

# Development of an Entrustable Professional Activities (EPA) Framework to Inform Surgical Residency Training Programs in Ethiopia: A Three-round National Delphi Method Study

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**BACKGROUND:** Entrustable Professional Activities (EPAs) have been proposed as a means to translate competencies into clinical practice. Although EPAs for residency training have become available, 1 set of core EPAs cannot automatically be transferred from one context to another due to cultural variability. Further, there is a lack of African- and Asian-based EPA development and implementation studies. We developed an end-of-training EPAs framework to inform surgical residency training programs in the local context of Ethiopian medical education.

**METHODS:** A three-round Delphi method was used to establish consensus about important surgical EPAs among experts. A total of 136 experts representing all surgical residency training institutions in Ethiopia were invited to participate. Round 1 & 2 consisted of senior expert panelists ( $n = 8$ ) to identify potential EPAs and determine the content validity. Round 3 consisted of a survey ( $n = 128$ ) to further validate the identified EPAs by attending surgeons who work with them. Each EPA had to achieve at least 80% or higher agreement among experts to be considered having acceptable content validity.

**RESULTS:** In round 1, a total of 272 EPAs were proposed, reduced, and grouped to 39 consented EPAs. In round 2, the same experts rated each EPA's relevance, resulting in 32 EPAs with a satisfactory item-level content validity index ( $I-CVI > 0.83$ ). Overall, in the survey in round 3, 29 EPAs met the standard criterion for acceptability ( $S-CVI/Ave = 0.90$ )

and achieved a high degree of final consensus ( $ICC = 0.998$ , 95% CI [0.996, 0.999]; ( $F = 439.2$ ,  $p < 0.0001$ ).

**CONCLUSIONS:** The framework of 29 validated and accepted EPAs can guide future surgical residency training programs in the Ethiopian medical education context. The framework allows programs to move from a time-dependent to an outcome-based model and transforms traditional assessment into entrustment decisions. Thus, the use of the framework can improve the quality of training and patient care in Ethiopia. (J Surg Ed 000:1–13. © 2021 The Authors. Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>))

**ABBREVIATIONS:** EPA, Entrustable Professional Activities ICC, Intra-class Correlation Coefficient I-CVI, Item-level Content Validity index S-CVI, Scale-level Content Validity index UA Universal Agreement

**KEY WORDS:** Competency-based medical education, Entrustable professional activity, Surgical training, Ethiopia

**COMPETENCIES:** Medical Knowledge

## INTRODUCTION

Education of health professionals has not gone hand in hand with the newly emerging health problems and often produces ill-equipped graduates.<sup>1,2</sup> To positively

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affect professional education and subsequent health outcomes, the development of new professional educational and institutional strategies is needed. They must adopt competency-based approaches to educational improvements and adapt them to rapidly changing environmental conditions based on global resources.<sup>1</sup>

Our surgical residency program embarked on the adoption of a competency-based medical education (CBME) as part of a nationwide project to develop new models of resident education. CBME is a viable approach to better equip medical graduates to respond effectively in complex situations.<sup>1,2</sup> Thus, over the past 5 to 10 years, many undergraduate and postgraduate medical education programs have undergone significant reforms to adopt this approach.<sup>3-5</sup> Various frameworks for competency-based medical education, such as CanMEDS (Canadian Medical Education Directives for Specialist),<sup>6</sup> ACGME (Accreditation Council for Graduate Medical Education),<sup>7</sup> Saudi MEDS,<sup>8</sup> and General Medical Council (GMC)<sup>9</sup> have been developed in various countries. They are used to guide the adoption of competency-based medical education around the world. CanMEDS is a widely used competency framework consisting of 7 roles for doctors irrespective of their medical specialty. The framework is currently used worldwide, including Ethiopian medical education, to inform undergraduate and postgraduate medical education programs.<sup>10-12</sup>

Although competency frameworks are relevant to guide the design of CBME programs, medical educators struggle to implement these competencies in their daily practice. These competencies usually are broad statements and describe general physicians' characteristics which are more descriptive of individuals rather than descriptive of tasks and responsibilities.<sup>13-14</sup> As such, these competencies are too complex to translate into a realistic training program,<sup>6</sup> making them too theoretical to train and validly assess.<sup>13-14</sup>

In addition, assessment of these competencies are separate from one another and do not assess across the range of roles expected of a competent specialist.<sup>10,15</sup> Summative judgment about a trainee's performance is made by informal observation, often assuming the amount of time spent in training.<sup>16-17</sup>

Therefore, to fully realize CBME and to ground competencies in the realities of day-to-day clinical practice, these theoretical competencies need to be translated into real-world tasks to be entrusted to the unsupervised execution by a trainee (i.e. EPA).<sup>5,12,13,16,18-20</sup>

Entrustable professional activities are defined as "units of professional practice, defined as tasks or responsibilities to be entrusted to the unsupervised execution by a trainee once he or she has attained sufficient specific competence".<sup>18</sup> Therefore, EPAs constitute a translation of competencies into tangible tasks in clinical practice

and makes competencies meaningful, trainable, and assessable for clinical teachers.<sup>5,12,13,16,18-20</sup>

Although a number of medical education providers are using EPAs in their training programs,<sup>21-24</sup> and core EPAs have become available worldwide, 1 set of core EPAs cannot automatically be transferred from one context to another.<sup>19</sup> Many medical schools who consider the implementation of EPAs into their programs have to undergo their own EPA development process, specifically addressing their local context within their own country's health care system. Especially African and Asian-based EPA studies are lacking and future research can be designed to consider cultural variability as an important aspect of the development or implementation of EPAs.<sup>19</sup> The present study aimed to develop valid end-of-training EPAs for surgical residency training programs as a framework to inform curriculum design, teaching, and assessing competencies in the local context of Ethiopian medical education.

