INTRODUCTION
In the past century, medical care in the western world has evolved tremendously. While in the early 1900s, healthcare was mostly a private affair, it has now become a major expense for all developed nations. Complex structures have emerged: modern-day healthcare professionals now evolve in highly diverse environments ranging from small private clinics to highly specialized teaching hospitals. With the rising costs of healthcare and the rapidly increasing demand for healthcare services, governments need to find new ways to render the delivery of healthcare services more cost-effective without compromising the quality of care or patient healthcare worker satisfaction. The challenge is superb; obstacles are numerous and solutions are often complex.

In recent years, many commissions and reports have strived to explore these obstacles and solutions. In Canada, the Final Report on the State of the Healthcare System (1), published in 2004, is one calling “medical apartheid” on the rigid specialty of healthcare structures and scope-of-practice rules—the rules defining which tasks different categories of healthcare professionals are permitted to perform—represents an ominous barrier to increasing productivity in healthcare. Another important Canadian report published in 2002, the Romanow Report (2), also highlights the need for change in the way healthcare services are delivered. By placing a special emphasis on “collaborative teams and networks of providers” the Romanow Report suggests that “traditional scopes of practice need to be redefined” (2).

In order to increase cost-effectiveness in healthcare, the taboo surrounding physicians’ rigid scope-of-practice should be broken; this would promote a stronger and more integrated multidisciplinary approach to medicine. The evidence supporting this thesis is growing at a breathtaking pace and revolves around five main themes. First, alterations to scope-of-practice rules fall into the very promising realm of catalytic innovations. Second, the re-definition of roles for healthcare practitioners—with a special emphasis on doctors, nurses, and pharmacists—allows for better patient and healthcare practitioner satisfaction and improved healthcare resource utilization. Third, a new generation of physician assistants can successfully help address the issue of rising healthcare costs. Fourth, smartly organized multidisciplinary teams can lead to better outcomes and resource utilization in healthcare. Finally, a certain number of compelling examples from the literature illustrate how multidisciplinary approaches have a high potential for encouraging better cost-effectiveness in healthcare.

CATALYTIC INNOVATIONS AND ALTERATION OF SCOPE-OF-PRACTICE RULES
Thanks to advances in technology, medical research is now able to target such complex issues as heart transplants, gene therapy and robotic microscopic surgery. Because of the impressive amounts of human and material resources involved in such “high-end, high-tech” innovative techniques, catalytic innovations tend to increase rather than decrease the costs of medical care (7). In an article published in the Harvard Business Review, Clayton M. Christensen, one of America’s most influential business thinkers and writers, describes such innovations as “sustaining innovation” (7).

In his opinion, sustaining innovations are necessary to solve complex medical problems affecting small groups of patients in specialized medical clinics, but they do not lead to decreases in medical costs. Christensen also goes a step further in affirming that in most developed countries, the omnipresence of sustaining innovations has led to the maintenance of the status quo by way of an excessive amount of resources being allocated to organizations that are “wedded in their current solutions, delivery models and recipients” (8).

In an interview with Mark D. Smith (9), Christensen describes another category of innovations: disruptive innovations. Contrary to sustaining innovations, disruptive technologies or services are available at much more affordable prices than existing alternatives. “They disrupt” the market by changing the approach to a problem and by bypassing more complex alternate solutions. They also allow the opening of a whole new market formed by purchasers who traditionally could not afford such products and innovations. In the same interview, Christensen depicts a third category of innovations—catalytic innovations—which he describes as being even more beneficial than disruptive innovations in the context of modern day healthcare. This third category of breakthroughs not only lowers the prices of products or services, but also focuses on bringing social change through scaling and replication (9). By making changes to rigid scope-of-practice rules, healthcare systems have the opportunity of creating a great number of catalytic innovations. For example, by allowing nurses or other healthcare practitioners to conduct a certain number of simple and highly reproducible medical acts that were traditionally completed by doctors, clinics can allow patients to be treated at lower costs while avoiding long waits. Yes, this perspective allows for the possibility that patients might receive healthcare services of an inferior quality due to the fact that the healthcare professionals who are providing them do not have the same level of training as physicians. However, in a North American context of limited resources where no less than 25% of doctors willingly affirm that their scope-of-practice is too wide (5), such catalytic innovations should definitely be considered as a promising avenue for addressing some of the most complex issues in healthcare.

