectal surgical programs or whether it should be a shared responsibility, and whether it should depend on the underlying condition — cancer or benign disease — or the clinical situation — emergency or elective. Answers to these questions are not straightforward, as it all depends on the context, infrastructure, resources, local epidemiology, and surgical workforce, among other things. Educators must define these boundaries if they are to meet the specific needs of the real world. These limits are not exclusive of surgical training; they are part of the epistemological issues associated with educating healthcare professionals and, at a theoretical level, of workplace-based learning.

Within the CBME framework, and to close the gap between competencies and real-world activities, Olle Ten Cate, professor emeritus at Utrecht University, introduced the concept of *Entrustable Professional Activities* (EPAs) in 2005. The adoption of this concept has expanded to different contexts, including Latin America (3,4). EPAs are described as "units of professional practice, defined as tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence". Under this conceptualization, there is a high level of agreement

that one EPA for the general surgeon is "to perform a laparoscopic cholecystectomy." This is a complex task that must be executed by a competent person within the domains of knowledge (anatomical, pathophysiological, surgical), skill (operative, communicative) and attitude (leadership, integrity, ethics). Thus, how to define a resident's reliability to perform a laparoscopic cholecystectomy? There are several considerations (5,6). First, there is a need for different sources of *summative assessment of* technical and non-technical domains of competence, as well as ad hoc assessments to provide effective feedback. In close connection, it is necessary to *collect data and information* from various sources (peers, patients, teachers, clinical records, among others) and experiences (number of cases, rotations), through specific instruments and methods for workplace assessment. Additionally, *data and information must be available* to the resident for self-assessment and reflection, and for establishing goals and plans to improve performance. Finally, it is necessary to provide a *statement of reliability* based on the data and available information regarding resident performance. These judgements are *the collegiate responsibility* of programs, usually entrusted to assessment committees that grant further levels of resident autonomy, promotion, or remediation.

In this educational revolution, EPAs have helped elucidate the central elements of CMBE for the future: competency-based outcomes, sequenced progression, tailored learning experiences, competency-focused instruction, and programmatic assessment (7). In turn, these elements are influenced by the local context, educational culture, program size, resources and learning experiences, among others. Driven by this rationale, in recent years, different countries of the Western Hemisphere have replaced traditional curricular design backgrounds — essentially built on competencies — and adopted national EPA-based frameworks to face the challenges of CBME. Some examples are the American Board of Surgery (8), the Royal College of Physicians and Surgeons of Canada (9), the Dutch Association of Surgeons (10), and the Colombian Association of Surgery (11), among others. This phenomenon will expand at a vertiginous pace in the coming years.

However, despite these advances, the implementation of CBME is still a major challenge whose implications transcend surgical training. The main challenges relate to assessment standardization, which includes: i) the need to align all stakeholders in order to optimize educational programs and learning environments, thus supporting competency-based progression (increasing autonomy and supervision); ii) efforts to redesign medical education and clinical service delivery simultaneously; iii) establishing expected outcomes for individuals, programs, educational institutions, and health systems against which to assess performance; and iv) the need to establish a culture of shared responsibility for the achievement of these defined outcomes (12).

On the other hand, *personalized education* (i.e., the systematic adaptation of instruction to individual students) (13), has focused on optimizing teaching on the theoretical basis of the zone of proximal development. It is based on the assumption that students at different levels (for instance, undergraduate and graduate medical education) will take control and responsibility over their learning objectives and tasks, in their search for lifelong learning. Within CBME, however, physician commitment to lifelong learning deserves more attention, since it is not always significant (14). One of the possible explanations for this failure can be traced to personalized education which, unfortunately, appears to be just wishful thinking as far as lifelong learning is concerned.

In essence, the challenges for the implementation of CBME, the limitations of personalized education in face of the needs of lifelong learning, and the complex equity issues in contemporary medical education, can play a role in explaining the difficulty to access, analyze, and use information and data derived from the convergence of educational and clinical practice. Precision Medical Education (PME) represents an emerging paradigm to tackle these issues.