## METHODS AND MATERIALS

### Design, Setting, and Participants

We used an exploratory sequential mixed method design to a) qualitatively identify a list of potential end-of-training EPAs with subject-matter experts (SMEs), b) rate the relevance of each potential EPA, and c) validate the list of EPAs quantitatively with a large number of subject-matter practitioners. The study took place within the departments of surgery at 10 public surgical residency training institutions in Ethiopia from May through December, 2020. According to the April 2019 Federal Ministry of Health Ethiopia and Clinton Health Access Initiatives residency program assessment, 12 public institutions offered surgical residency training programs in the country and there was a total of 121 general surgeons and 104 sub-specialist surgeons, 428 residents (average 42 per institutions), 917 in-patient beds (average 91 beds), 47 operation tables (average 4) and 69 recovery beds (average 7 beds) within these training institutions. Due to lack of permission from senior officials in 1 institution and an internal conflict in the other, data could not be collected from 2 residency training institutions. This study was conducted with the approval of the Ludwig-Maximilian's-University of Munich and Ethiopian Public Health Association institutional review board. Survey respondents provided informed consent to participate in this study.

### Data Collection Methods

We employed a conventional Delphi method, consisting of 3 rounds among experts to reach a consensus on valid

end-of-training EPAs for surgery residency training programs in Ethiopia. The Delphi method is widely used and accepted to collect data from experts within their area of expertise. Key features of the Delphi technique are identifying the participants (expert panel members), anonymity, structured data collection questionnaires, feedback to expert panel members allowing them to reflect and reconsider their responses, and statistical aggregation of responses.<sup>25-27</sup> A Delphi technique was selected for this study for several reasons. Unlike other approaches, it eliminates face-to-face meetings that may be difficult to organize during a pandemic, such as COVID-19, and in large geographical areas such as Ethiopia. This method is also an effective process for determining expert group consensus where there is little or no empirical evidence and where expert opinions are the best source.<sup>28-30</sup>

## Procedure

### *Assembly of Delphi Consensus Panel*

Professional expertise was the primary consideration in the assembly of the Delphi panel. The participants' willingness, practice setting, and geographical locations were also considered for panelists' selection. This study panel consisted of general and sub-specialist surgeons holding practice-based surgeons' roles with diverse geographical representation from surgical residency training institutions in all of the country's regions.

### *Round 1: Identification of potential end-of-training EPAs for Surgical Residency Training Programs (Delphi Consensus Panel)*

Participants in this round were purposefully selected based on their experience and active role in the National Technical Working Group in Surgical Training Programs. These participants are assigned by the Ministry of Health and are responsible for defining the scope of practice of a surgeon and reviewing the residency training curriculum. Once the list of candidate panelists was formed (n = 10), we sent an invitation email which included a description of the study, its objectives, the number of Delphi rounds, the promise of anonymity, benefits from participation, and an informed consent form which had to be completed prior to participation. To those SMEs who returned the informed consent (n = 8), we provided an open questionnaire paper containing the main attributes of EPAs and items to gather demographic characteristics. The experts were instructed to individually propose potential end-of-surgery residency training EPAs that beginner-level surgeons must be able to perform without supervision, based on literature and their expertise in the field. Short essays and videos describing the key features of EPAs were sent to all participants to

clarify the EPAs concept. Sample surgical EPAs were also shared, and explanations given over the telephone as needed. This helped to establish a common frame of reference for the experts. The time for completion was 5 weeks, email reminders were sent 1 week and 2 days prior to the questionnaire deadline.

At the end of round 1, we removed duplicate tasks/responsibilities and combined tasks sharing similar constructs (i.e., closely related tasks) and tasks performed for the same or similar purpose in consultation with senior experts in the professions. Criteria used to distinguish EPAs for other professional tasks proposed by ten Cate<sup>13</sup> and the Equal rubric tool - a tool used for evaluating the quality of EPAs - were used to guide this process. This served to ensure that the proposed EPAs meet the requirements and align with the elements of their definition described in the peer-reviewed literature.<sup>31</sup>

### *Delphi Round 2: Rating of the Relevance of End-Of-Surgery Residency Training EPAs*

Two weeks after the first Delphi round,<sup>33</sup> all panelists who had participated in round 1 was invited to the second Delphi round. In this round, panelists were asked to determine the content representativeness and relevance (i.e., content validity) of each end-of-training EPA proposed in round 1 based on a 4-point rating scale from 1 *not important/relevant* to 4 *very important/relevant* (see Table 1 in the Supplement).<sup>30-33</sup> The 4-point rating scale was preferable because it does not include the neutral middle rating common in odd number rating scales.<sup>33</sup> In addition to rating, participants had an opportunity to comment on the proposed EPAs.

