Expert Consensus on a Canadian Internal Medicine Ultrasound Curriculum

By The Western Canadian Internal Medicine Ultrasound Curriculum Committee

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Summary

Ultrasonography is increasingly used at the bedside. In the absence of an already developed curriculum appropriate for Canadian internal medicine training programs, 13 representatives from internal medicine programs in five Western Canadian provinces met for 2 days to develop and propose a consensus-based internal medicine curriculum for training in the bedside use of ultrasonography in a Canadian health care context. All 13 had had interest or leadership role in those programs. The curriculum's content was based on three overarching principles agreed upon by the group: (1) content should be selected on the basis of clinical or educational need; (2) content should be feasible (i.e., both cognitive and technical components of the curriculum could be reasonably taught and learned in a competency-based manner while minimizing potential risks to patients); and (3) content should be evidence based. A consensus-based curriculum of 16 proposed topics is to be considered for the core internal medicine residency training program (postgraduate year [PGY] 1 to PGY 3), and 22 topics are to be considered for general internal medicine subspecialty training programs (PGY 4 to PGY 5).

Résumé

L'échographie est de plus en plus utilisée dans les soins aux patients. En l'absence d'un cursus adéquat en échographie dans les programmes canadiens de formation à la médecine interne, treize représentants ayant un intérêt ou jouant un rôle de leadership dans ces programmes dans chacune des cinq provinces de l'Ouest se sont rencontrés pendant deux jours afin d'élaborer et de proposer un cursus consensuel en échographie pour la formation des internistes dans le contexte des soins de santé au Canada. Le groupe de travail s'est donné trois grands principes pour établir le contenu du programme : 1) il doit répondre à des besoins cliniques ou pédagogiques; 2) il doit être possible de le transmettre (ses éléments cognitifs et techniques peuvent raisonnablement être enseignés et appris dans le cadre d'un enseignement axé sur les compétences, avec un risque potentiel minime pour les patients); 3) il doit être basé sur des données probantes. Nous présentons ici un cursus consensuel comptant 16 propositions à intégrer dans le tronc commun du programme de formation des résidents en médecine interne (R1 à R3) et 22 propositions pour les programmes de formation en sous-spécialité de médecine interne générale (R4 et R5).

Keywords

bedside ultrasound; consensus, curriculum content; evidence-based; internal medicine program

Over the past decade, bedside ultrasound has been increasingly used by nonimaging specialists, including emergency physicians, obstetricians, and critical care specialists. Ultrasonography can be used as a preclinical tool to improve the understanding of anatomy, physiology, and pathology. Alternatively, it can be used as a clinical tool in making diagnoses at the bedside.¹ For example, as a preclinical or educational tool, ultrasonography may help learners improve their physical examination techniques (such as those for examining the liver),² and it may be used clinically as a diagnostic tool (e.g., for ruling out pneumothoraces).³ This increasing recognition of the role of point-of-care ultrasound at the bedside, as well as its role as a standard of care in assisting procedural skills such as central venous catheterization, highlights the relevance of clinical ultrasonography to internal medicine training and practice.⁴ However, proper training in its use is necessary.⁵ It is increasingly difficult to ignore the need for a defined internal medicine curriculum in regard to what ultrasonographic skills are important for delivering effective care to our patients. At a minimum, postgraduate training programs need to meet the objectives of training put forth by their accrediting bodies (e.g., the Royal College of Physicians and Surgeons of Canada). These typically include competency in placing central venous catheters and in performing a variety of diagnostic and therapeutic bedside procedures. For a number of these procedures, there is accumulating evidence that supports the use of ultrasound guidance for improving procedural safety.^{6–10} Programs that teach these procedures should implement appropriate training in, and assessment of, the use of ultrasound guidance. Further applications of ultrasound may include its use in diagnostic assessments¹¹ and as an educational tool (e.g., the use of ultrasound to provide visual feedback to enhance physical examination skills or to increase the understanding and knowledge of physiology and anatomy).^{12,13}

What to include in an ultrasonography curriculum appropriate for training in internal medicine has not yet been defined. There are a number of competing interests and demands, including the improvement of patient safety and the need to prepare residents for continuing training in subspecialties that require bedside ultrasound and an understanding of its uses and limitations. Practical considerations include the ability of existing practicing and teaching faculty to acquire, deploy, and teach bedside ultrasound skills; budgetary concerns; patient privacy issues regarding the storage of images; and availability of

time to learn ultrasonographic skills within an already full internal medicine educational curriculum. A frequent and important concern among educators is the potential for eager but naive adopters of the technology to use novice skills beyond the intended scope of such skills, resulting in harm to patients.¹⁴ Therefore, educators designing a curriculum must be mindful of potential risks and benefits, educational values, and unintended consequences.

