Preparing family medicine trainees for the information revolution

Pearls, potential, promise, and pitfalls

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Health care data are growing exponentially. Reports suggest that the United States generated 153 exabytes of health care data in 2013 and that an estimated 2314 exabytes will be produced in 2020.[1] These data, which come from varied sources (electronic medical records [EMRs], medical imaging, laboratories, pharmacies, billing, etc), are being harmonized both within and across institutions to drive meaningful change for patients. For example, in Ontario, different research groups are linking demographic, clinical, social, and utilization data from various disparate databases, including social service agencies, to identify patients who are or are at risk of becoming high-cost health care users and to support them with shared care plans.[2,3]

As patients age and acquire multiple comorbidities, their care becomes increasingly complex. A recent study showed that nearly 40% of patients admitted to general internal medicine services were older than 80 years of age and had a median of 6 comorbidities.[4] Family physicians will increasingly need to leverage the recent advances in data acquisition, storage, and analytics to make sound clinical decisions and ensure safe transfers of care as these patients move across the system. Despite a call to action in 2010 and the development and integration of e-health competencies into the CanMEDS framework, progress in the areas of informatics and analytics training has been slow.[5]

Given the current focus on competency-based medical education, Canadian family medicine (FM) residency programs must establish a minimum level of competence in informatics and analytics for graduates to succeed in this new environment. In this commentary, we propose the essential knowledge and skills for all FM trainees *(preamble)*, highlight established training programs that might be used as a springboard for designing our own programs *(pearls and potential)*, describe new and local interdisciplinary analytics initiatives relevant to FM residents *(promise)*, and identify barriers to scaling these initiatives across the country *(pitfalls)*.

Preamble

In the most recent CanMEDS framework, the eHealth Expert Working Group developed and integrated a basic set of e-health competencies into the various roles for graduating physicians.[6] These competencies are consistent with the medical informatics guidelines proposed by the American Academy of Family Physicians for matriculating FM residents.[7] While these competencies represent a precondition for engaging in clinical analytics, they are not sufficient. To understand, interpret, and meaningfully critique the outputs of predictive and prescriptive analytic tools, FM trainees will also need to recognize the different types (eg, unstructured vs structured) and sources (eg, health care administration, EMRs, laboratories, disease registries) of data and describe the different analytical approaches (eg, machine learning, multivariable regression), their associated advantages and disadvantages, and how they add value to common tasks in primary care like screening and chronic disease management. They will also need to be familiar with different ways of de-identifying data to ensure security and privacy; lead and support governance initiatives within their practice or network to enhance data quality; identify and act on strategic priorities; and engage partners within (eg, data scientists, research associates) and outside (eg, EMR vendors) the system. Finally, they will need to be comfortable with generating "canned" reports from their system and interpreting and critically appraising the results before acting on this information for clinical decision making.

For the much smaller proportion of FM trainees who wish to engage in clinical research and quality improvement (QI), the development of more technical skills (eg, extracting data from structured query language databases, performing statistical analyses using R software, writing basic programs in the Python programming language) will be required. This will permit deeper collaborations with biostatisticians, data scientists, and computer scientists in the design and deployment of predictive or prescriptive initiatives and the creation of reports or reporting tools for their physician colleagues.

Pearls and potential

In Canada, clinicians can pursue additional formal or informal training in informatics and analytics through postgraduate programs typically affiliated with schools of health policy, public health, or management. In contrast, in the United States, at least 4 clinical informatics fellowship programs have been accredited by the Accreditation Council for Graduate Medical Education; these are located at Stanford University in California; Oregon Health and Science University in Portland; the University of Illinois at Chicago; and the Regenstrief Institute in Indianapolis, Ind.[8] All 4 programs share

common educational underpinnings: rotations in different settings and information technology departments, project-based opportunities in QI and research, and interdepartmental collaborations.[8] Early evidence suggests these programs and others are working. For example, among the first group of residents enrolled in the University of California Los Angeles Health Resident Informaticist Program, 94% completed the program. Among their projects, 55% led to positive changes that affected "patient care, provider efficiency and workflow, reporting, or end user training."[9]

Although these programs have been successful, they still fall short of being feasible and scalable options in FM to establish a minimal level of competence without detracting from competing educational priorities and clinical care. One way to achieve this goal is to adopt the approach taken to integrate QI and patient safety training into postgraduate medical education. For example, at Queen's University in Kingston, Ont, FM residents participate in a yearlong experiential team project complemented by 10-hour structured didactic sessions that address fundamental topics within QI and patient safety.[10] Such longitudinal curricula have been effective in providing basic knowledge and skills without increasing curricular time or requiring substantial additional resources.[11]

Using a similar framework, we propose a series of linked didactic sessions totaling 5 to 10 hours and a concurrent independent or team-based research project that addresses applied approaches to informatics and analytics, with a focus on interpretation of data. In keeping with the recommendations of the International Medical Informatics Association on education in biomedical and health informatics, lecture topics would include principles of documentation and health data management; the structure, design, and analysis of the electronic health record; principles of data mining and data warehouses; ethical and security issues; basic informatics terminology; traditional statistics (eg, variance, central tendency, descriptive statistics, and multivariable modeling); and a high-level understanding of machine learning, simulation modeling, and natural language processing.[12] In addition to giving residents an opportunity to apply this knowledge to real problems, projects would allow for integration with the front-line experience of faculty physicians who would be called upon to provide guidance and mentorship for learners.

