



6 Future Health Care Trends: Impact on Postgraduate Medical Education

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Executive Summary

This paper is based on a targeted review of the medical, health care and educational literature as well as a more global review of current and future trends in society. We summarize trends in demographics, advances in science and technology, social and economic trends, and global and environmental changes, and their impact on components of the health care system including the social determinants of health.

Several broader societal themes appear repeatedly, specifically globalization, lifestyle and sustainability. These trends, emerging issues and predictions for the future are interrelated – each impacts the others in complex and unpredictable ways. The implications for postgraduate medical education (PGME) are also interdependent and include the following key considerations for the future of PGME:

1. PGME will need to respond to the following major issues: the increased burden and complexity of chronic illness due to the ageing population, the health impacts of climate change, and technological advances, especially related to information management and social networking.
2. PGME will need to respond to a world that is increasingly globalized, complex, diverse and uncertain, requiring an educational system that is flexible and responsive to change. Solutions to problems will need to be sought through transformation rather than growth. Changes will be required at the level of curriculum, delivery and the system of education.
3. Considerations of the future need to be part of every discussion about medical education and involve representatives from economic, political, socio-cultural, environmental and technology sectors.

Background

Change in medical education is a long-term project. Even under the most propitious circumstances, major curriculum changes require several years to plan and implement. Transformational changes to structures and institutions take even longer. Changes to undergraduate medical education (UGME), even if implemented next year, would not begin to impact learners entering into postgraduate training until 2016. Some of these trainees would not complete their programs until 2022. Of course, the world will not be the same place then as it is now. Yet most of what is written about medical education reform, cast as preparing physicians for the 21st century, is firmly rooted in addressing the problems of today – or yesterday. Rarely do medical educators lift their eyes to see what the future might bring, or to think through the implications of societal, economic or environmental changes for the delivery of health care, the practice of medicine, and the continuum of medical education.

This paper is one of 24 papers commissioned for the Future of Medical Education in Canada Postgraduate (FMEC PG) Project.

Predicting the future is fraught with risk, and the future of health care is far from exempt. Futures studies (futurology) attempt to predict future events and trends through the systematic study and pattern-based understanding of the past and present. Such studies examine not only possible, but also probable, preferable and wild card futures (scenarios) and seek to gain a holistic or systematic view based on insights from a variety of different disciplines. In this paper, we take a conservative, approach to focus primarily on trends that will form a probable future. Health systems are generally quite conservative and the probable future is for a slow but steady evolution. Nevertheless, even predictable trends and probable futures will have major implications for the future of health, health care and postgraduate medical education (PGME).

In this paper we summarize trends in demographics, advances in science and technology, social and economic trends, and global and environmental changes, and their impact on components of the health care system including the social determinants of health. Several broader societal themes appear repeatedly, specifically globalization, lifestyle and sustainability which will be flagged throughout.

Methodology

We conducted a search of the medical, health care and educational literature, especially the grey literature, as well as a more global review of current and future trends in society in areas such as economics, communications, technology and environment. Given the time constraints, we conducted a targeted rather than comprehensive review.

This topic does not lend itself to traditional systematic review searching as it is not a simple synthesis of what is already known, but rather a critical analysis of current best thinking in the area. That aside, we searched MEDLINE and EMBASE on OvidSP and ERIC (EBSCO) to ensure that reviews of future health care trends were retrieved. The following terms were most helpful: [future mp OR Forecasting MeSH] AND [healthcare mp OR Delivery of Healthcare MeSH] AND [Canada mp] AND [Education, Medical, Graduate MeSH OR Internship and residency MeSH OR postgraduate medical education mp]. Searches of the grey literature retrieved reports from organizations related to governance, study and provision of health care in Canada and PGME in Canada, United States, the United Kingdom and Australia. They included stakeholder organizations for the FMECPG project, Canadian Institute for Health Information (CIHI), Statistics Canada and Canadian Institutes of Health Research (CIHR) and equivalent international organizations. We identified trends and major issues based on existing reviews

and issues related to globalization, socialization, sustainability, uncertainty and economic volatility. We targeted specific websites and publications from the lay press and business world known to engage in future trends analysis (The Economist, Conference Board of Canada). These trends were synthesized and projected onto a framework for health care and PGME.

Results & Discussion

Trend analysis

Demographic trends

Although currently a young population compared to other G8 countries, the population of Canada is ageing due to decreased fertility and increased life expectancy. The number of seniors (>65 years) will surpass children around 2015, with the first cohort of baby boomers turning 65 in 2011. The proportion of the oldest seniors (>80 years) will increase sharply. Economic growth is slower in ageing populations principally due to the greater burden of dependency defined by Statistics Canada as the number of dependents ≤ 19 and 65+ for every 100 people in the working age population (1).

Population growth, and particularly growth in the proportion of the working age population, is dependent on net migration (globalization). By the year 2030, when deaths are expected to start outnumbering births, immigration will be the only source of population growth.

Canada already has an ethnically diverse population, and this is likely to increase in the 21st century. Currently, almost 20% of Canada's population is foreign born, among the highest in the world (12.5% in the United States) (2). The pattern of immigration has changed dramatically in the past century. Nationally, the share of immigrants from Eastern Europe, Asia and Africa more than doubled to 72% between 1981 and 2001. "The human capital of immigrants from more recent source regions may be initially less transferable because of the potential issues of language, cultural differences, education quality and discrimination." (3) The proportion of visible minority persons in the population as well as source countries for immigration vary greatly across the country (4). In Vancouver, 90% of visible minority persons are of Asian descent, with much smaller Black, Latin American and Arab populations than metropolitan Toronto or Montreal.