In the absence of any already developed curriculum appropriate for Canadian internal medicine training programs, we sought to develop and propose a consensus-based internal medicine curriculum for bedside ultrasound use in the Canadian health care context.

Methods

Internal medicine program representatives with an interest or leadership role in each of the four Western Canadian provinces (British Columbia, Alberta, Saskatchewan, and Manitoba) were identified by their respective programs and invited to partake in a 2-day meeting held at the University of Calgary on June 10–11, 2013. Each invited member had previous training or experiential point-of-care ultrasonography skills, educational expertise, and/or a leadership role in his or her university in advancing education in the use of ultrasonography in internal medicine. Although individual members of the working group have leadership roles locally, nationally, and internationally, this document reflects a consensus of individual opinions and is not intended to reflect the leadership groups to which the individuals belong.

Prior to the meeting, existing guidelines for ultrasonography practice and a training curriculum in emergency and critical care medicine were circulated among the participants. These guidelines covered a variety of topics, such as standards for ultrasound equipment, examination-specific guidelines, the safe use of ultrasound,¹⁵ the use of ultrasound in procedures,^{16,17} and training and practice standards.^{18–23}

On the first day of the meeting, participants discussed and agreed upon the overarching principles by which curriculum content would be selected. In the first round of discussion, a comprehensive list of candidate topics was created on the basis of the experience, knowledge, and interests of the attendees. The entire group was then divided at random into three working groups; each working group discussed and evaluated the proposed candidate topics. A preliminary discussion was held on whether a topic needed to be, should be, or could be included in the internal medicine curriculum, or whether it should not or could not be included in the curriculum. On the basis of the group response to candidate topics, each topic was searched on

Table 1. Results of First Round of Discussion by 13 Participants on 38 Topics Considered for the Canadian Internal Medicine Ultrasound Curriculum

Topic No.	Category	Potential Topic	Votes for Inclusion (%)	Consensus* for Further Consideration
1	Volume status	Internal jugular vein height	13 (100)	Yes
2	Volume status	Inferior vena cava measurement	12 (92)	Yes
3	Fluid collections	Pleural	13 (100)	Yes
4	Fluid collections	Ascites	13 (100)	Yes
5	Fluid collections	Pericardial	13 (100)	Yes
6	Renal	Hydronephrosis	8 (62)	No
7	Cardiac	Left ventricular function (gross)	13 (100)	Yes
8	Cardiac	Right ventricular function (gross)	12 (92)	Yes
9	Liver/spleen	Span	12 (92)	Yes
10	Head and neck	Thyroid	10 (77)	No
11	Pulmonary	Pulmonary edema	12 (92)	Yes
12	Pulmonary	Consolidation	10 (77)	No
13	Pulmonary	Pneumothorax	13 (92)	Yes
14	Soft tissue	Abscess/cellulitis	11 (85)	Yes
15	Soft tissue	Joint effusion	10 (77)	No
16	Ophthalmic	Retinal	0 (0)	No
17	Ophthalmic	Intracranial pressure	2 (15)	No
18	Vascular	Aortic dissection	0 (0)	No
19	Vascular	Abdominal aortic diameter	10 (77)	No
20	Vascular	Deep vein thrombosis	2 (15)	No
21	Lymphadenopathy	Lymphadenopathy	3 (23)	No
22	Genitourinary	Bladder	11 (77)	Yes
23	Biliary tree	Cholelithiasis	2 (15)	No
24	Biliary tree	Common bile duct size	1 (8)	No
25	Minors	Fetal	0 (0)	No
26	Minors	Children aged < 16 yr	0 (0)	No
27	Procedures	Central venous catheterization – internal jugular vein	13 (100)	Yes
28	Procedures	Central venous catheterization – subclavian vein	10 (77)	No
29	Procedures	Central venous catheterization – femoral vein	13 (100)	Yes
30	Procedures	PICC	12 (92)	Yes
31	Procedures	Arterial line insertion	12 (92)	Yes
32	Procedures	Peripheral intravenous access	13 (100)	Yes
33	Procedures	Thoracentesis	13 (100)	Yes
34	Procedures	Paracentesis	13 (100)	Yes
35	Procedures	Lumbar puncture	10 (77)	No
36	Procedures	Joint aspiration	12 (92)	Yes
37	Procedures	Abscess aspirate sampling	13 (100)	Yes
38	Procedures	Abscess incision and drainage	13 (100)	Yes

