



## 16 Innovations in Teaching and Learning in the Clinical Setting for Postgraduate Medical Education

### Co-leads

M. Lucas Murnaghan  
Milena Forte

### Authors

M. Lucas Murnaghan  
Milena Forte  
Ian C. Choy  
Erika Abner

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## Executive Summary

This paper addresses innovation in teaching and learning in postgraduate medical education (PGME). It is informed by current theories of professions education and workplace learning. It explores significant changes in the medical workplace that affect teaching and learning, and which have led to changes in both how and what is taught. It should be noted that other papers in this series address specific innovations in detail (i.e. interprofessional education, simulation, competency-based education, assessment, and information and education technology in PGME). As well, recent review papers such as the recent Association for Medical Education in Europe (AMEE) Guide (1) offer effective descriptions of current innovations on teaching in the clinical environment. It should also be noted that, while the evidence-based movement has systemically transformed medical practice and education over the past decade, it will not be addressed specifically in this paper.

Educational innovations may take a variety of forms: introducing new content knowledge into a curriculum, undertaking a common activity in a new way, combining ideas in ways not previously attempted, and incorporating new theoretical insights and research. Innovations in education can be placed on a continuum from daily activities designed to meet clinical or educational challenges through to institutional changes designed to alter the very structure of the workplace. In examining recent significant innovations in medical education, one may consider each innovation at a different point along this continuum. Some innovations, depending on their breadth, may inhabit more than one place.

The three key messages regarding innovation in teaching and learning in the clinical setting are:

1. Changes in the structure of the workplace have affected workplace learning. The context of the workplace is being altered by significant reductions in work hours and the introduction of new technology. Educators need to be alert to the negative effects of structural changes that interrupt or impede relationship development between clinical faculty and their learners.
2. The influences on workplace learning go beyond concrete structural and logistical changes such as technology and contact time. The learners themselves are changing, as is the society in which they are expected to learn. Though more difficult to define and study, these non-structural pressures are equally creating a need for innovation in teaching and learning.
3. The supervisor-resident relationship is central to the many forms of learning that occur in PGME. Effective supervisors support the learner, offer effective feedback, model professional identity formation and, via a process of cognitive apprenticeship, turn tacit knowledge into an overt exchange of ideas.

## **Background and Introduction**

This paper is one of 24 papers commissioned for the Future of Medical Education in Canada Postgraduate (FMEC PG) Project. This paper addresses innovation in teaching and learning in postgraduate medical education (PGME). It is informed by current theories of professions education and workplace learning. It explores significant changes in the medical workplace that affect teaching and learning, and which have led to changes in both how and what is taught. It should be noted that other papers address specific innovations in detail: commissioned paper 17: Inter and Intra-professional Collaborative Patient-Centred Care in PGME, commissioned paper 18: Simulation in PGME, commissioned paper 19: Innovations, Integration and Implementation Issues in Competency-based Training in PGME, commissioned paper 13: Assessment in PGME and commissioned paper 14: Information and Educational Technology in PGME. As well, recent review papers such as the recent Association for Medical Education in Europe (AMEE) Guide (1) offer effective descriptions of current innovations on teaching in the clinical environment. It should also be noted that, while the evidence-based movement has systemically transformed medical practice and education over the past decade, it will not be addressed specifically in this paper.

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In considering an environmental scan into innovations in teaching and learning in the clinical setting, and in the spirit of connecting “good ideas”, this paper begins by reviewing four significant theoretical changes in thinking about professions education that have developed over approximately the past 30 years and that have impacted PGME: 1) the importance of the signature pedagogy, 2) the concept of reflective practice, 3) cognitive apprenticeship, and 4) the nature of the teacher-learner relationship.

We then highlight four significant changes to the PGME workplace and corresponding educational innovations: 1) decreased contact time among teachers, learners, and patients, 2) shifting societal expectations, 3) evolving technology, and 4) emergence of millennial learners. While it is possible to note specific associated educational innovations for each of these changes (for example, more powerful technology leading to more sophisticated simulations), a more nuanced interpretation would be that many of these changes work together in the complex workplace of residency education.

## Theoretical Foundations and Perspectives on Innovation

### Signature Pedagogy

Shulman (3) describes the characteristic forms of teaching and learning in different professions as their “signature pedagogy”. A signature pedagogy defines “what counts as knowledge in a field” and how knowledge is “analyzed, criticized, accepted, or discarded”. A signature pedagogy has three dimensions: 1) surface structure or concrete acts of teaching, 2) a deep structure, or assumptions about how best to impart knowledge, and 3) an implicit structure, or set of beliefs about professional attitudes and values. Signature pedagogies include choices about teaching and learning, so that each pedagogy includes “negative space”, that is, methods and approaches that have not been included.