About 3.8% of the Canadian population identifies itself as being of Aboriginal origin, and 2.0% is registered under the Indian Act. Regionally, the proportion of the population reporting Aboriginal origin varies from 1.3% in PEI to 85% in Nunavut (5) (see Table in Appendix 3). The Aboriginal population is younger than the non-Aboriginal population (6), with less formal education (7), lower employment rates (8) and lower average earned income for full time employees at all levels of education (9). Due to its youth, this population is growing faster than the national average. Although the Aboriginal population is ageing due to increased life expectancy and decreased fertility, this phenomenon lags behind that displayed by the Canadian population as a whole. In the near future, large numbers of young Aboriginal adults will enter the labour market (6) rather than retire from it.

Health care workers will mirror to some extent the overall population in terms of demographics. More women are entering medicine and tend to work professionally fewer hours per week than their male counterparts, particularly during their early careers (10). Unemployment in the health care sector is lower than the general population and was the only sector to see job growth during the most recent economic downturn. High demand is likely to keep unemployment low in

the health care sector. However, both supply and demand will be influenced by scopes of practice and international mobility.

Advances in Science & Technology

There has been enormous progress towards understanding the human condition from a biological and scientific perspective. The process of ageing is now seen as a biological process rather than a chronologic one (11). Discoveries are on an increasingly precise scale such that life and disease are understood at the genetic and molecular level. While medical science in the 19th century focused on anatomy and in the 20th century on physiology; in the 21st century it is increasingly focused on molecular biology.

Uncovering the human genome has allowed scientists to look at common variation and identify risk factors for a number of diseases. Genetic biomarkers are being identified to tailor both type and dose of specific drugs. While this may currently apply to a very few diseases and drugs, science is now beginning to understand the interaction between genetics and the other determinants of health (12).

Less is known about the genetic and molecular basis of mental health where diagnoses and causality remain in flux. However, it is possible that, in the near future, science will recognize mental disorders not as discrete conditions with specific causes, but that "...psychiatric symptoms can arise from many causes and are more interrelated that current disease models allow." (13)

Advances in biomedicine have been facilitated and further enhanced by technology. Technologies that emerged in the latter part of the 20th century, such as fibre optics and digital imaging, are being advanced and incorporated with other technologies. Robotics are in use for some procedures, allowing for remote diagnosis, monitoring and surgical procedures. Computer systems are applied to genetic material in genomics and pharmacogenomics and to other biomolecules, for example, proteomics. When applied to the physical sciences, such technology can design and produce advanced synthetic materials for use in diagnosis (microfluids) and treatment, from Teflon[®] grafts to advanced biomaterials for targeted drug delivery.

With so much new information available, it is important to be able to capture, store, use and communicate it effectively. Data can be digitized, processed and shared over distance. The term eHealth describes the application of information and communications technologies (ICTs) in the health sector. It is applied to a variety of systems, programs and applications that can be used in everything from administration through to direct patient care (14). Telemedicine, for example, is broadly defined as the use of telecommunications to allow caregivers to interact with patients and/or other caregivers operating at remote locations (15). The information technology (IT) revolution has "...the potential for compressing distances, bridging borders, reducing costs and expanding participation – all in real time" (16). While Canada is behind some developed nations in adopting health information technology, there has been recent progress in developing an electronic health record made up of component health information systems (for example drug, laboratory, diagnostic imaging/picture archiving, hospitals, patient and provider registries).

Social and economic trends

The World Health Organization defines the social determinants of health as the circumstances in which people are born, grow up, live, work and age, and systems put in place to deal with

illness. These circumstances are, in turn, shaped by a wider set of forces: economics, social policies and politics (17).

The baby boomer generation has shaped the social dimension over the last 50 years and will continue to do so in the next few decades. This cohort has known economic prosperity and has been characterised by the principles of autonomy, consumerism and empowerment (18). With few exceptions, their career prospects have been secure. More recent generations, however, consider work-life balance more important than job security and are open to multiple career paths (lifestyle).

The major demographic and societal trends of the 19th and 20th centuries – industrialization and urbanization – will continue to leave their marks. Against a background of economic growth, scientific and technological advances and improved living conditions, there have also been changes towards sedentary lifestyles and refined (western) diets. Tobacco use has decreased somewhat in Canada, but is increasing worldwide. Psychological stress from rapid social change as well as alcohol and other drug use, result in both health and social problems (19).

Amongst the First Nations, risk factors for chronic diseases and disability are especially prevalent (33). Rates of smoking and obesity in First Nations adults living on reserve are more than double the national average. There are lower rates of overall alcohol consumption; however, the proportion of First Nations adults living on reserve who report heavy drinking is again double that of the general population.

Despite the recent recession, Canada and the world have witnessed a period of strong economic growth, with an average of 2% per capita growth since 1950 (20). During this time, however, income inequities have increased. The income gap between the rich and the poor has increased more in Canada than any other Organization for Economic Co-operation and Development (OECD) country, with the exception of Germany (21). “There is also considerable inequity in the geographic distribution of poverty, socioeconomic disadvantage and educational concerns across BC. . . (with) the poorest regions (in) rural and northern areas of the province.” (22) (See also commissioned paper 1 Health Inequities, Social Responsibility and Postgraduate Medical Education.)

Total spending on health care in Canada, including public, private and out-of-pocket expenses, was \$171.6 billion in 2008 or 10.7% of the gross domestic product (GDP) (23). At \$5,154 the national per capita expenditure is below that of the United States but above the OECD average and varies from \$5,096 in Quebec to \$6,266 in Alberta. Following the contraction of the economy in the early 1990s, total health expenditure per capita has been growing at a rate of 3.6% (23). While innovation in health care can be a driver of economic growth total health costs are increasing relative to GDP.

