The specialty of cardiac surgery is evolving rapidly with advances in new techniques and technology that have allowed for the surgical treatment of an increasing number of pathologies. During this time, however, alternative, catheter-based therapies for coronary, aortic, and valvular disease, traditionally treated with cardiac surgery, have emerged. This has had a considerable impact on the volume of cardiac surgical cases being performed and the number of cardiac surgeons required in the future. Consequently, a significant number of recent graduates from cardiac surgery training programs across Canada remain unemployed, resulting in diminished interest from medical students and unfilled residency positions.

To date, the management of the Canadian cardiac surgery workforce has occurred passively, with no systematic plan for...
future societal needs. The CSCS recognizes that improved health human resources (HHR) management is critical to the effective delivery of cardiac surgical care and has taken a leadership role in addressing the current manpower crisis in cardiac surgery. The following statement has been prepared to provide a framework for the active management of the cardiac surgery workforce.

**Supply and Demand for Cardiac Surgery**

The supply of HHR services in cardiac surgery is a function of the age and number of available providers, their workload, and their productivity. A survey undertaken by the CSCS in 2009 determined that approximately 13% of cardiac surgeons were older than 60 and almost half were older than 50 years of age (Fig. 1A). A total of 28,140 major cardiac cases were completed in 30 cardiac centres in Canada in 2007/2008, with a median number of 926.5 cases per centre and a median of 185 major cardiac cases per surgeon with a broad caseload distribution (Fig. 1B).

The demand for HHR services, on the other hand, has been traditionally founded on utilization-based models that account for the future and has developed the recommendations in this document as a call to action to interested stakeholders and policymakers to bring substantial improvements to health human resource management in cardiac surgery.
for the age and size of the population and the prevalence of disease. Demand is further influenced by technological innovation, change in patients’ preferences, and access to care. Rates of coronary artery bypass graft surgery have been steadily declining since 2001 in favour of percutaneous angioplasty, and this trend shows no sign of reversing. In contrast, the population is aging and rates of surgery other than coronary artery bypass graft including interventions for heart failure, valvular, and aortic disease are expected to increase. As such, it is expected that the overall demand for cardiac surgery will ultimately increase in the near future.

Workforce Dynamics
A survey of recent graduates of Canadian cardiac surgery training programs confirmed the general perception that securing full-time employment as a cardiac surgeon in Canada today is extremely difficult. As of 2009, 34% of recent graduates considered themselves underemployed, with the notable finding that licensed cardiac surgeons were accepting jobs other than as full-time attending cardiac surgeons. Medical students have become acutely aware of these challenges and this has translated into fewer interested applicants. As a result, unfilled cardiac surgery positions have persisted after the first iteration of the Canadian Residency Matching Service match in each year since 2006 (Fig. 2).

An analysis of workforce dynamics indicates that if present trends continue, a significant shortage of cardiac surgeons will develop by 2020, even if coronary bypass volumes continue to decline by 1% each year. Furthermore, at the 2009 residency enrolment rate of 5 students per year, a shortage of almost 50% of the total Canadian cardiac surgical workforce may develop. The workforce model developed in this report has potential for broad implementation and may be applicable to other clinical specialties as a means of anticipating and communicating the long-term effects of workforce decisions to stakeholders.

CSCS Recommendations
The CSCS recognizes that the current reactive and ad hoc approach to HHR in cardiac surgery is inadequate and may result in significant misalignment of cardiac surgeon supply and demand with consequent costs to Canadian patients and the field of cardiac surgery. The CSCS recommends a proactive approach be taken, based on comprehensive data collection and state of the art system models to predict future needs. Reports from the Canadian Medical Association and Health Canada underscore the need for concerted, ongoing HHR planning to identify gaps and develop appropriate policy responses to manpower challenges. The healthcare system has a limited ability to respond quickly to shortages, particularly for specialties that require long periods of training, underscoring the importance of anticipating and planning for changes in supply and demand.

The CSCS recognizes that designing interventions to change human resource management practice in cardiac surgery will require further discussion and leadership. Engagement of the CSCS membership, and effective communication to policymakers will be required for effective translation of accurate HHR predictions into public policy. In the meantime, the CSCS has developed an action plan, which recognizes the layered accountabilities in this complex system and has the potential to bring substantial improvements to the manner in which the Canadian cardiac surgical workforce is managed.

1. Royal College of Physicians and Surgeons of Canada
The CSCS recommends that cardiac surgery training remain as flexible as possible and preserve the ability to adapt to the changing practice environment. Cardiac surgery residents would benefit from increased exposure to noninvasive techniques/technology (ie, catheter-based therapies), critical care, diagnostic imaging, and minimally invasive surgical techniques. Upon completion of basic training, graduates should

![Figure 2. Cardiac surgery residency positions in Canada. Positions offered, filled, and vacant from 1997 to 2011 are shown.](image-url)
have access to fellowships in as many areas as possible, including vascular surgery, thoracic surgery, intensive care, and interventional cardiology. During accreditation renewal of residency training programs, review committees should consider the track record of graduates successfully attaining permanent, full-time attending positions. The approval of new training programs and the maintenance of existing programs should be linked to projected manpower needs across the country.