Signature pedagogies: 1) are pervasive and routine, 2) can distort learning through overuse and over-reliance on routine (requiring redirection), 3) can employ public performance(s) by the learner, and 4) reflect the reality that much professional action involves decision making under conditions of uncertainty.

Cooke et al. (4) describe case discussion as graduate medical education’s signature pedagogy. It allows the presenter to explore his or her underlying understanding and to create opportunities to invite participation of other learners. “A central function of the case discussion is to make visible the reasoning underlying the clinical formulation and management strategy for a particular patient.” PGME also includes pedagogies for practice and performance – experiential learning; pedagogies for inquiry, innovation, and improvement – learning to ask “what next” questions; and pedagogies of professional identity formation – “character, discipline, and ... the moral compass”.

### Reflective Practice

Schön’s (5) influential work *The Reflective Practitioner* offered an alternative conceptualization to the then-prevalent idea of the professional as a “techno-rational” actor who applied proven solutions to easily identifiable problems. Schön argued that practice existed not in the “high hard ground” of the technician-professional, but instead in the “swampy lowlands” where solutions to problems and, indeed, the nature of the problem itself may be obscure. The concepts of reflection *in* action as well as reflection *on* action have influenced both the content of and framework for professions education. The capacity for reflection and the expectation of reflective work has been developed as an explicit CanMEDS competency. (CanMEDS is the nationally approved inventory of competencies that accredited residency education programs include in the educational programs preparing residents for certification as a specialist.) Reflective activity is becoming formalized through innovations such as portfolios and reflective journals.

Boud et al (6) have developed the term “productive reflection” to describe reflective practices in the workplace. They note that productive reflection: leads to action; occurs in the context of producing a learning outcome that can be applied to a real situation; is linked to production, and enables workers to be active players in work and learning beyond their immediate situation.

### Cognitive Apprenticeship

The traditional idea of the craft apprentice is that of an apprentice linked to a master practitioner and learning through close observation and imitation of readily transferable

skills. Cognitive apprenticeship posits a different conception of the nature of apprenticeship learning, focusing on tacit knowledge embedded in sophisticated professional activities not readily transferable through observation (7). Engaging in cognitive apprenticeship, “knowledgeable, proficient people show learners how to do something and state aloud what they are thinking while doing the activity.” Effective cognitive apprenticeship teaching methods may include: modeling expert performance, coaching as students undertake tasks, scaffolding by providing supports to learners, requiring that students articulate their knowledge and problem solving processes, comparing student problem solving processes to those of the expert, and guiding students to explore their own mode of problem solving (8).

### Teacher-Learner Relationship

In their most recent publication: *A Summary of Educating Physicians: A Call for Reform of Medical School and Residency*, Cooke et al summarize their vision for moving medical education beyond Flexner’s era which has largely shaped PGME in the last one hundred years. As one of their four major recommendations, they call for renewed attention to professional identity formation. Built on a foundation of clinical competence, “the development of professional values, actions, and aspirations should be the backbone of medical education” (9). They argue that it should be an “explicit area of focus” taught via strategies that encourage formal instruction in ethics and reflective practice and sustained by relationships between students and faculty members that challenge, and support individual students (9). Other authors have echoed the importance of the supervisor-resident relationship as a “cornerstone of clinical learning and professional identity formation” (10-13). Learners value close relationships with supervisors, and expect them to set clear expectations, provide specific feedback and clearly communicate what they are thinking and why (10-12, 14, 15). By making their clinical reasoning transparent, teachers can make learning an overt rather than covert process. (11) This overt process is an essential element of cognitive apprenticeship.

### Methodology

An iterative process of discussions among the co-authors was performed to assemble a list of search words which would identify key areas of innovation within PGME. The following key words were utilized: innovation, duty hours, ambulatory care, work time directive, CanMEDS, patient safety, medico-legal, malpractice, risk management, technology, e-learning, simulation, telemedicine, PDA, communication technology, millennials, intergenerational, supervisory relationship. A comprehensive review of major databases (MEDLINE, EMBASE, ERIC, Canadian Legal Literature, and Web of Science) was employed using these key words to capture relevant literature. In addition to the database search, a hand search of the references from the identified literature was performed. Literature focusing solely on innovations in undergraduate education were excluded. For the purposes of recent innovations, we restricted ourselves to literature published in English within the last 15 years.

