The Practice of Radiology Education
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Challenges and Trends
The practice of radiology education: challenges and trends will provide truly helpful guidance for those of you involved in teaching and training in radiology. The goal of this book is ultimately to improve patient care. As a companion piece to the first book radiology education: the scholarship of teaching and learning, this book focuses on applying the concepts at a practical level that can be applied flexibly within educational programs for radiology residents and fellows in any medical imaging learning environment. This book focuses on the application of scholarship in terms of the “dissemination of useful, testable and reproducible information to others.” It links educational theory with practice and for those of you who wish to explore educational practice further, a number of chapters suggest additional readings and resources.

The publication is timely and congruent with one of the most important twenty-first century trends in medical education: the move from amateurism to professionalism in teaching. In the past, medical schools and other health professions’ training institutions have been criticized for their resistance to the adoption of the science of medical education. Very few of us learned how to teach as medical students and most of us have our teaching responsibilities thrust on us with little preparation. The award of a basic medical degree was assumed to carry with it basic teaching expertise, unfortunately an unwarranted assumption in some cases. At last, the realization is spreading that even a short introduction to teaching and learning can make a marked impact on our students’ learning and the quality of their educational experience. We can make learning more efficient and effective with the application of a few rudimentary principles and provide a coherent and cohesive educational program for our students.

Another important aspect of this unique publication is that it is customized specifically for radiology. For too long, doctors as individuals have had to translate what happened in primary and secondary classrooms to clinical training at undergraduate and postgraduate levels. It is now recognized that the application of tried and trusted educational principles to clinical practice within medical disciplines is a specialism in itself. Expertise in teaching and learning within medical disciplines has grown and developed over the years and it is the individuals with this expertise in radiology who have contributed to this scholarly work. What you read in this book is what is relevant for radiology teaching.

Contributors to the publication come from Canada and institutions across the world. The range of international contributors is one of the strengths of the book and ensures
that experts in the field provide you with cutting edge and up-to-date advice. I hope it will help to prevent obstacles for those of you new to teaching and to bolster your confidence as teachers. For those of you with several years of teaching experience, wishing to further improve your teaching expertise, it will provide thoughtful pointers for further development of your skills, always with a sound educational basis.

Everyone involved in this publication has gone to great lengths to ensure a readable and up-to-date publication designed to help you with your lifetime teaching journey within radiology.

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We thank all those who have championed this educational endeavour. Those champions include the chair of our department, Dr. Andrea Lum, our Program Director, Dr. Justin Amann, and the faculty and residents of the Department of Medical Imaging, Schulich School of Medicine and Dentistry, University of Western Ontario. These are the ones who have taken those first steps by inviting us into their everyday practices and by sharing their stories. We thank our deans for their continued enthusiastic support: Dr. Carol Herbert, Dean of the Schulich School of Medicine & Dentistry, University of Western Ontario; and Dr. Julia O’Sullivan, Dean of the Faculty of Education, University of Western Ontario. We also thank our research assistants for their scholarly and collaborative vision: Lisa Boyko, Monica Caldeira, Kyra Harris, Mark Hunter, and Liem Ngo. We thank Holly Ellinor, a valuable member of our team who has been significantly instrumental in the creation of both of our books and whose expertise in so many areas keeps the Centre for Education in Medical Imaging running so smoothly.

Teresa Van Deven

Vision is not enough; it must be combined with venture. It is not enough to stare up to the step; we must step up the stairs.

Vaclav Havel

To my sister, Kimberly Joan: It is she, through her years in medicine within the emergency department, critical care unit, the hyperbaric unit and the northern communities in British Columbia, Canada, who has shared her stories and struggles and who has consistently shown me how to move beyond mere vision towards venture.

An avid sailor, Kim has explored the seas aboard her ship, the Warrior’s Way, and through our journeys together, has taught me that even in the most violent of seas, we can face the challenges, defy the odds, and venture forth.

