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Entrustable Professional Activities (EPAs) Framework to Inform Surgical Residency Training Programs in Ethiopia Medical Education

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Submitted by : Equlinet Misganaw Amare

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Supervisors LMU:

Habilitated Supervisor	Prof.Dr. Martin R. Fischer
Direct Supervisor	Prof. Dr. Matthias Siebeck
3rd LMU Supervisor	Dr. Markus Berndt

Supervisor External:

Local Supervisor	Dr. Tegbar Yigzaw

Reviewing Experts:

1st Reviewer	Prof.Dr. Martin R. Fischer
2nd Reviewer	Prof. Dr. Matthias Siebeck
3rd Reviewer	PD Dr. Ferdinand Wagner
4th reviewer	PD Dr. Jens Wallmichrath

Dean: Prof. Dr. med. Thomas Gudermann

Date of Oral Defense: 11 January 2023

Affidavit

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Dean's Office
Medical Faculty

MMRS

Affidavit

Amare, Equlinet Misganaw

Surname, first name

Street

Zip code, town

Ethiopia

Country

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Dean's Office
Medical Faculty

MMRS

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Amare, Equlinet Misganaw

Surname, first name

Street

Zip code, town

Ethiopia

Country

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Place, date

Equlinet Misganaw Amare

Signature doctoral candidate

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Key Words

"Competency-based medical education, Entrustable professional activity, Ethiopia"(Amare et al., 2021) , Graduating surgery residents, Surgical Team, Surgical residency training

Abstract

Background

Entrustable Professional Activities (EPAs) are activities that are essential to the discipline and can be delegated to individuals without direct supervision in a specific health care context once they have demonstrated sufficient competence (Amare et al., 2021; Ten Cate et al., 2015; Ten Cate et al., 2017). Since EPAs are believed to have potential benefits, a wide range of specialty programs have proposed them, and they have become popular in medical programs (Amare et al., 2021; Beeson et al., 2014; Haines et al., 2017; McCloskey et al., 2017; Peters et al., 2017; Ten Cate, 2017; van Loon et al., 2014; Young et al., 2018). Even though core EPAs have become available globally (Amare et al., 2021; Touchie & ten Cate, 2016), they cannot automatically be adapted for use in other contexts(Amare et al., 2021; Shorey et al., 2019). With this in mind, the need to develop an EPA Framework for Surgical Residency Training in Ethiopia is imperative (Amare et al., 2021). The goal is for graduating surgical residents must be able to carry out these EPAs independently by the time they graduate. However, Graduates of general surgery residents have also been criticized for their ability to perform EPAs (Amare et al., 2021; Bucholz EM, 2011 Aug 15; Friedell et al., 2014; Moore et al., 2017; Perone JA, 2017 Apr 1; Wagner JP, 2018 Apr). " 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" (Amare et al., 2021), as well as to assess how faculty members judge residents' performance in executing EPAs, and how residents rate their own ability to systematically introduce and implement EPAs in the "surgical residency training programs" (Amare et al., 2021).

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" (Amare et al., 2021) . In addition, the survey was conducted at "four surgical residency training institutions in Ethiopia" (Amare et al., 2021) to investigate resident and surgical team members judgments of a graduating general surgery residents' competency in carrying out EPAs.

Result

"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)" (Amare et al., 2021). In carrying out EPAs, there was a statistically significant difference in judgments between residents and surgical team members (P =0.03, CI: 0.51-0.95) as well as between surgical faculty members (P =0.001).

Conclusion

"The framework of 29 validated and accepted EPAs can guide future surgical residency training programs in the Ethiopian medical education con- text. 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" (Amare et al., 2021). The perception/judgment gap that exists between residents and surgical teams and among faculty members could pose a problem in education and healthcare systems. Our study emphasizes the need to describe EPAs in sufficient detail and to make performance criteria transparent and understandable before fully implementing an EPA-based assessment.

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ACGME: Accreditation Council for Graduate Medical Education

AMC: Adama Medical Colleges

CanMED: "Canadian Medical Education Directives for Specialists" (Ten Cate & Hoff, 2017)

CBE: Competency-Based Education

CBME: Competency-Based Medical Education

CI: Confidence Interval

EPA: Entrustable Professional Activities

GMC: General Medical Council

HSTP: Heal Sector Transformation Plan

" ICC: Intra-class Correlation Coefficient" (Amare et al., 2021)

" I-CVI: Item-level Content Validity index" (Amare et al., 2021)

JU: Jimma University

ANOVA: Analysis of Variance

OT: Operating Theatre

SDG: Sustainable Development Goal

"S-CVI: Scale-level Content Validity index"(Getu et al., 2021)

"SD: Standard Deviation"(Getu et al., 2021)

SPHMMC: St. Paul Hospital Medical Millennium College

UA: Universal Agreement

UoG: University of Gondar

1. Introduction

1.1 Background

1.1.1 Competency-Based Educational approach as one of the proposed instructional changes to improve health-system performance.

As health problems have emerged, health education has failed to keep up. Graduates are usually not equipped to deal with these problems (Amare et al., 2021; J. Frenk et al., 2010; Morcke et al., 2013). “New infectious, environmental, and behavioural risks, at a time of rapid demographic and epidemiological transitions, threaten health security of all” (J. Frenk et al., 2010). “Professional education has not kept pace with these challenges, largely because of fragmented, outdated, and static curricula that produce ill-equipped graduates. The problems are systemic: mismatch of competencies to patient and population needs; poor teamwork; persistent gender stratification of professional status; narrow technical focus without broader contextual understanding; episodic encounters rather than continuous care; predominant hospital orientation at the expense of primary care; quantitative and qualitative imbalances in the professional labour market; and weak leadership to improve health-system performance” (Julio Frenk et al., 2010). “In almost all countries, the education of health professionals has failed to overcome dysfunctional and inequitable health systems because of curricula rigidities, professional silos, static pedagogy (ie, the science of teaching), insuffi cient adaptation to local contexts, and commercialism in the professions. Breakdown is especially noteworthy within primary care, in both poor and rich countries” (Julio Frenk et al., 2010).

The development of new educational and institutional strategies (Amare et al., 2021; Frank, Snell, et al., 2010) is necessary to improve professional education and health outcomes (Amare et al., 2021; J. Frenk et al., 2010). One of the proposed instructional changes is a competency-based educational approach, which is acknowledged as a viable way of tackling specific health issues and problems that jeopardize people's health security (Frank, Mungroo, et al., 2010; Frank et al., 2017). As a result, the Competency-Based Educational (CBE) approach was developed in response to requests for more accountability and a stronger emphasis on patient, population, and health professions education program outcomes (Frank, Mungroo, et al., 2010; Ibrahim et al., 2015; Touchie & ten Cate, 2016). More specifically, the Competency Based Medical Education (CBME) model was developed in response to the need to “reduce unacceptable variability in graduate abilities following medical training; evidence that some graduates are unprepared for safe and effective practice; patterns of suboptimal patient outcomes in health care systems; and calls for a fundamental re-examination of curriculum content to ensure relevance to twenty-first century practice” (Frank et al., 2017).

“A competency-based approach is a disciplined approach to specify the health problems to be addressed, identify the requisite competencies required of graduates for healthsystem performance, tailor the curriculum to achieve competencies, and assess achievements and shortfalls” (Julio Frenk et al., 2010).

By identifying the health problems to be addressed, identifying the vital competencies graduates must have to perform in the health system, tailoring the curriculum to meet competencies, and assessing accomplishments and gaps, a competency-based educational approach provides guidance for determining health problems to be addressed (Amare et al., 2021; J. Frenk et al., 2010).

“The International CBME Collaborators define CBME as “an outcomes-based approach to the design, implementation, assessment, and evaluation of medical education programs, using an organizing framework of competenciess”(McCloskey et al., 2017), and “an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome and organized around competencies derived from an analysis of societal and patient needs”(Amare et al., 2021; Frank, Mungroo, et al., 2010; Ten Cate, 2017).

“Competency-based medical education has been defined as ‘education for the medical profession that is targeted at a fixed level of proficiency in one or more medical competencies’6 and ‘an approach to preparing physicians for practice that is fundamentally oriented to graduate outcome abilities and organised around competencies derived from an analysis of societal and patient needs; it de-emphasises timebased training and promises greater accountability, flexibility, and learner-centredness” (Touchie & ten Cate, 2016).

“In 1978, in a visionary report for the World Health Organization define CBME as the intended output of a competency-based program is a health professional who can practise medicine at a defined level of proficiency, in accord with local conditions, to meet local needs” (McGaghie et al., 1978).

“Competency-based education (CBE) is a framework for designing and implementing education that focuses on the desired performance characteristics of health care professionals. Although ‘competence’ has always been the implicit goal of more traditional educational frameworks, CBE makes this explicit by establishing observable and measurable performance metrics that learners must attain to be deemed competent” (Gruppen et al., 2012).

When comparing CBME to a conventional educational approach, three key differences arise. First, CBE specifically maps the people' unique healthcare needs to a set of competencies to be developed in the workforce. “Second, CBE uses these expectations to then develop and implement learning experiences designed to produce the requisite knowledge, values, and skills in the learners to achieve these competencies. Finally, CBE uses the same set of competencies to develop critical assessment programs to determine the extent to which they are reached” (Gruppen et al., 2012).

“Traditional education tends to focus on what and how learners are taught and less so on whether or not they can use their learning to solve problems, perform procedures, communicate effectively, or make good clinical decisions. By emphasizing the results of education rather than its processes, CBE provides a significant shift in what educators and policy makers look for in judging the effectiveness of educational programs” (Gruppen et al., 2012). “Traditional educational programs too often have an insular character in which the expectations of learners are based on what has been taught in the past. In CBE, success is determined by the ability to perform to expectations that are largely determined by stakeholders outside of the educational program itself” (Gruppen et al., 2012).

