# A matrix for comprehensive surgical education

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From bench to bedside, and from the care of individuals to the health of populations, the scope of general surgery has exploded in recent years, as new scientific and technical insights have come to light and as greater focus on outcomes have identified new opportunities to improve patient care.[1,2] Surgeons of the twentieth century could not have predicted how technology would fundamentally and immediately reshape surgical practice, how complex multimodal therapies would be coordinated with airline industry–level precision or how organized systems of care would transform access to treatment and surgical outcomes.[1] As surgical progress accelerates, the next generation of surgeons will have exciting opportunities and will face unprecedented expectations and challenges.[3,4]

Remarkably, even in this era of rapid growth, the basic principles of surgical education outlined by William Halsted more than a century ago have endured and continue to produce surgeons with superb knowledge, technical skills and professionalism.[5] Surgical residents still go through a fixed period of time for training, are expected to master structured educational content and face escalating operative and perioperative responsibility. But a strong foundation of knowledge and skill, while fundamentally important, is only one aspect of comprehensive surgical training and practice. Optimal surgical care increasingly depends on rigorous and continuous adaptation of the scientific literature into clinical practice; skillful communication with patients, families and colleagues; insightful and decisive leadership of multidisciplinary teams; and dedicated advocacy for patients as they attempt to navigate the complex health care environment.

Effective physicians and surgeons instinctively possess many of these attributes. In fact, a formal survey of Fellows of the Royal College of Physicians and Surgeons of Canada identified 7 fundamental roles of medical specialists (the CanMEDS framework, Fig. 1).[6,7] This deconstruction of clinical excellence brought the essential attributes of modern physicians and surgeons into sharp focus for the first time and opened new avenues to improve surgical education.[7] Unfortunately, articulation of the CanMEDS roles also appeared to make surgical education much more complicated.[8,9] Surgical training programs struggled to find time in their already brimming curricula to devote to specific training in

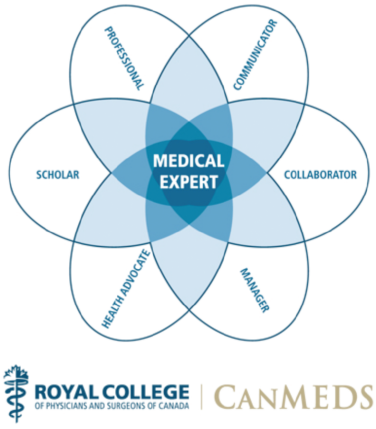


**Fig. 1.** In 1990, the Royal College of Physicians and Surgeons of Canada polled its members to identify "a comprehensive definition of the competencies needed for medical education and practice." This process ultimately led to the Canadian Medical Education Directives for Specialists competencies framework (known as CanMEDS). This CanMEDS framework identifies 7 roles of equal importance that any graduating physician must master and maintain to be considered a specialist. While traditional models of surgical education did confer these competencies in varying degrees, the act of clearly defining a full spectrum of competencies has made implicit training priorities more explicit and has created unprecedented opportunities for surgical trainees to attain greater mastery of the diverse competencies needed in modern medical practice. Copyright © 2006 The Royal College of Physicians and Surgeons of Canada. http://rcpsc.medical.org/canmeds. Reproduced with permission.

the CanMEDS roles, and surgical residents questioned the relevance and urgency of these newly mandated priorities.[10]

However, as experience with the CanMEDS roles has grown in surgical programs and skepticism among surgeons and residents has receded, the inherent relevance and role of the CanMEDS framework in daily surgical education has become increasingly apparent. All teaching surgeons have caught glimpses of CanMEDS roles in action during routine duties, such as obtaining consent (Communicator), running a trauma resuscitation or operative slate (Manager), teaching a medical student how to write postoperative orders (Scholar) or even discharge planning (Collaborator, Health advocate). These are exciting insights because they begin to inform the process of seamless integration of teaching CanMEDS roles during surgical training, and they increase the awareness of trainees and surgeons to the educational richness of everyday interactions.

## The matrix

The matrix for surgical education proposed in this paper is based on the premise that expertise in all of the CanMEDS roles is essential for effective surgical practice and that level of training–specific experiences in each of these roles are found throughout surgical residency. The matrix table (Fig. 2), with columns representing CanMEDS roles and rows representing academic curriculum and surgical rotations, reveals where specific CanMEDS roles figure prominently in surgical training and practice. It provides a foundational, reflective framework for training in roles other than Medical expert within the context of surgical training.