Promise

The Canadian Primary Care Sentinel Surveillance Network (CPCSSN) is one example of a practice-based research network that might be leveraged in conjunction with the aforementioned approach to provide FM residents with the data needed for their projects and thereby strengthen the connection between analytics and clinical medicine. It is the first multidisease EMR surveillance system that collects patient health information from 1100 participating primary care practices across 8 provinces and territories.[13] Given its geographic scale, its focus on 5 chronic diseases and 3 neurologic conditions, and the data it amassed from more than 1.5 million patients, CPCSSN is well positioned to give FM trainees across the country sufficient and varied data to extract, analyze, and interpret to answer different clinical questions.[13]

Another training opportunity is Acute Care Enhanced Surveillance (ACES), a real-time syndromic surveillance system that monitors visits to emergency departments at more than 140 hospitals in Ontario, capturing data from approximately 14 000 visits and 4000 admissions per day. These data are collected centrally within the ACES system, classified into several syndromic categories, and then automatically analyzed to detect increasing numbers of visits for particular syndromes. As FM is a community-based discipline, trainees must be able to identify and appropriately mobilize resources to address community needs. Acute Care Enhanced Surveillance provides an opportunity to become comfortable in this area by working with data collected in real time to protect public health. For example, ACES data have been used to monitor influenzalike illness activity, thereby improving infection prevention and control through real-time notification and enabling improved diagnostic predictive value.

While CPCSSN and ACES hold promise for training the next generation of family physicians, they were conceptualized as research platforms for improving individual and population health. Integrating training opportunities will require additional funding and collaboration between multiple stakeholders to develop and implement administrative (eg, policies and procedures) and technical (eg, secure servers at regional educational sites, licences for access) infrastructure.

Pitfalls

While these initiatives are well suited to facilitating the informatics and advanced analytics training of FM residents, multiple barriers exist. The first is time. Postgraduate medical curricula are already full and simply adding new content is not sustainable. To ensure that our proposed curriculum does not represent a new "ask" for time, we recommend its integration with existing teaching on research methods and resident research projects, which are already components of residency programs. Moreover, with the transition to competency-based medical education well under way, there are opportunities to consolidate complementary topics (eg, traditional statistical approaches with newer data science techniques) and to integrate lessons into day-to-day clinical work and ongoing QI initiatives. The latter might be achieved through observation of preceptors interacting with practice-based data or through lunch-and-learn "rounds."

Second, finding the expertise to teach some of the more esoteric and emerging topics is also a concern. A recent report suggests a shortage of 150 000 professionals

with strong data literacy and analytical skills in Canada.[14] Taking into consideration the specialized knowledge and skills required to teach and the human resource issues faced by smaller schools in recruiting and retaining talent, this shortage is likely to be exacerbated.[15] Folded into this concern is the need for clinical preceptors with sufficient experience in informatics and analytics to mentor FM residents. One possible solution to address the latter would be to develop a "boot camp" for involved faculty. These initiatives are time efficient and have been found to be effective educational interventions for improving skills, knowledge, and confidence.[16] Another solution is to combine faculty development and resident training by having clinical supervisors and residents partner with data scientists early in the research life cycle and continue collaborating as projects evolve.

To overcome these barriers, residency programs will need to determine if affiliate health systems have the infrastructure (information technology systems, EMRs, etc) and funding streams to cover associated operational, administrative, and human resource costs. If not, they will need to invest time in identifying suitable environments and personnel to host such initiatives. They will also need to provide training opportunities for academic physicians who supervise residents to develop the aforementioned competencies. One way to achieve these aims would be to develop multiple e-health centres of excellence, as the Centre for Family Medicine Family Health Team has done, that are capable of integrating FM trainees and supporting different research and educational initiatives.[17]

Conclusion

The prominence of the digital data environment will continue to grow, and advanced analytics will increasingly transform industries over time. The health care sector needs to be prepared to embrace this new era or risk being left behind. Our future generations of family physicians must be trained in these important emerging areas that will play fundamental roles in clinical practice and the care we provide to our patients.

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Competing interests
None declared

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