“Traditional graduate medical education is structured around time frames and curricular processes. It is an opportunistic approach defined by ‘‘dwell time,’’ whereby a specified number of months is assigned to discrete activities over prescribed periods. When those requirements are met, the ability to apply what is learned to the actual delivery of patient care is assumed, without actually assessing whether the application of that learning to health care delivery occurs.” (Iobst et al., 2010). “In contrast, competency-based training is based on the successful demonstration of the application of the specific knowledge, skills, and attitudes that are required for the practice of medicine“ (Iobst et al., 2010). By focusing on the ultimate outcomes of physician performance and patient care, CBME seeks to produce professionals whose skills are responsive to the needs of the populations and communities they serve and meet the needs of the health care systems and communities in which they practise” (Hawkins et al., 2015).

1.1.2 Benefit of Competency Based Medical Education (CBME)

CBME is widely recognized as a method of education and training that offers the greatest prospects for improving outcomes for learners and patients (Carraccio et al., 2016; McCloskey et al., 2017; Ten Cate, 2017). ”Competency-based medical education (CBME) has emerged as a core strategy to educate and assess the next generation of physicians” (Hawkins et al., 2015). “Competency-based frameworks offer structural, content- and process-based benefits. Perceived advantages of CBME include: a focus on outcomes and learner achievement; requirements for a multifaceted, observation-based assessment approach that embraces formative assessment; support of flexible learning and a time-independent trajectory along the continuum of education, and increased transparency and accountability to all stakeholders with a shared set of expectations and a common language for education, assessment and regulation” (Hawkins et al., 2015).

“ In research involving surgical residents, competency-based learning approaches led to improvements in clinical skills and patient care, and more rapid acquisition of procedural skills. Faculty members from an internal medicine residency programme, responding to a survey about the milestones format, felt that it provided a valid approach to the assessment of residents” (Hawkins et al., 2015).

A CBME program can only benefit the health of the community it serves (Gruppen et al., 2012) if it identifies the necessary competencies based on context-specific health concerns. Several research show that implementing CBME frameworks has educational or clinical benefits (Carraccio et al., 2016; Hawkins et al., 2015; Ten Cate, 2017). CBME when implemented properly and dynamically, may assist all training programs in providing better care to the patients and populations they serve. However, as the CBME reforms gained traction, so did the movements' critics. There have been critiques of CBME including reductionism, insufficient evidence, problems with implementation, and philosophical or ideological issues (Holmboe et al., 2017).

1.1.3 A shift toward Competency-Based Medical Education

“McGaghie et al. urged for the universal implementation of CBME in a visionary report for the World Health Organization in 1978, to ensure that health professionals education could adequately address local and regional population health needs” (McGaghie et al., 1978). “Indeed, for more than 60 years, competency-based education has been utilized or proposed as a method of teaching in a variety of jurisdictions and professions, including social work. Through improved education of future physicians, the transition to a competency-based framework will have a major positive influence on the health of individual patients and society ” (Frank et al., 2017).

“The move to competency-based medical education has been called a paradigm shift holding great promise for safer and higher quality health care” (Touchie & ten Cate, 2016). The most important stage in transitioning from a conventional to a competency-based educational framework is defining student competencies. These competencies not only reflect educational aims, but also institutional, disciplinary, or national agendas (Gruppen et al., 2016; Gruppen et al., 2012). In addition to establishing the learner's skills, CBME needs well defined performance criteria that allow faculty to determine whether the student has attained the minimum level of performance (Gruppen et al., 2016; Myers et al., 2015).

“Although academic scholars continue to debate over the educational and clinical outcomes of competency-based education, it has become the worldwide standard for postgraduate training of physicians. By aligning the requisite competencies desired in health professional trainees with each country’s health care priorities, competency-based training directly integrates graduate medical education (GME) with the health and healthcare needs of populations” (Ibrahim et al., 2015).

With the widespread adoption of competency-based education, “many undergraduate and postgraduate medical education programs” (Amare et al., 2021) are undergoing significant transformations (Gruppen et al., 2016; Holmboe et al., 2017; McCloskey et al., 2017; Ten Cate, 2017; Touchie & ten Cate, 2016; van Loon et al., 2014).

There are several motivating factors for the widespread use of CBME. As an educational method, competency-based education relies heavily upon pedagogy built around learner-centeredness (Gruppen et al., 2012; Ibrahim et al., 2015). As well as offering a framework for curriculum and evaluations, CBME also offers flexibility and the ability to learn on one's own terms (Gruppen et al., 2012; Ibrahim et al., 2015). At most, it acknowledges, in accordance with modern educational philosophy, that the end result of a training program is the production of specialists who demonstrate competency in a range of roles in dealing with contemporary medical problems (Gruppen et al., 2016). Furthermore, graduate medical education played a significant role in the adoption of CBE (Education, 2005; Frank & Danoff, 2007; Swing, 2002).

“Various frameworks for competency-based medical education, such as CanMEDS (Canadian Medical Education Directives for Specialist) (Amare et al., 2021; Frank, 2005), ACGME (Accreditation Council for Graduate Medical Education)(Amare et al., 2021; Education, 2005), Saudi MEDS(Amare et al., 2021; Rubin & Franchi-Christopher, 2002),and General Medical Council (GMC) have been developed in various countries. They are used to guide the adoption of competency-based medical education around the world” (Amare et al., 2021). “These frameworks were created to address the growing recognition that health care was too often unsafe and of poor quality and that medical education systems were not producing physicians with the abilities needed to meet the complexities of modern practice” (Holmboe et al., 2017). “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” (Amare et al., 2021).

1.2 Statement of the problem

1.2.1 Gaps in Ethiopian medical education

Ethiopia has a very low health workforce density (Medical Doctors, Health Officers, Nurses, and Midwives) of 0.96/1000 population. This is substantially lower than the African density of health professionals (2.2/1000 population) and five times below the World Health Organization's minimal requirement of 4.45 per 1000 population established to meet the Sustanable Development Goal (SDG) health targets (Haileamlak, 2018). The nation's chronic scarcity of health personnel, along with the low quality of medical education, created significant hurdles for graduates to address the real-life health problem effectively (Abraham & Azaje, 2013; Berhan, 2008).

The traditional content-based medical education has well-documented shortcomings for acquiring important skills among health professions. “These include a lack of relevance to actual health practice and insufficient attention given to teaching communication skills, problem-solving skills, clinical reasoning

skills and other social aspects of health" (Misganaw et al., 2022). This generates competency gaps among health care workers and jeopardizes their ability to treat health issues swiftly and effectively (Abraham & Azaje, 2013).

It became necessary to improve the quality of medical education in the country due to the low quality of medical education. Therefore, the improvement of the quality of health education is included in Ethiopia's Heal Sector Transformation Plan (HSTP) as one of the key components of the strategic objectives. Shifting from a traditional medical curriculum to a competence approach is one of numerous initiatives to enhance medical education quality under the HSTP.

As part of their shift to competency-based training, Ethiopia's postgraduate speciality medical training programs have adopted CBME curricula, including CanMEDS and ACGME competency frameworks. Eleven Postgraduate specialized medical training programs have already made the switch from traditional to competency-based curriculum. However, this shift in educational approach, structure, and anticipations has resulted in both tremendous innovation and challenges for health professions educators (Gruppen et al., 2016; Holmboe et al., 2017; Wagner & Reeves, 2015). When it comes to learning and assessing clinical competence, several experts have expressed doubts regarding whether CBME can capture it.

1.2.2 Challenges of the current competency framwork

"Although competency frameworks are relevant to guide the design of CBME programs, medical educators struggle to implement these competencies in their daily practice" (Amare et al., 2021). "These competencies usually are broad statements and describe general physicians' characteristics which are more descriptive of individuals rather than descriptive of tasks and responsibilities" (Amare et al., 2021). "As such, these competencies are too complex to translate into a realistic training program, making them too theoretical to train and validly assess" (Amare et al., 2021).

The current competency framework has also been criticized because Instead of an empirical, evidence-based model of professional practice characteristics, it was developed through a consensus-based process (Hawkins et al., 2015; Lurie, 2012).

Currently, it remains challenging for these frameworks to be implemented in assessment of clinical task performance in practice. It is often not possible to measure competencies adequately in isolation; many competencies become relevant only after being applied to a specific clinical setting (Hawkins et al., 2015; Ten Cate & Hoff, 2017). "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. Summative judgment about a trainee's performance is made by informal observation, often assuming the amount of time spent in training" (Amare et al., 2021).

A few of the potential threats and challenges of CBME include:

- “The threat of reductionism. In an effort to address the challenges of defining and assessing competencies, some have resorted to breaking them down into the smallest observable units of behaviour, creating endless nested lists of abilities that frustrate learners and teachers alike” (Frank, Snell, et al., 2010).
- “Promoting the lowest common denominator. Critics of CBME have pointed out that, by focusing on an array of competencies so comprehensively, learners may perceive a underlying message that milestones and not excellence are the ultimate pursuit in medicine” (Frank, Snell, et al., 2010).
- “Logistical chaos. Given that many educational systems around the world are time-based (e.g., requiring a precribed number of weeks for each rotation), how can a transition to a more competency-based system be accomplished? How can health care manage the scheduling of the thousands of medical trainees progressing at their own pace” (Frank, Snell, et al., 2010).
- “The tyranny of utility. A pure CBME approach is inherently utilitarian, and proposes cutting content and experiences that do not directly contribute to defined program outcomes. This can be unacceptable to some stakeholders in the profession” (Frank, Snell, et al., 2010).
- “The need for new educational technologies. Adopting CBME on a larger scale would require new teaching techniques, new modules, and new assessment tools to be practical and effective” (Frank, Snell, et al., 2010).
- “Inertia and lack of resources. For many jurisdictions, adoping a CBME approach would require significant investments in teaching, infrastructure and assessment, and perhaps even an augmented workforce” (Frank, Snell, et al., 2010).