PICC = peripherally inserted central catheter.

* > 80% agreement.

MEDLINE with the search terms “ultrasound,” “ultrason\$,” and “point of care,” as well as with terms related to the topic. Evidence on each candidate topic was then presented again to all participants.

On the second day, a modified Delphi technique was used to obtain a consensus on the content of a curriculum for internal medicine residency training programs.²⁴ In a blinded fashion, participants voted for inclusion versus exclusion of content in

the curriculum. Participants were also asked to indicate if the specific topic should be used for teaching physical examination, making a clinical diagnosis, or guiding procedures. Additional rounds of votes and discussion were repeated in an unblinded fashion until participants reached a consensus (≥80% agreement) on the topics chosen for inclusion. The entire group then voted on these topics in an unblinded fashion on their appropriateness for inclusion in the core internal medicine program (by the end

Table 2. Final Consensus of 13 Participants on 22 Topics Proposed for Inclusion in Provisional Internal Medicine Curriculum

Topic	Votes for Inclusion in Core IM Curriculum (%)	Consensus [†] to Include in Core IM Curriculum	Votes for Inclusion in GIM Subspecialty Curriculum (%)	Consensus [†] to Include in GIM Subspecialty Curriculum
Internal jugular vein height	13 (100)	Yes	13 (100)	Yes
Inferior vena cava measurement	12 (92)	Yes	13 (100)	Yes
Pleural effusion	13 (100)	Yes	13 (100)	Yes
Pneumothorax	13 (100)	Yes	13 (100)	Yes
Liver and spleen span	13 (100)	Yes	13 (100)	Yes
Ascites	13 (100)	Yes	13 (100)	Yes
Bladder	12 (92)	Yes	13 (100)	Yes
Abscess/cellulitis	12 (92)	Yes	13 (100)	Yes
Central venous catheterization – internal jugular vein	13 (100)	Yes	13 (100)	Yes
Central venous catheterization – femoral vein	13 (100)	Yes	13 (100)	Yes
Arterial line insertion	13 (100)	Yes	13 (100)	Yes
Peripheral intravenous access	13 (100)	Yes	13 (100)	Yes
Thoracentesis	13 (100)	Yes	13 (100)	Yes
Paracentesis	13 (100)	Yes	13 (100)	Yes
Joint aspiration	11 (85)	Yes	13 (100)	Yes
Abscess aspirate sampling	13 (100)	Yes	13 (100)	Yes
Abscess incision and drainage	9 (69)	No	13 (100)	Yes
PICC	5 (38)	No	13 (100)	Yes
Pulmonary edema	0	No	12 (92)	Yes
Left ventricular function (gross)	6 (46)	No	13 (100)	Yes
Right ventricular function (gross)	4 (31)	No	13 (100)	Yes
Pericardial effusion	7 (54)	No	13 (100)	Yes

IM = internal medicine; GIM = general internal medicine; PICC = peripherally inserted central catheter.

*Core internal medicine (PGY 1 to PGY 3) or internal medicine/general internal medicine subspecialty (PGY 4 to PGY 5).

of postgraduate year 3 [PGY 3]) and for internal medicine or general internal medicine subspecialty training (at the end of PGY 4 or PGY 5).

Results

Thirteen individuals participated in the process: two from the University of British Columbia, one from the University of Alberta, six from the University of Calgary, two from the University of Saskatchewan, and two from the University of Manitoba. The internal medicine specialties that were represented included general internal medicine, critical care medicine, infectious disease, nephrology, respiratory, and geriatrics. Participants included one current and one former chair of an internal medicine department, one core residency program director, one former program director for PGY 4 and PGY 5 trainees going into general internal medicine (GIM) practice, one GIM division head, five faculty/departmental leaders in ultrasonography training, and two postgraduate

trainees in their final 2 years of subspecialty training.

