Identifying Essential Procedural Skills for Medical Students: A Modified Delphi Technique

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ABSTRACT

BACKGROUND: Although Sri Lankan medical students need to acquire specific procedural skills during their undergraduate training, agreement on what skills they should obtain is inconclusive. This study aimed to generate consensus of the expert panel on essential procedural skills and level of expertise to be attained for Sri Lankan medical students and need for developing and implementing a pre-clerkship procedural training curriculum to improve procedural expertise.

METHODS: A three-round online modified Delphi study was conducted between August 2022 and January 2023. The initial questionnaire was developed from existing student logbooks and published literature. Round one invited the expert panel to rate their agreement on the inclusion of essential procedures for undergraduate medical training. In Round two, the panel rated their expectation of procedural expertise for a medical graduate on the first day of internship (ie, Observer to Proficient). Round three established the consensus on the need for a pre-clerkship procedural curriculum.

RESULTS: The expert panel included 17 clinicians involved in undergraduate medical education and supervision of intern medical doctors. In Round 1, they rated their agreement on including teaching of 64 procedures and suggested four additional procedures. In Round 2, experts re-appraised 33 items and rated the level of procedural expertise. In Round 3, experts re-appraised the ratings of 14 essential procedures and rated the support for a pre-clerkship procedural curriculum for medical students. Consensus defined as > 75% agreement was established with 35 essential procedural skills. Most of the experts expressed the need for a pre-clerkship procedural curriculum for medical students.

CONCLUSIONS: Through three rounds of modified Delphi, the current study established 35 procedural skills essential for a Sri Lankan medical graduate. The results also support the need for developing and implementing a pre-clerkship procedural training curriculum to improve procedural expertise of graduating doctors which demonstrate the importance of aligning existing medical curricula with competency-based medical education.

KEYWORDS: Clinical training, competency-based education, consensus, curriculum, procedural expertise

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Background

Developing procedural expertise is vital to undergraduate medical education. However, opportunities for gaining clinical experience are now on a decline[1–3] due to the ever-changing nature of healthcare practice, with several procedures once practiced by medical students and performed by intern medical doctors, being performed now by other health practitioners [ie, nursing officers are performing phlebotomy, intravenous (IV) cannulation[4,5] administering injections, wound dressing[5], midwives perform episiotomy,[6] and vaccination].[5] Studies have reported that many new graduates feel inadequately prepared for clinical practice.[1,7] The use of traditional approaches to teaching procedural skills,[4] inadequate supervision of procedural training by the clinical teachers, unwillingness of patients to accept trainee involvement in procedural care, rising emphasis on patient safety over medical students' learning and patient's right for trained care[8] have contributed to subpar procedural expertise of graduate doctors. Hence, the importance of developing and maintaining procedural expertise during practice becomes increasingly evident.[4,9,10]

To ensure achievement of procedural expertise by graduating doctors, Canada.[11,12] Switzerland,[13] Netherlands,[14] Germany,[13] UK,[15] US,[16] and Australia[10] have identified essential practical skills required by a graduate and mapped learning objectives and levels of expected expertise for identified skills. Similar attempts have been made in the Asian context, with Bangladesh, India, Nepal, and Malaysia having identified essential procedural skills a medical graduate should develop during their medical training.[17–20] Although another country can adopt procedural curricula developed in other countries, they may lack applicability in various aspects in a specific context.[21,22]

There is no national undergraduate medical curriculum in Sri Lanka, a limitation common to many other countries across the world and in the South Asian region. The

pre-requisite offered by the Subject Benchmark Statement of Medicine, Sri Lanka, requires graduate doctors to perform as required in general professional practice.[23] The need for more specificity as to which procedures a graduate doctor should be equipped with to perform successfully during internship, and the level of expertise required for specific procedures is a significant limitation of this document. In a background of various procedures in medical profession, the responsibility has thus fallen on individual medical schools to decide which procedures are taught during the undergraduate training and determine the level of expertise required for each procedural skill.

Context of the study

Eleven medical schools affiliated with State Universities offer undergraduate medical training programs in Sri Lanka. While all medical schools have undergone curricula reforms in recent years,[24] most of these changes have focused more on teaching-learning methods used in teaching theoretical components, notably lacking attention to methods used in teaching/learning clinical skills.

All medical schools in Sri Lanka conduct 5-year undergraduate programs. The first 2 years (pre-clerkship period) focus on teaching basic science subjects. The following 2 years (clerkships) include clinical rotations and teaching applied sciences. The last year is dedicated entirely to clinical rotations. Clinical training in the third and fourth years in most medical schools, including the Faculty of Medicine, University of Kelaniya, consists of rotations in General Medicine, General Surgery, Pediatrics, Gynecology, and Obstetrics, Psychiatry and related subspecialties in the affiliated state teaching hospitals. The final year consists of clinical rotations in General Medicine, General Surgery, Pediatrics, Gynecology and Obstetrics, and Psychiatry. Each clinical rotation between years three to five is 4-8 weeks long, and students are "attached" to one or more consultants in the ward/unit during this period.