The Conference Board of Canada considers the drivers of health care costs as structural factors over which funders have little control: population growth, ageing, chronic disease and inflation. Escalators are described as mechanical factors, those for which funders have some control such as pharmaceuticals, technologies and human resources (24). The board’s 2004 report identified three emerging escalators: access issues, patient safety and environmental issues, including the health effects and health care costs of environmental degradation. There are many divergent schools of thought regarding future health expenditures relative to GDP (25). While there is one school that suggests that demand for health care may decrease due to improved overall health of the population, most suggest that health care costs will increase due to increased demand for service and increased costs of services. For example, the Canadian

Academy of Health Sciences (CAHS) Report (30) quotes a study predicting that if current trends prevail, health care expenditures would make up 80% of total program spending by 2030, up from 46% today; all other programs such as education would be funded out of the remaining 20%. It remains to be seen whether these increases can be met by an increasing GDP or through increased efficiency and/or transformational change within the health care system.

Global and environmental trends

Globalization refers to the flow and exchange of goods, capital, labour and information (26). We live in a connected world both physically (through travel and migration) and virtually through information and communication technologies (ICTs). In a recent Lancet Commission review of health professions education, Frenk et al. (2010) refer to the growing interdependence in health created by global movements of people, pathogens, technologies, financing, information and knowledge(16). Interdependence has heightened awareness that, worldwide, resources of all kinds are finite, prompting a focus on sustainability. While this can be applied to individuals, organizations (corporate sustainability), concepts (sustainable development) and the physical environment (environmental sustainability), within health care, discussion has centred primarily on economic sustainability.

Climate change has been identified as the biggest global health threat of the 21st century (27, 28) and health systems will need to adapt to manage its impact. Global warming is incontrovertible (and evidence of its effects has been seen for several years), though the amount of change and its intensity, along with the willingness and capacity to mitigate it, are subject to considerable debate. Canada has observed an approximately 1°C rise in temperature since the beginning of the century, and we can expect this to continue by about 0.5°C per decade up to 5°C over the next century (34). The greatest changes will occur in the Canadian North, where temperature changes are projected to be among the highest in the world and where traditional resource-dependent communities are considered highly vulnerable.

Climate change will affect health directly and indirectly in six ways (28): changing patterns of disease and morbidity (e.g., increased deaths from respiratory and cardiovascular diseases, increases in vector-borne diseases); food (e.g., increased malnutrition and food insecurity); water and sanitation (due to changing rainfall and warming, including glacial melting); shelter and human settlements (e.g., energy shortages, environmental vulnerability of urban settlements due to flooding, landslides); extreme events (e.g., increase in natural disasters such as floods and droughts); population and migration (e.g., intensification of large scale population movements as a consequence of abandonment of inhospitable environments). Many problems are likely to increase tension and conflict between and within nations and communities.

Implications for Health Care in Canada

Epidemiology

The patient population is ageing. This cohort of seniors will not only be more numerous, but will also have different expectations of physicians and the health care system. While currently advocating for care for their elderly parents, these baby boomers will have high demands for their own care. The scope of care expected by this group includes not just basic, medically necessary needs, but also the virtually infinite requests for health enhancements, such as cosmetic and lifestyle treatments (sustainability). This is compounded by the medicalization of many conditions, particularly in mental health.

Ageing is associated with degenerative diseases such as dementia, the presence of one or more chronic conditions, as well as an increase in non-cognitive mental health problems. Overall, deaths due to cancers, cardiovascular disease and other non-communicable diseases are expected to increase (29). Advances in therapeutics are already turning previous fatal conditions such as HIV and some cancers into chronic conditions requiring long-term management.

A recent Canadian report on chronic health conditions suggests that chronic disease can be seen as a systemic issue, with blurred boundaries between multiple conditions and complex causality (30), a concept previously put forward by Tinetti (31). Many chronic diseases such as hypertension, heart disease, diabetes, osteoarthritis and chronic obstructive pulmonary disease (COPD) as well as some cancers, share risk factors that are largely preventable (11,32). Practitioners, public health organizations and society in general will focus on the reduction of risk factors related to a sedentary lifestyle, specifically obesity and inactivity, as well as substance misuse including smoking, alcohol and other drugs (32). Preventative activities not only reduce individual morbidity and improve population health, but also have the potential to reduce the anticipated health care expenditure for these chronic diseases (sustainability).

Canada will continue to reflect a marked heterogeneity in the many determinants of health such as age, socioeconomic status, genetic/ethnic background, health literacy, behaviour and health care utilization. Although life expectancy in Canada is amongst the best in the world with low infant mortality, this can conceal the significant inequities that exist between provinces and territories and within socioeconomic groups. Life expectancy varies not only between provinces (see Table in 3) but also within them. The prevalence of heart disease, diabetes and cancers in women are inversely proportional to household income quartiles, whereas self-perceived health and mental health improves. The prevalence of smoking and obesity are inversely related to household educational level.

It is difficult to generalize about the effects of immigration. Although new immigrants tend to be healthier than the general native born population, this effect decreases over time. Migration and travel will change the epidemiology of some diseases, including the threats of pandemic communicable disease. Mobility also results in more nuclear families and fewer extended families with their systems of informal supports. It is possible that there will be a greater need for formal support from the health care system.

In addition to chronic diseases, disability due to loss of vision, hearing and mobility will become more prevalent. Worldwide, depression contributes to the greatest number of years of life with disability (YLD) (29) with alcohol and drug use disorders, dementia, diabetes and chronic lung disease including asthma also in the top ten.

Although poor and developing less developed countries will be disproportionately affected by climate change, no country will be immune to its health impacts. Climate change poses a significant threat to traditional livelihoods in the short and medium term in northern Inuit communities and will exacerbate the existing health inequalities and poor health outcomes of Aboriginal Canadians (35).

For Canada's health system, climate change will result in changing risks. For example, the increased emergence of new, re-emergent and exotic diseases will mean that conventional expectations of likely diagnoses by family physicians and primary health care providers will be insufficient. The increase in extreme weather events such as heatwaves, floods and storms will increase pressure on emergency health services. Increased health surveillance will be required

to document baseline health measures and monitor changing health outcomes, especially in northern communities (34).