### Results

Recent research into workplace learning for new professionals has found that the structure of work profoundly affects learning (2). The structure of work includes the pace and intensity, the amount and nature of supports for learning, and the quality of supervision. Learning to become a professional occurs through a blend of work experiences with no direct connection to learning, work experiences with direct

connections to learning, and explicit learning experiences. This research has demonstrated that structural changes to the workplace will influence how and when learning occurs. In the following sections, these changes are identified along with their associated impact on teaching and learning.

### Contact Time

Over the past decades, a number of influences have led to decreased contact time between educators and learners in PGME. In parallel and related to these changes there has been a reduction in contact time between the learners and the patients themselves. Each of these has forced programs and individuals to modify their curriculum or personal practice in order to continue to provide the educational opportunities required by their trainees. Postgraduate trainees have been mandated to fewer work hours, leading to innovations that focus on excellent and efficient learning opportunities. From a systems standpoint, there has been a shift from in-patient to ambulatory care, motivated equally by efficiency and economy. As residency and fellowship programs have expanded in numbers and geographic scope, the contact time between faculty and student has also decreased. With an increased numbers of trainees, there has been a loss of preceptorship and educational experience with the individual teacher, with a greater focus placed on the content and context of the learning. Educators have adapted by creating new techniques that maximize shorter interactions and emphasizing reflection and critical thinking. Technological advances such as simulation and E-learning are responses to the shift from quantity to quality, as is the paradigm shift toward competency-based curricula. An increased focus on fellowship training, as an extension of previously adequate residencies, may also be a response to the more limited patient contact that has resulted from the shorter workday.

The United States and Europe have both taken explicit measures to limit trainee work hours. Overseas, the Europe Working Time Directive (EWTD), which was introduced in 1993, originally excluded medical trainees from its jurisdiction. Since 2009, medical trainees have been included, limiting their work hours to 48 hours per week. In the United States, the Accreditation Council for Graduate Medical Education (ACGME) has restricted duty hours since 2003. The motivation for this was an attempt to decrease medical errors due to fatigue, improved education, academic performance and well being of the residents. Canada's work hour restrictions are comparable though, in fact, predate the ACGME mandate. Unlike Europe and the United States, these decreases have come from provincial resident unions, as opposed to from a federal professional body such as the Royal College of Physicians and Surgeons. Work hour reform did not originate in curriculum design or from the educators; it has been driven by work-place change and unions and governing bodies of trainees. Interestingly, a recent systematic review demonstrated no clear evidence that reduced resident work hours improved patient safety (16). Educators and curriculum designers have been forced to conform to these changes and react by modifying their approaches and techniques. This reactive vs. proactive change has exposed the limited theoretical underpinnings of many of our educational methods and curricula and their proposed objective of professional competence.

Duty hour restrictions, by limiting learners' contact time with teachers and patients, have led to unique challenges in postgraduate medical training. Unable to maintain antiquated training models which have been used for generations, novel solutions were required. In order to keep pace with these work hour changes, training programs and

curricula have had to evolve to include new innovations. These developments have placed a greater emphasis on quality vs. quantity and share as a fundamental theme to maximize limited clinical time for both service and education. In a 'call to arms', Woodrow et al proposed that 'instead of trying to adapt the traditional model of apprenticeship training to fit in to these emerging shorter duty hours, a new structure of postgraduate training grounded in the principles of educational theory, incorporating evidence-based educational strategies, and tailored to evolving health care environments, may be required' (17).

With less time spent in direct patient care, educators have turned with newfound enthusiasm to technology and simulators to educate their trainees. A more thorough exploration of the impact of simulation and technology is made later in this paper. Along with rapid advances in technology, increasing demands in clinical training are leading to a revolution in how we teach and learn clinical and procedural skills (18). To optimize down time and time spent off-site by residents and fellows, many training programs have integrated E-learning into their curriculum, as will be described later.

There is conflicting literature on the effect that duty hour restrictions have had on the educational experience of trainees. In spite of initial skepticism and early negative reports (19, 20), recent studies have shown that surgical experience and evaluations have demonstrated that a suitable learning environment can be achieved with deliberate planning in spite of decreased work hours (21). One of the greatest examples of embracing change has been the innovative implementation of competency-based curricula, which have endeavoured to link their training programs to skills and competencies rather than time. In Toronto, the Royal College of Physicians and Surgeons of Canada has approved an experimental orthopaedic residency model. Paralleling the regular training program, a small cohort of residents is going about training with the goals of predetermined objectives as opposed to a fixed period of time. Concern has been raised that this design will over-emphasize the content and de-value the teacher-learner relationship. In the absence of a horizontal experience with a given preceptor or service, the learners must create a composite longitudinal model of patient presentations, treatments and outcomes. As with many new innovations, it is as yet unproven, though the educators and researchers in this program have been diligent in integrating the necessary evaluative measures into its design.