To our team: Dr. Kathy Hibbert, Dr. Rethy Chhem and Ms. Holly Ellinor. What an honour to be part of this collaborative team as we venture up those stairs together.
Kathy (Shackleton) Hibbert

Much of this second book has focused on the notion of crossing borders, taking risks and venturing into the wild. As Sir Ernest Henry Shackleton wrote in *The Heart of the Antarctic*, people

go into the void spaces of the world for various reasons. Some are actuated simply by a love of adventure, some have the keen thirst for scientific knowledge, and others again are drawn away from the trodden paths by the ‘lure of the little voices’ the mysterious fascination of the unknown.

This second journey into the “unknown” has proved to be as illuminating as the first. My colleagues, Dr. Rethy Chhem and Dr. Teresa Van Deven, have been wonderful shipmates along the way and I always enjoy where our discussions take us. A passage from St. John Wellas Lucas, “The Ship of Fools” captures our collaboration:

We were the fools who could not rest  
In the dull earth we left behind,  
And burned with passion for the south  
And drank strange frenzy from its wind.  
The world where wise men sit at ease  
Fades from our unregretful eyes,  
And thus across uncharted seas,  
We stagger on our enterprise.

I dedicate this book to my parents: Lorraine Audrey Shackleton and Jackson Wayne Shackleton. As my first teachers, they provided models of grace, courage and insatiable curiosity. The serious illnesses that they both faced brought us in close contact with the medical community, its services, its strengths and its limitations. Throughout it all, they continued to go about the task of “living” their lives. To quote Shackleton again, “Difficulties are just things to overcome, after all.”

Rethy Chhem

In memory of my first teachers and mentors:  
My mother, Nhiek Bophal  
My father, Chhem Kieth