All medical schools predominantly rely on clinical rotations during the 3-5 years of the study program for developing clinical and procedural skills. Most medical schools are also equipped with clinical skills laboratories, where some procedural skills are taught. During clinical rotations, students are provided a logbook with a list of procedures they must observe or perform during the clerkships. The list of medical procedures for each rotation is developed separately by each medical school. However, no published data supports the rigor of the methods used to determine the list of procedures from any medical school. Although some logbooks provide the level of skill/expertise for some procedures (ie, observe, assist, perform), most have significant limitations, including providing learning objectives and stating the required level of expertise for each procedure.[5]

After graduating from any Sri Lankan medical school, all medical graduates must undergo a year of internship as intern medical doctors. The registration to practice as a medical officer in Sri Lanka is only offered following the successful completion of this internship.[25] This internship occurs in hospitals under the purview of the Ministry of Health, Sri Lanka, during which time they are trained under supervising consultants. A medical student graduating from any medical school in the country should be able to undergo an internship in any part of the country, in common with many South Asian countries.

Currently, wide variations are observed in procedural expertise between medical students graduating from different medical schools across the island.[26] Lack of procedural curricula, lack of reviewing of existing procedural curricula, minimal assessment of procedural expertise, lack of critical review of procedural needs in clinical practice for intern medical doctors are contributory factors for declining procedural expertise. The need to review the procedural training that will enable medical students to function more efficiently in diverse clinical settings is evident. Hence, this study aimed to identify essential procedures and levels of expertise for essential procedural skills for Sri Lankan medical students and to determine the need for developing and implementing a pre-clerkship procedural training curriculum.

Methods

Study design

This study utilized a three-round modified Delphi technique to explore consensus from a panel of clinicians and medical student educators.[27] We sought to explore expert consensus to identify essential procedures, and the level of expertise expected for each procedure from a graduate doctor on the first day of their internship that could later be included in developing a structured procedural training curriculum applicable to all individual medical schools within the island. This study was conducted as a part of a mixed method study on procedural expertise of medical undergraduates and the study protocol is available at: https://medicine.kln.ac.lk/prog/erc/index.php/approved-proposals/approved-project-proposals-2020/103-january. The study group was advised by experts from Faculty of Medicine, University of Kelaniya regarding statistics. The reporting of this study conforms to the DELPHISTAR reporting guidelines[28]

Selection of participants to the Delphi panel

We used criterion and purposeful sampling to identify our expert panel. We identified two groups of experts who would have the pre-requisite knowledge and experience with medical students, interns, procedural training, and expertise. The groups included are: 1) clinicians involved in supervising

intern medical officers and 2) clinicians involved in the teaching of third- and fourth-year medical students. The faculty clinicians involved in teaching final-year medical students were excluded from the study to remove possible bias due to their potential roles in developing current logbook items. The panel members' disciplines included General Medicine, Surgery, Pediatrics, Gynecology, and Obstetrics. In addition, the panel members were expected to have at least 5 years of professional clinical experience as a consultant in their discipline. The expert's geographic distribution, gender, or other markers of diversity were not considered in the panel development.

All the identified experts were invited to participate in the study via telephone call and email an invitation. They were informed about the Delphi study's inclusion criteria and purpose. Responses from each participant were weighed equally. This study's ethical approval (reference number P/233/11/2019) was obtained through the Faculty of Medicine Ethics Review Committee of the Faculty of Medicine, University of Kelaniya. The Delphi rounds were conducted between August 2022 and January 2023. The overview of the Delphi process conducted in the study is shown in Figure 1. The number of rounds was defined in advance to be a maximum of three rounds.

Data collection

The online questionnaires developed using Google Forms® (Alphabet, Mountain View, California, USA) were emailed to each participant. Each Delphi round took about 1 month. In the absence of a response to the questionnaires within one week of the email, the first author reminded the panelist via a telephone call or email. The non-responders were prompted again by a phone call weekly after the first reminder. After a third prompt, non-responders were dropped from the study and no longer considered potential data sources.

The pilot of the Delphi rounds

Each round of the Delphi study was piloted with a selected group of 10 clinician academics who fulfilled the expert panel inclusion criteria. As they were a convenience sample known to the researchers, their responses were not included in the data nor included as participants in the expert panel. The pilot group was asked to critique the questionnaire using several criteria including adequacy of instructions, clarity of questions to identify incongruent and vague statements, comprehensiveness, and rating methods. In addition, the pilot group was asked to suggest corrections and recommend additional items for inclusion in the instrument. The modified and refined questionnaire was distributed among the Delphi panel.

Round 1

A comprehensive list of procedures was developed from the General Medical Council (GMC) guidelines on practical skills and procedures,[15] competency-based medical education guidelines, review of current procedural curricula, student logbooks, and existing literature on procedural skills. Keywords and phrases for the literature search included procedural skills, procedural expertise, curricula, medical students, and Boolean combinations. Databases searched included PubMed, MEDLINE, Scopus, and Web of Science. From this material, a core list of procedures that might be considered essential for the preparation of future graduate doctors was prepared.