Over recent decades, there has been a shift from in-patient to out-patient care where over 95% of doctor-patient encounters occur in the ambulatory care clinic (22). Teaching and learning in the ambulatory care setting presents logistical challenges due to the fast pace and rapid turnover and resultant limited contact between teacher and learner. In contradistinction to in-patient care, patients themselves may not be interested in being participants of a trainee-teaching encounter as they may have other competing priorities. Trainees are typically expected to see patients independently, while their attending physician is concurrently seeing patients. This inevitably leads to less observed clinical encounters and discourages full review of these trainee assessed patients by the preceptor. Previous studies have demonstrated that as few as 30% of cases seen by residents and students were discussed with faculty (23, 24). These changes in the educational milieu of clinical teaching and learning has forced educators to adapt and implement new methods and approaches to teach effectively. A variety of innovative methods and models have been recommended to optimize these brief clinical encounters including the One Minute Preceptor (25) and the SNAPPS model (26).



These models allow faculty to teach efficiently and effectively in a busy ambulatory clinic and focus the center of the educational encounter on the learner.

### Societal Expectations

This section addresses the issue of societal expectations as drivers for innovations in teaching and learning. The changing role of patients as health care consumers and partners in care is identified. Patients today can access medical information from many sources and expect their provider to work with them as health advocates. This has led to changes in the way we prepare residents to work with patients and has impacted the notion of physician as health advocate and professional.

Three interwoven movements have affected medical education within the past 15 to 20 years: the increased focus on physician competencies, the patient safety movement, and a heightened sensitivity to medico-legal and risk management. The innovations that have resulted from these movements include direct changes, such as curriculum content and teaching methods, and indirect changes, such as institutional changes in the workplace. These movements show continued growth and development and are likely to continue to affect future innovations in residency education. As noted in other sections, changes to the workplace have resulted in both anticipated and unanticipated changes in teaching and learning.

#### i) Physician Competencies and CanMEDS

The Royal College of Physicians and Surgeons of Canada began the development of the CanMEDS 2000 project in 1993; the project was “designed to ensure that postgraduate specialty training programs are fully responsive to societal needs.” In 2010, the College of Family Physicians of Canada adopted (with appropriate modifications) the CanMEDS competencies. Therefore, all residency programs across Canada will be expected to teach and evaluate across the seven competencies (27, 28). To fully meet the accreditation standards for the 2013 cycle of surveys, all programs across Canada must demonstrate that they teach and assess the CanMEDS competencies.

The effect of this change has been profound: disciplines must now incorporate new content into their formal programs, often delivered using novel instructional methods. Since evaluation of the non-medical expert competencies is also an accreditation requirement, specialties must also develop valid and reliable methods to assess learning in the workplace, which may require heightened observations and feedback to trainees. Changes to content and instructional design have resulted in an increased focus on faculty development. As well, since programs need to understand the full spectrum of teaching, many are undertaking curriculum mapping to ensure that they are meeting the accreditation requirements. As the 2013 accreditation cycle approaches, it is likely that the number of innovative curricular and instructional practices will increase.

#### ii) Patient Safety

The patient safety movement has grown in parallel with the development of CanMEDS competencies. Commentators have noted the changes over the past 10 years from a culture of blame to a focus on diagnostic error and corresponding need for a safe environment and appropriate training (29) (30). Patient safety affects teaching and learning in three ways: modifications to the work environment (31); the development of

explicit curricula on quality improvement and patient safety (32); and appropriate resident supervision.

Supervision in the workplace is a direct form of teaching and learning; the quality of learning may well depend on the quality of the relationship. While resident supervision is an element of patient safety, limited research literature is available on the effects of poor or ineffective supervision (33). These supervisory relationships are governed by individual institutional policies as well as those of the professional governing bodies and malpractice insurers. For example, the College of Physicians and Surgeons of Ontario sets out the expectations for both the supervisor and the trainee; these include the supervisor's assessment of the trainee's level of knowledge skill and judgment as well as the trainee's responsibility to communicate his/her level of competence. The Canadian Medical Protective Association has developed risk management considerations for supervising physicians premised on the jurisprudence that has considered whether the delegation, supervision and support provided by the supervisor were reasonable in the circumstances.