Disclaimer

The opinion of the authors does not necessarily reflect that of the editors.
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## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABR</td>
<td>Board of Radiology</td>
</tr>
<tr>
<td>ACA</td>
<td>Anterior cerebral artery</td>
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<tr>
<td>ACGME</td>
<td>Accreditation Council for Graduate Medical Education</td>
</tr>
<tr>
<td>ACR</td>
<td>American College of Radiology</td>
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<td>AFIP</td>
<td>Armed Forces Institute of Pathology</td>
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<td>AIP</td>
<td>American Institute of Physics</td>
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<tr>
<td>AIT</td>
<td>Applied imaging technology</td>
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<tr>
<td>AMA</td>
<td>American Medical Association</td>
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<tr>
<td>AMA/FREIDA</td>
<td>American Medical Association/Fellowship and Residency Electronic Interactive Database Access System</td>
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<tr>
<td>AMC</td>
<td>Australian Medical Council</td>
</tr>
<tr>
<td>AMSER</td>
<td>Alliance of Medical School Educators in Radiology</td>
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<tr>
<td>AUC</td>
<td>Area under the curve</td>
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<tr>
<td>AVM</td>
<td>Arteriovenous malformation</td>
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<td>BEO</td>
<td>Branch education officers</td>
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<tr>
<td>BSS</td>
<td>Basic safety standard</td>
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<tr>
<td>CAC</td>
<td>Curriculum Advisory Committee</td>
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<tr>
<td>CAGE</td>
<td>Acronym identifying 4 questions: Have you ever felt you should cut down on your drinking? Have people annoyed you by criticizing your drinking? Have you ever felt bad or guilty about your drinking? Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover (eye opener)?</td>
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<tr>
<td>CAMRT</td>
<td>Canadian Association of Medical Radiation Technologists</td>
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<tr>
<td>CanMEDS</td>
<td>Canadian Medical Education Directives for Specialists</td>
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<tr>
<td>CaPS</td>
<td>Curriculum and pedagogy support</td>
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<td>CaRMS</td>
<td>Canadian resident matching service</td>
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<td>CBL</td>
<td>Case based learning</td>
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<tr>
<td>CMA</td>
<td>Canadian Medical Association</td>
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<tr>
<td>CME</td>
<td>Continuing medical education</td>
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<tr>
<td>CMRTO</td>
<td>College of Medical Radiation Technologists of Ontario</td>
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<tr>
<td>CORA</td>
<td>Centre of Radiological Anatomy</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>CPD</td>
<td>Continuing professional development</td>
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<tr>
<td>CRPs</td>
<td>Coordinated Research Projects</td>
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<tr>
<td>CT</td>
<td>Computed tomography</td>
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<tr>
<td>DAT</td>
<td>Distance assisted training</td>
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<tr>
<td>DATOL</td>
<td>Distance assisted training on-line</td>
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<tr>
<td>DEC</td>
<td>Departmental education coordinator</td>
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<tr>
<td>DMI</td>
<td>Department of medical imaging</td>
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<tr>
<td>DOPs</td>
<td>Directly observed procedures</td>
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<tr>
<td>DOT</td>
<td>Directors of training</td>
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<tr>
<td>EBR</td>
<td>Evidence based radiology</td>
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<tr>
<td>EFSUMB</td>
<td>European Federation of Societies for Ultrasound in Medicine and Biology</td>
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<tr>
<td>EHRs</td>
<td>Electronic health records</td>
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<tr>
<td>ENT</td>
<td>Ear, nose &amp; throat</td>
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<td>EPAPS</td>
<td>Electronic physics auxiliary publication service</td>
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<tr>
<td>ERB</td>
<td>Evaluation Review Board</td>
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<tr>
<td>ESR</td>
<td>European Society of Radiology</td>
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<td>ESSR</td>
<td>European Society of Musculoskeletal Radiology</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>EULAR</td>
<td>European League Against Rheumatism</td>
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<tr>
<td>FREIDA</td>
<td>Fellowship and residency electronic interactive database access system</td>
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<tr>
<td>HCC</td>
<td>Hepatocellular carcinoma</td>
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<tr>
<td>HGH</td>
<td>Hamilton General Hospital</td>
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<tr>
<td>HHS</td>
<td>Hamilton Health Sciences</td>
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<tr>
<td>HOD</td>
<td>Heads of department</td>
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<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
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<td>ILO</td>
<td>International Labor Organization</td>
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<tr>
<td>IPX</td>
<td>Individual patient examination</td>
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<tr>