Delivery of Healthcare

Genomic and other biotechnologies as well as advanced digital imaging allow for earlier pre-symptomatic diagnosis and identification of a genetic predisposition. Although earlier diagnosis and intervention can delay complications and disability (compression of morbidity), it may also increase anxiety, stress and illness behaviour (the experience of disease) with attendant mental health issues (19). Ethical issues will continue to arise from increased interest in embryonic and other screening programs (36).

Several other factors are driving a shift in the focus of health care from acute illness and injury to chronic disease management. Technologies have allowed for safer, less invasive methods of both diagnosis and treatment. Minimally invasive surgery has progressed with fiberoptics, microtechnology and advanced digital imaging. These advances, coupled with a desire to control health care expenditure, have shortened hospitalizations with more care occurring in the community and the home. This trend is likely to be expanded with advanced bio- and communication technology.

Telemedicine will advance from teleconsultations "... to include cell phones and Internet-based telecommunications tools for remote and home health management with video assessment, remote bedside monitoring, and patient-specific care tools with event logs, patient electronic profile, and physician note-writing capability." (37) Such remote presence not only expands diagnostic and monitoring capabilities into the home and community but can also allow for simultaneous care for multiple patients (15) with delegated responsibilities to other health care workers. Medical services such as reading of electrocardiograms, radiographs, diagnostic tests and other services are moving across national boundaries, intensifying competition between professionals of different countries that have similar skills but operate with very different cost structures (16). Patients are also travelling across borders in pursuit of low cost quality care for dentistry, cosmetic surgery and, increasingly, advanced medical and surgical procedures (medical tourism). Facilities in some servicing countries are seeking to compete for foreign patients who have high costs or long waits for treatment (16).

Minimally invasive diagnosis and treatment have also resulted in merging scopes of practice within the medical profession, for example, interventional radiology. Some specialties could disappear as others are created or gain prominence. The desire to create efficiencies and promote quality may further the trend to subspecialisation and constricted scopes of practice. Procedure or condition specific health care facilities such as rehabilitation and convalescent centres, outpatient dialysis facilities and endoscopy centres may expand. This disease- and provider-centred care will challenge holistic, patient-centred care. Hospitals and health care facilities may be located for the convenience of patients rather than for physicians and universities (38).

Constricted scopes of practice will conflict with the focus on generalism and primary health care as adopted by the World Health Organization (39), BC Ministry of Health(40), the Association of Faculties of Medicine of Canada (41) and both the Romanow Commission on the Future of Health care in Canada(26) and the Senate Standing Committee on the state of the health care system in Canada, chaired by Sen. Michael Kirby (42). These latter reports also identified challenges encountered as health occupations are changing their scopes of practice with changes to professional roles and boundaries. "Each profession appears willing to take on more responsibilities, but is unwilling to relinquish some duties to other professions." (26)

The effective management of complex and multiple chronic diseases requires longitudinal care coordinated by an interprofessional team (30). Team-based practice will become the norm, not just within hospitals but in communities. While this may entail co-location, ICTs allow for the creation of virtual teams, with full remote access to patient-centred documentation through point-of-care devices. While this technology already exists, its implementation requires widespread adoption of an electronic health record, which has been slow.

ICTs are also fundamentally changing the physician-patient relationship. Early uses of the internet (Web 1.0) allowed both health care workers and patients to access medical information, albeit of varying quality. Using Web 2.0, with its networks of user-generated content, patients are able to participate actively in their care by interacting with health care workers. Patients are not only better informed about their condition and care, but are also able to interact with other patients (virtual communities). Mulgan suggests that “Health care will look more like education” with physicians engaging patients in self-care (19), a concept supported by Muir Gray in “The Resourceful Patient” (43) and recommendations from the CAHS report on Chronic Health Conditions (30). Patients are empowered by higher levels of education coupled with the access to information and choices regarding their health and well-being. Use of alternative health care providers as well as natural and culture-specific health products is increasing. Although currently not all patients will choose or be able to take advantage of these opportunities: for example, the elderly, new immigrants and those with low income and low education may have limited health literacy(44), and rural Canadians are less likely to access the Internet (45), this situation is changing with demographics, technological advances and social networking. Physicians will be required to adapt their interactions to the specific circumstances of individual patients (46).

Structured care (care plans) has gained prominence driven by quality of care, including patient safety and cost effectiveness and enabled by the scientific focus on evidence-based care. This contrasts with the potential for individualized medicine through genetic biomarkers and targeted therapies including pharmacogenomics. Rather than discarding evidence-based care, it is likely that care algorithms will evolve to include a variety of risk factors and other patient-specific information including genetic biomarkers. The large amount of clinical information stored on electronic health records will be able to facilitate development and refinement of these individualized care plans.

The practice of medicine is more than just the application of biomedical science and technology to a specific problem. Physicians are not only applied scientists and medical experts, but also integrate the roles of collaborator, communicator, health advocate, manager, scholar and professional in the provision of patient-centred care. So, while the technology exists, it is unlikely robotics will replace health care workers in the near future. Robotic-assisted surgery and remote surgery, with real-time guidance through advanced digital and magnetic resonance imaging are more likely to be expanded.

Finally, health care workers are also ageing and retiring. As they are being replaced by a new generation of workers, there is some evidence that there are workload differences between older and younger physicians, even when adjusting for gender and specialty (47). The contraction of the economy from an ageing population may result in all workers, including health care workers, extending their working lives. Coupled with increased demand, there may be labour shortages in some health care fields. We will become increasingly internationally interdependent in terms of key health resources, especially skilled workers (16)(47).