Generally, “practical and logistical concerns and challenges to the implementation of competency-based education and assessment frameworks include: (i) lack of structural models for CBME that accommodate individual, flexible learning plans, (ii) increased administrative requirements for competency-based education programmes, including the need for increased faculty development, and (iii) inconsistency in how competences are defined, developed, implemented and assessed. Addressing the challenges in the implementation of CBME requires the consideration of the implications for the complex systems in which our education programmes reside” (Hawkins et al., 2015).

We also noticed areas of concern within the existing competency based training program during the residency training program in Ethiopia. First the time it took to complete training was significantly longer than the five years. This is a particularly pressing issue at a time when there is a significant labor shortage as well as an increase in demand for specialized workers. The second problem is that our summative assessments have had a poor pass rate, which may indicate that trainees were ill-prepared for these

assessments. Trainee dissatisfaction was also high, particularly in the tension between commitments to service and training. Lastly, we realized our training program wasn't adequately preparing trainees for their future as consultants, indicating poor alignment within the program.

Despite the fact that workplace-based assessments are considered to be fairly valid, they are generally designed to assess specific competencies. Their assessment does not cover the full range of responsibilities expected of a competent surgeon. It is more likely to atomize competencies than to bring them together when they are assessed in this way. This could lead to a trainee having demonstrated competence in one set of competencies but not being able to integrate them across roles in order to demonstrate competency in another.

In addition, there is no clearly defined source of information that can be used to assess progress and base entrustment decisions. Thus, the basis for the development of Entrustment's decisions (i.e., high-stake decisions that have profound consequences for trainees, internships, and patients) is informal observation, often based on a belief that the length of postgraduate training provides a level of competence (Ten Cate et al., 2015).

1.2.3 EPAs as a means to translate competencies into clinical practice

“Competencies are a necessary blueprint for curricula, but too abstract to translate into a concrete training program. EPAs can be used to make competencies meaningful, trainable and assessable for clinical teachers (Carraccio & Burke 2010). Competencies alone are relatively abstract and need to be embedded in a relevant clinical context for educators to be able to train and assess them repetitious” (van Loon et al., 2014).

“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)” (Amare et al., 2021). “Entrustable professional activities (EPAs) were introduced to operationalize competency-based medical education and to facilitate the guidance and evaluation of learners in clinical workplaces” (Peters et al., 2017). “Entrustable professional activities were first described and subsequently used by medical residency training programs as a means to translate competency statements (ie, general qualities that every health professional should possess) into concrete tasks that supervisors can observe and delegate to trainees in the clinical environment” (Haines et al., 2017). “EPAs serve to operationalise the more abstract competencies (that some fear may be omitted from CBME models) into the context of the learner’s clinical work, and are representative of that work, whereas the competencies denote features of the learners themselves” (Ten Cate & Billett, 2014). “The EPA concept intends to

integrate different competencies within relevant and recognizable contexts and in this way to link the educational and medical worlds" (van Loon et al., 2014).

"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" (Amare et al., 2021). "Therefore, EPAs constitute a translation of competencies into tangible tasks in clinical practice and makes competencies meaningful, trainable, and assessable for clinical teachers" (Amare et al., 2021).

"An EPA is "a unit of professional practice, defined as a task or responsibility to be entrusted to a trainee once sufficient specific competence is reached to allow for unsupervised practice. EPAs are independently executable within a time frame, observable and measurable in their process and outcome, and suitable for entrustment decisions" (Ten Cate, 2017).

" Critical to the definition of EPAs are the following features, as outlined in the seminal papers of ten Cate and Scheele (ten Cate 2005; ten Cate & Scheele 2007). An EPA:

- is part of essential professional work in a given context
- requires adequate knowledge, skills, and attitudes
- leads to recognized output of professional labor" (Englander et al., 2017).

"On the basis of this work and the literature that has developed since, the International CBME Collaborators developed the following consensus definition in the context of medical training: Entrustable professional activity (EPA): An essential task of a discipline (profession, specialty, or subspecialty) that an individual can be trusted to perform without direct supervision in a given health care context, once sufficient competence has been demonstrated" (Englander et al., 2017).

"Briefly, EPAs are collections of tasks a trainee needs to be able to deal with in order to perform well in an essential part of his or her professional work domain" (van Loon et al., 2014).

"EPAs make the connection between education and patient care by delineating activities that alicensed physician, certified specialist, or other credentialed health professional is expected and allowed to perform into manageable units of practice that can be overseen, observed, assessed,and documented" (Ten Cate et al., 2020). " The EPA concept aims to guide leaners and clinical educators in establishing a graded increase in autonomy and responsibility toward readiness for the unsupervised practice of key tasks of the profession" (Peters et al., 2017). "The concept of EPAs allows trainers and trainees to make conscious decisions on what level of supervision is required from observation, through direct supervision to indirect supervision. At each point, a decision can be made as to what level of supervision is required for a trainee to perform an activity" (Ten Cate, 2014).

“The concept of an entrustable professional activity also implies that a trainee is able to group a number of competences together to perform the work-related activity. The trainee needs to be able to integrate these different components to perform the task. Entrustable professional activities are very much context dependent” (Sharma et al., 2018).

EPA vs competencies

“The relationship between EPAs and competencies has been delineated in the literature. EPAs are units of work, whereas competencies are the abilities of individuals. One of the defining markers of an EPA is that it requires the integration of multiple competencies, usually across domains of competence. Nevertheless, EPAs and competencies complement each other. Together, they provide a more holistic view of a physician than either could provide independently.” (Englander et al., 2017).

“EPAs are not an alternative for competencies, but a means to translate competencies into clinical practice. Competencies are descriptors of physicians, EPAs are descriptors of work. EPAs usually require multiple competencies in an integrative, holistic nature” (Ten Cate, 2013). “EPAs are units of professional practice, while competencies describe people’s abilities (e.g. knowledge, professional attitude, communication skill) ” (Ten Cate et al., 2015). “Competencies are general attributes of a doctor – for example, ‘The ability to apply interpersonal and communication skills’. In contrast, activities are elements of professional work – for example, ‘Discuss end of life care with a patient and family’. Tasks appropriate for an EPA must be: observable, measurable, executable within a given timeframe and suitable for entrustment decisions” (El-Haddad et al., 2016). “EPAs are executable within a given time, observable, measurable, confined to qualified personnel and suitable for focused entrustment decisions; competencies are often felt to be too theoretical to validly assess” (Ten Cate et al., 2015). “EPAs are clinical scenarios that incorporate multiple sub-competencies and may require different knowledge skill and attitudes from different sub-competencies to complete the patient care activity” (Beeson et al., 2014).

“Competencies almost invariably map to multiple EPAs and that the trustworthy execution of any EPA requires multiple competencies. Some EPAs are broad and complex, requiring competencies in various domains, while other EPAs may be more focused. Conversely, some competencies may be so general that they are important requisites for many EPAs, while others are rather specific, and only needed for few EPAs” (Ten Cate et al., 2015). “Finally, an EPA can be distinguished from a competency by completing this sentence: “Tomorrow the resident will be entrusted to. . .” (Chang et al., 2013).

1.2.4 Benefits of EPAs

EPAs serve multiple important functions by describing the critical work of the profession for medical providers, educators, and the broader health care community (Landzaat et al., 2017). Education based on

EPA principles is straightforward: Learners must be given sufficient training and opportunities to master these activities. Once learners have mastered each activity, they may be trusted to become members of the professional group. Once all can be trusted to learners, they are ready to join the professional group (Ten Cate, 2005, 2013; Ten Cate & Scheele, 2007). The development of curriculum, learner assessment, and redesign of clinical practice can be aided by EPAs within academic medical institutions (Bhuyan et al., 2014; Chang et al., 2013; McCloskey et al., 2017; Shaughnessy et al., 2013; Ten Cate & Scheele, 2007).

EPAs- As guide for development of Competency-Based curriculum

"EPAs, critical professional activities of a medical discipline, as the central focus of curriculum building, without disregarding general competencies" (Ten Cate & Scheele, 2007). "The value of EPAs is that they identify the professional activities of daily practice and can be used to drive curriculum development as well as assessment. A list of EPAs can serve to focus a curriculum, allowing program directors to assure that "must know" topics are not pushed out by "nice to know" topics" (Shaughnessy et al., 2013). "EPAs can also be used to drive curriculum development at the residency level. Program directors should use EPAs as they are intended to strengthen professional standards, improve patient safety, and enhance outcomes" (Bhuyan et al., 2014). "Workplace curricula can be structured along a range of EPAs that a trainee must have mastered after training has been completed. These EPAs can be linked to an organizing competency-framework by pointing out which specific domains of competence are considered most relevant for each EPA" (Mulder et al., 2010).

"The EPA concept is helpful in two ways. First, it invites curriculum builders to identify and select the important, representative or critical tasks that should be mastered, thus starting from clinical practice and focusing on the desired outcomes of training. Second, the concept implies that each task is linked explicitly to those domains of competence that are most crucial to this task, thus creating a base for observation and assessment of competencies as they manifest themselves in clinical practice. The set of EPAs identified when building a workplace curriculum should be a valid coverage of the profession and all domains of competence should receive attention in a well-balanced way" (Mulder et al., 2010).

EPAs- as a guide for teaching

"Entrustable professional activities are seen as ''a means to translate competencies into clinical practice'' (ten Cate, 2013, p. 157) and are applicable to learning activities both within the classroom and the clinic, as well as to lifelong learning upon graduation. As such, they require integration with clinical education, faculty development and continuing professional development in order for their successful application" (Wagner & Reeves, 2015). " The use of EPAs for both learning and for assessment has worked well, providing authentic evidence of performance and relevant learning opportunities" (Gruppen et al., 2016). "Entrustable professional activities offer a simple but powerful model for improving formative feedback for residents. Entrustable professional activities and CBME in general stress observational evaluation of the

outcome of not only units of work but also the work process itself. In defining EPAs, the activity in question is broken down into knowledge, skills, and attitudes demonstrated with successful, competent performance of an activity. This description of the work process may provide guidance to the novice learner, which may otherwise only be available through trial and error. For the supervising faculty member, EPAs may highlight specific areas for instruction and coaching, beyond simple feedback on medical knowledge that may be otherwise overlooked by an expert practitioner" (McCloskey et al., 2017). "For instance, similar to the Gastroenterology core curriculum, the Gastro-Intestinal EPAs can be used to structure didactic content. The objectives can be used for lectures, for development of reading lists, and to highlight self-study materials (Web-based modules, question-based review), which can guide learners in the achievement of the EPA" (Rose et al., 2014). "Incorporation of EPAs into didactic courses encourages a move from traditional lecture to more active modes of learning in which students are able to practice applying the content to real-world examples. Additionally, EPAs can be integrated into laboratories or simulations designed for students to apply learned knowledge with skill development" (Jarrett et al., 2018).

