THE FUTURE OF MEDICAL EDUCATION IN CANADA
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PROJET POSTDOCTORAL

14 Information and Educational Technology in Postgraduate Medical Education

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Executive Summary

This is the report of the environmental scan for the Future of Medical Education of Canada Postgraduate (FMEC PG) Project on the topic of “Information and Educational Technology in Postgraduate Medical Education”. The scan consisted of a literature review and interviews with seven key stakeholders from across the country. The concept of ‘technology’ typically refers to tools and instrumentation and not the many uses, adaptations, and cultural and social impacts arising from their use.

The scan identified that, although digital technologies are being used in Canadian postgraduate medical education (PGME), the digital world needs to be addressed more broadly to meet the needs of trainees and the healthcare system as a whole. Where there is digital activity, it is often fragmented and siloed, with little opportunity to collaborate or share between institutions. Problems exist in the management and strategic direction of technology institutionally, professionally and nationally. Significant problems also exist in working with and within digital environments, the lack of integration of digital methods into curricula, and the misalignment between PGME and Canada’s developing e-health environment.

A number of key themes were identified and are presented as a series of challenges. These can be summed up in the following key messages:

1. There is a need for a digital competency framework for physicians in training that is better aligned with the development of Canadian e-health.

2. There is a need for improved research, scholarship and critical appraisal of the role of digital media and methods in PGME.

3. Better use of education informatics leadership and more digitally informed leadership in PGME as a whole is required.

Background

Although the topic of this scan is 'technology', this can be a misleading term, as the concept of technology typically refers to tools and instrumentation and not the many uses, adaptations, and cultural and social impacts arising from their use. The availability of a given technology is not the same as the experience of using it, even though regulators may often only be interested in a technology's presence rather than its utility. In addition to technology as instrumentation, we can also consider activities within technologies, activities in and around technologies, and activities that are concerned with what technologies mean (1).

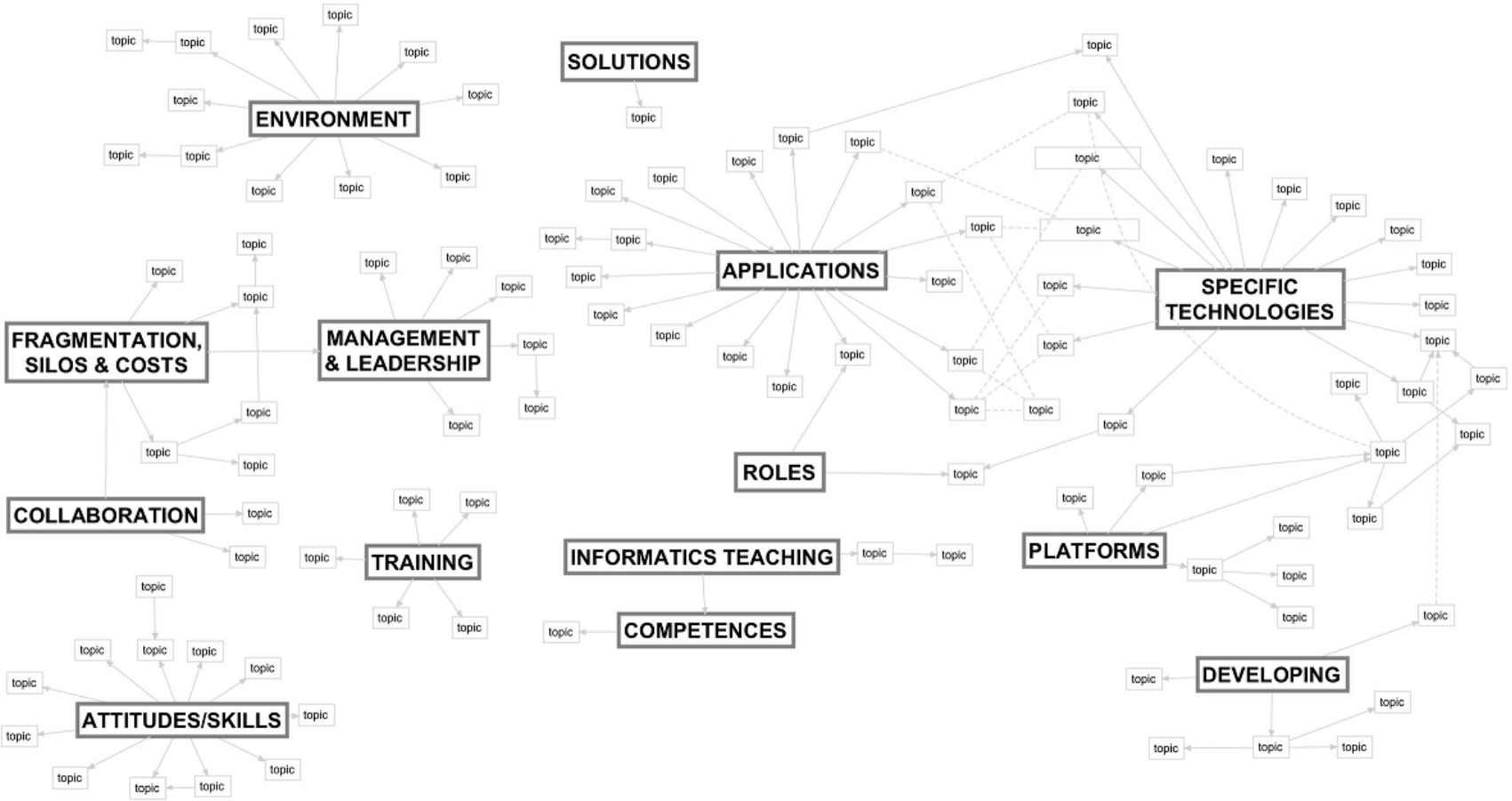
This scan describes the current use of digital media and methods across Canadian PGME, its impact on the sector and those who work in it, and some of the ways in which it can be developed. This covered all digital technologies (educational, logistical and environmental) and the ways in which they are used in Canadian PGME. This paper is one of 24 papers commissioned for the Future of Medical Education in Canada Postgraduate (FMEC PG) Project. Certain aspects of technology, such as simulation and distributed postgraduate medical education, were covered in other papers (commissioned papers 18: Simulation in Postgraduate Medical Education and 12: Distributed Education and Distance Learning in Postgraduate Medical Education). Their place in this scan is identified but not pursued in depth. A glossary of terms is provided in Appendix 3.