REDEFINING THE ROLES OF HEALTHCARE PRACTITIONERS
In the past few decades, with the progressive lengthening of life expectations and an on-going “medical apartheid”, many healthcare practitioners—and especially doctors—have been brought to play wider and wider roles in the lives of individuals. As mentioned above, this has led to important discrepancies between what healthcare professionals think their scope-of-practice should comprise of and what their workload actually consists of on a day-to-day basis. To illustrate this point, an article which was recently published in the American journal Health Affairs (3), maintains that American doctors, if asked the question: “what percentage of your time do you perform functions that require a medical degree?” would most likely provide a figure neighbouring 50%. Building on this example, let’s now further analyze how scope-of-practice issues specifically impact the work of four groups of key players of the healthcare workforce: physicians, nurses, pharmacists and other healthcare professionals.

DOCTORS
Acknowledging the fact that physicians are highly trained professionals, and that they are one of the most important healthcare expenses for most industrialized nations (11, 12), there is no doubt that their time should be used wisely and that their practice should focus on what they do best. There appears to be a consensus in the medical literature regarding the fact that where physician attention is the most essential is in the treatment, diagnosis and management of complex medical issues (7). Who other than highly trained specialists or experienced family physicians would be able to finally, and perhaps more importantly, detect a rare congenital disorder bringing subtle changes in a long followed patient’s health?

However, this simplified view of what physicians should be responsible for is not only the fact that there are many levels of specialization inside the medical profession itself. While general practitioners and medical specialists might at first glance be assumed to work in collaboration—referring patients to one another when issues are either too broad or too specialized for their scope-of-prac-
NURSES
While the diagnosis of medical conditions has traditionally been thought of as the most important aspect of a doctor’s practice, there is a growing body of evidence showing that simpler illnesses presenting with an easily identifiable pattern and consistent clinical findings can be managed very efficiently by nurses without the need for doctors to intervene directly (13). In fact, healthcare teams in which registered nurses work independently, yet in tight collaboration with practising physicians, have not only been reported to provide adequate health-care services and diagnoses to patients; they have also been shown to be associated with equal or increased levels of patient satisfaction, with no significant differences in clinical outcomes. Most importantly, these teams also yield the promise of improved cost-efficiency allowing for more medical acts to be performed by lower paid professionals (4).

Whereas doctors are often thought of as the ones who treat, patients, nurses are often considered as the ones responsible for caring for patients. This observation is usually correct, since in hospitals has led to very promising results in most industrialized countries (13), numerous obstacles including financial arguments and considerable opposition from organized medical associations are slowing down the process of training more advanced practice nurses. Some authors have brought the idea that one of the main reasons for this hesitation is the fact that many specialized nursing training programs—which can very well be considered as high-yield catalytic innovations—might be that in the context of limited financial resources, nursing fellowships are not "glamorous" as, say, the purchase of a new glistening MRI scanner or the development of a new artificial heart (8). In one of the few studies involving pharmacists have successfully been integrated in family healthcare teams, doctors report: "an improved availability of easy-to-interpret [...] drug information, an advantageous access to fresh perspectives regarding new and competing pharmaceutical products, more confidence about prescribing medications and more productive work relationships with pharmacists" (6). Furthermore, from the patient standpoint, this has allowed major improvements in patient education through ways of a facilitated access to high quality drug-related information.

In two separate American studies observing the effects of integrating pharmacists in the care of patients with type 2 diabetes mellitus and chronic hypertension, pharmacists have been shown to lead the way in terms of speed and monitoring of treatment. Contributions of pharmacists are becoming increasingly valuable resource in an environment where pharmaceutical products are becoming increasingly expensive. In fact, in settings where pharmacists have successfully been integrated in teams affected to direct patient management, improved reinforcement of screening for medical complications and better patient follow-up (16, 17). Also, in cases where pharmacists were involved in patient care they have been proven to allow better glycemic control, more sustainable lifestyle modifications and greater decreases in systemic blood pressure than in cases where patients with chronic illnesses were cared for following a traditional physician-managed approach. Once again, as the case for nurses, all of these results have been obtained with a high potential for significant cost reductions and improved overall cost-effectiveness.

In light of these benefits, one might wonder why systematic reforms aiming to fully integrate pharmacists in healthcare teams haven’t yet been undertaken. Once again, as it was the case for nurses, resistance from physician associations, which hesitate to disrupt the existing status quo, and the lack of appropriate financial incentives seem to be the major obstacles (6). One of the most commonly mentioned arguments relates to the increased time required for physicians to interact with pharmacists on a regular basis. As one might readily predict, this argument loses much of its significance once a short period of adaptation has been completed.