For each procedure in Round 1, experts were asked to consider the question: "Should the 'procedure' be taught to medical students during clinical training?" They were asked to score each skill using a Likert scale of one to five based on their opinions, with a score of 1 = strongly disagree; 2 = disagree; 3 = unsure/do not know; 4 = agree and 5 = strongly agree. The option "unsure/do not know" was included to enable a particular item to be left unanswered if the participant was unaware of how essential the procedure would be, for undergraduate medical training. Additionally, experts were asked to propose additional procedures that they felt should be taught during the undergraduate training using open-ended questions.

Round 2

We summarized expert responses for each element. The feedback was aggregated across all expert groups. Round 2 aimed to establish stability with procedures that did not achieve > 75% consensus in Round 1, and those were re-submitted in Round 2 with the median and IQRs obtained for each procedure.

We assumed that the agreement was unlikely to alter for items from Round 1 that achieved > 75%. Therefore, those items were not presented to the panel for further consideration in Round 2. In addition, new procedures proposed by experts in the first round were added to the Second Round.

As the second part of Round 2, we invited the expert panel to establish: "What level of procedural expertise should a medical student achieve by graduation?" for each of the procedures posed in Round 1. The instrument also included new procedures proposed by experts in the previous Round. The scale for the level of expertise was rated in four levels which was included in the Round 2 questionnaire as: Observer—understands and observes the procedure in the clinical environment, Novice—performs the procedure under direct supervision in a simulated environment, Competent—performs with supervision nearby in the clinical environment and, Proficient—performs proficiently under limited supervision in the clinical environment.[29] A "Not applicable" option was also provided for panelists.

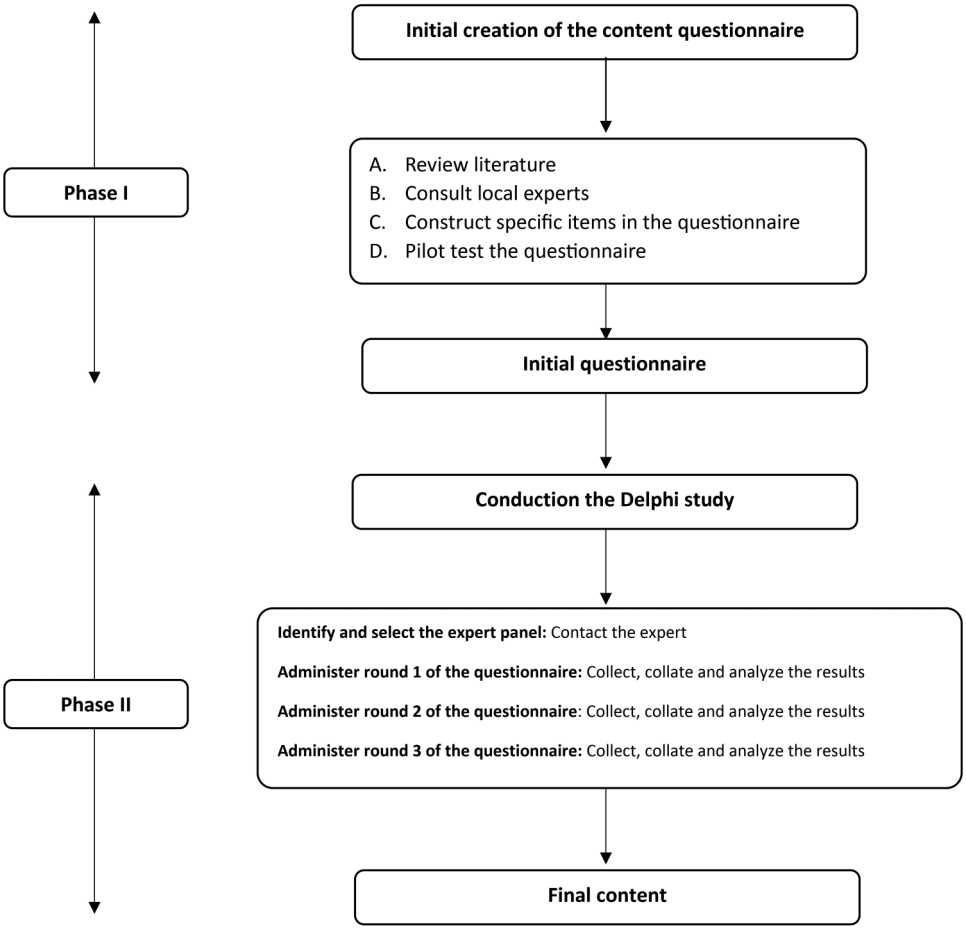

Figure 1. Development process of the final content for Delphi study.

Round 3

The participants were presented with a summary of the findings obtained in Round 2. The participants were asked to confirm or change their scores in this Final Round. Additionally, the expert's consensus on the need for developing and implementing a pre-clerkship procedural training curriculum was sought using a 5-point Likert scale (1= Strongly disagree to 5= Strongly agree).

