Medical simulation is the use of a device or series of devices to emulate anatomy, real-life clinical situations, and clinical procedures for the purposes of education, evaluation, and research.\(^1,2\) Simulation is a powerful tool in the education and evaluation of physicians and is rapidly becoming a central thread in the fabric of medical education.\(^3\) The effectiveness of simulation-based medical education (SBME) can be optimized by integrating simulation into an overall curriculum.\(^4\) Internal medicine training programs are introducing procedural training using simulation but are not as advanced as other programs, such as anesthesia and emergency medicine, in the use of technology-based simulation utilizing high-fidelity full-size mannequins.\(^5\) We feel simulation can be used to teach a wide range of CanMEDS competencies, and a comprehensive simulation curriculum should become a standard in internal medicine residency training.

### Benefits of Simulation-Based Training

Medical simulation complements traditional educational activities based on real patient-care experiences.\(^4\) Simulation-based training (SBT) is becoming more and more important as the health care delivery is evolving with increasing outpatient management of complex problems, higher acuity of admitted patients, and shorter hospital stays. These factors, along with decreased resident work hours, all contribute to fewer exposures to real-life situations.\(^2,6\) SBT is an effective tool that can be used to counter these obstacles and can be incorporated into a traditional curriculum or competency-based training. Simulators are readily available, help control for the variability of clinical exposures, avoid the ethical issues of training on real patients, and provide a standardized environment for immediate directed feedback.\(^2,7\) The use of simulation improves mastery of knowledge,\(^2,6\) learner satisfaction and confidence,\(^7,8\) procedural skills,\(^5,7,9\) and teamwork and communication.\(^4\) Furthermore, upon retesting, knowledge, procedural comfort, and performance are improved.\(^7\) In an emergency medicine program, trainees rated a novel simulation-based curriculum as highly effective and realistic. Residents responded favourably to replacing traditional lecture teaching with more active teaching formats, and, overall, they felt more satisfied with their learning experience.\(^10\) The evidence also shows that patients are more willing to allow students to perform procedures on them after they have completed simulation training.\(^11\)

### Simulation Resources

SBT requires an initial capital investment for the purchase of equipment and ongoing funding support to replace parts and upgrade equipment. Success of an SBT also needs salary support for technicians and instructors. University- or hospital-based centres where resources as well as expertise can be shared make SBT more economical. Most of the internal medicine residency programs in Canada currently have access to university simulation centres. Postgraduate training programs should collaborate to ensure these centres maintain state-of-the-art technology and human resources and are available for all trainees.

A variety of levels of technical fidelity can be used to achieve the goals of an internal medicine program. These may include but are not limited to partial task trainers, full-body task trainers, and moderate- and high-fidelity mannequins. Partial task trainers provide the opportunity to learn and practise procedures that are considered "core training"
requirements by the Royal College of Physicians and Surgeons of Canada (RCPSC). These include lumbar puncture, central line insertion, joint aspiration and injection, thoracentesis, and other procedures. Standardized patients (SPs), now a norm in medical training and evaluation, can be incorporated into hybrid simulation design where the SPs provide additional layers allowing for the creation of an increasingly complex curriculum that is designed with the flexibility to target residents at different levels of training. Full-body task trainers (e.g., Resusci Anne and MegaCode Kelly) and high-fidelity mannequins (e.g., SimMan) may be used to simulate complex medical scenarios.

Simulation Faculty
Recruiting faculty for simulation is challenging because of the usual reasons of time constraints, interest, and funding. Clinical teachers do not have the necessary skills to design and deliver simulation scenarios. This is becoming more evident with the use of more complex technology-based design and delivery such as that in full-scale simulation. Training continues to be a challenge. This is mainly due to the financial and time constraints that faculty experience when pursuing instructor training and the limited availability of instructor training offerings. Faculty development must be an integral part of every simulation-based curriculum. A simulation subcommittee that reports to the residency education committee can help to identify interested faculty, lead faculty development and explore research opportunities.