OTHER HEALTHCARE PROFESSIONALS
Not only have interests of nurses focusing on the effectiveness of multidisciplinary teams in healthcare have strived to describe the importance of programs involving such healthcare professionals as dieticians, physical therapists, occupational therapists, psychotherapists and social workers in teams affected to direct patient management, there is still a lack of research relating the cost-effectiveness and the changes in clinical outcomes related to the implementation of such programs (18). However, there is no doubt that these highly specialized professionals can play an important role in the management of patients in situations concerning their field of expertise. For instance, how often are family physicians required to provide nutritional, psychological or social counselling to patients in a setting where they have very little time to do so? How often are patients given a note to consult a dietician, a psychotherapist or an occupational therapist without there being adequate—if any—follow-up from their family physician? If patient access to the healthcare professionals who are best able to really appreciate and assist their patients, financial incentives to stimulate collaboration are created, there is a high potential for successfully decreasing the often overwhelming burden assumed by family doctors.

Finally, although the medical literature very seldom mentions the importance of well-trained and efficient administrative staff in assuring the effective functioning of healthcare institutions, these actors can also contribute enormously to making their workplaces much more cost-effective. Taking that no one should be perceived as very cumbersome tasks for other healthcare professionals (3), they should be more readily considered by their peers as essential members of a well-kept medical team.

A NEW GENERATION OF PHYSICIAN ASSISTANTS
In the US and in an increasing number of OECD countries, a new generation of healthcare professionals has recently made its entrance on
Physician assistants, with their intermediate status, which places them somewhere in between doctors and nurses, have many advantages. Mainly, they allow palliating for an increased need for healthcare resources by taking over some of the tasks that were traditionally performed by sleep-deprived junior doctors, overwhelmed primary care physicians or overworked nurses (19). In the early 2000s, there were close to 50,000 fully trained physician assistants in the US. Thanks to favourable governmental incentives and to the emergence of more and more specialized education programs across the country, this number is rising consistently from year to year.

Most commonly, physician assistant degrees consist of 2 years of graduate university education training following a previous degree, most commonly in the area of biomedical sciences, pharmacy or occupational therapy. Students usually enter the program with a strong GPA, certain amounts of clinical work experience and strong interpersonal skills (20). In 2007, there were 136,000 fully trained physician assistants in the US; 76% of them were at the master’s level and the remaining 24% of the programs offered doctoral or physician assistant training specializing in a certain medical assistant training specializing in a certain medical area.

In the US, physician assistants usually work under the close supervision of fully certified physicians. While many of their tasks can overlap with nurses’ job descriptions, they are usually not assigned to continuous patient care on hospital wards. Rather, their tasks are primarily directed toward treating patients for short interventions. One of their most common tasks is to complete patient history, filling out questionnaires, prescriptions, medications, suturing, applying casts, providing comprehensive patient education and doing rounds in nursing homes (20).

The results of physician assistant implementation in healthcare teams have been extreme- ly promising throughout the world in all or most countries where they are present (19). In the UK, a small team of physician assistants has successfully provided a large number of patients with similar quality healthcare services as residents and doctors. When asked, patients reported that they were highly satisfied with the attention they had received and were impressed by the empathy with which their healthcare providers had treated them. In addition, the doctors working with the team of physician assistants reported excellent professional interactions with the new staff members. From the very beginning, the new team comprising nurses, social workers and physicians allow for more efficient management of clinical tasks and for more effective and better patient outcomes (19).

A number of reasons for improved health care outcomes can be reached when multidisciplinary teams are used. The advantages of a multidisciplinary approach to healthcare are tremendous. However, achieving such a feat as the establishment of a work-functioning multidisciplinary team is all but a simple walk in the park. According to Regina E. Herzlinger, professor of Business Administration at Harvard, health care is a complex, multidisciplinary and multi-billion dollar industry that is extremely important. Among other roles, Family Physicians, nurse practitioners and other members of primary care program implementation and in the period of time following scope-of-practice changes are often considered as an unbearable short-term gamble which healthcare authorities are not always ready to take, especially without the presence of solid evidence. However, even the most promising trials and initiatives are starting to clear a path towards the advancement of multidisciplinary healthcare, there is still a pressing need for more credible and unbiased evidence comparing the two sides of the medal in order to bring comparable or superior clinical outcomes (4, 18).

PROMISING EXAMPLES FROM THE MEDICAL LITERATURE

More and more healthcare practitioners and entrepreneurs are starting to acknowledge the potential of catalytic multidisciplinary healthcare reforms and innovations. In North America alone, many states and provinces have made clear moves to develop and implement multidisciplinary paths or have clearly underlined the need for a redenition of scope-of-practice rules (21). Here are three examples of promising Canadian and American initiatives which have recently made their way into the medical literature.