Three principles of curriculum content were agreed upon by the group: (1) content should be selected on the basis of clinical or educational need; (2) content should be feasible (i.e., both cognitive and technical components of the curriculum content can be reasonably taught and learned in a competency-based manner while minimizing potential risks to patients); and (3) content should be evidence based (showing evidence of educational utility and/or improved outcomes).

The group considered 38 topics (Table 1) and selected 22 for further consideration. The group's members unanimously felt that fetal scans on pregnant patients and non-medically indicated scans on children (such as those done simply for training purposes) should not be performed by trainees. Although ultrasound is generally considered to be safe, sound waves do pose concerns about thermal and nonthermal safety.^{25,26} As such, all users are required to adhere to the “as low as reasonably achievable” (ALARA) principle.²⁵ The potential bioeffects are of

particular concern in high-attenuation tissues such as fetal and growing bones.^{27,28} As a result, Health Canada, for non-medical reasons, does not recommend ultrasound for obstetrical use.²⁶ Other topics were rejected because of the potential difficulty in teaching and learning them, the potential medico-legal risk, the low likelihood that an acquired skill would lead to changes in management, and the possibility of their being beyond an internist's scope of practice.

Of the 22 included topics, 16 were felt to be potentially suitable for inclusion into a core internal medicine training program (Table 2). Three Delphi rounds were conducted to reach a consensus. These 16 topics included measurement of the height of the internal jugular vein,^{29,30} inferior vena cava measurement,^{31,32} pleural effusion and thoracentesis,^{8,33,34} central line insertion and pneumothorax,^{3,6,7,35,36} liver and spleen examination,^{2,37} ascites and paracentesis,^{9,38} the bladder,^{14,39,40} cellulitis/abscess/aspirates,^{41,42} arterial line insertion,⁴³ peripheral intravenous access,^{44,45} and joint aspiration.¹⁰ Although the evidence for the role of ultrasound in establishing peripheral intravenous access in adults is not as consistent as that in pediatric patients,⁴⁶ the group felt that learning this skill is unlikely to be harmful and may improve the care of patients.

All 22 topics were deemed potentially suitable for a GIM subspecialty curriculum. The additional topics included abscess incision and drainage,^{41,42} peripherally inserted central catheters,¹⁶ pulmonary edema,⁴⁷ and focused and limited cardiac examination.^{48–50}

Discussion

This is the first consensus-based report on potentially appropriate curriculum content for inclusion into Canadian internal medicine training programs that is mindful of educational, patient safety, and evidence-based principles. Our committee recommends that the 16 proposed topics should be considered for the core internal medicine residency training program (PGY-1 to PGY-3) and that 22 topics be considered for training programs in the general internal medicine subspecialty. Fetal scans on pregnant women and scans on children should not be performed by trainees.

Our report has a number of limitations. First, it is based on expert opinion-based consensus and preliminary evidence only; we did not conduct a comprehensive systematic review using multiple databases on each of the candidate topics. Second, our first meeting was limited in scope, in that our group's members represented only the Western provinces; we did not intend to be exclusive, but owing to practical and feasibility issues, we began with a smaller regional group of centres. Third, although we aimed to adhere to educational, patient safety, and evidence-

based principles, the contribution of any curriculum to overall patient safety must ultimately be mindful of content, modes of curriculum delivery, assessment, and program evaluation. Our report does not specify the approach to the curriculum's delivery and implementation (e.g., who teaches, how teaching is done, and the exact content of the curriculum within a topic); consequently, each centre's experience will vary. Fourth, the proposed topics are intended only to be a starting point for curriculum design and should not be followed in a prescriptive manner. Last, we did not address device technology and its affordability or availability. Individual members of the working group have varied experiences with different types of ultrasound devices, but addressing which specific device functionalities training programs should provide is currently beyond the scope of the working group.

Future Directions

At its next meeting, the group intends to share further institutional experiences, discuss teaching resources and continuing professional development workshops for faculties, and set definitions of minimal competence for select skills. Further, the group plans to discuss potential research ideas that will assist the delivery of further evidence-based medical education in the use of ultrasonography in internal medicine.

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