Curriculum: Design, Integration, and Evaluation
The curriculum design should include content, teaching strategies, and a formal evaluation process.12 Programs should review the current residency curriculum blueprint to determine where simulation best fits within the curriculum. Collaboration among all stakeholders and local experts is important in identifying gaps in the current curriculum and assessing opportunities to use SBME strategies to fill these gaps. This consultation process can also identify areas in the curriculum with ineffective instruction modalities where the introduction of simulation, or the use of more advanced simulation, may better serve trainee learning needs and program goals. Once opportunities are identified, learning objectives should be determined and used to design teaching and evaluation modules that would include appropriate didactic content and simulation scenarios using a standardized format. The curriculum is best designed within the framework of the RCPSC CanMEDS competencies. This framework defines the key competencies needed for medical education and practice and is based on seven core roles: medical expert, communicator, collaborator, manager, health advocate, scholar, and professional. Modules of varying complexity can be developed and integrated in a graded manner across the 3-year training program. Many modules, or components of these modules, could be generalized for use in other programs.

Inter-professional training should be a key part of the simulation curriculum. Through the needs assessment process, programs should explore local trends in the complex interdisciplinary and inter-professional practice environment. Full-scale simulation scenarios can be scripted to reproduce complex situations, including ethical dilemmas, communication challenges, risk management issues, team dynamics, and cultural challenges that will target behavioural and cognitive skills training. Issues that could be taught through simulation include, but are not limited to, hierarchical barriers to communication; the inter-professional team environment of physicians, nurses, and other health care providers; and interface issues between the most responsible physician (MRP) team, rapid response team, and code team.

Evaluation is an essential step in curriculum design. Each simulation module developed must be validated and then evaluated using the Kirkpatrick evaluation model. This model measures the learner’s reaction, the resulting increase in knowledge and capability, and the change in behaviour and performance. Anonymous surveys could assess the effect of the simulation curriculum on the learners. Feedback from learners should be incorporated in the development and improvement of the curriculum. The use of objective structured clinical examinations (OSCEs) and direct observation could assess certain technical and non-technical skills. Impact on knowledge and behavioural and cognitive skills could be assessed through changes in third-party evaluation (e.g., the Medical Council of Canada Qualifying Examination and RCPSC examinations) and supervisor evaluation. The impact of SBT on learners’ overall performance and patient care is the most important; however, perusing such a measure is resource and time intensive.

Discussion
Technology-based simulation, using partial and full-body mannequins, was introduced into the Internal Medicine Residency Program at McMaster University in January 2009. We used partial task trainers for all levels of training. This initial experience was evaluated by surveying residents. Participants found the models to be useful training tools and agreed that these sessions improved their skills and confidence and provided information needed to perform the procedures safely. In June 2009, we conducted an inter-professional full-scale simulation, using a high-fidelity simulator (SimMan). In this
simulation, junior internal medicine residents had the opportunity to function as a team leader in a pre–cardiac arrest situation. We used debriefing to encourage reflective learning, mirroring the learning that occurs with difficult cases in real life. Participants found the simulation session realistic and useful in improving both communication and collaboration.

Effective use of simulation is a product of three components: training resources, trained educators, and curriculum integration. If any of these components is missing or deficient, the product will be ineffective. Our program has access to the McMaster University Centre for Simulation Based Learning. The centre is equipped with many task trainers as well as state-of-the-art high-fidelity and moderate-fidelity mannequins. The Internal Medicine Program has also invested in task trainers that can be transported to different sites, making SBT more easily accessible for learners at various hospitals. A director of simulation position was created, followed by the development of a SIMS (simulation in internal medicine residency training) Committee that has faculty and resident representation. We are currently working toward having a fully integrated simulation curriculum, with graded complexity spread over 3 years of residency training.

It is our desire to recruit internal medicine programs across the country to collaborate in developing a national SBT curriculum. We are in the process of implementing a national environmental scan and needs assessment to determine the extent of SBT in internal medicine training programs. This will lead to the identification of common goals and objectives that can serve as the first step in the development of a peer-reviewed national curriculum. Open-source inventories, shared knowledge, and collaboration will facilitate the introduction of SBT in programs that do not have experienced simulation faculty. This will be more effectively facilitated with the support of national organizations such as the Canadian Society of Internal Medicine and RCPSC.

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References