At the end of round 2, the relevance rating was recoded as 1 (for mean relevance rate of 3.00 or more), 0 (for mean relevance rate of less than 3), and the CVIs were used to quantify and determine the content validity of each proposed EPA. CVIs were calculated based on recommendations given by Lynn,<sup>33</sup> Davis,<sup>34</sup> Polit and Beck,<sup>35</sup> and Polit *et al.*<sup>36</sup> The definition and formula of I-CVI, S-CVI/Ave, and S-CVI/UA is shown in Table 2 in the Supplement.

In this round, EPAs with an I-CVI of .83 or higher (for 6-8 experts) were deemed acceptable. EPAs that did not achieve the required minimum I-CVI were eliminated.<sup>31,33,37</sup> The number of experts and its implication on the acceptable cut-off score of CVI is shown in Table 3 in the Supplement. After I-CVI and S-CVI/Ave were determined, retained EPAs, ratings, and the CVI were shared with experts to review their initial opinions and judgments. A 2-week deadline was given to complete this task.

### *Round 3: Rating of Agreement on Relevance and Representativeness of EPAs (Delphi Survey)*

The Delphi survey was conducted from September to November 2020 with the goal to further validate

**TABLE 1.** Socio-demographic Characteristics of the Expert Panel in Delphi Round 1 & 2 (n = 8)

Characteristics /Variables		n(%)
Sex	Male	7(87.5)
	Female	1(12.5)
	Total	8
Level of Specialization	Sub-Specialist surgeons	3(37.5)
	General surgeon (specialist)	5(62.5)
	Total	8
Specific (Main/Primary) Work/Practice Unit/Area	Operating theatre and surgical in-patient ward	7(87.5)
	Operating theatre, surgical in-patient ward, and surgical out-patient Department	1(12.5)
	Total	8
Main Role and Responsibilities	Teaching residents and clinical service	5(62.5)
	Teaching residents, clinical service, and leadership and management	2(25.0)
	Teaching residents, clinical service, and research	1(12.5)
	Total	8
Year of Practice Experience	5 to 10 years	5(62.5)
	> 10 years	3(37.5)
	Total	8

whether the candidate EPAs are supported by those who work with them. We determined the optimal sample size at  $n=100$ , based on an anticipated ICC = 0.80 and an acceptable 95% confidence interval width of 0.20 using the formula  $1 + 8(1.96)^2 (1 - p)^2 \frac{(1+p)^2}{2w^2p}$ .<sup>38,39</sup> Hence, we invited all SMEs (i.e., general and sub-specialists surgeons) working in all surgical residency training institutions in the country to participate in the survey. The survey was constructed using an Open Data Kit collect open-source android app, available for free use in survey-based data gathering.<sup>40</sup> In this survey, experts were asked to rate their level of agreement on the proposed EPAs using a 5-point rating scale (from "disagree strongly" to "agree strongly").<sup>4,33</sup> The questionnaire also included items on participants' socio-demographic information and on the characteristics of their clinical and academic experiences. For these data, I-CVI of 0.80 or higher and S-CVI of the overall scale instrument of 0.90 or higher were considered as the standard criterion for acceptability (Fig. 1).<sup>27, 33</sup>

## RESULTS

### Characteristics of the Delphi Expert Panel (Delphi round 1 & 2)

Eight out of ten invited panel members consented to participate (80% response rate) in the study, and all of the 8 experts completed both rounds of Delphi. Three of the 8 panels (37.5%) were sub-specialized in thoracic, gastro-intestine and nephrology area, and the majority of the panelists were male (87.5%). The average length of practice was 8.8 years (5-20 years range), all panelists

were involved in educating residents and providing clinical services in surgical residency training institutions (Table 1).

### Delphi Round 1: Identification of Potential end-of-training EPAs for Surgery Residency Programs

In the first Delphi round, 8 professional panelists proposed a total of 272 tasks and/or responsibilities (i.e., potential end-of-surgery residency training EPAs) that beginner-level surgeons must be able to perform without supervision. On average, each expert proposed 34 EPAs, with a minimum of 19 and a maximum of 65. A complete list of proposed EPAs by expert panelist in round 1 is shown in Table 4 in the Supplement. After removing duplicates and grouping closely related units of work, a set of 39 potential end-of-training EPAs remained (Table 2).

### Delphi Round 2: Rating of the Relevance of Core EPAs Statements (content validation)

All the panelist participating in round 1 ( $n = 8$ ) completed the second rounds of the Delphi survey (100% response rate). Thirty-two out of the thirty-nine (82%) EPAs were rated as "very important or important" by more than 83% of the panelists (i.e., achieved acceptable item-level content validity index I-CVI > 0.83). Among these, 22 (56.4%) EPAs achieved 100% agreement among experts (S-CVI/UA = 1.00). Seven EPAs (18%) failed to achieve an acceptable level of content validity index (Table 3).

