From trauma care to injury control: a people's history of the evolution of trauma systems in Canada

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The last 2 decades have seen a remarkable evolution in the quality of injury care in Canada, yet few likely appreciate the magnitude and scope of this tremendous accomplishment. When, in 1966, the United States National Academy of Sciences first described accidental death and disability as the "neglected disease of modern society,"[1] it set in motion an unending elaboration and refinement of systematized trauma care in the United States that has heavily influenced the subsequent development of Canadian trauma systems. Incredibly, this process has really only got underway in the last 15–20 years.

The American military experience framed trauma as a surgical disease and launched North American surgeons into full stewardship of trauma-systems development. Although the early focus on trauma care was the appropriate surgical management of serious injury and shock, subsequent recognition of both the preventability of injury and the critical interdependence of all phases of trauma care has drawn surgeons and others into the broader occupation of injury control. Whereas trauma care used to be about removing ruptured spleens, it is now squarely about system-building, performance improvement, population-level outcomes-based research, injury prevention and public advocacy. In this paper I try to chronicle how far Canadian trauma systems have evolved in a very short time, and I recognize the pivotal leadership of a relatively small group of individuals, a preponderance of them surgeons.

The burden of injury in Canada

Nearly 14 000 Canadians die each year of injury, and approximately 250 000 are hospitalized, resulting in a combined estimated direct and indirect cost of injury of $12.7 billion annually.[2] More importantly, injury has remained the leading cause of death among Canadians under age 45 for decades, and is currently the leading cause of potential years of life lost among those up to the age of 70 years. Although the economic burden levied on Canadians by trauma ranks fourth among disease groups, national investment in injury control research ranks 15th, with an allocation of less than 1% of available funding.[3] Without doubt, the building of interest, methodology and infrastructure sufficient to break the silence of the information void has been the critical step in launching organized trauma care in Canada.

Founding fathers

Although many have contributed to the creation of trauma systems in Canada over the past 4 decades, only a handful could rightly be described as patriarchs of Canadian trauma.

Dr. Charles Burns, a Manitoban general surgeon, is widely credited as having conceptualized Canada's first regionalized trauma system in Winnipeg in the 1980s, an effort that contributed to the early rise to prominence of critical care at the Winnipeg Health Sciences Centre. Dr. Burns also established a rudimentary trauma registry in Winnipeg, and shouldered into existence the now-thriving Trauma Association of Canada (TAC), serving as its first president in 1983. Although efforts were quietly in progress across the country in the early 1980s to initiate systems of trauma care in most major cities, Charles Burns was an outspoken advocate with an important legacy. His early publications in this journal were among the first ever advancing the new concept of organized trauma care for Canada.[4,5]

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In Toronto, orthopedic surgeon Robert McMurtry[6] and emergency physician Peter Lane pioneered the early transformation of the University of Toronto's Sunnybrook Hospital into what was arguably Canada's first, fully functional, modern, premier trauma centre. A milestone achievement was the establishment at Sunnybrook of Canada's first hospital-based rotor-wing medical transport. Thirty years later, a single helicopter has grown into Ontario's recently consolidated $100 million/yr emergency air ambulance service, ornge. With 12 helicopters and 4 fixed-wing aircraft, (all bright orange, hence the name) it is the largest provincial air ambulance network in the country.

Also in 1977, Canada's first critical care flight paramedic training program was initiated. The establishment of a government-sponsored provincial air medical transport system was a pivotal advance for Ontario's trauma network as it linked major centres to all regions of the province, including 140 remote northern Aboriginal communities. It was a strategic accomplishment that galvanized Sunnybrook's trauma mission from then onward.

In the shadow of Sunnybrook, St. Michael's Hospital was quietly but effectively assuming the mantle of Toronto's "other trauma centre" with much of the groundwork laid by current *CJS* coeditor, orthopedic surgeon James Waddell. In 2006, St. Michael's recruited back to Canada from the United States accomplished traumatologist, Avery Nathens, who, as the only clinician to hold a Canada Research Chair for trauma research, promises to propel us further forward in understanding the effectiveness of trauma systems.