Methodology

The scan involved a structured literature review, a series of interviews with key stakeholders and a thematic review of the wider literature on technology and medical education. The literature review was conducted using the protocol set out in Appendix 4. This returned 32 papers. Two were excluded on the basis of non-relevance. The remaining 30 were reviewed for key pointers and common themes. A thematic review was made of the broader literature on medical education, technology and education informatics based on the lead author's knowledge and experience in this area. Individual interviews were conducted with five physician educators and two educational technology specialists. Each hour-long interview was structured around the questions set out in Appendix 5. A semi-structured format was used to allow for exploration of other areas of interest. All interviews were transcribed and thematic analyses carried out first independently and then collaboratively by the interviewer and the commissioned paper lead. A VUE topic map[a] was created collaboratively to record emerging themes and the relationships between them from both the literature review and the interviews (see Figure 1 and Appendix 6). Limitations include the amount of time available, research ethics board restrictions on surveying all of the schools and the weakness of the current literature, an issue that has been noted elsewhere (2-4).

[a] The Visual Understanding Environment (VUE) is a topic mapping tool - see http://vue.tufts.edu

Figure 1: Simplified VUE topic map showing main topics and connections between them



Results

Digital media and methods have been used for educational purposes for years with the result that the many forms of ‘e-learning’ are now merging into the education mainstream. The debates over whether digital methods are better or worse than traditional ones are largely resolved (essentially, good educational design and alignment to the context of use are more important than media choice), but with small positive changes associated with convenience and flexibility of digital media. A major indication of this is the findings of the meta-analysis carried out by the United States Department of Education in 2010, which identified that: *“on average, students in online learning conditions performed better than those receiving face-to-face instruction”* (5).

Despite this growing consolidation, teachers and residents are still exploring how to make best use of digital media and methods and how to work around them (6). This development is reflected in the increasing value associated with real, personal and embodied experiences rather than synthetic ones (7, 8) and the growing digital augmentation of the real, particularly through mobile devices (9). Despite the many challenges to the way we think about and work with knowledge, learning and communication, human values and experiences remain the primary concern of medicine and medical education.

The adoption of digital media and methods in PGME in Canada appears to be very uneven. It is in the conservative nature of medicine to be slow to adopt, or adapt to, new technologies no matter how beneficial (10). While much of the rest of the world has gone digital, medicine remains a relative laggard, and even though digital media and methods are being layered into Canadian healthcare in ever-increasing quantities (11), those responsible for the education and training of physicians and surgeons seem strangely reluctant to engage with them. This is not to say that digital media and methods should be embraced unquestioningly, but at present there seems to be little more than superficial levels of engagement from within the Canadian PGME sector.

A lack of strong leadership of and responsibility is a contributing factor to the current situation. Even those whose work is to champion the use of digital media and methods consider it their mission to find technological solutions for any issue that they encounter. A better focus is one of advocacy, consultation and guidance regarding the ‘if’ as well as ‘how best’ to make use of digital media and methods (6). To do this, digital practice needs to be grounded in the fundamental values of both educational and clinical practice in PGME.