### Delphi Round 3: Rating of Agreement on the Relevance and Representativeness of Core EPAs Statements

Of all the total invited surgical residency training institutions in the country ( $n = 12$ ), data was returned from 10

**TABLE 2.** Candidate end of Training EPAs Statements for Surgical Residency Training After Grouping Closely Related Units of Work and Removing Duplicates in Delphi Round 1**EPA # Core EPAs Statements**

Collecting information (history, physical examination) in an organized fashion  
 Recommending screening and diagnostic tests, interpreting and understanding the implication test, and communicating the result of a test with the patient or a peer  
 Documenting clinical encounters  
 Identifying urgencies/emergencies and initiating early management for critically ill surgical patients  
 Communicating with co-workers, patients, and families including breaking bad news  
 Educating patient and obtaining informed consent in preparation for surgical care  
 Leading and Conducting routine ward rounds in collaboration with interprofessional teams  
 Consulting health care providers and supervising resident students caring for surgical patients  
 Performing preoperative preparation and optimization of patients for surgical procedures  
 Managing postoperative patients (complicated and uncomplicated)  
 Performing basic (minor) surgical procedures  
 Repairing Hernias (Herniorrhaphy)  
 Performing craniotomy and elevate depressed skull and removing subdural hematoma (burhole)  
 Performing creation of an opening (stoma) into the windpipe (Tracheostomy, Cricothyroidotomy)  
 Performing removal of part or all of the thyroid gland (Thyroidectomy)  
 Performing removing of part or all parts of the parathyroid gland (Parotidectomy, total, partial)  
 Performing Lobectomy and Pneumonectomy  
 Performing emergency thoracotomy for patient with blunt/penetrating thoracic trauma  
 Performing removal of some or all breast tissue, 1 or both breasts (Mastectomy), axillary lymph nodes  
 Incision and removal of part of the esophagus (esophagostomy/esophagectomy)  
 Performing removal of stone from gallbladder (open Cholecystectomy)  
 Performing Common Bile Duct (CBD) exploration  
 Performing Part or complete removal of the spleen (open splenectomy)  
 Evaluation and surgical management of patient with Peptic Ulcer Disease (Performing vagotomy, pyloroplasty, antrectomy, and gastrojejunostomy) (Billroth procedure)\*\*\*  
 Performing removal of appendix, appendiceal mass, and appendiceal abscess  
 Performing an exploratory laparotomy for trauma  
 Evaluation and surgical management patient with partial or complete blockage of the small intestine)  
 Evaluation and surgical management of patient with colon and /or rectal disease  
 Evaluation and management of abnormal twisting of of part of the large or small intestine (Volvulus)  
 Evaluation and surgical management of patient with hemorrhoid (Hemorrhoidectomy)  
 Repairing of rectal/anal fistula  
 Removing stones into the urinary bladder (Performing cystolithotomy)  
 Diagnosis and management of patient with benign prostatic hyperplasia, benign prostatic hypertrophy.  
 Evaluation and removal of stone in the upper urinary tract (Nephrolithotomy, pyelolithotomy, ureterolithotomy, nephropyelourterolithotomy)  
 Performing an emergency nephrectomy  
 Performing Caesarean section, salpingo-oophorectomy, hysterectomy, and uterine repair  
 Providing initial management for trauma /fracture patients  
 Performing below knee, above knee, and upper limb amputation  
 Performing skin graft

Note: These statements were labeled as "core" to denote that these EPAs are expected of all graduates independent of practice setting.

residency training institution (83 %). Out of 172 attending surgeons available in the ten training institutions during the data collection period, data were collected from 128 surgeons (response rate = 74.41%). The majority of participants in the study were males (94.5%), general surgeons (81.25%), and with less than 5 years of work experience (55.46%). All study participants were primarily involved in educating residents and providing medical services in the operating theater (see Table 5 in the Supplement).

Thirty-two EPAs with a I-CVI of 0.80 or above from Delphi round 2 was included in the final validation survey. Out of these 32 EPAs, 29 EPAs (90.6%) achieved an acceptable item-level content validity index (I-CVI > 0.96) and were retained (Range of their I-CVI values for EPAs retained on the scale was 0.90-1.00). Among these, 18 EPAs achieved 100% agreement among surgeons (S-CVI/UA = 1.00). The proportion of EPAs on a scale that achieves a relevance rating of 3 or 4 by all the attending surgeons (S-CVI/Ave) is 0.92. On the other hand, 3 EPAs