Data analysis

Descriptive statistics were used to describe experts' responses to each item in all the rounds. The median and interquartile range were calculated to determine the indicators for selection in the following rounds and to present the feedback to the panel. Measurements of the percentage of agreement, range of ratings (interquartile ratings), mean, and median were analyzed using IBM SPSS version 22 (IBM, 2014). The coefficient of variation (CV) was used to assess the consistency of the experts' opinions concerning the items. In this study, a priori decision to establish consensus was made if 75% or more of experts agreed on an item rating consistent with previous studies.[30–32] As an example, for Round 1, the agreement was calculated as the percentage of experts agreeing or strongly agreeing that the "procedure" should be taught to medical students during clinical training. While 100% agreement means that all the panelists agreed or strongly agreed that the procedure should be taught, a 0% agreement for a procedure indicates that no expert in the panel either agreed or strongly agreed that the same be taught to medical students.

Results

The Delphi expert panel

Three Delphi rounds were conducted between August 2022 and January 2023. Of the 32 experts contacted, 29 agreed to participate. The consensus opinions were derived from the expert group of clinicians and faculty educators affiliated with four hospitals in Sri Lanka, with all experts having more than 10 years of clinical experience. Table 1 shows the expert panel characteristics.

Of the 29 clinicians who responded, 17 completed Round 1, with a response rate of 59%. Those who participated in Round 1 were sent the Round 2 questionnaire, and 14 completed questionnaires were received, representing a response rate of 82%.

Table 1. Characteristics of the Delphi expert panel.

SPECIALTY	ROUND 1 n = 17 (%)	ROUND 2 n = 14 (%)	ROUND 3 n = 11 (%)
General medicine	4 (23.5)	3 (21.5)	3 (27.3)
Surgery	4 (23.5)	4 (28.5)	3 (27.3)
Pediatrics	5 (29.5)	4 (28.5)	3 (27.3)
Gynecology and obstetrics	4 (23.5)	3 (21.5)	2 (18.2)
Years in clinical experience as consultants in respective fields			
	n = 17 (%)		
<10	0		
11-15	2 (12)		
16-20	7 (41)		
>21	8 (47)		

Those who participated in Rounds 1 and 2 were sent the Round 3 questionnaire, with a 65% response rate.

Round 1

Round 1 comprised a list of 64 procedures. Table 2 shows the agreement for inclusion of procedures for teaching in undergraduate medical programs as rated by the experts. A 100% agreement was observed for eleven procedures. Three procedures achieved >90%-100% agreement, and five scored > 80%-90% (total rated >75%= 19 procedures). Items rated between >6 and < 75% (n = 29) were presented for re-appraisal in Round 2 for stability of scoring. Sixteen procedures that were rated with 0% agreement were removed from Round 2. The CV of items in round 1 was 0 to 0.27.

Following analysis of experts' suggestions, four new procedures were added, and one was rephrased (prescribe and administer oxygen was changed to administer oxygen). The new items were suggested by a Pediatrician and a Physician. Both experts responded to all three rounds.

Round 2

In Round 2, 33 procedures were re-considered by the experts who identified 16 procedures as essential which needed to be taught to medical students (agreement >75%). The CV of items in round 2 was 0 to 0.25. As shown in Table 2, 17 procedures did not establish consensus. No further procedures were recommended after the first round. A total of 35 procedures were identified as essential with the completion of Rounds 1 and 2.

The level of expertise required for each procedure was presented for a rating on a 5-point Likert scale (1= Observer, 2= Novice, 3= Competent, 4= Proficient, 5= Not applicable) in Round 2. A total of 52 items were presented in Round 2 to identify procedural expertise. Eight procedures were rated with 100% agreement and two procedures were rated above 90% agreement as requiring "proficient" level of expertise. Three items were placed with 100% agreement and three items were rated with >90% agreement as needing an "observer" level of expertise upon graduation. Items rated with >75% agreement (n = 22) were not given for re-appraisal of required expertise levels in Round 3. Moreover, 17 items that were confirmed as not essential (agreement <75%) by the end of Round 2 were not given for re-appraisal of expertise in Round 3. Consensus for levels of expertise for 35 essential procedures (19 procedures identified in round 1 and 16 procedures identified in round 2) as rated by the expert panel is shown in Table 3.

Round 3

In Round 3, the experts re-considered 14 procedures to achieve consensus on the required level of expertise upon graduation (Table 3). The CV of items in round 3 was 0 to 0.21. Two procedures were considered to require a "proficient" level of expertise, with > 75% agreement. Three items were rated to require a level of "competent" with > 75% agreement. Nine procedures achieved between 55 and 73% agreement but did not establish the threshold for consensus in attaining a level of expertise. The question about the need for developing and implementing a pre-clerkship procedural curriculum was considered positively by most experts, with > 90% agreement.

Discussion

Procedural training is a fundamental component of undergraduate medical education. However, a wide variation is observed in the selection of procedures between different medical schools in Sri Lanka, a finding common to other contexts.[32–34] The Subject Benchmark Statement for Medicine, Sri Lanka stipulates that a graduate medical doctor should be able to "perform practical and technical procedures, including investigative and therapeutic measures, which are relevant to general professional practice in Sri Lanka,"[23] it does not define the essential procedures that are relevant to the general practice and so should be included in undergraduate medical curricula. The current pre-requisite expects a medical student graduating from any medical school in the country to develop expertise in a range of procedures to enter the internship and work safely in complex and unpredictable clinical environments encountered in various hospitals in any part of the country.