Elsewhere in Ontario, others also made key advances. In Hamilton, general surgeon and intensivist Frank Baillie was instrumental in establishing Canada's first centralized regional emergency communications network, CritiCall, in 1987. CritiCall linked physicians in southwestern Ontario for the efficient transport of acutely ill and injured patients to appropriate, available facilities. David Wesson at Toronto's Hospital for Sick Children, William Tucker at St. Michael's Hospital, Murray Girotti at London Health Sciences Centre, and Joe Pagliarello and Jean-Denis Yelle at the Ottawa General Hospital must also all be recognized for their contributions to sculpting local trauma systems and for coming together to establish Ontario's provincial trauma network. Facilitated greatly by health ministry Daria Parsons, this was of milestone importance, not just because it consolidated oversight for Ontario's 9 adult and 4 pediatric lead trauma centres, but because it secured active government commitment to support modern standards in an inclusive trauma-care delivery system for the 13 million inhabitants of Canada's most populous province. To date, only Ontario, Quebec and Nova Scotia have garnered formal provincial government commitment to comprehensive province-wide trauma-care systems.

In Quebec, a somewhat parallel story unfolded. Canada's largest province rolled out its regionalized trauma system in 1992 with the designation of 59 hospitals as provincial trauma-care facilities, among them 4 university-affiliated lead trauma centres. A government trauma advisory board, *le Groupe-conseil ministériel en traumatologie*, was convened in 1991 as a collaboration of the ministry of health (Pierre Bouchard), medical expertise (Pierre Fréchette, Hôpital Enfant-Jésus, Québec) and the Quebec automobile insurance board (Pierre Lapointe) to drive the consolidation of Quebec's trauma-care system. This informal tribunal convivially known among insiders as the "3 Pierres" and others, conceived a fully comprehensive "trauma services continuum" plan based on Haddon's 3 tiers of prevention: preinjury (e.g., lower speed limits), injury (e.g., seatbelt and helmet legislation) and postinjury (optimal care).[7] Ambitious, it was unique in Canada for the enormity of its scope and the partnerships on which it was based. It was even more notable for the leading role for oversight and partial funding it conferred on the provincial automobile insurance agency, *la Société de l'assurance automobile du Québec (SAAQ)*. Pierre Lapointe, chair of the advisory group, is recognized for his relentless work over more than a decade to mount and oversee a tailored system of accreditation for institutions formally committed to trauma care. There was a great deal for this group to accomplish, however, as one methodologically controversial but nonetheless disturbing study identified an unfathomable 52% mortality for severely injured trauma patients in Quebec before 1992,[8] presumably due to transfer delays and unorganized care.

Two Canadians eminently authoritative in modern trauma care in the formative years of the late 1980s and early 1990s, not only in Canada but also elsewhere, were Quebec cardiothoracic surgeons David Mulder (McGill University) and Léon Dontigny (Université de Montréal). As productive contributors to the American College of Surgeons Committee on Trauma (ACS-COT) their direct interaction with the chieftains of American trauma not only provided a conduit by which the tenets of the American model of systematized trauma care found their way into Canada but also facilitated the career development of an entire generation of Canadian trauma surgeons. Mulder brought distinction as the only Canadian president of the American Association for the Surgery of Trauma (AAST), an involvement that garnered a formal liaison between the TAC and the ASST. This linkage was instrumental in establishing combined meetings with the TAC and the high-profile American organization, and an expedited review process for TAC academic submissions to the *Journal of Trauma*, the prime showcase for trauma research in the world.