These issues should be considered within the broader Canadian context. The last Statistics Canada survey of Internet use noted a rise from 73% of citizens in 2007 to 80% in 2009, with digital divides on the basis of income, education and age narrowing over the same period. Despite this trend, a recent national review of Canada’s digital economy notes that we are falling behind the rest of the world’s developed nations in our investment in and application of digital technologies, with investment in information and communication technology (ICT) in the healthcare and social assistance sector declining more than 10% between 1996 and 2006 (12). The report notes the need for significant investment in ICT in healthcare and education. However, at present, the only federal initiative of any size is Canada Health Infoway and its program of facilitating provincial e-health programs (see www.infoway-inforoute.ca).

The Statistics Canada report also identifies that the investment required in people, training and support is many times greater than that in the technologies themselves and that ultimately “for Canada to become a leader in the digital economy, digital skills development must be fostered in all Canadians” (ibid, p30). More specifically “in the health sector, steps need to be taken to ensure that large scale investments in electronic health information systems are not undermined

by a shortfall in the supply of health informatics and health information management professionals" (ibid, p32). There is little sign of a response to this challenge in the Canadian PGME system at present.

One reason that residents are being left to their own devices is the pervasive belief that they are intrinsically digitally competent. This has been promoted by a number of publications that talk about 'digital natives' and the 'net generation' (13, 14). However, there is growing evidence that the 'net generation' is an illusion and that contemporary residents have a surfeit of confidence not matched by actual competence (15, 16). The risks associated with technology use are higher for preceptors, and there is also a tendency for teachers to cede authority for digital media and methods to their residents. This is reflected in the lack of guidance around the use of mobile devices in the clinical workplace, with preceptors often not knowing what their residents are using or how. This means that it is often left to the resident to set appropriate boundaries around activities such as social networking (17).

The neglect of digital media and methods is a hidden curriculum issue inasmuch as it is required but rarely taught or formally assessed. The move away from internal memorization to accessing and appraising medical information as and when it is needed is a case in point (18). It implies that physicians will need to be adept at creating, accessing, appraising and using information as well as being able "to adapt continually to a changing informational environment and a changing healthcare system" (19). That residents are not being substantially prepared for these changes is not just a hidden curriculum issue in terms of the mixed messages it sends but also a null curriculum in terms of the deliberate exclusion of something fundamentally required (20).

Residents take their lead from their preceptors. Preceptors, therefore, need to be the ones providing guidance and positive modeling of how to use digital media and methods in professional practice. However, in the current environment, the lack of structure or affirmative guidance may lead residents to relinquish or at least downplay their digital competence to align with that of mentor. These risks may be related to broader issues of identity misalignment and dysphoria in developing physician identities (21, 22) and need to be more fully explored.

Over all, the research literature has not as yet provided a substantial evidence base to guide the use of digital media and methods in Canadian PGME. This is related to the absence of common and robust reporting standards (23), which, in turn, reflect the relative immaturity and repetitiveness of much of the literature in this area (2).

Respondents in the key stakeholder interviews identified similar issues to those found in the literature. For instance, institutional and government funding to support technology infrastructure is significantly lacking, including the basics such as network and server capacity. The need for better and more support for developing and using electronic learning resources was also identified. The absence of accreditation (or any other) requirements for physician digital competencies also means that future practitioners are increasingly unprepared for practice in Canada's increasingly digitized healthcare systems.

Respondents also noted the many differences between undergraduate (UG) and postgraduate (PG) medical education. Very few institutions provide an integrated educational technology service for both PG and UG, and, even where integrated services are provided, there are tensions over prioritizing of resources. There was also a perception that UG spends a lot more on technology (especially staff) than PG. As a result, information and educational technologies were not seen as particularly well supported for postgraduate medical education (PGME). The dependence on information technology (IT) departments with little appreciation of education (even less of PG education) was of particular concern. Dependence on poorly supported

technology leads to heightened risks, and, when it fails, disproportionately dented confidence and morale. Technical problems are being amplified by PGME's location in hospitals rather than academic centres, often without the ready access to those who can address technical problems.

The clinical workplace is the primary location of PGME learning. Residents have no office in this environment so they have to carry what they need with them. Mobile technologies were identified as the only practical way to remain connected in such an environment. Furthermore, since mobile technologies are particularly individual focused, they align well with the more individual-focused nature of PGME. However, using mobiles means that the residents' digital activities go largely unscrutinized at the institutional level and are likely to differ from preceptor expectations. Residents also make use of personal computers on the wards for accessing the electronic medical record (EMR) and other hospital systems. Hospital environments were identified as being significantly resident unfriendly in terms of technology. For instance, hospital firewalls often emphasize security at the cost of utility by blocking social media and other tools that residents use to interact with their peers. Many hospital computers were considered to be below an acceptable standard, leading to a greater dependence on personal mobile devices.