<td>ISI</td>
<td>Institute for Scientific Information</td>
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<td>ITERs</td>
<td>In-training evaluation reports</td>
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<tr>
<td>JoVE</td>
<td>Journal of visualized experiments</td>
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<tr>
<td>LID</td>
<td>London imaging discovery</td>
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<tr>
<td>LOE</td>
<td>Levels of evidence</td>
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<tr>
<td>MCA</td>
<td>Middle cerebral artery</td>
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<tr>
<td>MCQ</td>
<td>Multiple-choice question</td>
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<tr>
<td>MDCT</td>
<td>Multi-detector computed tomography</td>
</tr>
<tr>
<td>MF</td>
<td>Medical Foundations</td>
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<tr>
<td>MIIRC@M/MIIRCAM</td>
<td>Medical Imaging Informatics Research Centre at McMaster University</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
</tr>
<tr>
<td>MRT</td>
<td>Medical radiation technologist</td>
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<tr>
<td>MSF</td>
<td>Multi-source feedback</td>
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<tr>
<td>MSK</td>
<td>Musculoskeletal</td>
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<tr>
<td>MSK US</td>
<td>Musculoskeletal ultrasound</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>MSUS</td>
<td>Musculoskeletal ultrasound</td>
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<tr>
<td>MUMC</td>
<td>McMaster University Medical Center</td>
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<tr>
<td>OA</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>OBOs</td>
<td>Open biomedical ontologies</td>
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<tr>
<td>OSCE</td>
<td>Objective structured clinical examination</td>
</tr>
<tr>
<td>PACS</td>
<td>Picture archiving and communication system</td>
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<tr>
<td>PBL</td>
<td>Problem based learning</td>
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<tr>
<td>PET</td>
<td>Positron emission tomography</td>
</tr>
<tr>
<td>PGE</td>
<td>Postgraduate education</td>
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<tr>
<td>PGY</td>
<td>Post-graduate year</td>
</tr>
<tr>
<td>PPI</td>
<td>Personal progress index</td>
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<tr>
<td>QOL</td>
<td>Quality of life</td>
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<tr>
<td>RadLex</td>
<td>Radiology lexicon</td>
</tr>
<tr>
<td>RANZCR</td>
<td>Royal Australian and New Zealand College of Radiologists</td>
</tr>
<tr>
<td>RCA</td>
<td>Regional Cooperative Agreement</td>
</tr>
<tr>
<td>RCPCSC</td>
<td>Royal College of Physicians and Surgeons of Canada</td>
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<tr>
<td>RCR</td>
<td>Royal College of Radiologists (UK)</td>
</tr>
<tr>
<td>RCRT</td>
<td>The Royal College of Radiologists of Thailand</td>
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<tr>
<td>RF</td>
<td>Radiology foundations</td>
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<td>RHPA</td>
<td>Regulated Health Professions Act</td>
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<tr>
<td>R-ITI</td>
<td>Radiology–integrated training initiative</td>
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<tr>
<td>ROC</td>
<td>Receiver operating characteristic</td>
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<tr>
<td>RPGs</td>
<td>Role playing games</td>
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<tr>
<td>RSNA</td>
<td>Radiological Society of North America</td>
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<tr>
<td>RST</td>
<td>Radiological Society of Thailand</td>
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<tr>
<td>RTC</td>
<td>Residency Training Committee</td>
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<tr>
<td>RTCs</td>
<td>Regional training courses</td>
</tr>
<tr>
<td>RTMR</td>
<td>Registered technologist, magnetic resonance</td>
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<tr>
<td>RTNM</td>
<td>Registered technologist, nuclear medicine</td>
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<tr>
<td>RTR</td>
<td>Registered technologist, radiological technology</td>
</tr>
<tr>
<td>RTT</td>
<td>Registered radiation therapy technologist</td>
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<tr>
<td>SJHH</td>
<td>St. Joseph’s Healthcare Hamilton</td>
</tr>
<tr>
<td>SSMD</td>
<td>Schulich School of Medicine &amp; Dentistry</td>
</tr>
<tr>
<td>TAI</td>
<td>Traumatic aortic injury</td>
</tr>
<tr>
<td>TC</td>
<td>Technical co-operations</td>
</tr>
<tr>
<td>TCP</td>
<td>Technical Cooperation Program</td>
</tr>
<tr>
<td>THES</td>
<td>Times higher education supplement</td>
</tr>
<tr>
<td>TPAC</td>
<td>Training Program Assessment Committee</td>
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<tr>
<td>US</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>WBS</td>
<td>Whole-body screening</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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The first book of this series, *Radiology education: the scholarship of teaching and learning*, was written as a way to begin a dialog about possibilities for bringing educational scholarship, in the broad sense, into the realm of the medical imaging world. It included a range of discussions that honored the multiple ways in which Ernest Boyer has defined scholarship; i.e., scholarship of discovery, scholarship of teaching, scholarship of integration, and scholarship of application. It included the voices of scholars and practitioners from around that world who have begun to think about their practice in new ways, and who offered glimpses into the “everyday world,” so that we might all begin to better understand how to come together as a community of radiology educators and reconsider the structures and practices that are currently in place, and where we might begin to envision what we might do better in our overall goal of improved patient care.