On the east coast, Nova Scotia has, in less than a decade, elaborated

Atlantic Canada's flagship trauma system and one of the most functional emergency medical systems in Canada. Before 1995, 50 private and publicly owned ambulance services operated independently in Nova Scotia without unified oversight or recognized standards. In 1994, the provincial department of health undertook to reorganize its emergency health-services division as a comprehensive provincial prehospital program integrating a communications network, a coordinated ground and air ambulance system, a training and simulation centre, a medical first-responder program to enhance rural care, and the provincial trauma program. From its inception in 1997, emergentologist John Tallon assisted by nurse-administrator Paula Poirier have deftly stewarded the Nova Scotia Trauma Program to its current state of operability. Tallon's 2002 report on injury in Nova Scotia presented the data required to assure sustained government engagement — an impressive demonstration of the persuasiveness of advocacy armed with sound data.

Elsewhere in the Atlantic provinces, trauma systems are less developed. Although Newfoundland boasts the only currently active fellowship-trained trauma surgeon in the Maritimes, the low yearly volume of major trauma (only 84 registry-reported cases in 2004–5)[9] combined with the challenge of bringing systematized care to a small population dispersed over complex geography has called for an adapted approach. A 2006 consultative report drawing attention to the absence of systematized trauma care in New Brunswick, made note of ad hoc decanting of higher level trauma to adjacent Quebec and Nova Scotia, and emphasized a need for interprovincial collaboration that is certainly pertinent across Canada.[10]

On the west coast, the history of trauma systems echoed the Sunnybrook story in that it was orthopedic surgeon, Robert Meek, and general surgeon, Norman Hamilton, who just 15 years ago rallied a multidisciplinary group of colleagues to develop a vision for coordinated trauma care for British Columbia. Aided by general surgeon Judith Vestrup, the first trauma director of the Vancouver General Hospital (VGH) and others, this group formed the BC Trauma Steering Committee that tabled a comprehensive trauma systems blueprint for British Columbia in 1990. (A vision of trauma care in the province of British Columbia. British Columbia Trauma Steering Committee [unpublished report] May 1990).

Drawing attention to regional disparity in injury prevalence and survival, this report revealed unsettling truths about the status quo. Data from 1985–1987 showed, for instance, that up to 80% of deaths arising from injury in remote regions occurred in the prehospital setting.[11] British Columbia first introduced a system of designated trauma hospitals in 1991 and has made great strides since then. Following the recruitment of trauma surgeon Richard Simons as VGH trauma director from San Diego in 1996, Vancouver's regional trauma system matured substantially with demonstrated improvement in outcomes.[12] In 2001, the provincial government further advanced regional programming by coalescing 52 health authorities into 5. An integrated provincial bed management system (*bc bedline*) was also launched that year. The establishment of a unique trauma-services remuneration contract, a high-quality registry, Canada's principal designated military trauma training centre, an accelerated trauma-specific helicopter medical evacuation program, and significant advancement toward integrated provincial oversight for trauma are all recent major contributions to systematized trauma care in British Columbia.

Next door in Alberta, efforts were also underway to bring systematized trauma care to each of the provinces' 2 major cities. In Calgary, Robert McMurtry, transplanted from Toronto, pushed for improved organization around trauma care, while Stewart Hamilton, subsequently a president of the Royal College of Physicians and Surgeons of Canada (RCPSC), did the same in Edmonton. As elsewhere in Canada, the key initial challenge lay in the politically charged repartitioning of the regional mission for advanced trauma care to a single site where a seat of local and provincial leadership for trauma could be established. In Calgary, a cooperative program for systematized trauma care was initiated in 1988. The rise to prominence of the Foothills Hospital as the lead trauma centre for southern Alberta began with its designation in 1996 as Calgary's lead adult trauma centre and was perhaps assisted by 3 events: the launch from Calgary in 1985 of a professional 5-helicopter medical evacuation service (Alberta Shock Trauma Air Rescue Society), which is unique in Canada for its fully private funding without cost to users; the spectacular demolition of the Calgary General Hospital Bow Valley Centre (home of Alberta's first dedicated trauma operating theatre) in 1998, which coercively encouraged regionalized programming; and the subsequent recruitment of surgeon-intensivist John Kortbeek whose leadership as Calgary Health Region trauma director was transformative.