We utilized the modified Delphi approach, in which a set of items were already prepared to present to the expert panel.[35] The consensus opinion is deemed valid when evidence is limited, and the area of exploration is considered particularly relevant in medical education as it systematically gathers the judgments of different expert groups and can identify agreement and disagreement.[36] This modified Delphi study aimed to identify essential procedural skills for Sri Lankan medical

Table 2. The consensus of inclusion of procedures for undergraduate teaching presented in Rounds 1 and 2.

NO.	PROCEDURE	ROUND 1 AGREEMENT[a] MEDIAN (IQR)	ROUND 1% AGREEMENT	ROUND 2 AGREEMENT[a] MEDIAN (IQR)	ROUND 2% AGREEMENT
Cardiovascular system					
1	Venipuncture	5 (0)	100	-	-
2	Blood transfusion	5 (0)	100	-	-
3	Basic life support	5 (0)	100	-	-
4	Venipuncture for blood culture	5 (0)	100	-	-
5	Set up an infusion	4 (4–5)	88	-	-
6	Neonatal resuscitation	5 (4–5)	88	-	-
7	Arterial blood gas sampling	4 (4–5)	52	5 (4.5–5)	86
8	IV cannulation	4 (4–5)	65	5 (4–5)	79
9	Pediatric vascular access	4 (3–4)	29	4 (4–5)	79
10	Defibrillation	4 (3–5)	47	4.5 (4–5)	64
11	Prepare and administer injectable (IV/IM/SC)	3 (2–4)	29	4 (3–4)	64
12	Take 3/12 lead ECG	3 (3–4)	11	2 (3–2)	28
13	Measure capillary blood glucose	3 (3–5)	25	2 (2–1)	7
14	Bone marrow biopsy	3.5 (3–4)	18	2 (1.75–2.5)	7
Musculoskeletal system					
15	Basic wound closure and dressing	5 (4–5)	88	-	-
16	Cervical collar insertion	5 (4–5)	94	-	-
17	Log rolling of patient	4 (4–5)	70	5 (4.5–5)	93
18	Local anesthesia (inject/topical)	4 (3–5)	52	5 (4–5)	79
19	Suturing of lacerations	4 (3–4)	18	5 (4–5)	79
20	Abscess incision and drainage	2.5 (2–3)	0	-	-
21	Excisional biopsy	2 (1.75–2)	0	-	-
22	Fine needle aspiration	2.5 (1.75–3)	0	-	-
Respiratory system					
23	Use inhaled devices, including spacers	5 (4.75–5)	94	-	-
24	Airway management	4 (4–5)	65	5 (5–5)	93
25	Administer oxygen	4 (3–5)	59	5 (4–5)	93
26	Direct laryngoscopy	3 (3–4)	17	2 (1–2)	0
27	Endotracheal intubation	3 (2–4)	12	1 (1–2)	0
28	Thoracentesis	3 (1.75–4)	11	1 (1–1.25)	0
29	Endotracheal tube exchange	2 (2–3)	6	1 (1–2)	0
30	Chest tube placement and management	3 (1.75–4)	6	1.5 (1–2)	0
31	Pleural aspiration	2.5 (1–4)	6	1 (1–1.25)	0
32	Pleural biopsy	2 (1–3)	6	1 (1–1.25)	0

(continued)

Table 2. Continued.

NO.	PROCEDURE	ROUND 1 AGREEMENT[a] MEDIAN (IQR)	ROUND 1% AGREEMENT	ROUND 2 AGREEMENT[a] MEDIAN (IQR)	ROUND 2% AGREEMENT
33	Foreign body removal from ear/nose	1.5 (1–2)	0	-	-
34	Posterior nasal packing for epistaxis	2.5 (1.75–3)	0	-	-
Genito-urinary system					
35	Catheterization	5 (0)	100	-	-
36	Urine dipstick test	3 (3–4)	23	2 (2–1)	7
37	Testing for STI	3 (1.75–4.25)	11	1.5 (1–2)	0
Nervous system					
38	Lumbar puncture	4 (4–5)	29	5 (4–5)	86
Alimentary system					
39	Nasogastric tube insertion	5 (0)	100	-	-
40	Abdominal paracentesis	4.5 (4–5)	88	-	-
41	Gastric lavage	4 (2.75–5)	41	2 (1.75–2)	0
Reproductive system					
42	Assessment of ruptured membranes	5 (0)	100	-	-
43	Perform and repair episiotomy	5 (0)	100	-	-
44	Normal vaginal delivery	5 (4–5)	88	-	-
45	Insertion of contraceptive implant	4 (4–5)	70	5 (4.5–5)	86
46	Perform a cardiotocogram	4 (4–4.25)	65	5 (4–5)	79
47	Insertion and removal of intra uterine contraceptive device	4 (4–5)	65	5 (4–5)	79
48	Basic prenatal ultrasound scan	3.5 (3–4)	12	3.5 (2.75–4)	7
49	High vaginal swab	3.5 (3–4)	6	2.5 (1.75–3)	0
50	Pap smear sample collection	2 (1.75–2)	0	-	-
51	Cervical polypectomy	2 (1.75–2)	0	-	-
52	Vulva/vaginal biopsy	2 (1.75–2)	0	-	-
53	Cervical biopsy	1.5 (1–2)	0	-	-
54	Cervical smear sample collection	1.5 (1–2)	0	-	-
55	Endometrial biopsy	1 (1–1.25)	0	-	-
56	Instrumental vaginal delivery	2 (1.75–2)	0	-	-
57	Assisted breech delivery	2 (1.75–2)	0	-	-
58	Transvaginal ultrasound scan	2.5 (2–3.25)	0	-	-
Miscellaneous					
59	Hand washing	5 (0)	100	-	-
60	Surgical scrubbing for theater	5 (0)	100	-	-
61	Gowning and gloving (closed/double)	5 (0)	100	-	-
62	Nose/throat/wound swab	5 (4–5)	94	-	-