EPAs –as guide for assessment

"Assessment is central to the success of the competency-based education model. As the student progresses to each competency, his/her need for supervision with an overall task decreases. As the student's knowledge, attitudes and skills expand, he/she progresses from level to level in the didactic to practice-based settings with decreasing supervision until he/she can be completely entrusted by the faculty with a given task. By verifying each competency in a simple, categorical yes/no method, the faculty can feel confident that he/she knows where a student is to correctly assign and thus, entrust clinical tasks"(Jarrett et al., 2018). "The concept of EPA was introduced by ten Cate in 2005 as a novel method of assessment in medical education. The aim was to 'help supervisors in their determination of competence of trainees" (Jarrett et al., 2018).

"Entrustable professional activities (EPAs) exemplify assessment based on trust, as an emerging strategy for supervision grounded in the trust a supervisor holds in a trainee to perform a given activity (ten Cate et al. 2010; Mulder et al. 2010). EPAs form ''part of essential professional work in a given context'' and ''should be entrusted only to those individuals who have adequate competency to carry them out.'' (Sterkenburg et al. 2010; ten Cate 2006; Mulder et al. 2010, Hicks et al. 2010). Assessment based on EPAs defines the degree of independence or supervision with which a trainee can be entrusted to perform a workplace task. Based on professional experience and understanding of the activity, the supervisor making an entrustment decision incorporates information from observations and inferences to render a forward-looking judgment about future performance of an activity" (Hauer, Soni, et al., 2013; Hauer et al., 2014).

“Core to the EPA concept is trust. Trust is a central concept for safe and effective health care. Patients must trust their physicians, and health care providers must trust each other in a highly interdependent health care system. In teaching settings, supervisors decide when and for what tasks they entrust trainees to assume clinical responsibilities. Building on this concept, EPAs are 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” (Ten Cate, 2013)

Trust is central to clinical practice and is also an important component of the assessment of learners within clinical environments by educators/preceptors. There must be trust that the learner has the necessary knowledge, skills, and attitudes to safely and effectively perform the professional practice related activities at the appropriate supervision levels, but also trust that the learner has appropriate self-awareness regarding personal limitations and knows when to ask for assistance (El-Haddad et al., 2016; Pittenger et al., 2016; Ten Cate, 2013).

“ Trust plays a central role in the daily interactions of supervisors and trainees. Supervisors regularly need to decide what level of trainee supervision is needed for safe patient care. Assessment using EPA formalises these daily clinical entrustment decisions, by providing a framework to collect evidence and document what clinical supervisors are already doing – using their expert judgement based on their observations of the trainee's proficiency” (El-Haddad et al., 2016).

“Trust allows the trainee to experience increasing levels of participation and responsibility in the workplace in a way that builds competence for future practice. Trust develops between supervisor and trainee as “an emergent state” influenced by the interactions, context, and situation, as well as individuals’ information processing, thoughts, and motivation. Trainees experience variation in how they are supervised and the amount of trust their supervisors have in them for unsupervised activities. Without trust, trainees can be perpetually marginalized to an assisting or observational role and left unprepared for eventual unsupervised practice. Over-trust, which occurs when someone trusts an individual more than is appropriate for the situation, can perpetuate inaccurate assessment of trainee ability and risk unsafe patient care”(Hauer et al., 2014).

“Supervisors’ clinical and teaching expertise, experience in the context, attitudes, and sense of accountability inform their ongoing observation, assessment and decision-making, which determine their trust in the learner. Appropriate trust enables participation in developmentally appropriate learning opportunities. The supervisor can then iteratively observe and assess to support further learning based on anticipating entrustment decisions”(Hauer et al., 2014). “Trust is engendered based on both trainees’ competence, as manifested by their knowledge and clinical performance, and their attitudes toward learning, interactions, and feedback-seeking” (Hauer et al., 2014).

“EPAs form “part of essential professional work in a given context” and “should be entrusted only to those individuals who have adequate competency to carry them out. Assessment based on EPAs defines the degree of independence or supervision with which a trainee can be entrusted to perform a workplace task. Based on professional experience and understanding of the activity, the supervisor making an entrustment decision incorporates information from observations and inferences to render a forward-looking judgment about future performance of an activity” (Hauer et al., 2014).

“The distinction between competencies as an educational framework and as evaluation tools has become blurred. Attempts to reliably measure the competencies separately from one another have not been successful, and this has frustrated clinical educators tasked with assessing trainees in the new competency-based training paradigm. The concept of EPAs was developed for medical education as a workbased assessment tool. Adequate completion of the critical activities defined by EPAs requires the possession of several competencies. Therefore, as a relevant representation of the day-to-day activities of a specific medical specialist, EPAs “bridge the gap” between the theory of competency-based training and the application of those competencies in discrete activities that can be observed and assessed. Assessment through entrustment embraces the subjectivity of experienced evaluators and validates subjective, holistic impressions of trainees based on specific knowledge, skills, and attitudes” (Rose et al., 2014).

“EPAs allow decisions regarding entrustment to be made for separate units of professional practice, resulting in a gradual, legitimate participation in professional practice, rather than on the last day of training. It transforms traditional assessment into entrustment decisions as a frame of reference” (Touchie & ten Cate, 2016) . With EPAs, increased entrustment of the trainee to independently perform clinical care occurs as they are assessed to have achieved progressively higher levels of the Milestones associated with the Competencies.

“Supervisors regularly need to decide what level of trainee supervision is needed for safe patient care. Assessment using EPA formalises these daily clinical entrustment decisions, by providing a framework to collect evidence and document what clinical supervisors are already doing – using their expert judgement based on their observations of the trainee's proficiency” (El-Haddad et al., 2016).

“Entrustment decisions require a specification of exactly what has been decided. Trust relates to the acceptance that the trustee is permitted to act in circumstances where risks are present but can be managed. Trainees may be trusted and licensed to drive a car unsupervised when adequate driving skill and relevant knowledge has been demonstrated. Their competence has reached a threshold that permits them to do this. The risk of accidents is now considered low and manageable. For trainees in the health

care domain, a subtler transition between full supervision and unsupervised practice aligns better with heath care practice. The five levels of decreasing supervision, most used when applying EPAs, are described in Fig 1.2.4.1." (Ten Cate et al., 2015).

EPA-based assessment is framed as entrustment to carry out critical activities under a designated level of supervision. In other words, a trainee is primarily evaluated to determine how much supervision s/he needs for a specified EPA, designated by five levels of supervision (ten Cate & Scheele 2007; ten Cate 2013): (1) no permission to act, (2) permission to act with direct, pro-active supervision present in the room, (3) permission to act with indirect supervision, not present but quickly available if needed, (4) permission to act under distant supervision not directly available (''unsupervised'') or (5) permission to provide supervision to junior trainee

Level 1 - Be present and observe
Level 2 - Act with direct, pro-active supervision, i.e. with a supervisor physically present in the room
Level 3 - Act with indirect, re-active supervision, i.e. readily available on request
Level 4 - Act with supervision not readily available, but with distant supervision and oversight
Level 5 - Provide supervision to junior trainees

Figure: 1.2.4.1. " General framework of permissions, related to supervision levels" (Ten Cate et al., 2015)

" Entrustment refers to the granting to trainees the privilege to perform the professional activity, or EPA, without supervision within the context of a residency program"(Chang et al., 2013). "A summative entrustment decision, formalising a further step toward autonomy, acknowledges not only ability, but also the right and duty to act. Summative entrustment decisions about EPAs in health care are like a new driver's license. From that moment on, the learner is being trusted to act unsupervised. Trust involves accepting a risk of driving in heavy traffic, as well as working in a busy clinic, as not all situations can be foreseen or observed. Summative entrustment decisions should lead to STARs (Statements of Awarded Responsibility) with an expiration date" (Touchie & ten Cate, 2016) . "Summative entrustment decisions for an EPA at level 4 should be regarded as certification or a license to practice for that particular unit of professional practice"(Ten Cate & Scheele, 2007). "The focus on the fourth level as the target for unsupervised practice for any learner and the level 4 milestone also align, whereas level 5 on both scales reflects an aspiration that is not required for all graduates " (Touchie & ten Cate, 2016).

Entrustment serves to acknowledge ability, and provide permission to act unsupervised and to enact duties in health care practice. True competency-based medical education grants certification as soon as competence is adequately demonstrated. EPAs allow decisions regarding entrustment to be made for separate units of professional practice, resulting in a gradual, legitimate participation in professional practice, rather than on the last day of training. It transforms traditional assessment into entrustment decisions as a frame of reference. date (Touchie & ten Cate, 2016).

Although entrustment is similar to the decisions faculty supervisors make every day about trainees, the formal entrustment decision must be a carefully considered advancement decision based on specific criteria as well as global impressions. Entrustment should not be casual and should not be based solely on number of months of experience. A critical element of entrustment is the concept of trustworthiness for clinical work, which Kennedy et al describe as consisting of 4 dimensions: knowledge and skill, discernment of limitations, truthfulness, and conscientiousness. Ultimately the most important consideration with entrustment is the safety of patients in the hands of the person entrusted to perform the clinical activity. In practice, the entrustment decision will only be as good as the data used to make the decision. Entrustment decisions carry significant consequences for trainees, training programs, and patients. High-stakes decisions of this type must be made based on data generated from assessment tools with robust validity evidence that withstand scrutiny.