Respondents noted that informatics teaching seems to be largely absent from many programs and only a minor, even arbitrary part of others (typically some kind of evidence-based medicine (EBM) along with basic EMR training). Respondents (including residents) reflected the general belief that contemporary residents are intrinsically digitally literate. This inattention of faculty and preceptors to digital media was a recurring issue. In some cases this unwillingness to face technical challenges is defended in terms of academic freedom and autonomy. This issue is exacerbated by many PG faculty being located away from academic centres, a growing issue as more programs are being launched in rural and remote locations (see commissioned paper 2.5: Integrated Education, Distributed Education and Distance Learning in Postgraduate Medical Education). Some respondents identified a growing digital divide between preceptors and residents, with some preceptors refusing to use email, while their residents have already moved on to other forms of communication such as Twitter and Facebook.

Respondents identified faculty development and training as essential but again problematic. Like clinical skills, digital skills are acquired and honed through practice. Traditional faculty development offerings tend to be distanced from the learning contexts in which they will be applied. Respondents identified the value of just in time (JIT) training as a way of addressing this issue including the logistical challenges of providing it. It was also noted that administrators were failing to keep up with contemporary tools and technologies and needed better training, for instance, in the use of web conferencing and learning management systems. Remote and distributed teaching was identified as a particular challenge with many preceptors needing support and training on how to teach (not just how to use) video- and web-conferencing in PGME, particularly at sites not previously designated as teaching locations

Respondents also identified a need for more formal and active engagement of medical educational informatics professionals in the PGME environment as well as a need for organized activities around medical education informatics in Canada. Nearly all of the respondents indicated a need for a national medical education informatics forum. More advanced technology workshops were also requested for faculty eager to evaluate new technologies, select appropriate solutions and implement them. Again, a national support group or meeting may be a good way of addressing this. However, there seemed to be very little awareness of existing structures, and the ability of such organizations to meet PGME needs was unclear. While resource sharing was greatly desired by respondents, the severe limitations of Canadian digital copyright laws were identified as a barrier, as were challenges using clinical material for teaching. There are ways to address this, but they are relatively unknown in PGME (24).

The quality of the online resources for PGME was seen as very variable, which was, in turn, directly linked to the absence of technical or educational standards for their design or their ability to share data and services. Developers in PGME tend to develop and innovate in silos rather than collaboratively. Even within institutions, development tends to be fragmented and random. Systems do not talk to each other and are often hard to access and sustain. There is a particular need for standards (both technical and quality assurance) to connect and integrate existing and new technologies, and a clear role for medical authorities (such as the various Colleges and other professional societies) in accrediting, approving or otherwise quality assuring materials and tools. The cost of creating digital media was raised as an issue, in particular when it leads to using (cheaper) third-party vendors. A number of respondents noted dissatisfaction with vendor solutions as they fail to understand PGME needs, and find it difficult to work in the PGME environment. Issues of the cost of technology and its evaluation also need to be considered in terms of total cost of ownership (TCO) and return on investment (ROI) as a whole system, not just capital components.

There was also an appetite for both faculty and trainees to know how to create their own digital resources, particularly virtual patients and other case- and simulation-based material. Even a basic awareness of the costs and time involved and the availability of open repository systems would help. Respondents requested better support for creating video resources as well as making better use of the large quantity of video material available online (such as through YouTube). Several respondents raised the popularity of mobile devices and the increasing need to develop applications for mobile platforms. One of the respondents involves summer students in building educational websites and mobile Apps. Again, the need for standards was a recurring theme, particularly for platforms such as video- and web-conferencing, encounter logging systems, and simulation.

Finally, senior leaders were identified as often making inappropriate and uninformed decisions regarding the use of digital media and methods in PGME. This reflects a common inattention effect amongst management arising from a superficial appreciation of digital media and methods (25) along with the dominance of corporate rather than academic models of IT management. The general absence of positive modeling of digital competencies has led to a degree of inappropriate and uninformed behaviour that requires the adoption of ‘digital professionalism’ (26).

Specific Technologies

A number of specific technologies were identified by both respondents and the literature as either being used or intended to be used in PGME, including; videoconferencing, web conferencing, portfolios, video learning objects, clickers/audience response systems, encounter logging systems, and virtual patients. Respondents also identified many technologies that they do not use in PGME including SMART boards, and most forms of social media (often because of poor network value or economies of scale given the individual paths residents take). Particular note was made of the following:

- Learning management systems (LMS) form the core of most university’s e-learning infrastructure by providing an integrated and centralized set of course content, tracking, assessment and reporting tools. As such they tend to be single institution-wide systems and are nearly ubiquitous in UGME (e.g., WebCT, Blackboard, Moodle, Desire2Learn). There has been only limited uptake of LMS in PGME, mostly for course websites rather than as comprehensive virtual learning environments. These systems, designed for generic higher education programs and courses, are considered a poor fit for PGME.