(continued)

Table 2. Continued.

NO.	PROCEDURE	ROUND 1 AGREEMENT[a] MEDIAN (IQR)	ROUND 1% AGREEMENT	ROUND 2 AGREEMENT[a] MEDIAN (IQR)	ROUND 2% AGREEMENT
63	Compartment pressure (abdomen/ extremity) measurement	1.5 (1–1.25)	0	-	-
64	Packing and preparation of instruments for sterilization	2 (2–2.25)	0	-	-
Items suggested in Round 1 by the expert panel					
65	Measure capillary PCV	-	-	5 (4.5–5)	93
66	Exchange transfusion	-	-	5 (4–5)	86
67	Leaking scan for dengue	-	-	4 (4–5)	79
68	Pediatric lumbar puncture	-	-	5 (4–5)	79

[a]Agreement 1 = strongly disagree; 2 = disagree; 3 = unsure/don't know; 4 = agree and, 5 = strongly agree.
IV, intravenous; IM, intramuscular; SC, subcutaneous; STI, sexually transmitted infections; PCV, packed cell volume.

students in terms of essential procedures and the level of expertise in each procedure and establish the need for implementing a pre-clerkship procedural curriculum for medical undergraduates. To our knowledge, this is the first study that explored and achieved consensus in identifying essential procedures and expertise levels for undergraduate medical training in a South Asian context. Each round of the Delphi was piloted to ensure the relevance of the items selected and the acceptability of the panelists. The three-round modified online Delphi technique that identified a list of 35 essential procedures with consensus on level of expertise for 26 essential procedures, representing the consensus opinion of an expert group of Sri Lankan healthcare clinicians and educators. The experts agreed on the importance of procedural expertise and agreed on the need to improve medical students' procedural expertise through pre-clerkship procedural training. Our findings provide vital information about the essential procedural expertise integral to the clinical practice of intern medical doctors in Sri Lanka. Comparing our results with other procedural training guidelines in other countries reveals a marked difference.

Although our findings concur with most of the recommended procedures from the UK's GMC revised 2019 list,[15] measurement of capillary blood glucose, urine dipstick, taking a 3- and 12-lead ECG, and administering injectable were not identified as essential for medical students by Sri Lankan clinicians, although these are simple and frequently encountered procedures in the ward setting. These findings of our study are intriguing and may reflect changes in the roles and requirements of medical students and intern medical doctors in the ever-changing healthcare system. Most of these procedures are currently conducted by nursing officers (ie, measurement of capillary blood glucose, and administering injectable) or other healthcare professionals (ie, 3- and 12-lead ECG by ECG technicians), which may have led the expert group to reconsider the need of expertise for these procedures for the intern medical officer on the day on of his/her internship. While these procedures are now done by the nurses or other healthcare professionals, the final responsibility of administering medicine/injectables lies with the prescriber. These factors may need to be accounted for in procedural curricular revisions, to ensure that the medical students are equipped to practice effectively within the legal boundaries.

Although the students are expected to perform these procedures during their clinical rotations as stated in the current logbooks, the consensus opinion of the expert panel reflects the need to revising the requirements of the undergraduate medical programs according to the needs of the healthcare system of the country. Similar changes in the content of procedural training were observed in the UK,[15] where the number of practical skills and procedures a UK graduate must know and be able to do has reduced from 32 items in 2014 to 23 in 2019. Similarly, most of the procedures in the German National competency-based learning objective catalog medicine,[13] Dutch nested EPAs,[37] core procedural competencies for Australian undergraduates[33] also were not considered essential by the expert panel in in this study (ie, chest tube placement and management, gastric lavage, compartment pressure measurement). The 1-year internship of the intern medical officers in Sri Lanka occurs in different hospitals affiliated to the Ministry of Health, and most interns are required to work in the ward setting. The above procedures such as gastric lavage usually take place in the emergency treatment units where senior medical officers are placed. Measurement of compartment pressure and chest tube placement although not requiring advanced technology, requires considerable technical skill where at least a postgraduate trainee is consulted. Thus, intern medical doctors are rarely required to be competent in such procedures in the local context.