“While a traditional assessment reflects how a trainee has performed when observed, an entrustment decision looks into the future and represents a calculated risk, anticipating that the trainee will do well when there is no supervision. It combines evaluation with an estimation of risk” (Ten Cate et al., 2015).

“Entrustment decisions may be distinguished in (i) ad hoc entrustment decisions that happen every day, usually taken by individual supervisors and pertaining to immediate permission for the trainee to act, and (ii) summative entrustment decisions that are grounded in more systematic observation, leading to lasting permission to act under a specified level of supervision, comparable with the driver’s license that formalises permission to drive unsupervised from that point onwards” (Ten Cate et al., 2015). “Ad hoc entrustment may stimulate development and evaluation of trainee readiness for summative decisions. Conversely, a summative entrustment decision is a general statement that must be documented, awards a higher level of responsibility for future actions and should be recognisable by third parties. Both are important in EPA-based curricula. The ad hoc decision experiences of a supervisor may be documented in the trainee’s portfolio (was this a justified decision? If not, why not?). Summative decisions may be informed by multiple ad hoc decisions supplemented with information gathered through other channels (multi-source feedback, knowledge assessment and skills assessment). Summative entrustment decisions should be multi-source decisions based on the summation of smaller elements of information” (Ten Cate et al., 2015).

“EPAs as an assessment methodology allow supervisors to observe the performance of a learner in an authentic environment, executing professional work. For example, the EPA of performing an appendectomy requires that a physician has the knowledge and skills to know when and how to perform the procedure, can explain to the patient why the procedure is necessary and what is to be expected, and will coordinate with other health care providers to complete the procedure safely. The supervisor or a group

of supervisors observes how the learner has performed the task and judges how much they would entrust the learner to do the EPA with a certain level of supervision in the future. Observation of a learner conducting an EPA would enable a supervisor to determine the learner's ability to perform that activity with decreasing supervision and increasing autonomy" (Teherani & Chen, 2014) .

"Using EPAs as the cornerstone of assessment is strongly encouraged in part because these critical activities and the concept of entrustment should both be familiar to clinical faculty, even inexperienced evaluators. Furthermore, use of EPAs emphasizes direct observation as the most important assessment method, which should lead to increased opportunities for faculty-trainee interaction to form a more complete basis for assessment" (Rose et al., 2014).

Assessment of the EPAs will be by observation of the clinical activity, review of the case notes and discussion with the trainee about the activity. The EPA is a global assessment of competence, as such trainees will be observed in real practice and will either be able to be entrusted (pass) or not entrusted (fail) in the particular activity. For those who are not entrusted it will be necessary to "unpack" the activity to identify the areas of weakness so there can be further remediation supported by specific workplace-based assessment to ensure they have improved that specific skill.

"EPAs facilitate competency-based assessment in clinical practice via supervisors' entrustment decisions, implying that a trainee is qualified to perform an EPA with a certain degree of independence" (Hauer, Kohlwes, et al., 2013). "In essence, what an EPA assessment should be doing is formalizing what currently is done in a potentially haphazard way. It makes it more specific to a stage of training, is defined, and allows for feedback and revision. It should provide most supervisors with tools to manage activities and bring structure to the process of teaching and evaluating a trainee's progress" (Rashid, 2015). "Ultimately, EPAs are useful for clinical assessment because they incorporate multiple competencies, observable behaviours, and the ability to draw conclusions about accountability and trustworthiness" (Post et al., 2016).

EPA help programme/supervisor /a student/trainee as a whole

"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. EPAs help training programs to move from fixed-length to variable-length programs and transform traditional assessment into entrustment decisions where the endpoint is defined by these entrustable activities. EPAs may eventually allow for a major shift in the structure of training programs. Programs may be able to transition from a time-dependento an outcome-dependent model tailored to the pace of achievement of the individual learner" (Amare et al., 2021).

“The EPAs provide clear behaviorally based objectives for faculty to reflect on a fellow’s performance to aid in assessment. Faculty in a certain rotation might review the relevant portions of the EPAs related to their clinical setting and then review the related subcompetencies of the reporting milestones. Group discussion can lead to a shared mental framework and allow for more consistent assessment across faculty” (Rose et al., 2014).

“EPAs can also be used to structure teaching and provide assessment guidelines for both trainees and supervisors. An EPA-based training programmed can equip supervisors to make an informed, safe entrustment decision. 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. It also helps trainees develop learning plans by identifying the necessary knowledge, skills, and attitudes at each training level. Finally, EPAs help trainees to engage in self-reflection and motivate trainees to earn entrustment”(Amare et al., 2021)

Students will benefit from the use of EPAs as they provide a strong connection between classroom and practice, with students being able to discern how the curriculum prepared them for practice. EPA adoption can help students link their learning to real expectations and responsibilities. EPAs are a mechanism for defining the abstract concept of professional identity so students can understand their role and responsibilities on the health care team in a tangible way (Jarrett et al., 2018).

“EPAs can help trainees identify the goals and expectations of training, not just from individual programs but also from the specialty and society as a whole. Trainees can use the EPAs to identify the specific knowledge, skills, and attitudes they need to master to achieve entrustment. The EPAs are a useful tool as fellows engage in self-reflection or develop learning plans for each stage of training. EPAs can motivate trainees to earn entrustment and thereby competence as early as possible in the training, provided that the implications of entrustment are clearly defined and meaningful and that opportunities for supervisory roles and advanced learning exist” (Rose et al., 2014).

“Quality formative feedback is essential for learning, and programs are expected to provide each fellow with evaluation of performance with feedback. In turn, fellows are expected to be able to incorporate formative feedback into daily practice. Feedback should focus on specific knowledge, skills, and attitudes that the evaluator has witnessed directly ; therefore, EPAs are ideally suited to facilitate the feedback process. Feedback is generally welcomed when it is based on performance and tailored to the learner’s goals. We recommend using EPAs to help trainees pinpoint the specific knowledge, skills, and attitudes that, once mastered, would lead to an entrustment decision, which necessarily leads to development of competence” (Rose et al., 2014).

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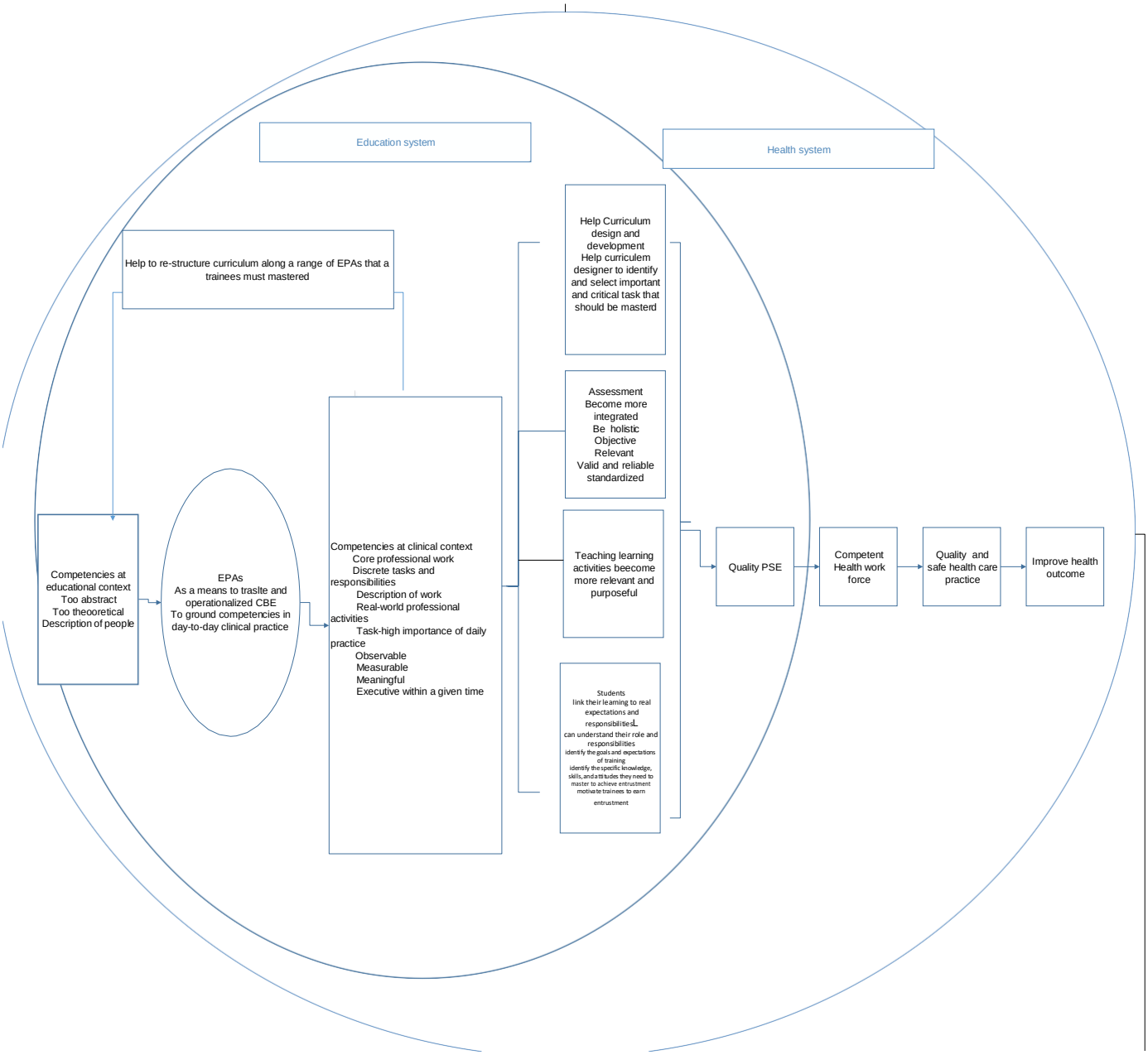

Figure 1.2.4.2: The conceptual framework of potential benefits of EPAs (modified from WHO Framework, 2010).