- Video technologies including web-conferencing, videoconferencing and video-based educational resources (typically of clinical skills) were a recurring theme. Current models of distributed medical education are fundamentally tied to videoconferencing, despite its limitations, not least because of concerns with the quality of service and appropriate use of web-based technologies. The ability to view a brief instructional video before and/or after carrying out a particular clinical skill or task was seen as particularly useful (27).

- Simulation was another recurring theme with two clinicians observing that high fidelity (mannequin) simulations are costly and not the best fit to many learning situations, indicating that more attention needs to be paid to low fidelity simulation modalities such as Virtual Patients and electronic cases [see commissioned paper 18: Simulation in Postgraduate Medical Education].

- Computer-based learning (CBL) resources are materials intended for instructional purposes such as online tutorials, multimedia reference materials and self-study packages on particular topics. Although they are being used in PGME (28, 29) respondents observed that there was very little sharing of resources between institutions. Although greatly valued by residents (who see their preceptors as facilitators rather than directors of their learning), their preceptors may be more skeptical and question whether these digital resources may actually hinder trainees' ability to think and reason through problems, essentially learning reversal effects (30). While multimedia learning can be significantly superior to paper-based resources (31), its use is again somewhat fragmented in PGME.

- Clinical systems such as EMRs and picture archiving and communication systems (PACS) are generally an untapped resource in PGME, and, where they are taught, it is almost exclusively at the level of operator training. This is seen as problematic as many residents need to retrain on different systems at each rotation. These variations could be used to more positive effect by using them to teach the principles and issues of information management in clinical systems (32, 33). The use of decision support systems, guidelines, algorithms and checklists can also provide value and promote safety within the clinical context (34) and can be used as the locus of teaching and learning.

- Clinical encounter logging systems are simple database applications through which learners keep a log of the clinical encounters, tasks and other hey events they encounter while in the clinical workplace. These logs are used to ensure learners have the appropriate spread of experiences and to support reflective learning. Logging tools are increasingly delivered through mobile devices to allow the logging to take place at the bedside. The use of these tools seems to be fairly widespread, with relatively good alignment between PG and UG around logging, which would seem to afford opportunities to build bridges between the two. However, the problem of resident logs receiving little review or preceptor feedback is a common problem (35). A number of respondents also identified the need for standards and interoperability for logging systems.

- E-portfolios are online systems that allow their users to store multiple records and artifacts (such as videos or written documents) to track their learning over time. Although they were mentioned it was largely in terms of pilots. In the United Kingdom Foundation program the e-portfolio has become a central part of the residency process as it contains the negotiated learning plans and the tracking of how they were fulfilled for both trainee and their mentors (36). This work and its strengths and weaknesses is considered in more depth in the report from the FMEC team that visited the UK. Given the work

elsewhere and the value arising from their appropriate use, the use of portfolios could be better developed for Canadian PGME.

- Web 2.0 technologies are online tools that allow their users to create, share and comment on each other's work. They include social networking tools (such as Facebook), content exchange (such as YouTube) and content generation (such as Wikipedia). The only tools of this type that were mentioned were wikis, although these were used more for collaboration between preceptors and program managers than for residents. Although the use of Web 2.0 technologies can apply to PGME (16), the focus needs to be well aligned with the learning objectives and other needs of those involved.

There are a number of digital technologies for education that were not mentioned in the interviews. Notably absent from the interviews was the use of digital techniques for assessment, evaluation and audit. However, reporting resident evaluations of their experiences and preceptor evaluations of their residents is required and this currently involves a mix of digital and paper-based media. A final group of essential technologies that were not mentioned in the interviews comprises the knowledge bases and tools that support research and evidence based medicine (EBM).

The roles of the librarian and the library are essential in assuring access and skills to make use of these resources but are often considered as separate from the mainstream of digital media and methods in PGME. Digital games and gaming is another area that can be used in PGME, particularly in developing surgical skills (37, 38). Virtual patients can also be built as games (39), but again there seems to be little use of these kinds of designs in Canadian PGME. A last group of technologies that were absent from the interviews includes those built around virtual worlds and virtual reality. Second Life has been piloted in postgraduate context, albeit with unclear success or widespread application (40).

Many current applications of technologies were identified: communications, providing information, encounter logging, collaborative working, just in time learning and simulation. However, at present, the uses of these applications are seen as quite conservative relative to the opportunities they afford. This was reflected in interviewees' anticipatory observations ('that technology x should be applicable to educational purpose y'), aspirational observations ('that we should be using x for y'), and unmet expectations ('I don't know why we don't use x for y'). The exploration of what might or should be is also well-represented in the literature (41, 42) and has been noted as a problem (6) if not related to the needs of residents and residency programs.

Residents' activities typically span multiple tools and devices. Considering the digital ecologies in which these activities take place is as important, if not more so, as the individual technologies and processes within them. Even where digital media and methods are used, their integration with the overall curriculum is relatively low. Despite this, the importance of curriculum integration is a fundamental one (43) and needs significantly more attention than it currently receives.