This second volume from the Centre for Education, Department of Medical Imaging at the University of Western Ontario is a compilation of the experiences and reflections of radiologists, physicists, and educators whose common aim is to produce high-quality imaging practitioners who are well-prepared to serve patients and to reflect critically on their practice over the course of their careers so as to ensure continuous quality improvement. It is noteworthy that, during the course of the production of the first book, the name of the department of diagnostic radiology and nuclear medicine within the Schulich School of Medicine & Dentistry was changed to the department of medical imaging, to reflect better the range of imaging modalities that are being and will be taught to our learners who will become the radiologists and nuclear medicine physicians of the future.

In this second book, *the practice of radiology education: challenges and trends*, the authors have responded to calls from the community to bring the dialog even further into the “everyday world” by engaging with practitioners in ways that lay out current practice to make it visible. This is an act of courage. A number of the authors who contributed to this book are not accustomed to academic writing and by making visible the practices that are currently in place, we necessarily invite scrutiny. The theme of partnership and

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shared experience comes through clearly in this book, whether the partnership is between an educator-scholar and a clinical radiologist, between training programs in different countries, between medical radiation technologist and physician, or between physicist and radiologist. A partnership which we are particularly proud is the relationship between the two University of Western Ontario faculties of medicine & dentistry and education, which is manifested in the work of the Centre for Education in Medical Imaging.

This volume builds on the first by offering a practical guide, from a primarily Canadian perspective, to assist colleagues around the world design educational programs. Part I of this volume is focused on curriculum. It includes a chapter on designing a radiology curriculum for medical students to ensure core skills and to attract some students into a career in imaging, but the emphasis is on postgraduate medical education, i.e., residents in medical imaging, with experience shared around curriculum, rounds, and academic afternoons. There is specific advice regarding teaching modules in clinical inquiry and case review. There is attention to training of team members, notably medical radiation technologists.

Part II focuses on programs and trainees, with chapters that examine resident workload and productivity, how residents carry out case reviews, and how to ensure that residents’ learning is complete and systematic in the face of the randomness of cases presented in practice. Resident logs, for instance, are suggested as a means to ensure sufficient experience with procedures to assure competency. There are international contributions from Australia/New Zealand, Austria, and Thailand, which shine additional light on what works in educational practice. Specific attention is paid to building scientific capacity in PET/CT and in Medical Physics, particularly in developing countries.

Part III examines leadership and resources. Chapters on fostering leadership, developing the academic mission in a department, selecting residents and chief residents, and managing learners with difficulty provide practical guidance, grounded in sound theory and principles.

Thinking critically about one’s own practice can be a difficult intellectual, moral, and professional work. For radiologists unaccustomed to reading educational research (particularly those aimed at a research community), it can be difficult to contextualize the theories to their personal professional practice. It is here that the value of a collaborative endeavor between medicine and education becomes most evident. The struggles that are described by the radiologists in this volume are familiar to educators, but until those struggles can be articulated, the challenge remains “where do we begin?” By taking these first tentative steps and demonstrating the courage it takes to lay out their practice in writing, the authors have provided a fertile ground for educational dialog.

We recognize that radiology practices, like most professional practices, are situational and that what is offered here is a work in progress. Education is a process, not an event. This book represents an opportunity to engage more deliberately in the educational process and serves as a beginning from which we can begin to learn with and from each other as we work toward improving what it is that we do and value so highly. This book is produced by practitioners for practitioners, having fully integrated the concept of “reflective practice” that allows them to enhance not only their own practice but also benefits colleagues who may face similar challenges elsewhere. The ultimate outcome is that our patients and community will benefit.
If we are to advance the academic mission in departments of medical imaging, it is important to attend to fostering resident research in general, as well as, more specifically, translational research. It is our fond hope that the chapter that describes the role of scholarship in the establishment of our centre for education in medical imaging will encourage other departments to engage in the scholarship of teaching and learning, so that the next generation of imaging practitioners and their teachers will utilize curricula and educational tools that have been rigorously evaluated. The overarching goal of our centre is that all practitioners will have the opportunity for evidence-based learner-centered education to enable collaborative patient-centered care and reflective practice.

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