PRECISION MEDICAL EDUCATION (PME): A NEW ALTERNATIVE TO CBME

In 2015, former USA President Barack Obama (2009-2017) launched the Precision Medicine Initiative (PMI) (15) promoted by the National Institutes for Health (NIH) in the United States. The following argument is at the core of this initiative:

> "Until now, most medical treatments have been designed for the 'average patient.' As a result of this "one-size-fits-all" approach, treatments can be very successful for some patients but not for others. Precision Medicine, on the other hand, is an innovative approach that takes into account individual genetic, environmental and lifestyle differences. It gives medical professionals the resources they need to target the specific treatments of the illnesses we encounter, further develops our scientific and medical research, and keeps our families healthier" (15).

Two formulations of precision education emerged with the scientific support of precision medicine built on a predictive, personalized, preventive, and participatory approach (p4), and driven by systemic approaches to diseases, emerging technologies, and analytical tools (16). On the one hand, Sara Hart, professor of the Psychology Department at the University of Florida, mentioned that the PMI could contribute to the understanding and treatment of learning problems in the clinical context — usually associated with psychiatric disorders — which involve complex psychological, genetic, and environmental mechanisms. From a general perspective, this approach was called the Initiative for Precision Education (IPE) (17). The second formulation came from the field of medical education. Known as *Precision Medical Education* (PME), it represents an alternative for medical schools and residency programs to access, analyze and manage large amounts of data within the personalization of content, access routes and assessment required by CBME. As such PME, can provide timely information to students, educators, and programs. For Triola and Burk-Rafel, researchers from the New York University (NYU) School of Medicine, PME refers to:

> "A systematic approach that integrates longitudinal data and analytics to drive precise educational interventions that address each individual learner's needs and goals in a continuous, timely, and cyclical fashion, ultimately improving meaningful educational, clinical, or system outcomes"(18)

Additionally, PME emerged as a strategy to overcome the challenges of lifelong learning in CBME, improving personalization, efficiency, and individual agency, as well as challenges affecting programs, organizations, and health systems (19). More recently, the American Medical Association (AMA) recognized the potential of this approach on several grounds (20):

> "The current process of medical education across a physician's career is challenged by inefficiencies and inequities. Like other aspects of modern life, enhanced access to—and visualization of—data can facilitate individualization. Precision education allows educators and learners to leverage data and technology to improve the personalization of education and the efficiency of learning. Precision education demands flexibility within training programs, such that the appropriate experiences and coaching are offered to support the development of each individual".

Against the backdrop of these challenges, the AMA defined in 2023 a new level of strategic focus on four high priority areas in medical education: CBME, transitions in the training continuum, equity, diversity and belonging, and PME. For the AMA, greater precision offers the opportunity to elevate equity, diversity and belonging through an improved understanding of peoples' experiences and needs (20).

Therefore, information is changing the content and form of what is taught and to whom it is taught.

Data automation and technology are at the heart of PME, different from what happens in the purely "analogue" approach to personalized education. PME facilitates collection and analysis of all types of digital data, including data from students and electronic medical records. It does so through the use of *electronic portfolios* where students can track their performance, and establish objectives and improvement strategies. Artificial intelligence is at the centre of these advances, and it is expected to be able to make portfolios "smart," for example by recommending specific learning experiences and guiding real-time assessments for students (14). Similarly, PME can help educators leverage aggregate data from student portfolios to critically evaluate program outcomes. Based on these aspects, and adapting the proposed p4 approach for precision medicine, Triola and Burk-Rafel proposed a similar framework for PME that includes the following aspects (18):

- A *proactive* approach to acquiring and using student data.
- *Personalized* information through precision analysis (including artificial intelligence and decision support tools).
- *Precision* educational interventions (learning, assessment, and training trajectories) designed together with the students through a shared approach.
- Interventions that can *predict* meaningful educational, professional, or clinical outcomes.