**TABLE 3.** Rating on the Relevance of Core EPAs Statements by 8 Experts

EPA statement #	# of Experts in agreement	CVI for item (I-CVI)	UA	Remark
1	8	1	1	Qualified for next round validation
2	8	1	1	Qualified for next round validation
3	8	1	1	Qualified for next round validation
4	8	1	1	Qualified for next round validation
5	8	1	1	Qualified for next round validation
6	8	1	1	Qualified for next round validation
7	8	1	1	Qualified for next round validation
8	8	1	1	Qualified for next round validation
9	8	1	1	Qualified for next round validation
10	8	1	1	Qualified for next round validation
11	8	1	1	Qualified for next round validation
12	8	1	1	Qualified for next round validation
13	7	0.88	0	Qualified for next round validation
14	8	1	1	Qualified for next round validation
15	8	1	1	Qualified for next round validation
16	2	0.25*	0	Not qualified for next round validation
17	2	0.25*	0	Not qualified for next round validation
18	7	0.88	0	Qualified for next round validation
19	7	0.88	0	Qualified for next round validation
20	2	0.25*	0	Not qualified for next round validation
21	8	1	1	Qualified for next round validation
22	7	0.88	0	Qualified for next round validation
23	7	0.88	0	Qualified for next round validation
24	8	1	1	Qualified for next round validation
25	8	1	1	Qualified for next round validation
26	8	1	1	Qualified for next round validation
27	8	1	1	Qualified for next round validation
28	8	1	1	Qualified for next round validation
29	8	1	1	Qualified for next round validation
30	8	1	1	Qualified for next round validation
31	7	0.88	0	Qualified for next round validation
32	4	0.50*	0	Not qualified for next round validation
33	7	0.88	0	Qualified for next round validation
34	2	0.25*	0	Not qualified for next round validation
35	3	0.38*	0	Not qualified for next round validation
36	7	0.88	0	Qualified for next round validation
37	7	0.88	0	Qualified for next round validation
38	7	0.88	0	Qualified for next round validation
39	3	0.38*	0	Not qualified for next round validation
	S-CVI/Ave	0.85		
	Number of EPAs achieved 100% experts in agreement		22(56.4%)	

Note. I-CVI, item-level content validity index; scale-level content validity index, universal agreement method (S-CVI/UA) = 0.56; scale-level content validity index, averaging method (S-CVI/Ave) = 0.85

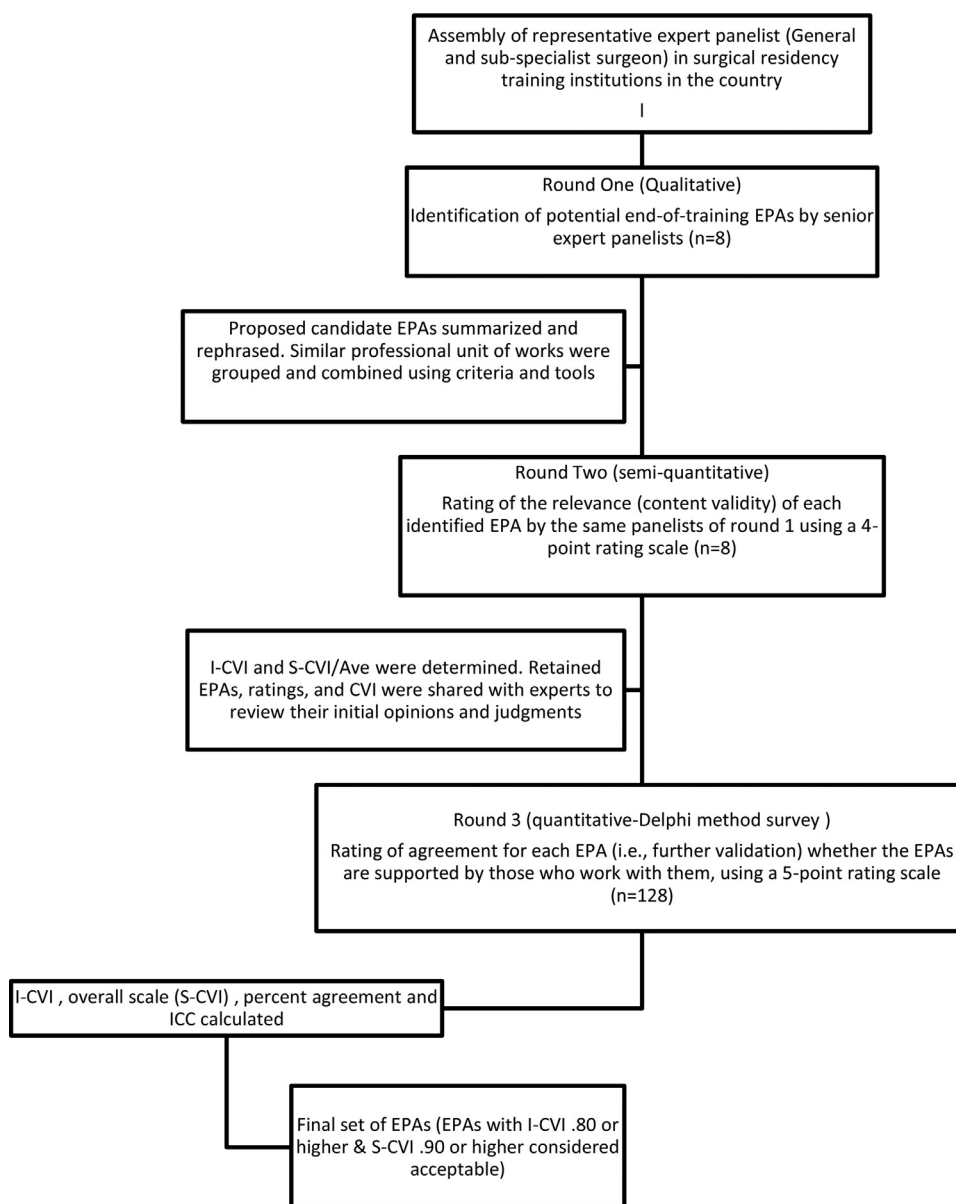
\*EPAs falling below the level of 0.83 of the content validity index standard and not qualified for next round validation.