Generally, a potential benefit of the use of EPAs in Post Graduate Medical Education is that it can facilitate entrustments in a for clinicians and resident's comprehensible way. " Entrustment is the clinically meaningful summative judgment based on a rich source of information about the quantity and quality of a resident's professional performance"(van Loon et al., 2014).

EPA development and validation

"Studies of EPAs to date have focused mostly on defining critical activities requiring entrustment decisions at the postgraduate level in specific residency programmes. Defining these activities, as well as identifying possible gaps between supervisor expectations and what residents actually do in the workplace, are important steps in making sure that incoming residents assume the level of responsibility expected by their clinical supervisors (CSs) to ensure that their learning is maximised and that patients receive optimal and safe care" (Touchie et al., 2014).

"Identifying EPAs as suitable units of professional practice is usually an iterative process among professionals. One method is to have a small group of professionals with a similar background analyse a week of work in the profession, starting Monday morning and ending Sunday evening, at a typical location, such as a health care subspecialty ward, and identify units of work that can serve as an EPA. An important question to ask is what graduates of the programme are expected to do when starting a new phase in the trajectory, such as a residency after graduation, a fellowship after residency or unsupervised practice after a residency or fellowship" (Ten Cate et al., 2015).

"Identifying core EPAs as suitable units of professional practice is usually an iterative process among professionals. 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" (Amare et al., 2021). "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" (Amare et al., 2021) .

"EPAs should be as relevant as possible, and supported by those who work with it. With validation we primarily focus on content validation (Is an EPA truly part of work, does it comply with the EPA definition and is it fit for its purpose?). Validation of EPAs aims to align them as closely as possible with common requirements for graduates from the programme and should lead to well-founded recognition of entrusted EPAs. Content validation of a set of EPAs also aims to cover all core activities of a profession"(Ten Cate et al., 2015). Evidence for content validity of EPAs can be gathered with several techniques as shown in the figure (modified based on (Bok, 2015).

Strategy	Explanation	References to examples
Expert meetings, national or international	Meetings of experts during conferences or gathered for this purpose are used to build consensus about EPAs	Chang et al. (2013), Fessler et al. (2014a,b), Chen et al. (in press), Hauer et al. (2013) and Caverzagie et al. (2015)
Surveys	Asking an expert populations to score the validity of EPAs for a designated purpose	Boyce et al. (2011)
Delphi procedure (Jones & Hunter 1995)	Carefully selected experts are surveyed with a list of EPAs to score their validity on a scale; aggregated results are presented to the subjects to refine their original score. If needed, a third round is conducted	Fessler et al. (2014a,b), Hauer et al. (2013). In preparation: Wisman-Zwarter et al., Duijn et al. and Peters et al.
Nominal group technique (Jones & Hunter 1995)	Establish a listing of potential EPAs among an expert group until no new EPAs can be thought of. Then refine the list by grouping and prioritizing to finalize with a best consensus list	Touchie et al. (2014)
Interviews	Programme directors can be interviewed asking ''what activities would you expect incoming residents be able to do without direct supervision'' or hospital department heads about which EPAs newly hired specialists should be able to do autonomously	Westerveld et al. (2004) and Spenkelink-Schut et al. (2008)

Figure 1.2.5.1 : " Strategies described in the litrarture to validate EPAs"(Ten Cate et al., 2015)

1.2.5 Number and breadth of EPAs

"The breadth of an EPA can be related to the end-of-training programme requirement, or the entrance requirement for the next phase of training. The breadth or the size of EPAs is directly linked to the number of them, and the smaller they are the more are needed to cover professional practice need for progressive independence or autonomy" (Ten Cate et al., 2015). "The suggested number of EPA for a full postgraduate programme is 20–30. The selected EPA should be 'critical activities that constitute a specialty', which can be unique to the practice setting or context where the assessment occurs" (El-Haddad et al., 2016).

Source	Programme	Length (years)	Number of EPAs
Mulder et al. (2010)	Physician assistant education	2.5	5–8
Boyce et al. (2011)	Psychiatry residency, 1st year	1	4
Jones et al. (2011)	Paediatric residency	3	17
Hauer et al. (2013)	General internal medicine residency	3	30
Chang et al. (2013)	Internal medicine (patient-centred med. home programme)	Unspecified	25
Shaughnessy et al. (2013)	Family medicine residency	3	76
O'Keeffe (2014)	Developmental-behavioural paediatrics residency	Unspecified	14
Englander et al. (2014)	Undergraduate medical education (± 2.5 year clinical)	2.5	13
Fessler et al. (2014a,b)	Pulmonary care residency	1–2	18
Fessler et al. (2014a,b)	Critical care medicine residency	1–2	13
Rose et al. (2014)	Gastro-intestinal fellowship	3	13
Caverzagie et al. (2015)	Internal medicine residency	3	16
Chen et al. (in press)	Undergraduate medical education pre-clerkship training	2	5
Shumway et al. (2015)	Haematology/oncology fellowship	2–3	5
Schultz et al. (2015)	Family medicine	2	35

Figure 1.2.5.2. Number of EPAs proposed, related to programme length(Ten Cate et al., 2015)

1.2.6 EPA description /elaboration

“For educational purposes, it is not sufficient to identify EPAs only as a simple list of tasks or titles. The reason is that most formulations of tasks are open to multiple interpretations. To enable an entrustment decision (‘‘the trainee may now do this with only indirect supervision’’), there must be specifications ”(Ten Cate et al., 2015). “Ideally EPAs should be described in sufficient detail so that trainers and trainees know exactly where the trainee stands and what exactly they can and cannot do” (Sharma et al., 2018). “To qualify as an EPA, the task must be clearly described, which also maps the necessary competencies” (Moore et al., 2017).

The description contains a brief title, a breakdown of the clinical task to be performed, the necessary prerequisite knowledge/skill/attitudes, information used to assess progress and the basis for entrustment decision. The recommended full description of an EPA, therefore, includes the rubrics evolved from earlier versions of this format (Mulder et al. 2010; ten Cate 2013).

1. Title of the EPA	An EPA title should be concise and informative, i.e. readily understood. As it only reflects work, it should not be stated as a learning objective, or skill, merely as an activity. Try to limit to 10 words or less. Use neutral infinitive tense to avoid the association with individuals (e.g. ‘‘discharging patients’’ instead of ‘‘discharges a patient’’)
2. Specification and limitations	This specification should clearly list what is included in the activity and what is not included, given the level of the intended trainees. It should also include the context and targeted transition (e.g. entering residency, fellowship, autonomous practice)
3. Most relevant domains of competence	This section relates the EPA to the competency framework used. Those domains of competence or competencies of the framework that are most applicable may be mentioned
4. Required experience, knowledge, skills, attitude and behaviour	Trainees should be aware what knowledge, skills and attitudes are expected before they can be trusted to carry out the EPA; this will help them to prepare for entrustment. It may also be helpful to understand which workplace experiences are considered necessary before entrustment (type of rotation, type of patients, number of procedures)
5. Assessment information sources to assess progress and ground a summative entrustment decision	Supervisors should be aware what sources of information should be used to determine progress. That can be observed behaviour or skill at the bedside or at morning report meetings; a skills test; information from colleagues, nursing and patients; a double-checked procedure; a case-based discussion and other sources. For trainees as well as supervisors it is important to state how many times an EPA or its constituent parts must have been observed to enable taking a summative entrustment decision, and to state who takes this decision. It is highly recommended that multiple staff members sign off such decisions. Supervisors should feel personal responsibility for these important decisions
6. Entrustment for which level of supervision is to be reached at which stage of training?	The consequence of an entrustment decision is stated as the permission to act under a designated level of supervision (e.g. indirect supervision, or distant supervision) not generally permitted before that time Next, it is necessary to state at which transition of training trainees must ultimately master the EPA at the designated level. Graduation should require that all core EPAs of the programme be mastered When building an individual workplace curriculum it is useful to estimate when this trainee is expected to receive the entrustment decision, based on prior training and expected rotations and experiences
7. Expiration date	Optional but recommended is stating expiration dates. Entrustment should drop if no maintenance of competence for this EPA happens, e.g. over a period of one up to 5 years, depending on the EPA. Revalidation may require a marginal or a more substantive check

Figure 1.2.7.1. “Components of a fully described EPA”(Ten Cate et al., 2015).

1.2.7 EPAs are context dependent

“Although a number of medical education providers are using EPAs in their training programs, and core EPAs have become available worldwide, 1 set of core EPAs cannot automatically be transferred from one context to another” (Amare et al., 2021). “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” (Amare et al., 2021). “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” (Amare et al., 2021).

With this in mind, the need to develop EPA “framework to Inform surgical residency training programs in the context of Ethiopia medical education” (Amare et al., 2021).The goal is for graduating surgical residents must be able to excuet out these EPAs independently by the time they graduate. However, concerns have also been raised about the graduating general surgery resident's ability in executing EPAs (Friedell et al., 2014). According to studies, surgical residents lack confidence and are unable to execute EPAs autonomously upon graduation (Bucholz EM, 2011 Aug 15; Perone JA, 2017 Apr 1; Wagner JP, 2018 Apr). 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”(Amare et al., 2021), as well as to assess how faculty members judge residents' performance in executing EPAs and how residents rate their own ability in order to systematically introduce and implement EPAs in surgical residency training programs.

1.2.8 Objectives

- 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”(Amare et al., 2021).
- To assess how faculty members judge residents' performance in executing EPAs and how residents rate their own ability in order to systematically introduce and implement EPAs in surgical residency training programs.

2. Material and Methods

2.1 Methods and materials (Study 1)

2.1.1 Study design, setting and study population

“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 subjectmatter practitioners”(Amare et al., 2021).