### iii) Medico-Legal and Risk Management

In addition to direct approaches such as identifying, teaching and assessing explicit competencies, societal concerns may be asserted through emerging jurisprudence. In medical negligence, these are best understood through consideration of the standard of care required by physicians and resultant risk management processes and procedures.

Other authors have noted the possible value of changes in curricular content to risk management. These changes may include managing risks around patient communication, especially post-adverse event communication (34) as well as various initiatives to teach patient safety and quality assurance (32).

### Influence of Technology

Technological advances in information and communication technology (ICT), simulation, and medical technology have had a profound effect on the lives of today's medical trainees. As these technological innovations have become increasingly pervasive and indispensable in our everyday lives, they have changed the nature of how medical trainees work, learn and even think. Consequently, these technologies will also continue to drive and direct innovations in PGME.

Today's residents are more connected than ever to an increasingly diverse pool of resources, and now have a multitude of choices as to where and how they interact with them. E-resources such as online discussion forums, technology-enhanced problem-based learning tools, email, electronic library resources, and adaptive education systems that accommodate themselves to the baseline knowledge of its learners (35) are just some examples of how ICTs have dramatically changed the way learners access knowledge.

For example, e-resources have improved the breadth of knowledge accessible to learners, helping to overcome many of the limitations of traditional face-to-face teaching such as logistical barriers, access to collaboration and expertise (36), and the implementation of longitudinal educational programs (35, 37, 38). Furthermore, e-resources have given learners a myriad of new tools through which to interact with their instructors, colleagues, and educational material.

Along with improving the range and types of educational material available to today's residents, ICTs such as personal digital assistants (PDAs) and, more recently, smartphones have made such material both instantly and constantly available. Over 70% of today's residents have reported daily clinical use of these devices for applications such as lab data retrieval, referencing pharmacology guides, and accessing treatment protocols. Answers to clinical problems or questions posed during rounds are now accessible within seconds, allowing trainees to both acquire and apply knowledge immediately within the same clinical setting.

Videoconferencing technology has addressed the distance barrier to educational resources through technologies such as telemedicine, telementoring and telesimulation. Expanding on the concept of e-resources, telementoring provides an effective means for real-time guidance and instruction to trainees in remote locations (39-41).

Telesimulation represents an even further evolution of this technology combining the remote proctoring benefits of telementoring with the deliberate practice and patient safety profile of simulation-based medical education (42, 43). Interactive educational resources and training that was once restricted to a single institution can now be easily shared on a global scale.

Simulation-based medical education (SBME) is another technology that has had a significant impact on resident access to knowledge and skills. The details of the various types, limitations, and benefits of SBME are discussed in a separate commissioned paper. However, the common attribute amongst these various manifestations of SBME is that they have fundamentally changed how and where residents acquire certain skills and knowledge. Residents are no longer reliant on their preceptors and the clinical setting in the same way as previous generations were.

In spite of the vast array of technological innovations and implementations, there is a common theme amongst them: improved access to educational material in breadth, timing and distance. Some may consider these technologies timely given that current economic limitations, restricted work hours (44-46), and an increased emphasis on longitudinal learning (35, 37, 38) has placed increasing pressure on educators to develop more efficient and effective methods of teaching residents. However, improved accessibility to medical information should not be equated to improved medical education (47). For example, while PDAs have been shown to provide residents with additional time for other education practices, how residents use this additional time is unknown (48). Additionally, while residents have been shown to prefer electronic resources for referencing previously learned material, they preferred printed media for initial learning (49). Studies have also demonstrated that the knowledge retention from passive electronic information retrieval is inferior to the retention gained from more traditional self-directed educational activities (50, 51), exemplified by the so-called "palmomental reflex" of residents' use of smartphones and PDAs (52). Similarly, research in SBME has also emphasized that simulators alone are not as effective as those that are combined with instructor training and an educational and professional context (53, 54). And as will be explored later in the Changing Learner section, the idea that this current generation of learners is uniformly technologically adept has recently been called into question.

These examples, however, do not mean that technological advances do not have a place in PGME. Rather, they illustrate that these technologies should supplement and be integrated within the existing educational framework. It appears that the question of *how* residents use this technology is just as important, if not more so, than *if* residents

use this technology. Therefore, educators must look at ways to discourage passive use of ICTs as simple portals to information, and find ways to integrate and leverage their potential within the broader learning programs.