(EPA # 13, 16, & 30) received lower than the acceptable item-level content validity index (I-CVI < 0.80) (Table 4).

Values from the study groups in the survey are clustered fairly tightly together (dot plot Fig. 2) and the inter-rater reliability assessment using the Intraclass Correlation Coefficient (ICC) was significant (ICC = 0.998 with a 95% CI [0.996,0.999] (F = 439.2, p < 0.0001) as shown in Table 5.

## DISCUSSION

This study aimed to develop valid end-of-training EPAs for entry into beginning-level surgical practice. The study is the first of its kind to be developed as a framework for informing curriculum, teaching, and assessing competencies in postgraduate medical education programs in Ethiopia.



**FIGURE 1.** Schematic representation of data collection methods and procedure.

Setting professional activities that require entrustment decision is important for the program, trainees, educators, and the wider health care community. The hope is that our framework of EPAs will directly and positively impact training and ultimately improve patient and family care outcomes.<sup>41</sup> EPAs help training programs to move from fixed-length to variable-length programs<sup>42</sup> and transform traditional assessment into entrustment decisions where the endpoint is defined by these entrustable activities.<sup>12</sup> EPAs may eventually allow for a major shift in the structure of training programs. Programs may be able to transition from a time-dependent

to an outcome-dependent model tailored to the pace of achievement of the individual learner.<sup>4,43</sup>

EPAs can also be used to structure teaching<sup>44</sup> and provide assessment guidelines for both trainees and supervisors. An EPA-based training program can equip supervisors to make an informed, safe entrustment decision.<sup>41</sup> EPAs help trainees relate their learning to actual workplace expectations and responsibilities and to know what is required to complete a specific EPA and gain trust.<sup>12,17-18,45-46</sup> It also helps trainees develop learning plans by identifying the necessary knowledge, skills, and attitudes at each training level. Finally, EPAs help

**TABLE 4.** Rating of Agreement on the Relevance and Representativeness of Core EPAs Statements

EPA #	Core EPAs Statements for Surgical Residency Training Program	# of Experts in Agreement	CVI for item (I-CVI)	% Agreement	UA
1	Collecting information (history, physical examination) in an organized fashion <sup>†</sup>	128	1.00	100	1
2	Recommending screening and diagnostic tests, interpreting and understand the implication test, and communicating the result of a test with the patient or a peer <sup>†</sup>	128	1.00	100	1
3	Documenting clinical encounters <sup>†</sup>	128	1.00	100	1
4	Identifying urgencies/emergencies and initiating early management for critically ill surgical patients <sup>†</sup>	128	1.00	100	1
5	Communicating with co-workers, patients, and families including breaking bad news <sup>†</sup>	128	1.00	100	1
6	Educating patient and obtaining informed consent in preparation for surgical care <sup>†</sup>	128	1.00	100	1
7	Leading and Conducting routine ward rounds in collaboration with interprofessional teams <sup>†</sup>	128	1.00	100	1
8	Consulting health care providers and supervising resident students caring for surgical patients <sup>†</sup>	128	1.00	100	1
9	Performing preoperative preparation and optimization of patients for surgical procedures <sup>†</sup>	128	1.00	100	1
10	Managing postoperative patients (complicated and uncomplicated) <sup>†</sup>	128	1.00	100	1
11	Performing basic (minor) surgical procedures <sup>†</sup>	128	1.00	100	1
12	Repairing Hernias (Herniorrhaphy) <sup>†</sup>	124	0.97	97	0
13	Performing craniotomy to elevate depressed skull and remove subdural hematoma (burhole) <sup>*</sup>	25	0.20 <sup>*</sup>	20%	0
14	Performing creation of an opening (stoma) into the windpipe (tracheostomy, cricothyroidotomy) <sup>§</sup>	128	1.00	100%	1
15	Performing removal of part or all of the thyroid gland (Thyroidectomy) <sup>§</sup>	124	0.97	97%	0
16	Performing thoracotomy for patient with blunt/penetrating thoracic trauma <sup>*</sup>	26	0.20 <sup>*</sup>	20%	0
17	Performing removal of some or all breast tissue, 1 or both breasts, axillary lymph nodes, (Mastectomy) <sup>§</sup>	126	0.98	98%	0
18	Performing removal of stone from gallbladder (open Cholecystectomy) <sup>‡</sup>	126	0.98	98%	0
19	Performing Common Bile Duct (CBD) exploration <sup>§</sup>	127	0.99	98%	0
20	Performing partial or complete removal of spleen (Open splenectomy) <sup>§</sup>	127	0.99	99%	0
21	Evaluation and surgical management of patient with Peptic Ulcer Disease (Performing vagotomy, pyloroplasty, antrectomy, and gastrojejunostomy (Billroth procedure) <sup>‡</sup>	127	0.99	99%	0
22	Performing removal of appendix, appendiceal mass, and appendiceal Abscess (Open appendectomy) <sup>‡</sup>	127	0.99	99%	0
23	Performing an exploratory laparotomy for trauma <sup>†</sup>	128	1.00	100%	1
24	Evaluation and surgical management patient with partial or complete blockage of the small intestine <sup>†</sup>	128	1.00	100%	1
25	Evaluation and surgical management of patient with the colonic and/or rectal disease <sup>‡</sup>	128	1.00	100%	1
26	Evaluation and management of abnormal twisting of part of the large or small intestine (Volvulus) <sup>†</sup>	128	1.00	100%	1
27	Evaluation and surgical management of patient with hemorrhoid (Hemorrhoidectomy) <sup>§</sup>	128	1.00	100%	1
28	Rectal/anal fistula Repair <sup>§</sup>	127	0.99	99%	0
29	Diagnosis and management of patient with Benign prostatic hyperplasia, benign prostatic hypertrophy (BPH) <sup>§</sup>	123	0.96	96%	0
30	Performing ob/gyne surgery (salpingo-oophorectomy, hysterectomy, and uterine repair) <sup>*</sup>	10	0.08 <sup>*</sup>	8%	0
31	Providing initial management for trauma /fracture patients <sup>†</sup>	128	1.00	100%	1
32	Performing below knee, above knee, and upper limb amputation <sup>§</sup>	126	0.98	98%	0