Summary

This scan has identified that, although digital media and methods are being used in Canadian PGME, there are many more ways in which they can be used and addressed. Where there is digital activity it is often fragmented and siloed with little opportunity to collaborate or share between institutions. Problems exist in the management and strategic direction of technology institutionally, professionally and nationally. Significant problems also exist in the use of digital environments, the extent of integration of digital media and methods into PGME curricula, the alignment between PGME and the developing e-health environment, and the alignment between

resident and preceptor needs and current practice. We have identified a number of key themes structured as a series of challenges:

Challenge 1: Digital Everywhere

The broad societal adoption of ICTs (44) creates an environment of expectation and 'best practice' that frames the use of digital media as an indicator of progress, modernity and efficiency. At the same time, there is a growing want for authentic largely non-digital experiences based around individual, face-to-face encounters. Concepts such as 'economies of presence' significantly frame the use and value of educational technology in PGME (45).

Communication technologies, in particular email, have transformed how residents and preceptors communicate and, more importantly, their expectations about how they communicate. Any online action, although ephemeral to its creator, may nevertheless be stored indefinitely, and social technologies, such as Facebook, can blur the personal and professional aspects of their users' lives leading to potential risk and disruption (46). Logistical technologies also make up a significant part of the residency experience including CaRMS (the Canadian Resident Matching Service), CanMEDS (the national competency framework for physicians from the Royal College of Physicians and Surgeons of Canada), placements, licensing and tracking of continuing medical education. The power to track the use of digital media increases our ability to audit and scrutinize both residents and teachers in ways previously unimaginable. This raises issues of accountability and trust that indicate changing relationships between residents and preceptors (47).

Better understanding and literacy is required to work meaningfully and effectively in digital practice, education and academic environments. Canada is falling behind the rest of the world in digital education and healthcare, and unless it wants to be a low informatics and low competence practice environment, this must be substantially addressed.

Challenge 2: Embracing the Cyborg Professional

Some preceptors have been slow to adopt digital media and methods in the PGME context and, in many cases, have ceded control and authority to their residents. This abdication of responsibility is a serious omission in the preparation of tomorrow's doctors, and, as a result, there is a need for better critical and evidence-based practice around PGME teaching. It would seem that contemporary residents start off by expecting digital skills to be a part of both being a resident and being a physician.

However, the adoption of a 'cloak of competence' involves residents following their preceptors' values and attitudes, and in the contemporary environment, there is a significant risk that this will lead to them internalizing the low status of digital media and methods in medicine as a whole. Similarly, the response of many institutions to frame digital mistakes (such as inadvertent Facebook disclosures) in terms of discipline and punishment, essentially seeking to limit resident actions through regulations and threats of misconduct, will also not serve (48). A new digital professionalism is a way to address this issue (26).

The idea of the cyborg is a fusion of the technical and biological (49), and there is an argument to be made that information devices are extensions of our mentalities, allowing us to externalize knowledge and processing (50). Our personal technologies, therefore, redefine our relationships with information and knowledge, and the shift in medical education from knowledge acquisition to knowledge articulation is clearly dependent on such relationships. However, the concept of residents and teachers as cyborgs is not easily assimilated into PGME. For instance we usually require residents to be stripped of their prosthetics for the purposes of assessment (51).

There is also a pervasive attitude throughout Canadian medical education at all levels that educational technology is the domain of the technologist and not the educator. The result is that it is sometimes left to engineers and technical managers with little appreciation of the dynamics or needs of medical education (52). The use of the term e-learning identifies technology-enhanced learning as something set apart from regular learning. This is an error, and digital media and methods should not be treated as 'other' any more than communication or professionalism are.

Not only do managers, policy makers and leaders in PGME need to be better oriented to the use of digital media and methods, there is also a collective need to move the discussion beyond matters of instrumentation to their use within educational and healthcare systems as a whole. This will become increasingly important in the face of the changing ways in which medical education constructs, values, pays for and ultimately sustains medical education in the years to come (53). Over all, we need to understand and address the totality of the digital professional, rethinking competence and ability, but also ensuring residents can function in environments.

Challenge 3: Medium as Message

According to the Canadian Adverse Events Study, of almost 2.5 million hospital admissions in Canada 185,000 were associated with an adverse event, a significant proportion of which were associated with information management errors (54). Although interprofessional and team-based learning can provide ways to address this, there is a need for tomorrow's doctors to be better prepared to practice as information professionals along with their more traditional roles. Current models of investment focus on the technology and not the people. However, as the Industry Canada report clearly identifies, the investment required in the people around systems and technology is significantly greater than that in the tools themselves. So far, Canadian medical education at all levels has failed to respond to this challenge or even, in many cases, to acknowledge it.