Summary: Implications for Postgraduate Medical Education

The world is constantly changing. This paper has focused on likely scenarios and made predictions based on current trends rather than trying to second guess potential wholesale technological, economic, social and political change. It is evident we live an increasingly open system. Many aspects of our lives, from trade to conflict, from communications to climate change, exist not just within national boundaries but also in an interconnected world. As witnessed over the past decade, we can no longer predict or control many of the major changes that impact our lives directly or indirectly.

The pace of change is increasing too: consider how the speed and ease of communication has impacted our working lives. We therefore need to accept that we will not be delivering PGME within a stable system. We do not know what problems the physician of the future will need to deal with, though we can predict they are likely to be more complex than those of today. It will be necessary for physicians of the future and the institutions that train and govern them to be flexible and responsive to change. Some would go further and say that we should be creating a system and training leaders who can work with leaders in other sectors *to shape the preferred future*.

In this paper, we have identified a number of interrelated trends, emerging issues and predictions for the future. Each impacts the others in complex and unpredictable ways. The implications for PGME are also interdependent. We have tried to represent some of these interdependencies and major implications in Table 1.

Table 1: Summary of future trends and implications for PGME

Trend / Prediction	Likely consequences	Implications for PGME
Ageing population	<ul style="list-style-type: none"> • Increase in chronic disease (prevalence and complexity) and disability; • Shift in focus from acute intervention to chronic and preventive care; • Collaborative team-based care; • Increase in health care costs; • Shrinking workforce; • Informed patients with high expectations. 	<ul style="list-style-type: none"> • Need to train physicians who are prepared to go into currently less attractive career paths: primary care; geriatrics; mental health. • Need to train physicians who work as part of teams. • Need to train physicians who work in partnership with patients in chronic disease management and self care.
Increased population diversity (immigration, generational differences)	<ul style="list-style-type: none"> • Cultural diversity will change the nature of society and its values; • Potential for increased health disparities; • Diversity in genetic make up, disease susceptibility; • Health care teams will include workers from many nationalities. 	<ul style="list-style-type: none"> • Personalized medicine • Need to train physicians willing and able to work in culturally diverse and underserved areas. • Need to train physicians who will work in multicultural and multigenerational teams.
Technological & biomedical advances	<ul style="list-style-type: none"> • Genomics / proteomics; • Sophisticated simulation; • Nanotechnology; • E-health and telemedicine; 	<ul style="list-style-type: none"> • Location of specialized practice. • Changes in scope of practice.

Trend / Prediction	Likely consequences	Implications for PGME
	<ul style="list-style-type: none"> • Minimally invasive techniques; • Increased health care costs. 	<ul style="list-style-type: none"> • New specializations. • More flexible career paths (training and retraining). • Easy access to up-to-date information. • Remote medicine.
Globalization	<ul style="list-style-type: none"> • Climate change impacts on health (global warming); • New health surveillance systems to monitor effects of climate change; • Population migration; food, water and shelter insecurity; • Globalization of the workforce; • International interdependency and instability; • Provision of some health care abroad (at lower cost). 	<ul style="list-style-type: none"> • 'Eco-medical literacy'. • Environmentally responsible health care system and workers. • Increased need for specialists in environmental health and public health; • Increased role for international medical graduates. • Social responsibility has an international dimension. • Need for advocacy and collaboration with other sectors (public health, policy, environmental scientists).

We consider that these interrelated factors will affect the future of PGME at three levels: curriculum, delivery and the system.

Curriculum: Those changes that require a curriculum response, for example, an increasing focus on population health, preventive medicine and chronic disease management, will be the most straightforward to implement. Entirely new curricula may be needed in some areas, for example, the integration of competencies for climate change (eco-medical literacy); see Appendix 4 for an example proposed by Bell (49).

Delivery: Because PGME is essentially work-based learning, changes in the delivery of care, driven by technological advances or costs, will have an impact that may make the current models of training unsustainable. Co-location of trainees at university-based general hospitals will only be one of many models of health care within which PGME is situated, increasing the complexity of governance and administration of programs and providing challenges to teaching and learning integrated patient-centred care. While currently supporting the tenets of the Canada Health Act (accessibility, portability, universality, portability and public administration), Canadian values may change, changing the economic and political landscape of health care. Despite this, there are issues that will likely transcend such changes. Health care costs are increasing. While health care can be an economic driver itself, it is likely that future challenges will be met by *transformation* rather than by *growth* (48) and that there will be increasing scrutiny of expenditures, effectiveness and value.

System: Finally some of the challenges of the future may be met only by fundamental systemic change in the way that PGME is organized. The future requires a system that is flexible and nimble, able to respond to emerging needs and to uncertainty. Future problems will be solved

not by adding more resources but by transforming the way we currently use resources. Future problems, such as the fallout from climate change, will only be addressed through new collaborations with sectors outside of PGME (e.g., economic, political, socio-cultural, environmental and technology sectors). Long-held assumptions about the system of PGME within the continuum of medical education may need to be re-examined in order to develop a more efficient and flexible system for training and retraining. These would include a re-examination of the traditional system of UGME leading to a fixed period of postgraduate training. Other models may be more appropriate to meet future needs such as more fluid boundaries between UGME and PGME, and the concept of 'laddering' to permit trainees to move on and off the training ladder and provide more flexibility without jeopardizing service delivery needs .

In conclusion, thinking about the future needs to be part of every discussion about the medical education system on an on-going basis. We need to become accustomed to looking ahead and building that dimension into our thinking and our conversations. These discussions need to involve a wide range of perspectives, including representatives from the economic, political, socio-cultural, environmental and technology sectors, people who have their fingers on the pulse of change in those fields and can help medical educators think through the implications. In this way, we can more honestly claim that we are training doctors for the future.