(continued)



**TABLE 4** (continued)

EPA #	Core EPAs Statements for Surgical Residency Training Program	# of Experts in Agreement	CVI for item (I-CVI)	% Agreement	UA
	EPAs achieved 100% experts in agreement	S-CVI/Ave	0.92	92%	18(56.2%)
	Average proportion of items judged as relevant across the 128 experts	0.92		92%	

Note. I-CVI, item-level content validity index; scale-level content validity index, universal agreement method (S-CVI/UA) = 0.56; scale-level content validity index, averaging method (S-CVI/Ave) = 0.92; average proportion of items judged relevant across the 128 experts = 0.92

\*EPAs failed to meet the standard criterion for acceptability(EPA # 13, 16, 30)

†EPAs that mirrors EPAs statements of others (#19)

‡EPAs that mirror EPAs statements of others but different in surgical approach

§EPAs different form other EPAs statements (#10)

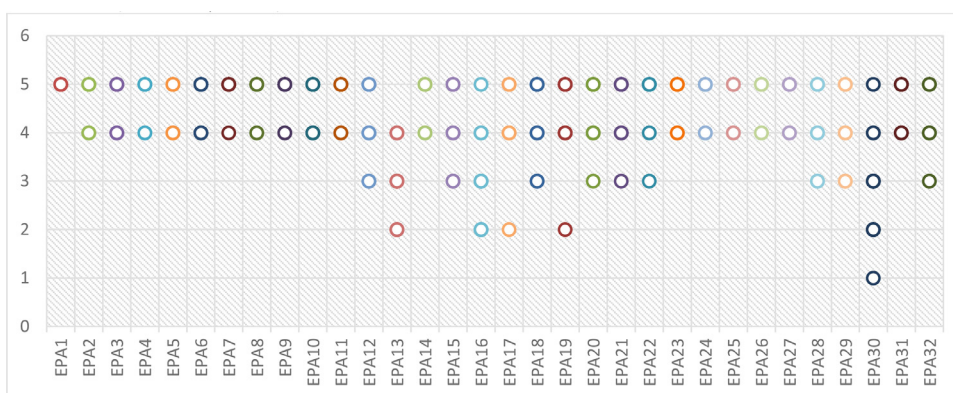
trainees to engage in self-reflection and motivate trainees to earn entrustment.<sup>47</sup>

Identifying core EPAs as suitable units of professional practice is usually an iterative process among professionals.<sup>17</sup> EPA identification processes usually begin by assembling a working group consisting of Subject Matter Experts (SMEs). Subject Matter Experts are then asked to identify core and important professional practices (i.e., potential end of training EPAs), which can be performed by the trainees unsupervised. This present study’s EPA identification process was consistent with most of the studies conducted across the different settings.<sup>3,24,48-51</sup> As such, our study relied entirely on expert knowledge to construct the survey instrument. This allowed experts to express their views, share their experience, and provide information beyond what is available in the literature.<sup>51</sup>

Soliciting only few expert opinions might not be enough to ensure the relevance of a set of EPAs . Therefore, it was important to further validate our set of EPAs with instructors who have been working in the subject and will be working with these EPAs in the future.<sup>17,52</sup> Evidence for content validity of EPAs can be gathered with several techniques. The Delphi method survey<sup>17</sup>

chosen for this study ensured that EPAs are truly part of the real work and supported by those who work with them. In this iterative Delphi process, a very high final agreement and overall content validity index were reached on 29 end-of training EPAs. This implies that these core EPAs are highly relevant to represent the profession, truly part of the real work, and well adapted to the local context. Particularly, the perfect EPA validity index obtained from the survey with 128 respondents, is a strong indicator for the suitability to use our framework among educators.<sup>53,54</sup>