### The Changing Learner

Many systemic changes in the medical workplace have been discussed above. In this section, we draw attention to the changing face of resident learners within that workplace and to examine their relationship to their teachers, their work, and each other.

As individuals, postgraduate trainees are more diverse than ever. The last two decades have seen more women, more international medical graduates and increasingly more non-traditional students in many North American schools (55, 56). While these learners have largely adapted to existing roles inherent in medical education structures, by their very presence, they are also shaping the community that they are entering. Lave and Wenger's theories of "communities of practice" and "legitimate peripheral participation" suggest that as learners become initiated to and eventually fully entrenched in a community they not only come to embody the professional practices of the community, but also are empowered to modify them (57). Thus, enquiry into postgraduate learners' context, choices, and expectations may be important not only in planning teaching programs, but may also offer clues as to what changes or innovations lie ahead.

Within this community of increasingly diverse individuals, there exists a generational cohort poised to enter our postgraduate training programs that has garnered much interest and attention both in the media and among educators. Often referred to as the Millennial Generation, it has also been described as the "Net Generation" or "Gen Y" (58). This cohort is defined as including those born roughly between 1980 and 2000. Millennials are starting to enter residency programs across the country and will continue to do so for the next couple of decades. There has been much discussion and debate in both the popular press and the academic literature as to whether Millennials have common defining features, if their learning styles and needs are different than their "Gen X" and "Boomer" predecessors and what, if any, the significance of all this is for educators.

There is a small but growing body of empirical evidence to complement the flurry of opinion articles in the popular press about Millennials and what makes them unique. A handful of studies suggest that Millennials do possess some shared values and traits that influence how they learn, and that differentiate them from previous generations (10, 15, 55, 59-62). The most cited characteristics seem to be that Millennials have a stronger preference for working in teams and a greater desire for frequent communication and feedback (10, 15, 60). Two small medical education studies by Borges et al showed Millennials to have stronger team instincts, tighter peer bonds and a greater need to belong to social groups than their Generation X counterparts. Her group also found that Millennials were more rule conscious, adaptive and open to change. Studies in the workplace have corroborated Millennials preference to work in teams, and have also noted their expectation of more frequent, positive, and affirming communication with supervisors than previous generations of workers (10).

There is little doubt that technology has a profound impact on learners today. In a previous section, we describe the many ways in which innovations in technology have changed the nature of PGME and how they are likely to continue to change it in the future. However some authors go further to argue that, because of their exposure to

digital technology since birth, Millennials are different than previous generations of learners in terms of how they process information and learn (56, 63, 64). They caution that in order to teach this new generation of “digital natives” effectively, teachers and training programs need to respond to those differences or risk becoming obsolete (58, 63, 64). For instance, some would advocate adapting *how* we deliver curricula: “Instruction may need to be delivered in shorter segments and perhaps incorporate more material delivered in media such as videos and an interactive format (14).” Others rebuke this view and point to the lack of rigorous evidence to support it. They warn against painting all Millennials with one generational brush, and highlight the differences among them (59, 61, 62). Recent research by Bennet et al. suggests that, while the use of technology is ubiquitous among Millennials, the type and context of this use can differ greatly, along with their skills. Therefore, they argue that a “dramatic shift from text-based to multimedia educational resources...should be viewed with some scepticism (59).”

Do the current signature pedagogies (65) of the medical profession fit the Millennials learning style, or do they clash? Twenge asserts that medical education has always emphasised learning by doing, which is the preferred learning style of this generation (14). As bedside teaching becomes less common (for reasons described elsewhere in this paper), perhaps simulation-based learning will, at least in part, replace it. The signature pedagogy of PGME, the case discussion, invokes the Socratic style of questioning, which is interactive but usually a linear, teacher-driven conversation between two people. This may give way to a more learner-driven multi-input process where the teacher is more of a facilitator of experiential learning. Collaboration among professionals is a highly valued function in current medical education rhetoric. Millennial students seem well-suited to function in this paradigm based on their strong preference to work in teams. Their need for supportive structure and concurrent expectation of intensive feedback may challenge the current signature pedagogy of the profession of “see one/do one/teach one”, although it may align well with the patient safety and quality assurance movements underway.