References

1. Statistics Canada. Health Profile - Definitions, symbols and source [Internet]. cited 3/1/2010]
2. Statistics Canada. 2006 Census: Immigration in Canada: A Portrait of the Foreign-born Population, 2006 Census: Highlights [Internet]. November 20, 2009 cited 1/15/2011]
3. Picot G. Immigrant Economic and Social Outcomes in Canada: Research and Data Development at Statistics Canada. Ottawa: Government of Canada, Minister of Industry; 2008. Report No.: 11F0019M
4. Bélanger A, Malenfant EC. Population projections of visible minority groups, Canada, provinces and regions. 2001-2017. Ottawa: Government of Canada, Minister of Industry; 2005. Report No.: 91-541-XIE
5. Statistics Canada. Health Profile. Statistics Canada Catalogue No. 82-228-XWE. Released June 15, 2010. [Internet]. Ottawa: Government of Canada
6. Statistics Canada. Projections of the Aboriginal populations, Canada provinces and territories 2001-2017. Ottawa: Government of Canada, Minister of Industry; 2005. Report No.: 91-547-XIE
7. Human Resources and Skills Development Canada. Educational Attainment / Learning [Internet]. Ottawa: Government of Canada cited 1/15/2011]
8. Human Resources and Skills Development Canada. Work / Unemployment Rate [Internet]. Ottawa: Government of Canada cited 1/15/2011]
9. Wilson D, Macdonald D. The Income Gap Between Aboriginal Peoples and the Rest of Canada. Ottawa: Canadian Centre for Policy Alternatives; 2010
10. Task Force Two. Canada's Physician Workforce: Occupational human resources data assessment and trends analysis. Final Report; 2005.
11. Fontana L. Modulating human aging and age-associated diseases. *Biochimica et Biophysica Acta (BBA) - General Subjects*. 2009 10;1790(10):1133-8.
12. Bortz WM. Biological basis of determinants of health. *Am J Public Health*. 2005;95(3):389-92.
13. Weinberger DR. 2020 visions: Mental Health. *Nature*. 2010 01/07;463(7277):27-8.
14. Health Canada. eHealth - Main page [Internet]. Government of Canada cited 1/18/2011]
15. Chung KK, Grathwohl KW, Poropatich RK, Wolf SE, Holcomb JB. Robotic telepresence: Past, present, and future. *J Cardiothorac Vasc Anesth*. 2007 8;21(4):593-6.

16. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, Fineberg H, Garcia P, Ke Y, Kelley P, Kistnasamy B, Meleis A, Naylor D, Pablos-Mendez A, Reddy S, Scrimshaw S, Sepulveda J, Serwadda D, Zurayk H. Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. *The Lancet*. 2010 12/4;376(9756):1923-58.
17. World Health Organization. Key concepts: Social determinants of health [Internet]. cited 3/1/2010]
18. Towle A. Continuing medical education: Changes in health care and continuing medical education for the 21st century. *BMJ*. 1998 January 24;316(7127):301-4.
19. Mulgan G. 20 predictions for the next 25 years. 17 Health: 'We'll feel less healthy'. *The Guardian* 2011 January 2:Society
20. Taylor T. Thinking about a "new economy". *The Public Interest*. 2001;Spring(143):3-19.
21. Campaign 2000. 2010 Report Card on Child and Family Poverty in Canada: 1989-2010; 2010
22. Health Officers Council of BC. Health Inequities in British Columbia Discussion Paper. November 2008
23. Canadian Institute for Health Information. National Health Expenditure Trends, 1975 to 2010; 2010. 172 p
24. The Conference Board of Canada. Understanding Health Care Cost Drivers and Escalators The Conference Board of Canada; 2004. 126 p.
25. Canadian Medical Association. In search of sustainability: prospects for Canada's health care system Ottawa: Canadian Medical Association; 2001. 31 p.
26. Romanow RJ. Building on Values: The Future of Health Care in Canada - Final Report. Canada, Commission on the Future of Health Care in Canada; 2002. Report No.: Cat. No. CP32-85/2002E-IN
27. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, de Oliveira JAP, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J, Patterson C. Managing the health effects of climate change: *Lancet* and University College London Institute for Global Health commission. *The Lancet*. 2009 5/16;373(9676):1693-733.
28. Costello A, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N. Managing the health effects of climate change. *The Lancet*. 2009;373:1693-733.
29. World Health Organization. The global burden of disease: 2004 update. Geneva: WHO Press; 2008

30. Nasmith L, Ballem P, Baxter R, Bergman H, Colin-Thorne D, Herbert C, Keating N, Lessard R, Lyons R, McMurchy D, Ratner P, P., Tamblyn R, Wagner E, Zimmerman B. Transforming care for Canadians with Chronic Health Conditions: put people first, expect the best, manage for results. Report of the expert panel appointed by the Canadian Academy of Health Sciences. Ottawa: Canadian Academy of Health Sciences; 2010
31. Tinetti ME, Fried T. The end of the disease era. *Am J Med.* 2004 2/1;116(3):179-85.
32. World Health Organization. Global Health Risk: Mortality and burden of disease attributable to selected major risks. Geneva: WHO Press; 2009
33. Canada HC. A Statistical Profile on the Health of First Nations in Canada: Determinants of Health, 1999 to 2003. [Internet]2009 2009-02-12. Report No.: 2010
34. Berrang Ford L. Climate change and health in Canada. *McGill Journal of Medicine.* 2009;12(1):78-84.
35. Ford JD, Berrang Ford L, King M, Furgal C. Vulnerability of aboriginal health systems in Canada to climate change. *Global Environmental Change.* 2010;20(4):668-80.
36. Goldstein DB. 2020 visions: Personalized medicine. *Nature.* 2010;463(7):27.
37. Ackerman MJ, Filart R, Burgess LP, Lee I, Poropatich RK. Developing next-generation telehealth tools and technologies: Patients, systems and data perspectives. *Telemed J E Health [Internet].* 2010;16(1):Citation abstract only.
38. Foot DK. Some Economic and Social Consequences of Population Aging. Brief No.7 ed. Montreal: Institute for Research in Public Policy; 2008. 4 p.
39. World Health Organization. Primary health care [Internet]. cited 3/1/2010]
40. Government of BC, Ministry of Health Services. Primary Health Care [Internet]. Victoria: Province of British Columbia cited 3/1/2010]
41. Association of Faculties of Medicine of Canada. Future of Medical Education in Canada [Internet]. Ottawa: AFMC cited 3/1/2010]
42. Canada, The Standing Senate Committee on Social Affairs, Science and Technology. Final Report on the state of the health care system in Canada: The Health of Canadians – The Federal Role. Government of Canada; 2002. Report No.: 6, Recommendations for Reform
43. Gray, JAM. *The Resourceful Patient.* Oxford, UK: e-Rosetta Press; 2002. 154 p.
44. Canadian Public Health Association. Health literacy - frequently asked questions. [Internet]. cited 2/8/2011]
45. McKeown L, Noce A, Czerny P. Factors Associated with Internet Use: Does Rurality Matter? Ottawa: Government of Canada, Minister of Industry; 2007. 1 p.