The number of EPAs reached in the final consensus of attending surgeons in this study corresponds to the number recommended for postgraduate programs (i.e., 20-30).<sup>18,42,55</sup> Not surprisingly, nearly two-third of the core EPAs for surgical residency graduates in our study mirror the EPA statements of the Royal College of Physicians and Surgeons of Canada,<sup>21</sup> the American Board of Surgery,<sup>22</sup> global resident performance<sup>23</sup> and the Royal Australian College of Surgeons<sup>24</sup> for medical school graduates. The similarity across different settings indicates that these EPAs are core professional tasks and/or responsibilities and are highly important for beginner-level surgeons’ daily practice regardless of the cultural



**FIGURE 2.** Dot plot showing attending surgeons agreement values (n = 128).

**TABLE 5.** Interrater Agreement for the Attending Surgeons (N = 128)

Variable	*Intraclass Correlation Coefficient (95% CI; Lower, Upper)	F test	p value
Attending surgeons judgment	0.998 (0.996,0.999)	439.201	0.0001

\* Average measure

and geographical context. In the EPA-competency mapping, all EPAs identified in this study incorporated one or more CanMED competencies adopted for the surgical residency training programs in Ethiopia (see Table 6 in the supplementary file). This indicates that EPAs in this study meet the requirements and align with the elements of their definition as described in the peer-reviewed literature.<sup>20,31</sup>

Some EPAs in our studies are similar in purpose to others but different in approach. For example, others have included an EPA “Performing laparoscopic appendectomy,<sup>23,24</sup> cholecystectomy,<sup>23</sup> and hemicolectomy.”<sup>23</sup> In our setting, there is no such advanced surgical approach in the real workplace for surgical residents, and thus, these EPAs are defined as “performing appendectomy, cholecystectomy, and hemicolectomy using open surgery.” This difference shows that the degree of complexity of an EPAs differs depending on the context in which it is practiced.<sup>19</sup> These differences likely reflect differences in the medical practice of specific countries based on the availability of skill mix and technologies.

On the other hand, almost one-third of the EPAs in our study are different from others and made to fit the local context of the country’s health care system. In addition, there are also differences in definition of some of the EPAs in our study. For example, others have defined the EPA as “performing complex operations.”<sup>23</sup> In our study, these complex operations were identified and made to be separate EPAs. On the other hand, others have defined the EPAs by dividing them into separate tasks and /or responsibilities like “managing uncomplicated postoperative surgical patients, “managing complicated postoperative surgical patients,”<sup>21</sup> “providing consultation,”<sup>22</sup> “providing supervision,”<sup>22</sup> “repairing inguinal hernia,”<sup>23,24</sup> and “repairing umbilical hernia,”<sup>23,24</sup> In our study, these EPAs are integrated into 1 core EPA statement as “managing postoperative surgical patients (complicated &uncomplicated)”, “providing consultation and supervision” and “repairing hernia” respectively. This all indicate that 1 set of core EPAs cannot automatically be transferred from one context to another<sup>19</sup> and medical schools who consider the implementation of EPAs into their programs have to undergo their own EPA development process according to their local context.

Finally, since the concept of EPA is relatively new,<sup>20</sup> this study built additional knowledge for the global scientific community by extending previous work on the introduction of EPAs as a framework to inform surgical residency trainings, particularly in a resource-constrained setting. In addition, the findings allow the program to make a major shift in the structure of training i.e., move from a time-dependent (fixed length) to an outcome-dependent model) and transforms traditional assessment into entrustment decisions.

### Strengths and Limitations of the Study

The most important strength of this study is its national outreach and coverage so that the results can be generalized to a larger population due to the size and geographical representation of experts. In addition, our study used a rigorous methodology and a nationwide consultative process using Delphi expert panels and surveys to reach a consensus on a framework of end-of-training EPAs. Lastly, the core EPAs statements give us a starting point for implementation of competency-based education in postgraduate surgical teaching. The important next step is to develop an evaluation tool for these EPAs that can serve as a foundation for entrustment decisions so that they can be implemented in the surgical residency training institutions. Limitations of the study include unable to include attending surgeons in some institution due to political crisis and the absence of the positive aspects of face-to-face interaction among experts for the exchange of information that would have helped to identify the reasons for a dispute.

### CONCLUSIONS

A framework of 29 validated and accepted EPAs was developed using national input of practicing surgeons and an iterative expert group consensus process. This accepted framework of EPAs can be used as a guide for surgical residency training programs in the Ethiopian medical education context and provides a basis to move the structure of training programs from a time-dependent to an outcome-based model and to transform traditional assessment into more objectively measurable entrustment decisions. In the end, our framework can be a stepstone to improve the overall quality of surgery training and patient care.

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## DECLARATION OF COMPETING INTERESTS

The authors declare they have no conflict of interests.

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## SUPPLEMENTARY INFORMATION

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