As the use of digital media and methods grows to become a central part of the healthcare environment, digital competencies are both the means to learn and the means to practice. Specific technologies and systems that now form a core part of clinical care may include, for example: electronic health records (EHRs) and EMRs, PACS and imaging, laboratories, order entry, point of care, decision support and guidelines, logistics (scheduling, organization management), communication, and patient access and support (pubic health websites, hotlines, personal health records). All of these shape and direct the context of care, but their profile within residency programs is often limited to operational training on the systems in use in their institution (55).

Furthermore, although the federal Canada Health Infoway project and provincial EHR and EMR programs are developing e-health infrastructure, there is little relationship between postgraduate training and these programs. As a result, successive cohorts of residents are entering practice with little or no appreciation of the strategic role of informatics or a clear or consistent idea of their responsibilities with regards to the use of digital media and methods. As long as we invest in e-health but fail to connect this to the training of those who will use it (let alone their ability to appraise or shape it), we are eroding the roles and responsibilities of future physicians and their ability to be leaders within the healthcare system as a whole.

Challenge 4: Collaboration and Scholarship

There is significant variation in what is provided, how it is provided and why it is provided. Very few educational technology units in Canadian medical schools serve both UG and PG programs.

Some PGME programs concentrate on logistics and tracking, others provide some educational materials. Low levels of collaboration, coordination and consolidation within schools or between schools exacerbate the problem, as do the lack of common standards (technical, interoperability, infrastructural or quality). Training needs to improve both in terms of the levels and competencies it addresses (for instance going way beyond operator training) and in terms of the means by which it is provided (JIT, on demand and in context).

The literature in this area is weak, but there is a lack of funding or other opportunities to undertake the required studies or even to bring practitioners together to address this shortcoming. The retreat of Canadian funding for medical education research is a major problem in the sector as a whole, particularly given the scarcity of good evidence. Where studies have been done, they are often repeated media comparison or other intervention-based designs that do not move the field forward, although efficiency and other factors are now beginning to be considered, if not actually assessed (56, 57). Reviews and guides can provide more utility but are predominantly focused on UG issues (58, 59). Meetings and symposia are needed to bring those involved in the using digital media and methods in PGME together to foster exchange of ideas and materials as well as to support the development of better and more strategically focused scholarship throughout PGME.

Conclusion

A number of core steps were identified that address the shortcomings around the use of digital media and methods in Canadian PGME. These include developing a national digital literacy and professionalism curriculum, creating common educational and technical standards, and creating better opportunities for digital educators to collaborate and align PGME with the development of Canada's digital healthcare system. It should be emphasized that this report does not advocate for the widespread adoption of digital media and methods for their own sake, but rather for a broader and more critical engagement with them so as to better assess them and make appropriate use of them.

The three key messages from this scan are:

1. Canadian PGME accreditation and regulation structures largely ignore digital media and methods, despite them making up a growing part of the healthcare environment. Furthermore, digital competencies are lacking, or are at best arbitrary, in PGME. A national program based around a common model of digital competencies, potentially as part of CanMEDS, would focus the development of digital themes within programs, faculty development and the regulating and accrediting authorities.

2. Research and scholarship around digital media and methods needs to be better supported both in terms of resources and in terms of the nature and focus of inquiry. The three federal research agencies (CIHR, SSHRC and NSERC) need to reverse their retreat from funding health professional research, and funding agencies in general need to support innovative and critical approaches to exploring and appraising the role of digital media and methods in Canadian PGME, including the ways they relate to quality-assured practice.

3. The role for education informatics leadership needs to be developed and expanded in PGME. There is also a need for more digitally informed leadership in PGME as a whole. This should include positive engagement, mentoring, development of digital competence in leaders, support for strategic initiatives and scholarship, and alignment with the growing e-health environment for Canadian healthcare.

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Appendix 1: About the Authors

Dr Rachel Ellaway (PhD) is the Assistant Dean for Informatics at the Northern Ontario School of Medicine in Sudbury. She is also an Associate Professor and the Acting Director of Simulation for the School and is currently Chair of the Undergraduate Medical Education Committee. She is sits on the boards of eHealth Ontario and the journal Medical Teacher and is Chair of the AFMC Informatics Resource Group. Her research covers a range of technology-related educational themes including simulation, virtual patients, imaging, systems, interoperability, critical and theoretical approaches to technology, education informatics theory and practice and education systems and environments. Dr Ellaway is the Lead for commissioned paper 14: Information and Educational Technology in Postgraduate Medical Education

Dr Maureen Topps (MD) is the Associate Dean for Postgraduate Medical Education at the Northern Ontario School of Medicine. Among her many roles Dr Topps serves on the FMEC Phase 2 Steering Committee. Dr Topps acted as a reviewer and adviser to this scan.