46. Lussier M, Richard C. Because one shoe doesn't fit all: A repertoire of doctor-patient relationships In: Wilson Centre for Research in Education, University of Toronto, Centre de pédagogie appliquée aux sciences de la santé Université de Montreal, editors. National Literature Reviews, Environmental Scan Project, Future of Medical Education in Canada. <http://www.afmc.ca/fmec/activities-env-literature.php> ed. Funded by Health Canada; 2009; p. 450-6.
47. Canadian Institute for Health Information. Canada's Health Care Providers, 2007. Ottawa: CIHI; 2007
48. Better Value Healthcare. The 21st Century Healthcare Crisis [Internet]. cited 1/18/2011]
49. Bell E. Climate change: What competencies and which medical education and training approaches? BMC Medical Education. 2010;10(1):31.

Appendix 1: About the Authors

Jean Jamieson, MD, MHSc, works for the Postgraduate Office at the UBC Faculty of Medicine. She has worked as a general practitioner, medical health officer and health administrator. Her research interests are community based education and health human resource planning. She currently lives in Squamish, B.C. with her husband and two children. This FMEC paper builds on the paper that Jean was commissioned to write for the UBC Faculty of Medicine Dean's Task Force on Undergraduate Medical Curriculum Renewal.

Angela Towle, PhD, is currently spending a sabbatical year in the Centre for Health Education Scholarship at UBC following 8 years as Associate Dean, MD Undergraduate Education, Curriculum & Vancouver Fraser Medical Program in the Faculty of Medicine. During her time as Associate Dean she was part of the leadership team that implemented the expansion and distribution of the medical school. She also co-chaired the Dean's Task Force on Curriculum Renewal from 2009-2010. She is also Co-Director of the Division of Health Care Communication in the UBC College of Health Disciplines which has a research and development focus on patient /client involvement in health care decision-making and in health professional education.

Appendix 2: Annotated Bibliography

Canadian Medical Association. Looking at the future of health, healthcare and medicine. Ottawa. Canadian Medical Association. 2000.

Towle, Angela. Continuing Medical Education: Changes in Health Care and Continuing Medical Education for the 21st Century. *BMJ* 316.7127 (1998): 301-4.

Although 10 years old, this report and journal article both summarize many of the trends affecting health care in the early part of this century.

2020 Visions. Nature 463.7277 (2010): 26-32.

This paper from Nature briefly outlines anticipated progress in several key areas of science and technology, including several relating to medicine including personalized medicine, mental health, synthetic biology, lasers, demographics and the university.

Gray, J. A. Muir. *The Resourceful Patient.* Oxford, UK: e-Rosetta Press, 2002.

This thought provoking book by UK based surgeon and public-health physician Muir Gray discusses the changing role of the physician – patient relationship. He argues that patients can and should be given the tools needed to engage with their physicians and other health care providers to become ‘co-producers’ of their own healthcare.

Tinetti, Mary E, and Terri Fried. The End of the Disease Era. *The American Journal of Medicine* 116.3 (2004): 179-85.

Drs. Tinetti and Fried outline the limitations to the disease based model of medical care and propose that health care should be based on “... attainment of individual goals and the identification and treatment of modifiable biological and non-biological factors rather than solely on the diagnosis treatment, or prevention of individual diseases.”

A survey of ageing populations: Into the unknown | *The Economist* 2/26/2010
<http://www.economist.com/specialreports/displaystory.cfm?story_id=E1_TPRRRDGT>.

A special report on health care and technology: Medicine goes digital | *The Economist* 2/26/2010 <http://www.economist.com/specialreports/displayStory.cfm?story_id=13437990>.

These two special reports are available by subscription through the Economist. The first, dated 25 June 2009 deals with demographic, economic and social consequences of the ageing population. The latter dates from 16 April 2009 and contains a number of related articles on health care and technology.

Costello A, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N. Managing the health effects of climate change. *The Lancet.* 2009;373:1693-733.

This is the final report a year-long Commission held jointly between The Lancet and University College London Institute for Global Health. It provides a comprehensive review of the complex ways in which climate change will affect health in the 21st century.