“The study took place within the departments of surgery at 10 public surgical residency training institutions in Ethiopia from May through December, 2020”(Amare et al., 2021). “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”(Amare et al., 2021). “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”s (Amare et al., 2021).

“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” (Amare et al., 2021). “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” (Amare et al., 2021).

2.1.2 Data collection methods, tools and data analysis

“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”(Amare et al., 2021). “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”(Amare et al., 2021).

“Procedure: Assembly of Delphi Consensus Panel” (Amare et al., 2021)

“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” (Amare et al., 2021).

“Round 1: Identification of potential end-of-training EPAs for Surgical Residency Training Programs (Delphi Consensus Panel)” (Amare et al., 2021).

“Participants in this round were purposefully selected based on their experience and active role in the National Technical Working Group in Surgical Training Programs” (Amare et al., 2021). “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) ”(Amare et al., 2021). “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” (Amare et al., 2021).

“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” (Amare et al., 2021).

“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 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” (Amare et al., 2021).

Entrustable Professional Activities (EPAs) as Discrete Units of Work

This EPA has a clearly defined beginning and end

Neither the beginning nor the end of the activity is clearly defined		The beginning OR the end is clearly defined but not both		The beginning and end are both clearly defined
1	2	3	4	5

This EPA is independently executable to achieve a defined clinical outcome

Routinely depends on multiple other contributing tasks/activities	Routinely depends on one other contributing task/ activity	Can be independent, but commonly depends on other tasks/activities to achieve its clinical outcome	Typically independent, but infrequently depends on other tasks/activities to achieve its clinical outcome	Independent of other tasks/ activities to achieve its clinical outcome
1	2	3	4	5

This EPA is specific and focused

Describes a large, general area of practice or describes domains of competence	Is a general category of work that serves a broad purpose	Is a general category of work that serves a clear and focused purpose	Includes a few closely-related units of work that serve a common, clear and focused purpose	Is specific work that serves a clear and focused purpose
1	2	3	4	5

This EPA is observable in process

The activity cannot be observed or monitored	Parts of the activity can be monitored, but only indirectly	Some parts of the activity can be directly observed	Most of the activity can be directly observed, but not the entire activity	The activity can be observed in all aspects from beginning to end
1	2	3	4	5

This EPA is measureable in outcome

The outcome of the work cannot be described or measured	Limited aspects of the outcome can be inferred from indirect assessment but not direct measurement	The outcome of the work can be inferred, but not directly described or measured	The outcome of the work can be largely described and/or measured directly	The outcome of the work can be fully described and/or measured directly
1	2	3	4	5

This EPA is clearly distinguished from other EPAs in the framework

Cannot be meaningfully distinguished from one or more of the other EPAs	Has clear similarity or overlap with one or more of the other EPAs	Has similarity with other EPAs in the framework, but there are also some clear distinguishing features	Has some similarity with one or more EPAs in the framework, but there are clear and important distinguishing features	Has no apparent overlap with other EPAs in the framework
1	2	3	4	5

EPAs as Entrustable, Essential, and Important Tasks of the Profession

This EPA describes work that is essential and important to the profession

Very low importance to professional practice	Limited importance; is non-essential to practice	Important but professional practice could succeed without it	Important and is expected for professional practice	Very important and essential to professional practice
1	2	3	4	5

Performing this EPA leads to recognized output or outcome of labour

No discernable product or recognized outcome from the work	Variably produced outcome but it is not clearly attributable to the work	Variably produced outcome attributable to the work, or a typically produced outcome not clearly attributable to the work	Typically a defined outcome attributable to the work	A clear and defined outcome consistently produced from the work
1	2	3	4	5

The performance of this EPA in clinical practice is restricted to qualified personnel

Is routinely done by untrained persons	Requires limited training to perform	Requires training to perform	Requires training and qualification/certification to perform	Exclusively performed by trained and qualified individuals within the profession
1	2	3	4	5

This EPA addresses professional work that is suitable for entrustment

Has no influence on the well-being of patients or the public as a whole	May contribute to health care system, but only minimally or indirectly influences the care of patients or the public as a whole	Contributes to the well-being of the public as a whole, but lacks direct influence on clinical care	Expected of a physician and contributes to safe clinical practice, but is not clinical care itself	Clearly expected of a physician as part of delivering competent clinical care
1	2	3	4	5

EPAs' Curricular Role

This EPA requires the application of knowledge, skills, and/or attitudes (KSAs) acquired through training

The KSAs required for the task are not acquired through training	Training adds somewhat to the KSAs required for the task	The KSAs required for the task require training, but success is strongly influenced by non-trainable qualities	The task is largely dependent on trainable KSAs for success and is influenced only modestly by non-trainable physician qualities	The task is completely dependent on KSAs acquired through training for success
1	2	3	4	5

This EPA involves application and integration of multiple domains of competence

Does not reflect any identified domain of competence	Reflects only one domain of competence	Reflects one domain of competence, although other domains may be identifiable	Requires integration of multiple domains to perform but with one domain dominant	Involves the integration of multiple domains of competence
1	2	3	4	5

The EPA title describes a task, not qualities or competencies of a learner

Describes a single quality/ competency of a clinician without describing application in clinical work	Describes a single quality/ competency of a clinician and references application in a clinical context	Describes the clinician who integrates multiple qualities/competencies but does not describe clinical application	Describes the clinician who integrates multiple competencies and also describes the associated professional activity	Describes only a professional activity
1	2	3	4	5

This EPA describes a task and avoids adjectives (or adverbs) that refer to proficiency

Employs adjectives that focus it primarily on proficiency and not the task	Employs adjectives that focus it primarily on proficiency, but also describes the task	Employs adjectives referencing proficiency, but overall primarily describes the task	Employs no adjectives referencing proficiency; it does imply some aspects of proficiency of the learner	Employs no adjectives referencing proficiency and does not imply proficiency of the learner performing the task
1	2	3	4	5

Figure 2.1.2.1. Equal rubric tool - a tool used for evaluating the quality of EPAs(modified based on (Taylor et al., 2017)

Round 2 of the Delphi Process: Evaluating the Relevance

“Two weeks after the first Delphi round,33 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” (Amare et al., 2021). “The 4-point rating scale was preferable because it does not include the neutral middle rating common in odd number rating scales. In addition to rating, participants had an opportunity to comment on the proposed EPAs” (Amare et al., 2021).

“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(Lynn, 1986),(Polit & Beck, 2006) and (Polit et al., 2007) ” (Amare et al., 2021).

“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. 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” (Amare et al., 2021).

Round 3: “ *Delphi Survey* ”(Amare et al., 2021)

“The Delphi survey was conducted from September to November 2020 with the goal to further validate 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 $1+ 8 (1.96)^2 (1 - p^2) \frac{(1+p)^2}{2w2p}$ ” “Hence, we invited all SMEs (i.e., general and sub-specialist’s 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. 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’’). 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" (Amare et al., 2021).

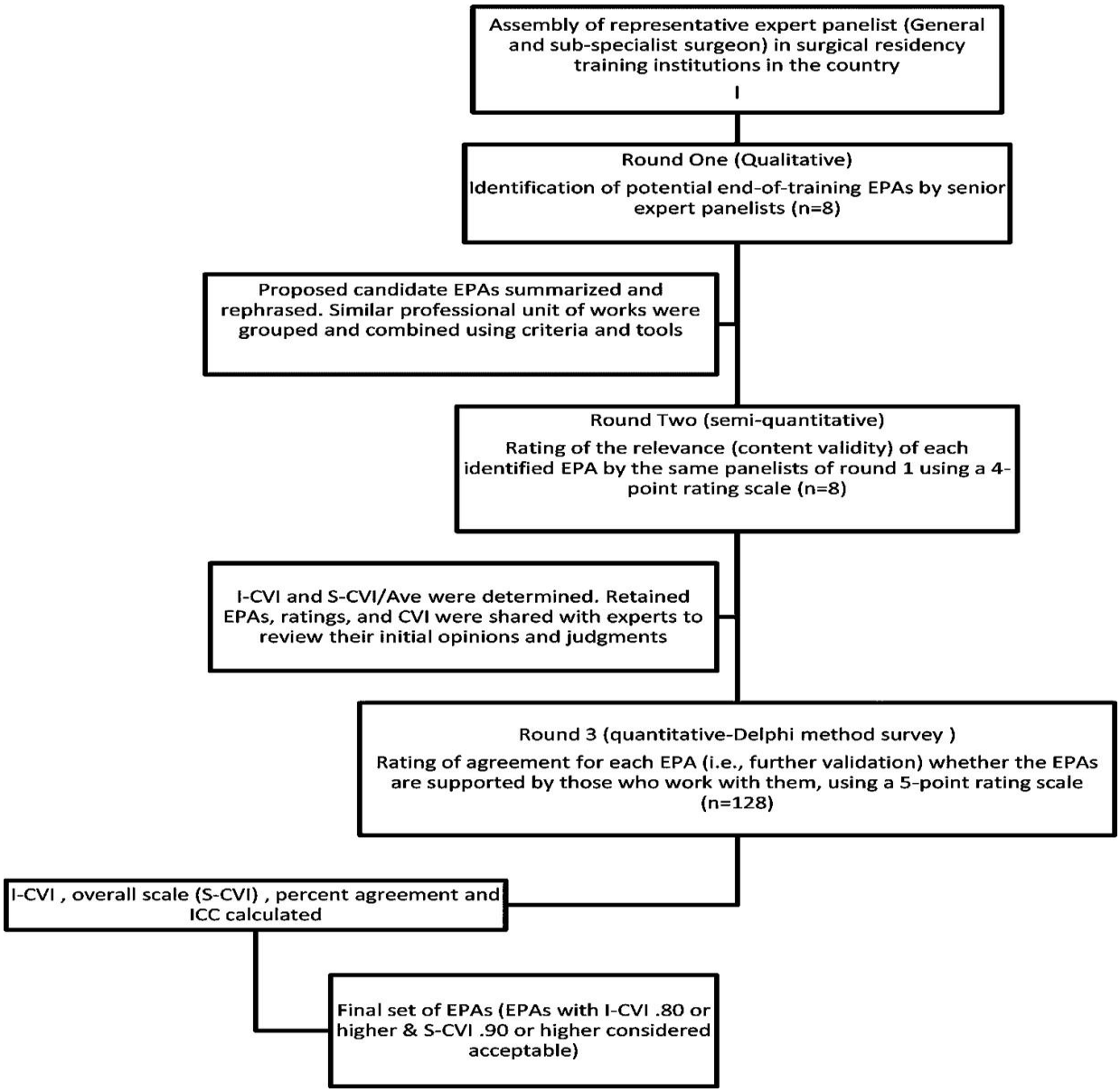

FIGURE 2.4.1. "Schematic representation of data collection methods and procedure"(Amare et al., 2021)