ONTARIO FAMILY HEALTH TEAMS

In 2009, almost 2 million Ontarians had access to comprehensive family health teams through an extending network of Family Health Teams (23). These teams, created by independent groups of healthcare practitioners since the beginning of the years 2000, have received numerous incentives and generous support from their provincial government and organizations. In fact, seeking primary healthcare for its citizens, the Ministry of Health of Ontario has created a vision allowing physicians, nurse practitioners and other members of the team to practice in a productive working environment where cooperation and knowledge exchange are extremely important. Among other roles, Family
Health Teams are meant to promote disease management programs for chronic illnesses, self-care programs, health promotion, patient-centered care and facilitated navigation and care coordination for patients seeking services in multiple healthcare institutions.

Although the implementation of Family Health Teams in Ontario has been welcomed almost unanimously by citizens and healthcare practitioners, there still exists an important gap between the reality of practising in a team-based setting and what is taught to medical and nursing students in Ontario medical and nursing schools (24). Hence, even though they are extremely promising, multidisciplinary approaches to medicine need not only be implemented on the field; they also need to be accompanied by pertinent reforms in healthcare education in order to ensure that the new generation of workers will be better equipped to deal with the new challenges of team-based practice.

MINUTE CLINICS

In the US, a very popular example of how scope-of-practice rules have been changed in order to provide patients with more affordable and convenient healthcare services is the advent of so-called “Minute Clinics” (21). These clinics are run entirely by nurse practitioners who use software-based protocols in order to offer vaccinations and basic medical attention for a limited set of healthcare conditions. Monetary incentives and feedback are then provided by Kayerse Permanente’s headquarters with the effect of promoting constant progress and improvement among healthcare teams.

CONCLUSION

Considering the size of the challenge of controlling healthcare expenses in a context of growing healthcare needs and aging demographics, the application of new ways to improve the cost-effectiveness of healthcare systems is essential. One of the most promising avenues suggests that doctors should be encouraged to review the rules regulating the scope of their practice in order to promote a stronger multidisciplinary approach to healthcare. In order for this solution to yield the most effective results, healthcare institutions should simply follow the model of catalytic innovations, a model encouraging both simpler and more affordable solutions with a special emphasis on social change. In addition, scope-of-practice reforms should be accompanied by pertinent reforms in healthcare education in order to ensure that the new generation of healthcare practitioners are equally if not superiorly satisfied with healthcare services that otherwise would not have access to other health care providers.

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26. Over the past year, funding awarded through this program has allowed students to participate in a wide variety of initiatives covering an array of fascinating disciplines - from an annual Aerospace Medical Association Meeting, and international Lunabotics competitions to Solar-Terrestrial science conferences.
27. The Canadian Space Agency (CSA), via its Space Learning Program offers a bevy of opportunities that Canadian university students may wish to leverage.
28. The second learning opportunity funded by the CSA is the NASA Academy summer program. NASA Academy provides students at the upper undergraduate or early graduate levels with an opportunity to spend 10 weeks paired with a researcher at one of the NASA centres. Students selected to participate are given the extraordinary opportunity to conduct space research with an experienced researcher in addition to developing their own group project with fellow students.
29. NASA Academy participants are treated to a wonderful introduction to the space field through a series of presentations, meetings and visits at the various NASA centres across the United States. In the past two years, two McGill students have been selected through this competitive process - Medical student Laura Drudi in 2010 and Atmospheric Science student Alexandra Anderson-Frey for the summer of 2011. Information for those interested in applying to the 2012 edition of IAC , to be held in Naples, Italy, information on the application process will be posted on the student (17+) section of the CSA web site in the late fall.
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32. Finally, the My Research section of the CSA website profiles the next generation of space leaders, providing a showcase for students involved in space-related research. The profiles

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The Canadian Space Agency (CSA), via its Space Learning Program offers a bevy of opportunities that Canadian university students may wish to leverage. Through the Space Learning Grants Program, the CSA provides funding to upwards of 200 students each year – the majority being undergraduate and graduate students – which supports their participation in space-focused learning initiatives. This grant program, designed to assist students with funds to help cover travel, registration and living expenses, is open to students from primary school right up to the doctorate level, so long as the student is either a Canadian citizen or permanent resident of Canada.

Over the past year, funding awarded through this program has allowed students to participate in a wide variety of initiatives covering an array of fascinating disciplines - from an annual Aerospace Medical Association Meeting, and international Lunabotics competitions to Solar-Terrestrial science conferences.

While individual requests for funding can be submitted and considered, budget-permitting, on an ad-hoc basis year-round, there are also two opportunities both earmarked and funded through this program on an annual basis. The first is the International Astronautical Congress (IAC) – the largest annual international space conference. Each year in September, students are asked to submit abstracts to the CSA on relevant conference topics that will also allow them to highlight their research at the congress. Each abstract undergoes an internal evaluation by CSA scientists, engineers and medical professionals with those achieving the highest rankings

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Space Learning Grants
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