Most medical schools in Sri Lanka are equipped with clinical skills laboratories, where neonatal resuscitation training is

Table 3. Consensus on the level of expertise required for each essential procedure.

NO.	PROCEDURE	ROUND 2 Level Of EXPERTISE[a] MEDIAN (IQR)	ROUND 3 LEVEL OF EXPERTISE[a] Median (IQR)	LEVEL %
Cardiovascular system				
1	Venipuncture	4 (0)	-	O (0), N (0), C (0), P (100)
2	Measure capillary PCV	4 (0)	-	O (0), N (0), C (0), P (100)
3	Blood transfusion	4 (0)	-	O (0), N (0), C (7), P (93)
4	Venipuncture for blood culture	4 (0)	-	O (0), N (0), C (7), P (93)
5	Set up an infusion	4 (4–5)	-	O (0), N (0), C (18), P (82)
6	IV cannulation	3 (2–4)	4 (3–4)	O (0), N (0), C (55), P (45)
7	Basic life support	4 (3.25–4)	4 (3–4)	O (0), N (9), C (55), P (36)
8	Pediatric vascular access	1 (1–1.25)	-	O (18), N (82), C (0), P (0)
9	Neonatal resuscitation	2 (1.75–2)	-	O (18), N (82), C (0), P (0)
10	Exchange transfusion	1 (0)	-	O (100)
11	Leaking scan for dengue	1 (0)	-	O (100), N (0), C (0), P (0)
12	Arterial blood gas sampling	3 (2–3)	2 (1.75–2)	O (36), N (64), C (0), P (0)
Genito-urinary system				
13	Catheterization	4 (0)	-	O (0), N (0), C (0), P (100)
Alimentary system				
14	Nasogastric tube insertion	4 (0)	-	O (0), N (0), C (0), P (100)
15	Abdominal paracentesis	4 (3–4)	4 (0)	O (0), N (0), C (18), P (82)
Respiratory system				
16	Airway management	3 (2–3)	2 (2–2.5)	O (0), N (64), C (18), P (18)
17	Administer oxygen	3 (3–4)	3 (3–4)	O (0), N (18), C (45), P (36)
18	Use inhaled devices, including spacers	3 (2–3)	3 (3–4)	O (0), N (0), C (55), P (45)
Nervous system				
19	Lumbar puncture	1 (0)	-	O (93), N (7), C (0), P (0)
20	Pediatric lumbar puncture	1 (0)	-	O (100)
Musculoskeletal system				
21	Suturing of lacerations	4 (3–4)	4 (3–4)	O (0), N (0), C (27), P (73)
22	Basic wound closure and dressing	4 (3–4)	-	O (0), N (0), C (15), P (85)
23	Cervical collar insertion	2 (2–3)	2 (0)	O (18), N (64), C (18), P (0)
24	Log rolling of patient	2 (1–2.5)	2 (2–2.75)	O (9), N (73), C (18), P (0)
Reproductive system				
25	Insertion and removal of intra uterine contraceptive device	1 (0)	-	O (93), N (7), C (0), P (0)
26	Normal vaginal delivery	1.75 (1.25–1.75)	-	O (93), N (7), C (0), P (0)
27	Assessment of ruptured membranes	1.75 (1.25–1.75)	-	O (82), N (18), C (0), P (0)

(continued)

Table 3. Continued.

NO.	PROCEDURE	ROUND 2 Level Of EXPERTISE[a] MEDIAN (IQR)	ROUND 3 LEVEL OF EXPERTISE[a] Median (IQR)	LEVEL %
28	Perform and repair episiotomy	4 (3–4)	-	O (0), N (9), C (9), P (82)
29	Perform a cardiotocogram	3 (2–3)	3 (0)	O (0), N (0), C (82), P (18)
30	Insertion of contraceptive implant	3 (2–3)	3 (0)	O (0), N (9), C (91), P (0)
Miscellaneous				
31	Hand washing	4 (0)	-	P (100)
32	Nose/throat/wound swab	4 (0)	-	P (100)
33	Surgical scrubbing for theater	4 (0)	-	O (0), N (0), C (0), P (100)
34	Gowning and gloving (closed/double)	4 (0)	-	O (0), N (0), C (0), P (100)
35	Local anesthesia (inject/topical)	3 (2–3)	4 (3–4)	O (0), N (0), C (21), P (79)

[a]1= Observer, 2= Novice, 3= Competent, 4= Proficient, 5= Not applicable.
IV, intravenous; PCV, packed cell volume.

routinely conducted. Nevertheless, intern medical doctors are not required to perform neonatal resuscitation in the clinical setting. Hence, most experts in the panel may have considered that intern medical officers may not need to be able to perform neonatal resuscitation under close supervision in the clinical environment upon the first day of internship. Also important to note are the procedures rated as requiring the level of "observer," emphasizing the internship's value for further learning and improvement.