Over the past five years, these strategies have been used actively in different medical programs in the United States, including Vanderbilt, Oregon, Thomas Jefferson, NYU and Stanford (21). To date, these initiatives have taken shape through several projects linking the use of multiple sources of data for teaching and assessment purposes. For instance, The TRainee Attributable & Automated Care Evaluations in Real-Time (TRACERs) Project aims to link attributable measures of resident participation in clinical care, though electronic health records (EHRs), to workplace assessment in real time (22). Similarly, through translational PME initiatives implemented in Stanford, researchers focus on the connection of PME with CBME through EPAs (21).

TOWARDS PRECISION SURGICAL EDUCATION (PSE)

As mentioned up to this point, PME appears to be a promising strategy to strengthen CBME, lifelong learning, and equity in education. The available experience shows its potential for undergraduate medical education, predominantly in the North American context and university environments. However, this approach has potential benefits for postgraduate medical education (PGME) and other contexts of practice, considering the growing expansion of CBME, the adoption of EPAs, and the unequivocal incursion of artificial intelligence in medical education.

The education of surgeons is right at the centre of these transformations; thus, precision education in this field can shape a promising future. Designated as *Precision Surgical Education* (PSE), this approach could improve the assessment of resident performance in relation to minimum performance standards, and strengthen their interests and professional expectations through their use of vast arrays of data and information. Similarly, it has implications for quality of surgical programs and organizations. Within these aims, PSE could assist numerous surgical disciplines (general surgery, gynecology, orthopedics, urology, plastic surgery, among others). Although, in our opinion, PSE is still premature, it can nonetheless be operationalized using the p4 approach as follows (Figure 1):

- ***Proactive*** approach to acquiring and using data. Four types of data and information, in the form of performance indicators and standards, can be included in electronic portfolios available for residents, surgeons and program directors:

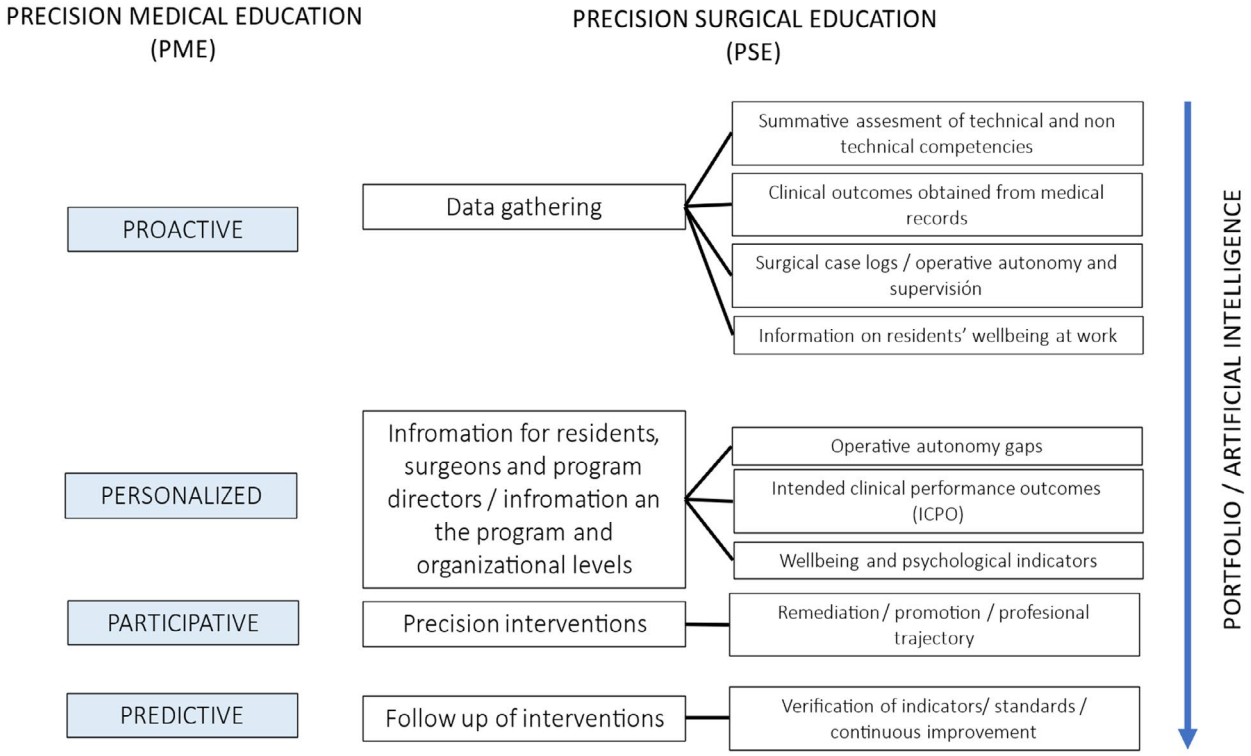

Figure 1. Precision surgical education.
Source: Authors.

1. Data on resident performance in technical, non-technical, and attitudinal domains (professionalism, knowledge, integrity, communication, and operative skills, among others) obtained through 360-degree tools that include the perspectives of surgeons in charge of training, peers, medical staff, nursing, and patients.
2. Data on outcomes of surgical care related to resident participation. This information could be accessed from patient medical records.
3. Data on resident operative volume obtained from surgical case-logs. These records must report the number of surgical cases and contain information on the role of the resident (i.e., main surgeon, first assistant), as well as the level of supervision and operative autonomy from the perspective of both residents as well as surgeons. To this end, the Zwisch scale (23) and the System for Improving and Measuring Procedural Learning (SIMPL) (24) can be used to identify gaps in operative autonomy with respect to the programmatic standards.
4. Data on occupational and psychological wellbeing at the workplace, for example, burnout, work-engagement and professional satisfaction among residents.

- ***Personalized*** *information* generated through precision analysis. Portfolio-stored data can provide personalized information about the learning trajectory, operative autonomy, comprehensive competence assessment, and psychological wellbeing of each individual resident. The high volume of data may require the use of artificial intelligence, which should be understood as a means, instead of an end for PSE.

A central aspect of information is to report clinical outcomes, adjusted by the level of resident

autonomy and supervision. These outcomes, known as educationally *sensitive patient outcomes* (25), are still at an early stage of development as far as resident assessment is concerned. Nonetheless, they can help educators link medical education interventions with patient outcomes. More recently, in 2018, Shumacher et al. proposed the concept of *resident-sensitive quality measures* (RSQM) to specify those actions carried out by residents that impact patient care in the clinical work and learning environment (for example, daily prescription of medications, communication with family members, etc.) (26). However, considering that surgical residents actively participate in operative procedures, we propose going beyond RSQM to include specific outcomes of surgical care — adjusted to the level of supervision and autonomy — as a comprehensive estimate of resident performance. We refer to these measures as *intended clinical performance outcomes* (ICPOs). ICPOs may include indicators of morbidity — for example, rates of surgical site infection (SSI), unplanned reoperations, readmissions, complications, mortality, care costs, and patient satisfaction.

- Precision educational interventions designed with the ***participation*** of residents. At this stage, collegiate bodies (for example, evaluation committees) must analyze the information available in each resident portfolio to inform judges, in order to design precise interventions aimed to overcome performance gaps and build upon the positive performance. The use of portfolios as an active reflection strategy can help residents when it comes to setting goals and plans for their professional careers.
- Interventions that can ***predict*** meaningful educational, professional, or clinical outcomes based on the indicators proposed in the first stage.