The Trauma Association of Canada

Whereas the foundation for regionalized trauma care in Canada was laid by a small cadre of individuals working within separate provincial jurisdictions up to the early 1990s, it was an equally thin but like-minded second generation of surgeons, many now fellowship trained in trauma, who built substantively on these beginnings in the late 1990s. Since 2000, this core group has collaborated across provincial borders to develop the tools needed to advance significantly the maturation of our regional trauma programs. The vehicle of this success has been the TAC.

Initially conceived as a substructure of the RCPSC, the TAC was launched in 1983 by Charles Burns and others as a small surgical association committed to trauma care on a national scale. A year later, in 1984, the TAC was officially born as an organization within the Canadian Association of General Surgeons, but soon evolved into an independent association with a scope of interest extending well beyond its surgical origins.

In 2000, the TAC's reinvigoration by an infusion of new energy resulted in tremendous strides. Although a great many have assisted, Drs. John Kortbeek (Calgary), Mary van Wijngaarden-Stephens (Edmonton), Richard Simons (Vancouver), Fred Brenneman (Toronto) and John Tallon (Halifax) must be credited with taking systematized trauma care in Canada to a higher level. Four among them being recent TAC presidents, their substantive experience, deft stewardship and compelling common sense came at a critical moment. Not only have they raised the standard of trauma care substantively in their home provinces, but they have collectively provided the country with a national trauma organization well equipped to uphold high standards in trauma care. The TAC's accomplishments under their leadership include a national trauma registry developed in collaboration with the Canadian Institute for Health Information (CIHI), the elaboration of both institutional and regional trauma accreditation standards promulgated by an active site-verification program, key representation at national forums, and the mounting of successful stand-alone annual meetings owing in large part from a broadened membership base.

The intentional diversification of the Association's membership in recent years has been a strategic success that has broadened the TAC's pertinence as the national authority on trauma care. In contradistinction to its primarily surgical sister organizations in the United States, the TAC has become uniquely multidisciplinary. In addition to subspecialty surgeons (including most of Canada's 30 or so actively practising fellowship-trained trauma surgeons), the association today also brings together emergentologists, intensivists, nurses, prehospital care providers, military personnel, registry analysts and researchers, among others. The Trauma Coordinator's of Canada (TCC) was formed in 2001 to facilitate the national initiatives of trauma program nurse leaders, the undisputed true agents of local systems implementation and quality assurance. TCC presidents Paula Poirier (Halifax) and Tracey Taulu (Vancouver) have been invaluable in helping the TAC realize its larger objectives in a busy period of growth. Not only has its diversity enabled the TAC to become a broad-based forum for the discussion of trauma, but it has facilitated several projects of national importance. As inaugural president of the TAC, Charles Burns initiated 2 of these that merit further consideration: the national trauma registry and national standards of care for trauma.

National standards

The ACS-COT first produced its *Resources for the Optimal Care of the Injured Patient* (now in its 5th edition) in 1976[13] as the authoritative North American reference outlining institutional requirements for appropriate trauma management, and defining American standards for trauma-centre accreditation. After a decade-long effort launched by Dr. Burns as first chair of the TAC's standards committee, the TAC produced Canada's own accreditation standards in 1993.[14] The TAC undertook its first hospital evaluations in 1995 and today 19 Canadian institutions have up-to-date accreditation or verification. The arduous task of trauma-centre evaluation is conducted by a very dedicated subset of TAC members who merit high praise for their "extracurricular" effort to raise the national standard of care.