Tamara Bahr (MScCH) is Manager of Instructional Design for Postgraduate Medical Education, University of Toronto. She facilitates many of the educational technology initiatives within postgraduate medical education. Her interests are in simulation technology, digital literacy, electronic resources development, mobile learning, and educational informatics for the heath sciences. In addition to co-authoring this paper, Ms Bahr conducted the interviews for the commissioned paper 14: Information and Educational Technology in Postgraduate Medical Education

Appendix 2: Annotated Bibliography

The problems associated with the scant research evidence around the use of digital media and methods in PGME make it hard to identify key papers to support the breadth of the discussions presented here. We have, therefore, selected papers that complement some of themes discussed in this paper:

Choules AP. The use of elearning in medical education: a review of the current situation. Postgrad Med J. 2007 83(978): pp212-6.

This paper typifies the weak state of the literature on the use of digital media and methods in PGME.

Rothman, D and Blumenthal, D, Eds. (2010). Medical Professionalism in the New Information Age. Piscataway, NJ, Rutgers University Press.

This book sets out a vision for the future of the profession of medicine in the digital age and how it is likely to change as a result of developing societal and technical forces.

Ellaway, R H (2009). E-learning and e-teaching. A Practical Guide for Medical Teachers. Dent, J. A. and Harden, R. M. Edinburgh, UK, Churchill Livingstone: pp229-237.

This chapter sets out a primer for many of the practical issues and concepts set out in this paper and relates them to a range of practical approaches to working with digital media and methods in medical education.

Appendix 3: Glossary

AFMC	Association of Faculties of Medicine of Canada
CME	Continuing medical education
CMG	Canadian medical graduate
CPD	Continuing professional development
EBM	Evidence based medicine
EMR	Electronic medical record
EHR	Electronic health record
PHR	Personal health record
ICT	Information and Communication Technology
IMG	International medical graduate
JIT	Just in time
LMS	Learning management system
PACS	Picture Archiving and Communication Systems
PC	Personal computer
PGME	Postgraduate medical education
ROI	Return on investment
TCO	Total cost of ownership

Appendix 4: Literature Search Strategy

Population	Canadian postgraduate medical education and residencies, ditto worldwide
Intervention	Technology – as medium, as intervention and as environment
Comparator	[using vs. not using] + [using A vs. using B] + [what happens when using A – i.e. phenomenon rather than comparator]
Outcome	Change in the experience, efficiency or quality of learning (individual and collective) and program delivery (any aspect thereof) and their relation to service delivery and sustainability

First pass: based on the following terms:

- postgraduate AND education AND [medical OR surgical OR laboratory OR health professional OR training OR resident OR residency OR specialty]

  AND

- [technology OR e-learning OR elearning OR CBT OR Computer-Based Training OR IBT Internet-Based Training OR WBT OR web-based training OR web OR www OR e-teaching OR e-assessment OR technology-enhanced OR technology-enhanced learning OR computer assisted instruction OR CAI OR computer assisted learning OR CAL OR computer supported collaborative working OR CSCW OR Computer-supported collaborative learning OR CSCL OR software OR hardware OR wetware OR problem-based learning OR PBL OR web OR email OR SMS OR haptic OR virtual reality OR augmented reality OR informatics OR virtual world OR virtual OR pager OR social networking OR digital media OR cellphone]

  AND

- [computer OR computerized OR PDA OR portfolio OR mobile OR web 2.0 OR wiki OR facebook OR discussion board OR portal OR medical record OR simulation OR learning management system OR LMS OR virtual learning environment OR VLE OR powerpoint OR audience response system OR videoconferencing OR web conferencing OR podcast OR reusable learning object OR RLO OR tracking OR logging OR laptop OR phone OR virtual patient OR conferencing OR games OR gaming OR game-based OR video game OR videogame OR wii OR second life OR network OR cyborg OR creative commons OR e-health OR point of care OR PACS OR curriculum map OR topic map OR knowledge map OR database OR PIM OR avatar OR]
- Modifiers: Canada/Canadian, [+provinces], rural, urban, primary, tertiary, formative, summative, collaboration, professionalism, competence, competency, ECDL, bedside

Limits: studies completed since 1985

Second pass: identify common authors from the first pass and search on their parallel work

Sources: PubMed, ERIC, major medical education journals (should all be PubMed linked), discipline specific journals, educational technology journals, medical education management journals. grey literature from: AFMC, RCSPC, MCC, AAMC, NHS Foundation Program.

Appendix 5: Respondents

Ms. Deirdre Bonnycastle, University of Saskatchewan

Dr. Chi Ming Chow, MD University of Toronto

Dr. Kevin Imrie, MD University of Toronto

Dr. Marcus Law, MD University of Toronto

Dr David Topps, MD University of Calgary

Mr. Steve Pennel, Memorial University

Appendix 6: VUE Topic Map of Emerging Themes