For example, most experiences in surgical training are devoted to increasing competence in the Medical expert role. Through reading, didactic teaching, clinical exposure and operative experience, residents will build basic knowledge and expertise in the care of surgical patients in every rotation and every educational encounter. Other CanMEDS roles can be taught at grand rounds or academic half days, but teaching of these roles might be more effectively accomplished in the context in which they are most intensely needed. For example, discharge of patients from a trauma service into the community provides an important

| | Surgical expert | | Communicator | Collaborator | Manager | Health advocate | Scholar | Professional |
|---|---|---|---|---|---|---|---|---|
| | Medical expert | Technical skills | | | | | | |
| Academic curriculum<br>Academic half days, skills labs | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Written and oral exams | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Journal club | ■ | | ■ | | | | ■ | |
| Technical skills assessments and Global Rating Scale for the Evaluation of Technical Skills (GRITS) | | ■ | | | | | | |
| Trauma surgery rotation | ▒ | ▒ | ▒ | ▒ | Seniors | Juniors | ▒ | ▒ |
| Acute care surgery rotation | ▒ | ▒ | ▒ | ▒ | ▒ | ▒ | ■ | ▒ |
| Surgical oncology rotation | ▒ | ▒ | ▒ | ■ | ▒ | ▒ | ▒ | ▒ |
| Victoria general surgery rotation | ▒ | ▒ | ■ | ▒ | ▒ | ▒ | ▒ | ▒ |
| Surgical Residents as Teachers Program | | | ■ | | | | ■ | |
| Surgeon Scientist Program | | | ■ | | ■ | | ■ | |
| Surgery and Global Health Program | | | | | | ■ | | |

**Fig. 2.** Matrix for comprehensive surgical education. The matrix provides a framework that illustrates at a glance where programs are addressing educational priorities across the CanMEDS spectrum. The formal academic curriculum and clinical rotations (light shading) can be used to address all CanMEDS roles. However, individual rotations can serve as hubs for individual CanMEDS roles depending on their areas of expertise and case mix. Such CanMEDS hubs expand their formal goals and objectives, evaluations and educational content to advance expertise in their CanMEDS area of specialization. Longitudinal programs such as the Surgical Residents as Teachers Program provide a more sustained and longitudinal exposure to CanMEDS roles as a primer for lifelong commitment to growth in these areas. These educational initiatives must be accompanied by evaluations that fit in to a parallel assessment framework. We believe that not all CanMEDS roles need formal teaching in all contexts; rather surgical programs can tailor CanMEDS initiatives according to their individual strengths. The main priority is to have at least some legitimate shading in every column.