2. Residency training programs

The CSCS recommends that training programs engage in active career counselling with individual residents throughout their training. Research endeavors and clinical elective time should be encouraged and tailored to each trainee’s specific goals. Qualified individuals, such as residents in other surgical specialties who are keen to enter a cardiac surgery training program midstream should be considered for transfer if deemed appropriate for the program. In contrast, trainees who are not deemed to be suitable for a career in cardiac surgery should be identified early and helped to transition to another program. Residency programs should develop clear and well-documented methods of assessing trainee performance to determine yearly promotion and ultimately competence as an independent cardiac surgeon. The clinical service needs of a division including on-call coverage and patient care should have no influence on decisions regarding accepting new or advancing existing trainees.

3. Fellowship training programs

The CSCS recommends that Canadian and international medical graduates should not be hired and maintained in fellowship and/or clinical associate associate positions indefinitely. A structured and limited timeframe should be established for these positions after which the candidate should be offered a permanent position or encouraged to seek viable employment elsewhere.

4. Hospitals and universities

The CSCS recommends the creation, whenever feasible, of jobs for highly trained and currently under- or unemployed graduates of Canadian training programs. Potential strategies include junior mentored positions and combining cardiac surgery with complementary positions such as intensive care and/or research. Academic, administrative, and educational pursuits of new hires should be fostered and reimbursed according to the value placed on these activities by the hospital and university. Hospitals should track case volumes per surgeon and cardiac surgical quality indicators including in-hospital mortality and morbidity; length of intensive care unit and hospital stay; and long-term survival and readmission to hospital on a regular basis. Quota allocations for cardiac surgery training positions should reflect regularly updated data on provider supply and demand.

5. Regulatory bodies and government

The CSCS endorses the adoption of a quality improvement agenda as has been proposed by several provincial and national agencies including the Canadian Medical Association. The CSCS recommends that quality indicators including morbidity/mortality rates and waiting times should be tracked to help determine optimum case volume per surgeon. Government payers for cardiac surgical services should consider flexible payment models that vary with HHR needs (ie, fee for service models in times of surgeon shortage and alternative payment plans or blended funding models in times of surgeon excess). The CSCS recognizes the need for a Canadian Institute for Health Human Resources that would coordinate HHR planning across all medical specialties and health care providers. Such an institute would provide a broader perspective on the country’s HHR needs and foster the creation and maintenance of a stable health workforce necessary for the provision of quality care in Canada.

6. Cardiac surgery division heads

The CSCS recommends that division/department heads be transparent with their short- and midterm manpower needs, including, if possible, desired academic and clinical areas of niche expertise. The CSCS suggests that these individuals consider graded integration of junior colleagues who are mentored by a senior surgeon transitioning toward retirement as a means of gradually expanding the division. Division and department heads should consider factors other than economics when making hiring decisions and should strive toward an optimum balance of clinical responsibilities, academic productivity, and work-life balance within their group.

7. Individual cardiac surgeons and trainees

The CSCS strongly encourages individual surgeons to rekindle their ties with the medical student community and urges students to consider cardiac surgery as their chosen specialty. Outreach activities including lectures, student training sessions, research projects, simulation labs, and early exposure of medical students to the cardiac operating room may improve recruitment. Surgeons may demonstrate the opportunity for an improved lifestyle by promoting work-life balance within their practice. Surgeons are also encouraged to provide advanced notice of their retirement plans whenever possible. Trainees are encouraged to remain as competitive as possible in the marketplace, by adapting to emerging techniques and technology and engaging in high quality research.

8. Canadian Society of Cardiac Surgeons

The CSCS will take a leadership role in enhanced HHR data acquisition and active management of the Canadian cardiac surgery workforce.

a. The CSCS will develop and house the CSCS Workforce Data Repository. This national HHR databank will include a registry of all cardiac surgeons licensed in Canada including international medical graduates, their date of licensure, and their employment status. To ensure individual surgeon privacy, only aggregate level data will be shared.

b. The CSCS will conduct an annual survey of the division/department heads of each cardiac surgery centre in Canada and collect data on case volume per centre and per surgeon, case mix, average surgeon age, and each centre’s projected HHR needs for the subsequent 2-5 years.

c. The CSCS will conduct an annual survey of program directors and determine the status of recent graduates and fellows from each training program. The CSCS will
also determine the recent attrition of residents from each program.
d. The CSCS will run the aforementioned system dynamics model simulation every 3 years with updated data from the CSCS Workforce Data Repository.
e. The CSCS will publish the above in a publicly available annual report on the cardiac surgery workforce in order to provide enhanced transparency of the current and projected workforce to its members. The CSCS will proactively contact provincial health bodies and collaborate with them in providing and sharing data on cardiac surgery services in each province.
f. The CSCS will provide feedback and disseminate its recommendations to interested stakeholders including the Royal College of Physicians and Surgeons of Canada, regulatory colleges and medical associations, Ministries of Health, medical schools, residency programs, and cardiac divisions.

Conclusions
The availability of forecasting models and high quality, consistent data on HHR productivity, workload, utilization, and demand is a prerequisite for our profession’s capacity to predict and plan for changes in HHR. The CSCS recognizes that improved HHR management is a key component to providing optimal cardiac surgical care for Canadians in the future and has taken a leadership role in actively managing the Canadian cardiac surgery workforce.

Disclosures
The authors have no conflicts of interest to disclose.

References

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