PSE poses significant challenges. Moreover, those challenges might shift into disadvantages if PSE is not adopted as a central component of organizational change. The need for continuous faculty development is worth mentioning, given that PSE represents an individual and organizational feedback system. PSE aims to strengthen resident career trajectories and program quality. This challenge requires a careful use of information by faculty and administrative members, considering that electronic portfolios and artificial intelligence could not, on their own, take care of feedback and change. Similarly, PSE raises the need for rational and ethical use of data derived from surgical care in the assessment of residents. In light of this aim, PSE strategies should seek to maintain data confidentiality and manage sensitive data of patients and institutions. Finally, PSE faces different sources of information related to resident wellbeing, learning climate and organizational culture. For the effective management of these sources of information, as well as those derived from surgical care, PSE requires institutional investment and organizational arrangements designed to guarantee the sustainability of this initiative.

CONCLUSION

Information and data are rapidly revolutionizing CBME through PME. Generative artificial intelligence is at the centre of this transformation, but it should be understood as a means and not as an end. The adoption of PME in surgery can contribute to the training of future professionals. Based on the p4 approach, PSE is a promising strategy feasible to operationalize with the help of different data and information sources. Intended clinical performance outcomes (ICPO) are crucial for this initiative.

AUTHORS' CONTRIBUTIONS

All the authors participated in creating the document through conception and design, data and information acquisition; planning the article, review of the intellectual content and final approval of the version sent to the editorial process.

REFERENCES

1. Ten Cate O. Competency-Based Postgraduate Medical Education: Past, Present and Future. GMS J Med Educ. 2017;34(5). doi: https://doi.org/10.3205/zma001146
2. Morcke AM, Dornan T, Eika B. Outcome (competency) based education: An exploration of its origins, theoretical basis, and empirical evidence. Advances in Health Sciences Education. 2013;18(4). doi: https://doi.org/10.1007/s10459-012-9405-9
3. Ten Cate O. Entrustability of professional activities and competency-based training. Vol. 39, Medical Education. 2005. doi: https://doi.org/10.1111/j.1365-2929.2005.02341.x
4. Melo de Andrade MV, López MJ, Domínguez Torres LC, Durán Pérez VD, Durante E, Gutiérrez Barreto SE, et al. Actividades profesionales a confiar: hacia una estandarización del lenguaje y significado en español y portugués. Investigación en Educación Médica. 2022;11(43). doi: https://doi.org/10.22201/fm.20075057e.2022.43.22437
5. Ten Cate O, Chen HC, Hoff RG, Peters H, Bok H, Van Der Schaaf M. Curriculum development for the workplace using Entrustable Professional Activities (EPAs): AMEE Guide No. 99. Med Teach. 2015 Nov 2;37(11):983–1002. doi: https://doi.org/10.3109/0142159X.2015.1060308
6. Humphrey-Murto S, Wood TJ, Ross S, Tavares W, Kvern B, Sidhu R, et al. Assessment Pearls for Competency-Based Medical Education. J Grad Med Educ. 2017;9(6). doi: https://doi.org/10.4300/JGME-D-17-00365.1
7. Van Melle E, Frank JR, Holmboe ES, Dagnone D, Stockley D, Sherbino J. A Core Components Framework for Evaluating Implementation of Competency-Based Medical Education Programs. Academic Medicine. 2019;94(7). doi: https://doi.org/10.1097/ACM.0000000000002743
8. EPAs for General Surgery - American Board of Surgery. [accessed 5 Mar 2024] Available from: https://www.absurgery.org/get-certified/epas/general-surgery/
9. EPAs and CanMEDS Milestones. [accessed 5 Mar 2024] Available from: https://www.royalcollege.ca/en/cbd/cbd-implementation/specialty-education-design/cbd-milestones-epas.html
10. Wijnhoven BPL. Surgical training and research in the Netherlands. Keio J Med. 2019;68(3):68. doi: https://doi.org/10.2302/kjm.68-005-ABST
11. Domínguez LC, Sanabria ÁE, Torregrosa-Almonacid L, Sánchez W, Vega NV, Vargas F, et al. Foundations for a national competence-based curriculum in general surgery: Delphi consensus of the division of education of the colombian association of surgery. Revista Colombiana de Cirugia. 2021;36(4):582–98. doi: https://doi.org/10.30944/20117582.898
12. Caverzagie KJ, Nousiainen MT, Ferguson PC, ten Cate O, Ross S, Harris KA, et al. Overarching challenges to the implementation of competency-based medical education. Med Teach. 2017;39(6):588–93. doi: https://doi.org/10.1080/0142159X.2017.1315075
13. Tetzlaff L, Schmiedek F, Brod G. Developing Personalized Education: A Dynamic Framework. Vol. 33, Educational Psychology Review. 2021. p. 863–82. doi: https://doi.org/10.1007/s10648-020-09570-w
14. Cutrer WB, Spickard WA, Triola MM, Allen BL, Spell N, Herrine SK, et al. Exploiting the power of information in medical education. Med Teach. 2021;43(S2):S17–24. doi: https://doi.org/10.1080/0142159X.2021.1925234
15. Precision Medicine Initiative | The White House. [accessed 5 Mar 2024] Available from: https://obamawhitehouse.archives.gov/precision-medicine
16. Hood L, Friend SH. Predictive, personalized, preventive, participatory (P4) cancer medicine. Nat Rev Clin Oncol. 2011;8(3). doi: https://doi.org/10.1038/nrclinonc.2010.227
17. Hart SA. Precision Education Initiative: Moving Toward Personalized Education. Vol. 10, Mind, Brain, and Education. 2016. doi: https://doi.org/10.1111/mbe.12109
18. Triola MM, Burk-Rafel J. Precision Medical Education. Academic Medicine. 2023;98(7):775–81. doi: https://doi.org/10.1097/ACM.0000000000005227
19. Desai S V, Burk-Rafel J, Lomis KD, Caverzagie K, Richardson J, O'Brien CL, et al. Precision Education: The Future of Lifelong Learning in Medicine. Acad Med. 2024 Jan 29; doi: https://doi.org/10.1097/ACM.0000000000005601
20. Precision education | American Medical Association. Available from: https://www.ama-assn.org/education/changemeded-initiative/precision-education
21. Chan TM, Thoma B, Finnell JT, Gordon BD, Farrell S, Pusic M, et al. Precision medicine within health professions education: Defining a research agenda for emergency medicine using a foresight and strategy technique (FaST) review. AEM Educ Train. 2024 May 1;8(S1):S5–16. doi: https://doi.org/10.1002/aet2.10983