Educators and training programs will have to respond to the growing challenge of teaching today’s learners, who are more numerous than ever, more heterogeneous in their needs, and more demanding of their teachers; yet there is little evidence to guide us in this regard. It seems imprudent to dramatically change curricular design based on what we assume might be the changing needs of our learners, but equally ill-advised not to consider their learning preferences and communication styles as we forge ahead with curricular renewal and innovation. Perhaps customization of learning should be occurring both at the level of curricular design and of the supervisor-trainee dyad. To be most effective, teachers will need to be flexible and responsive to their learners’ needs. They should have the skills required to facilitate learning. These include being able to set learning objectives, effectively provide feedback, and tailor teaching approaches to individual learners. Therefore, we should be intentional in our selection of teachers and provide formal opportunities for existing faculty to develop their skills in this area (9, 66), while also ensuring that we preserve time and space for the supervisory relationship to develop.

## **Discussion**

This paper has defined and outlined a variety of forms of educational innovation, informed by education theory and recent research into workplace learning. The

importance of the signature pedagogy has been introduced as an invisible thread that weaves through the fabric of PGME.

Changes in the structure of the workplace will affect workplace learning. The structural changes described in this paper include decreased contact time, evolving societal expectations, increased use of technology, and the changing learner profile. Though seemingly separate and discrete, further exploration demonstrates how interconnected these structural shifts actually are. They converge in their pressure on the teacher-learner relationship and consequent need for innovative solutions and increased support. The interplay of these shifts and their subsequent educational innovations reinforce the need to examine and monitor PGME from a comprehensive perspective. The synergistic effect of individual innovations can have further reaching implications than the educator or program planner may consider, with the total impact adding up to more than the sum of its parts. The very signature pedagogy can be altered by these changes, and attention to this evolution must be paid as novel innovations are considered, introduced and evaluated.

Mandated decreased work hours and systemic shifts in the medical model from in-patient to ambulatory care have dramatically decreased contact time among teachers, learners and patients. This reduction has encouraged the development of new techniques, models and curricula. As training programs have grown in size and geographic scope, there has been an erosion of preceptorship and the educational relationship. Educators have adapted by incorporating new techniques that maximize shorter interactions and emphasize reflection and critical thinking. Technological advances have assisted in improving the efficiency of training programs, and competency-based curricula have shifted the focus from quantity to quality of education. Each of these changes and innovations presents new challenges, and the onus of outcomes research lies with those that strive to improve PGME.

The emphasis on competencies as described in CanMEDS and accompanying focus on patient safety and risk management have significantly changed learning in the workplace. Programs are required to include non-medical expert role content in formal programming as well as attend more closely to informal learning through work. Heightened concerns about patient safety have an effect on what residents can undertake, how they undertake it, and how they are supervised. Innovations in teaching and learning in the clinical setting will continue to be reactive to societal expectations and proactive through increased efforts towards optimal patient safety.

Changes in technology have affected medical education in numerous and profound ways. The overarching theme of these changes is the near-unrestricted access to large amounts of information. The educators' role as the primary or sole source of knowledge and skills has now been supplanted by smart phones, online videos, and electronic libraries. However, access to information cannot be equated to improved medical education. The educator has become all the more important in the role of mentoring the learner as the cognitive apprentice through this seemingly overwhelming amount of information. Passive use of technology must be discouraged, and instead integrated into broader curricula where the educators' experience and clinical expertise can be used to guide the application of knowledge.

Residents are simultaneously learners and workers. Their imprint in the PGME workplace cannot be ignored. As a new generational cohort is poised to enter postgraduate training programs, their learning styles and work-life preferences should be

considered when developing and introducing new innovations into curricula. There is much anecdotal evidence but little actual research into how Millennials might differ from previous generations. Studies to date suggest that one of the biggest differences is their strong preference to work in teams, which fits well with current rhetoric of medical education. The other differences, their need for supportive structure and concurrent expectation of intensive feedback, may challenge the current signature pedagogy of “see one/do one/teach one’ but may serve to remind us of the value of the supervisory relationship.

These aforementioned changes are interconnected and work to alter the clinical milieu as well as the overall educational experience. As described, changes in the structure of the workplace will affect workplace learning, and systematic changes in training programs or hospitals can have profound effects on how and where learning is occurring. The impact of these changes can be felt at the core of PGME: the supervisor-resident relationship. This relationship is central to the many forms of learning that occur in PGME. Effective supervisors support the learner, offer effective feedback, model professional identity formation and, via a process of cognitive apprenticeship, turn tacit knowledge into an overt exchange of ideas. Many innovations have seemingly neglected the importance of this relationship and risk jeopardizing its central role in PGME. Educators need to be alert to negative effects, in particular, structural changes that interrupt or impede relationship development between clinical faculty and their learners.