Appendix 3: Selected Health Indicators by Province

	Canada	BC	Alberta	Sask	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	PEI	Nfld	Nunavut	NWT	Yukon
Community														
Youth 0-19 yrs	23.3	21.8	25.0	26.3	26.2	23.7	22.2	21.7	21.6	23.8	21.2	42.1	30.4	24.1
Seniors 65yrs+	15.3	14.7	10.4	14.7	13.8	13.7	14.9	15.5	15.8	15.3	14.8	3.0	5.2	8.0
Dependency ratio	59.2	57.6	54.9	69.7	66.7	59.7	59.1	59.4	59.6	64.4	56.2	82.1	55.3	47.3
Aboriginal pop'l'n	3.8	4.8	5.8	14.9	15.5	2.0	1.5	2.5	2.7	1.3	4.7	85.0	50.3	25.1
Immigrant pop'l'n	19.8	27.5	16.2	5.0	13.3	28.3	11.5	3.7	5.0	3.6	1.7	1.6	6.9	10.0
Child poverty	17.5	19.3	13.9	17.9	21.2	17.9	17.4	16.0	16.4	12.5	18.5			
Post-secondary ed'n	62.6	62.7	61.3	54.7	55.0	63.5	65.0	55.2	62.7	59.6	58.1	43.9	58.5	63.4
Urbanization	85.4	89.2	81.3	62.0	70.2	93.2	85.4	63.5	66.8	67.1	50.6	0.0	45.1	75.3
Health Behaviours														
Regular Doctor	84.9	86.8	80.6	83.4	85.6	91.5	73.3	92.1	92.8	91.1	87.0	11.8	37.8	77.8
Current smoker	21.4	18.6	23.3	21.6	20.5	18.6	22.5	22.0	23.3	20.4	23.2	61.3	35.7	35.5
Heavy drinking	16.7	15.5	18.2	18.7	17.4	15.6	18.6	19.2	20.8	21.0	25.1	19.7	31.1	28.4

Source: Statistics Canada. 2010. HealthProfile. Statistics Canada Catalogue No 82-228-WXE. Ottawa. Released June 15, 2010. <http://www12.statcan.gc.ca/health-sante/82-228/index.cfm?Lang=E>

Dependency ratio: number 0-19 and 65+ per 100 working age population, 2006 Census. All others Percent of population.

Child poverty/childhood low income: Children aged 17 and under living in low income families. Post secondary graduates among population aged 25 - 54. Urbanization: Population living with a Metropolitan Influenced Zone

	Canada	BC	Alberta	Sask	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	PEI	Nfld	Nunavut	NWT	Yukon
Births/Deaths														
Life expectancy	79.5	80.4	79.5	79.0	78.4	79.7	79.3	79.0	78.8	78.6	77.9	68.7	76.2	76.8
Infant mortality	5.0	4.2	5.5	6.3	6.6	5.1	4.7	4.1	3.6	3.1	6.3	12.1	5.7	5.8
Low birth weight	5.6	5.7	6.7	5.6	5.6	6.2	5.7	5.5	6.1	5.3	5.6	7.6	4.4	5.3
HIV disease	1.3	2.5	0.8	0.6	1.3	1.2	1.5	0.3	0.6	0.0	0.7	0.0		0.0
Unintent'l injuries	25.6	29.3	30.6	35.5	33.0	22.3	23.0	29.9	25.3	32.0	25.7	62.4	53.6	59.3
Suicide	11.3	10.4	14.1	11.3	11.4	7.7	16.5	13.2	9.0	10.0	6.7	80.2	20.8	18.5
Health Conditions														
Overweight/obese	51.1	45.1	55.1	58.6	58.0	51.4	49.2	62.9	60.3	59.0	64.6	51.0	62.8	54.3
High blood pressure	16.4	14.9	14.6	18.2	17.1	17.2	17.0	20.7	21.5	17.9	21.6	11.8	12.3	13.7
Diabetes	6.0	5.4	4.8	5.6	5.6	6.4	5.7	6.6	7.7	6.0	8.1	4.3	5.2	4.2
COPD	4.2	3.8	3.3	4.3	3.9	4.0	4.8	5.4	7.0	3.2	4.7			
Positive mental hlth	73.9	70.4	73.8	71.7	71.1	74.0	76.8	68.1	74.5	73.7	74.1	70.5	64.3	74.7

Source: Statistics Canada. 2010. HealthProfile. Statistics Canada Catalogue No 82-228-WXE. Ottawa. Released June 15, 2010. <http://www12.statcan.gc.ca/health-sante/82-228/index.cfm?Lang=E>

Infant mortality per 1000 live births, Deaths per 100,000 popl'n . All others Percent of population

Health Conditions and Health Behaviours from the Canadian Community Health Survey, 2009.

Overweight & Obesity based on BMI (self reported height and weight)

Self report of diagnoses , smoking (daily or occasional) and heavy drinking.

Appendix 4: Implications of climate change: example of an approach to curriculum development

The implications of climate change for the education and training of health professionals has received surprisingly little attention in the literature. The European Commission has identified the need for member states to assess the kinds of specialist skills that will be needed in the future in response to shifting patterns of disease caused by climate change, and in the USA public health organizations have identifying preparedness for climate change as a key challenge of their definition of 21st century health workforce crises(49).

Bell (2010) has identified the need for a 'eco-medical literacy' curriculum(49), deriving from the disciplines of occupational and environmental medicine, as well as a natural extension of rural and remote medicine and training (although she notes that national curriculum statements of rural and remote practice as well as many local curriculum documents currently make no ostensible reference to climate change, even in well resourced countries such as Canada and Australia). Specifically in relation to postgraduate training she identifies the need to target those who may be considering or already are practicing in regions most affected by climate change. The competencies could be integrated into existing programs in the domains of core clinical knowledge and skills, extended clinical practice, emergency care, population health, indigenous health, professional, legal and ethical practice, and rural and remote context. She illustrates the detail of what eco-medical competencies might look like for postgraduate training in the domain of professional, legal and ethical practice as follows:

- Demonstrates knowledge of how to access local, national and international information about climate change effects on health, relevant to adapting health services.
- Shows how to use information about climate change effects on health to improve decisions about health services delivery.
- Initiates and participates in collaborative learning opportunities with health and environmental professionals active in climate change management. Demonstrates application of this knowledge to adapt and improve health service delivery.