22. Burk-Rafel J, Sebok-Syer SS, Santen SA, Jiang J, Caretta-Weyer HA, Iturrate E, et al. TRainee Attributable & Automatable Care Evaluations in Real-time (TRACERs): A Scalable Approach for Linking Education to Patient Care. Perspect Med Educ. 2023;12(1). doi: https://doi.org/10.5334/pme.1013
23. George BC, Teitelbaum EN, Meyerson SL, Schuller MC, Darosa DA, Petrusa ER, et al. Reliability, validity, and feasibility of the zwisch scale for the assessment of intraoperative performance. In: Journal of Surgical Education. J Surg Educ; 2014. p. e90–6. doi: https://doi.org/10.1016/j.jsurg.2014.06.018
24. Bohnen JD, George BC, Williams RG, Schuller MC, DaRosa DA, Torbeck L, et al. The Feasibility of Real-Time Intraoperative Performance Assessment With SIMPL (System for Improving and Measuring Procedural Learning): Early Experience From a Multi-institutional Trial. Vol. 73, Journal of Surgical Education. 2016. p. e118–30. doi: https://doi.org/10.1016/j.jsurg.2016.08.010
25. Yin HS, Jay M, Maness L, Zabar S, Kalet A. Health Literacy: An Educationally Sensitive Patient Outcome. J Gen Intern Med. 2015;30(9). doi: 10.1007/s11606-015-3329-z
26. Schumacher DJ, Holmboe ES, Van Der Vleuten C, Busari JO, Carraccio C. Developing resident-sensitive quality measures: A model from pediatric emergency medicine. Academic Medicine. 2018;93(7). doi: https://doi.org/10.1097/ACM.0000000000002093

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