Laboriously revised in 2003 and 2007, the TAC's accreditation guidelines[15] now provide a sophisticated, evidence-driven tool for the promotion of continuous quality improvement in trauma care and are a major achievement of the TAC executive. Although voluntary, TAC accreditation–verification is recognized by most provincial health authorities (Quebec has evolved a parallel accreditation program based on comparable standards). The TAC originally opted to oversee its own accreditation program under the distant aegis of the RCPSC rather than assimilating with the Canadian Council on Health Services Accreditation (CCHSA). Recently it has been suggested that formal linkage to the CCHSA may be beneficial,[16] particularly as a means of adding political weight to accreditation recommendations and providing much needed infrastructure support. Evolving from process-based institutional evaluation to outcomes-based system evaluation, the TAC's accreditation program is a monumental accomplishment with clear impact on trauma care right across Canada.

National Trauma Registry

The ACS introduced the concept of a national trauma registry in 1989. Seven years later, the National Trauma Data Bank (NTDB) became operational, and in 2006 it had logged well over 1 million patients seen at over 600 designated United States trauma centres.

In Canada, Manitoba may have been the first province, under Charles Burns, to initiate a hospital-based registry of trauma data over 20 years ago.[17] Although most provinces have now developed active trauma registries, it was the creation of the Ontario Trauma Registry at the Hospital Medical Records Institute, a founding institution of the CIHI, in 1992 that ultimately led to the establishment of Canada's National Trauma Registry (NTR) in 1997.

Former Sunnybrook emergentologist (and now president and CEO), Barry McLellan, was instrumental in the implementation of this project during his tenure as TAC president in 1996.[18] The early creation of the Trauma Information Specialists of Canada and the NTR Advisory Committee to standardize coding and ensure data reliability was crucial to the success of the NTR.

Using discharge abstract data from all Canadian hospitals, the CIHI first reported from its national injury-related minimum data set in 1996. The CIHI reported nearly 2 million injury-based hospitalizations in 2006 (average length of stay 10 d, hospital death rate 4%). More comparable to the US NTDB, the NTR also reports on a comprehensive data set of severely injured patients currently contributed to by 46 hospitals in 8 provinces. Estimated to represent 90% of reportable major trauma in Canada, there were 11 000 admissions in 2006 (average length of stay 16 d, hospital death rate 13%).[9]

The full value of the NTR as a population-level evaluative tool is enormous and far from realized, as Canada must still develop meaningful performance benchmarks and risk-adjusted outcome norms. Important interprovincial trauma-system variations such as the absence of critical care paramedics and emergency prehospital helicopter transport in Quebec or the dearth of trauma-trained general surgeons in the Maritimes should be studied. More importantly, linked registry data will be crucial to gauging the success of injury prevention strategies targeting at-risk populations such as children, young men, workers and Aboriginal Canadians.

In 2003, the Canadian Institutes for Health Research in partnership the Canadian Injury Research Network, SMARTRISK (a national nonprofit injury prevention organization) and the Insurance Bureau of Canada initiated *Listening for Direction on Injury*,[3] an 18-month multi-institute collaboration to identify strategic priorities for research, capacity building, knowledge translation and infrastructure support for the management of injury. That a large number of Canadian trauma surgeons are clinically and scientifically committed, not just to injury care at the patient level, but injury control at the population level[19] underscores the quality of trauma-system development in Canada.

Education

The Advanced Trauma Life Support (ATLS) course of the ACS began as a manual entitled *Early Care of Soft Tissue Injuries* in 1954, became *Early Care of the Injured Patient* in 1972 and, after several iterations, was formalized into an ACS-sponsored educational program in 1980. ATLS was enthusiastically marshaled into Canada by proponents like McGill University's Rea Brown who was the first in North America to bring ATLS training to medical students. Dr. Brown's legendary enthusiasm for trauma sparked the careers of several productive trauma surgeons. Although many Canadians have promoted the now ubiquitous ATLS, none has been more active than Toronto surgeon Jameel Ali who was conferred a lifetime achievement award by the ACS-COT for his advocacy and research demonstrating the course's efficacy.[20]

Underscoring the critical role of timely surgical stabilization in the severely injured, 2 operative courses newly available in Canada offer advanced training to practising surgeons. The Advanced Trauma Operative Management course developed in the United States in 2003 is offered in Toronto, Calgary and will soon be available in Edmonton. Vancouver, under Richard Simons, has recently imported the Definitive Surgical Trauma Care course from South Africa via Australia. Because both are excellent hands-on tools for teaching key surgical strategies, their dissemination to the practising community surgeon likely to first encounter major trauma in Canada will be invaluable.