We were not surprised by the additional procedures suggested by the expert group (measurement of capillary packed cell volume (PCV), leaking scan for dengue) in our study. Sri Lanka, as a tropical country, has a high prevalence of dengue,[38] with hospitals encumbered with dengue patients for many months a year. Capillary PCV measurement and scans to look for "leaking" are routine and frequently performed procedures among dengue patients in general medicine wards. Intern medical doctors are responsible for performing the capillary PCV, and postgraduate trainees routinely perform leaking scans (ultrasound scans to look for leaking) of patients suspected to be in the hemorrhagic phase, which reflects our findings of expected expertise levels.

Nor were we surprised by the procedures rated with 100% agreement in Rounds 1 and 2 underlying the need to achieve an expertise level of "proficiency" for a graduating medical doctor. Most of these procedures are done exclusively by medical doctors in the ward setting (ie, blood transfusion, basic life support, assessment of ruptured membranes, repairing episiotomies, and nasogastric tube insertion). Moreover, urinary catheterization especially of males and unmarried females are also performed purely by doctors and with them lies the legal responsibility. However, we speculate that the >90% agreement for proficiency in taking a nose/throat swab may be influenced by the recent COVID-19 pandemic. Although abdominal paracentesis has achieved varying levels of importance and expertise in different settings,[9,10] relatively higher priority and expertise levels were reported in our study. Sri Lanka has a high prevalence of liver disease, with alarming numbers of chronic liver disease patients being admitted for care in hospitals,[39] many of them requiring a peritoneal tap. The duty of performing this procedure invariably falls on the intern medical doctor, with many medical students, usually in professorial rotations, called upon to assist and eventually perform.

Although learner support for procedural education has been previously documented,[5] the perceptions of clinicians and medical teachers in Sri Lanka were yet to be explored. To address this issue, the third round of our Delphi study aimed to determine the need for procedural education in undergraduate medical education, specifically as a pre-clerkship procedural curriculum. The benefits of a pre-clerkship procedural curriculum are well established.[40] This study's expert panel comprised experienced clinicians involved in medical student education and supervision of intern medical doctors in different categories of hospitals in Sri Lanka. The positive attitude shown by this panel for implementing a pre-clerkship procedural curriculum suggests that teachers recognize the value of such a curriculum to improve the procedural expertise of their learners.

The present study has some limitations. Thirty-three procedures did not reach a consensus in our research. For example, log rolling and prepare and administer injectables fell short of reaching the 75% consensus in Round 2. The level of expertise for nine identified essential procedures (log rolling, cervical collar insertion, suturing of lacerations, use of inhaled devices, administering oxygen, airway management, basic life support, IV cannulation, and arterial blood gas sampling) did not reach consensus in Round 3. We were specifically interested

in preparing students for the internship and, thus, achieving procedural expertise. We relied on published literature[4] and the current student logbooks used in Sri Lanka to identify procedural skills deemed essential for a medical student. Our findings could be due to differences across countries. Additionally, some procedures provided in the Sri Lankan student logbooks did not reach a 75% consensus (ie, urine dipstick test, prepare, and administer injectables). Given that many hospitals have staff to perform specific procedures postgraduate trainees routinely perform leaking scans (ultrasound scans and some being carried out in units that are not readily accessible to all medical students and intern medical doctors), it may be that these procedures were not perceived as a requirement for a graduating medical student.

We anticipated a lower response rate from the expert group invited to participate in this study. However, we observed a higher-than-expected participant attrition in the study that may affect the reliability of the study findings. Although participating in research is highly encouraged and is taken up as a social responsibility in the West, the enthusiasm for healthcare research outside academia in Sri Lanka is wanting.

In a previous study, we explored how medical students learn procedures and what causes the lack of preparedness for clinical training. While a lack of teaching was prevalent, the students needed adequate information on what to learn and achieve to engage in self-directed learning.[5] Through this study, we were able to generate an agreement on the essential procedural skills that require training during medical school, and the need for planned teaching to better equip medical students with skills needed to function effectively in diverse clinical environments.

Conclusions

The present study used a modified Delphi technique to establish a consensus of 35 essential procedural skills and related expertise levels required for Sri Lankan medical students by graduation. The findings emphasize the changing role of the current doctor, with an insight into what is expected of a graduate doctor in the procedural skills domain, when stepping into the internship. Our findings support the importance of teaching these procedures within the pre-clerkship years of medical curricula aligning with the change to competency-based medical education. The findings underline the importance of producing competent medical graduates who are able to thrive in the present-day challenges in diverse healthcare settings.

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Authors' Contributions

All the authors made substantial contributions for the work. All the authors gave final approval to the submitted paper. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. For individual contributions: KK contributed to research conceptualization, data acquisition, data analysis and drafting of the article. TS contributed to data interpretation, and critically revising the manuscript. RP contributed to critically revising the manuscript.

Statements and Declarations

Ethics approval

The study was approved by the Ethics Review Committee of the Faculty of Medicine, University of Kelaniya (P/233/11/2019). All the steps in the study were performed in accordance with the relevant guidelines and regulations set forth by the Ethics Review Committee of the Faculty of Medicine, University of Kelaniya.

Consent to participate

Study participation was voluntary, and all participants were assured of anonymity and confidentiality. All participants provided informed consent prior to participation and consent to publication.

Consent for Publication

Not applicable.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Supplemental Material

Supplemental material for this article is available online.

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