Innovation is not simply change for the sake of change. In whatever form it takes (technological advance or paradigm shift), an innovation is more than a reactive solution to a logistical challenge. Not every innovation that is introduced is adopted or deemed successful in retrospect. Successful innovations in PGME recognize and respect the complex interplay among workplace, learner and patient. Educational innovations must be implemented with consideration for the impact they will have on the ultimate goal of medical practice, which is optimal patient care. Through thoughtful consideration of the educational impact of a proposed programmatic change, future innovations will continue to evolve the signature pedagogy of PGME.

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## Appendix 1: About the Authors



Dr. M. Lucas Murnaghan studied at Queen's University in Kingston, Ontario where he completed his undergraduate and medical degrees. His orthopaedic residency was completed at The University of British Columbia. During that time he participated in a one-year elective in medical education and concurrently obtained his Masters of Adult Education. His fellowships included experience in Vancouver, Melbourne and Dallas focusing on pediatric orthopaedics and arthroscopy. His clinical interest is the orthopaedic care of athletic injuries in the paediatric, adolescent and collegiate athlete. His clinical practice in Toronto is based at The Hospital for Sick Children and Women's College Hospital. He is a member of The Wilson Centre as a Clinician/Educator Researcher.



Dr. Milena Forte is a graduate of the University of Western Ontario Medical School. She completed her family medicine residency at McMaster University in 2000 and a subsequent women's health fellowship at the University of Toronto in 2001. Currently, Dr. Forte is a family physician and a faculty member in the department of Family and Community Medicine at the University of Toronto. She practices full-care obstetrics and oversees the maternity care program for family medicine residents at Mount Sinai Hospital. Dr. Forte is a graduate of the Education Scholars Program in the Faculty of Medicine at the University of Toronto and a member of the Wilson Centre.

Her research interests are in the area of feedback and teacher-learner relationships.



Dr. Ian Choy completed his medical training at McMaster University in 2007. He is a General Surgery resident currently in the Surgeon Scientist Program at the University of Toronto. Ian is completing a Masters of Education degree in Health Professional Education at the Ontario Institute of Studies in Education. He is also a fellow at the Wilson Centre and a member of the Clinical Investigator Program. The focus of his research is on telesimulation and knowledge translation of laparoscopic surgical skills in developing countries.



Dr. Erika Abner is an Educational Consultant with the Postgraduate Medical Education Office, Faculty of Medicine, University of Toronto. As a legal educator, Dr. Abner has taught at Osgoode Hall Law School, at the Ontario Bar Admission Course, and within law firms as both a consultant and the Director of Continuing Legal Education at a major Canadian law firm. She completed her doctorate from OISE/UT in 2006, researching mentoring in law firms. Her continuing research interests include the transition from school to practice, comparative professions education, and developing expertise in legal writing.

## **Appendix 2: Annotated Bibliography**

### **Temple, John. Time for Training: A Review of the impact of the European Working Time Directive on the quality of training. May 2010**

This report was commissioned in response to the concern that the EWTD was having a detrimental effect on the training of doctors. The report recommends that high quality training can be delivered in 48 hours, though recognizes that current practice relies too heavily on doctors in training for service in hospitals. Without making specific educational suggestions, the report did conclude that significant changes were required to training schemes and the role that postgraduate trainees should play in the care of patients.

### **Shulman, L. (2005). Signature pedagogies in the professions. *Daedalus*, 134(3), 52-59.**

This essay describes the elements of the signature pedagogy – characteristic forms of teaching and learning – and explains the positive and negative results of the reliance on the signature pedagogy. Signature pedagogies are unique to each profession; they have a role “in shaping the character of future practice and in symbolizing the values and hopes of the profession”. A signature pedagogy has a surface structure (concrete acts of teaching and learning), a deep structure (assumptions about the best way to impart knowledge and know-how), and an implicit structure (beliefs about professional attitudes, values and dispositions). Signature pedagogies should give adequate attention to all dimensions of practice: the intellectual, the technical, and the moral. Pedagogy is compromised whenever one of these dimensions is unduly subordinated to the other.

### **Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 32.**

This influential essay argues that “learning and cognition...are fundamentally situated” – that the activity in which knowledge is developed and deployed is not separated from learning. Students should engage in authentic activities, defined as the ordinary practices of the culture, to gain access to methods that experienced practitioners use to frame and solve problems. Practitioners can promote learning by making tacit knowledge explicit, supporting students’ attempts to do a task, and finally by empowering students to continue independently.