At present, only 3 Canadian centres offer university recognized fellowship training in trauma, although a number of clinical fellowships are available. Neither the Accreditation Council for Graduate Medical Education in the United States nor the RCPSC in Canada yet recognize trauma as accreditable specialty training.

Injury prevention and advocacy

Every day, nearly 6000 Canadians are injured and 40 die.[21] Annually, there are nearly 37 000 brain and spinal cord injuries with a combined direct and indirect cost estimated at CAN$1.5–4.0 million each.[22] Although trauma systems are practically about tertiary prevention — optimizing care once injury has occurred — the mantra of lead trauma organizations has long been that trauma is no accident. It is therefore appropriate that program leaders are becoming increasingly active in injury prevention advocacy.

Of the many national nonprofit injury prevention organizations operating in Canada, SMARTRISK (www.smartrisk.ca) and ThinkFirst Foundation of Canada (www.thinkfirst.ca), both founded in 1992, are among the most active. Following from the 1986 initiation of a similar program in the United States, ThinkFirst brings the important message of brain and spinal cord injury prevention to our youth. Unequalled in his pioneering work as president of ThinkFirst, Toronto neurosurgeon Charles Tator has helped educate thousands of Canadian schoolchildren over the past decade, an effort that rightly helped garner him the Order of Canada in 2000 and a litany of other distinctions. His impact is inspirational to those of us who recognize public advocacy as an important requirement of our work in building complete systems of trauma care in Canada.

Injury prevention work has been ongoing in Canada for 40 years. The Traffic Injury Research Foundation was established by Transport Canada in 1964 to maintain a national motor vehicle injury and fatality database in support of road safety programs. Although this and other initiatives have indeed reduced injuries in Canada, there remains much room for progress. If Canada performed to Swedish standards, it is estimated that 1233 pediatric trauma fatalities would have been prevented between 1991 and 1995.[22]

On the heels of the sixth World Conference on Injury Prevention and Control held in Montréal in 2003, the federal government created the Public Health Agency of Canada in 2004 to better coordinate national health strategies. Its clear mandate is to control chronic diseases, respond to public health emergencies, and support effective injury prevention programs. It has been proposed that the Public Health Agency of Canada establish a Canadian injury prevention centre with oversight for a national injury surveillance program.[22] If we are to learn anything from our experience in modern trauma care, it is that the effort of prevention is the only credible solution to the needless tragedy of major injury, and those who seriously dedicate themselves to acute trauma care must also dedicate their valued stature and energy to one day putting themselves out of work.

Conclusions

This review provides a cursory glimpse at the surprisingly late but rapid evolution of regionalized systems of trauma care in Canada, a process that has consolidated substantively only in the last decade. That such a patchwork of individual effort has coalesced so effectively into thriving, well-integrated systems of trauma care is remarkable. A shift in focus from the management of trauma to the control of injury reflects genuine maturation of our trauma systems and is an enormous credit to those who helped erect them. Although a vast mix of disciplines have collaborated on all levels, and important contributions from nursing and prehospital contributors have been underrepresented here, strong surgical leadership has often been the key catalyst. As a historical narrative, this tribute to those who have diligently assisted the building of systematized trauma care in Canada is far from complete, as many have gone unrecognized. Notwithstanding, it has truly been the galvanizing vision and leadership of remarkably few that has crystallized a lasting legacy of well-organized injury management that stands to better protect the health of all Canadians across this vast country.

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