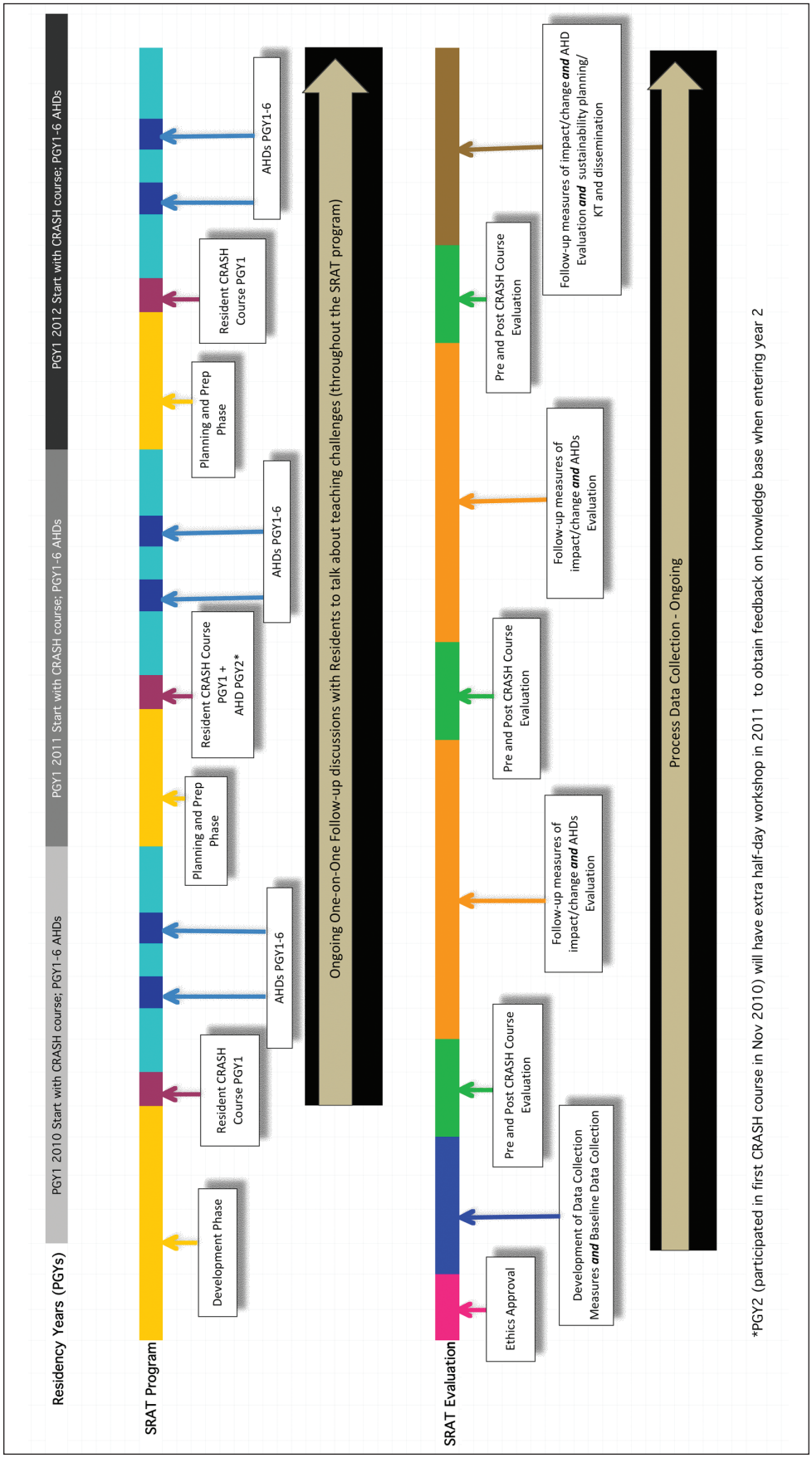


**Fig. 3.** Surgical Residents as Teachers (SRAT) Program: a blueprint for longitudinal development and evaluation. The figure provides a snapshot (first 3 years) to illustrate the longitudinal nature of the SRAT Program, including the educational curriculum and evaluation plan. In addition to the educational offerings, the Acute Care Surgery rotation will be the clinical rotation where residents will apply their learning, be given teaching support and be evaluated on their teaching encounters. AHD = academic half day; CRASH = competencies in resuscitation and stabilization of hospital patients; KT = knowledge translation; PGY = postgraduate year.

opportunity for junior residents to explore issues in Health advocacy, whereas trauma resuscitation and other crisis situations provide an invaluable context to teach and evaluate the performance of the Manager role among senior residents. Similarly, attendance at and participation in multidisciplinary tumour board meetings on a surgical oncology rotation may illustrate the importance of surgeons as Collaborators in addition to Medical experts. In our program, a busy, resident-driven acute care surgery service with many trainees at various levels will be used to run a clearly defined surgical residents-as-teachers program that will be used to illustrate key aspects of the CanMEDS Scholar role. Finally, for the Communicator role, a busy general surgery rotation at a community hospital will be used to set the stage for discussion of the importance of effective communication among services, staff and patients in advancing care and optimizing outcomes. Whereas all clinical rotations ultimately provide exposure to all CanMEDS roles, recognizing specific rotations as hubs for certain roles other than Medical expert allows explicit objectives to be expanded, formalized and evaluated in detail and according to level of training. In addition, this reflective framework allows program directors and curriculum designers the ability to completely integrate the CanMEDs roles into the educational and clinical experiences of residency training. It creates a clear and definable way to reflect on how each central role of a surgeon is being discussed, taught, reflected on and assessed (Fig. 2).

While specific rotations can be retooled to identify and intensify nonexpert teaching opportunities within their own surgical contexts, residency programs can also create relevant strategies for teaching and learning CanMEDS roles outside of conventional rotations. Development of excellence in most CanMEDS roles requires an approach of graded responsibility and sophistication (to be relevant to the level of training) and sustained effort throughout residency and practice. A longitudinal and developmentally appropriate approach that cuts across rotations and years of training for teaching certain roles shows residents that their Medical expert and nonexpert development can be balanced and sustained throughout their professional lives. For example, our Surgical Residents as Teachers Program, a key aspect of our CanMEDS Scholar training, starts in the first year of training with a 1-day workshop embedded into a rotation focused on evidence-based medicine and critical care, where the importance of residents as teachers is emphasized, and where fundamental principles of bedside teaching and learning are highlighted and discussed (Fig. 3). This initial exposure is supported and advanced at academic half-day sessions throughout the year. Furthermore, our acute care surgery rotation has championed the Scholar role by including specific goals and objectives for junior and senior residents. This clinical rotation has committed to embed "learning to teach" as part of its mandate and has included teaching competencies in their corresponding rotation in-training evaluation reports. A similar cross-cutting or longitudinal approach, with increasing sophistication and responsibility, is also being taken in our Surgeon Scientist Program and Surgery and Global Health Program.

## Conclusion

The word "matrix" has been variously defined as "a rectangular array of quantities or expressions set out by rows and columns; treated as a single element and manipulated according to rules," "a mass of fine-grained rock in which fossils, crystals, or gems are embedded," or "an enclosure within which something originates or develops (from the Latin for womb)."[11] We believe that the matrix for surgical education proposed here, at least figuratively, encompasses all of these definitions. The matrix will help surgical residents, residency education committees and accrediting bodies identify the performance of CanMEDS roles that are the foundational (but implicit) aspects of excellent surgical practice. By making the importance of these educational "gems" explicit at each stage of surgical training, residency programs will be able to broaden the value of each clinical and academic encounter and, in so doing, prepare surgical residents more comprehensively for exciting and rewarding careers in an increasingly dynamic profession.

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