2.2 Methods and materials (Study 2)

2.2.1 Study Setting and Participants

The survey was carried out from June 21, to August 21, 2021 at the Departments of Surgery of St. Paul Hospital Medical Millennium College (SPHMMC), University of Gondar (UoG), Jimma University (JU), and Adama Medical Colleges (AMC) in Ethiopia. These institutions are among the country's major residency training centers and perform a large number of surgical procedures each year (more than 3,000 different procedures). Participants in the study included surgical faculty team members (general and sub-specialized surgeons, anesthetists, and Operating Theatre (OT) nurses) with two years or more of experience in surgical residency training. Furthermore, general surgery residents who had completed their training and were about to graduate (Year 4 residents) were invited to be a part of the study.

2.2.2 Survey tool

The survey instrument contained all the twenty-nine end-of-training EPAs (see supplementary file Table 1) for surgical residents in Ethiopia. (Amare et al., 2021) and the recommended standard framework of supervision levels were used to judge resident performance on a 5-point Likert scale (Ten Cate et al., 2015; Touchie & ten Cate, 2016).

Supervision levels are defined as:

1	Not safe to perform the task (safe only to observe
2	Safe to perform under direct supervision
3	Safe to perform under indirect supervision
4	Safe to perform independently with oversight
5	Safe to supervise others

Summative entrustment decisions for an EPA at level 4 should be regarded as certification or a license to practice for that particular unit of professional practice (Ten Cate et al., 2015; Touchie & ten Cate, 2016).

The survey questionnaire also contained questions about participants' socio-demographic information, clinical specialization, and years of experience (see supplementary file Table 2). In the survey, surgical team members were asked to rate the observed performance of a group of graduating surgical residents

in each of the 29 EPAs. This means that the surgical team members rated the residents' performance as a group rather than as individuals. Residents were asked to rate their own capabilities in performing each of the 29 EPAs. During a morning general session, we fully briefed all participants on the purpose and procedures of the study and obtained informed verbal consent.

2.2.3. Data Analysis

Mean and standard deviation of performance scores were calculated for surgical team and resident evaluations separately. A two-sample independent t-test (t-value, and p-value) was used to determine if the mean rating of performance by the two groups (surgical team and residents) differed significantly and Cohen's d to assess size of the mean difference. A one-way between-groups analysis of variance was conducted to explore the impact of clinical area of specialization on the rating of residents' performance in executing EPAs.

2.3. Ethical Considerations

"This study was conducted with the approval of the Ludwig-Maximilian's University of Munich and Ethiopian Public Health Association institutional review board. Respondents provided informed consent to participate in this study" (Amare et al., 2021).

3. Results

3.1 Result (Study 1)

3.1.1 "Characteristics of the Delphi Expert Panel (Delphi round 1 & 2)"(Amare et al., 2021).

"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" (Amare et al., 2021). (Table 3.1.1.1).

TABLE 3.1.1.1."1: Socio-demographic characteristics of the Delphi Round 1" and 2 Expert Panel" (modified based on (Amare et al., 2021).

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

3.1.2 "Delphi Round 1: Identification of Potential end-of- training EPAs for Surgery Residency Programs"(Amare et al., 2021)

"In the first Delphi round, 8 professional panelists pro- posed 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 3.1.2.1 at the appendix" (Amare et al., 2021).

"After removing duplicates and grouping closely related units of work, a set of 39 potential end-of-training EPAs remained" (Amare et al., 2021) (Table 3.1.2.2).

TABLE 3.1.2.2 "Candidate end of Training EPAs Statements for Surgical Residency Training After Grouping Closely Related Units of Work and Removing Duplicates in Delphi Round 1"(modified based on (Amare et al., 2021).

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)
	Perfroming 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.

3.1.3 "Delphi Round 2: Rating of the Relevance of Core EPAs Statements (content validation)"(Amare et al., 2021)

"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 con- tent 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 accept- able level of content validity index"(Amare et al., 2021) (3.1.3.1).

TABLE 3.1.3.1."Rating on the Relevance of Core EPAs Statements by 8 Experts" (Amare et al., 2021)

EPA statement #	*# of Experts in agreement*	*CVIforitem(I-CVI)*	*UA*	*Remark*
1	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
2	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
3	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
4	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
5	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
6	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
7	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
8	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
9	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
10	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
11	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
12	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
13	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
14	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
15	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
16	*2*	*0.25**	*0*	*Notqualifiedfornextroundvalidation*
17	*2*	*0.25**	*0*	*Notqualifiedfornextroundvalidation*
18	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
19	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
20	*2*	*0.25**	*0*	*Notqualifiedfornextroundvalidation*
21	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
22	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
23	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*

24	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
25	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
26	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
27	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
28	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
29	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
30	*8*	*1*	*1*	*Qualifiedfornextroundvalidation*
31	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
32	*4*	*0.50**	*0*	*Notqualifiedfornextroundvalidation*
33	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
34	*2*	*0.25**	*0*	*Notqualifiedfornextroundvalidation*
35	*3*	*0.38**	*0*	*Notqualifiedfornextroundvalidation*
36	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
37	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
38	*7*	*0.88*	*0*	*Qualifiedfornextroundvalidation*
39	*3*	*0.38**	*0*	*Notqualifiedfornextroundvalidation*
	S-CVI/Ave	*0.85*		
	NumberofEPAsachieved100%	*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"(Amare et al., 2021).

3.1.4 "Delphi Round 3: Rating of Agreement on the Relevance and Representativeness of Core EPAs Statements"(Amare et al., 2021)

"Of all the total invited surgical residency training institutions in the country (n = 12), data was returned from 10 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"(Amare et al., 2021).(Table 3.1.4.1).

Table 3.1.4.1: Demographic characteristics of participants at round 3 Delphi method survey

Name of institutions	Level of specialization		Sex		Year of service		
	General surgeon	Sub -special-ist	M	F	<5 year	5-10 year	>10 year
University of Gondar (n=16)	9	7	16	0	8	5	3
Bahir Dar University (n=9)	7	2	9	0	4	5	0
Jimma University (n=15)	8	7	13	2	11	4	0
Hawassa University (n=12)	10	2	12	0	7	4	1
Haromiya University (n=10)	10	0	9	1	5	4	1
St Paul Millennium Medical College (n=21)	15	6	18	3	9	8	4
Adama Medical College (n=8)	8	0	8	0	1	5	2
Arisi University (n=10)	10	0	9	1	9	1	0
Wolaita Sodo University (n=9)	9	0	9	0	7	2	0
Wollo University (n=18)	18	0	18	0	10	3	5
Total	104	24	121	7	71	41	16

“Thirty-two EPAs with a I-CVI of 0.80 or above from Delphi round 2 was included in the final validation sur- vey. 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 (EPA # 13, 16, & 30) received lower than the acceptable item-level content validity index (I-CVI <0.80)”(Amare et al., 2021). (Table 3.1.4..2).

Table 3. 1. 4.2 . "Rating of Agreement on the Relevance and Representativeness of Core EPAs Statements" (modified based on (Amare et al., 2021)

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

	S-CVI/Ave	0.92	92%	
EPAs achieved 100% experts in agreement				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)

"Values from the study groups in the survey are clustered fairly tightly together (dot plot 3.1.4.1) 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 shaown in figure 3.1.4.1"(Amare et al., 2021).

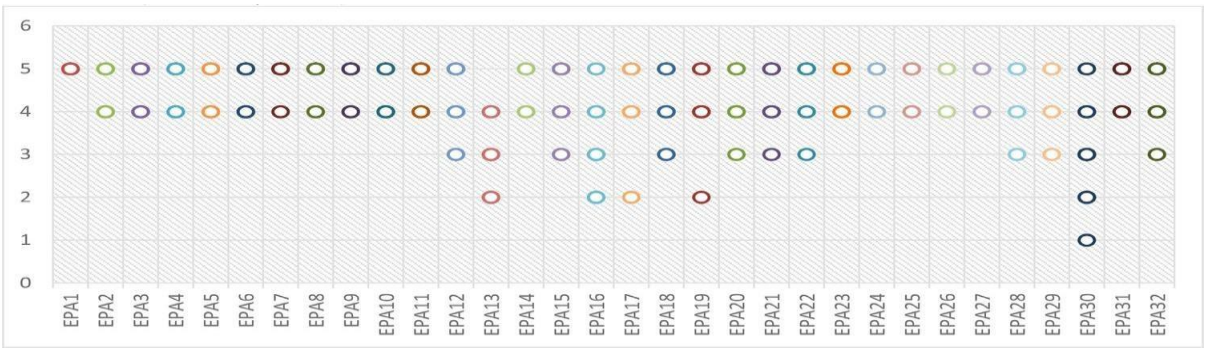

FIGURE 3.1.4.1.Dot plot of agreement values among attending surgeons (n = 128)(Amare et al., 2021).

TABLE 3.1.4.3. "Inter-rater Agreement for the Attending Surgeons (N = 128) "(Amare et al., 2021).

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

3.2 Result (Study 2)

Out of a total of 137 eligible surgical team members (i.e., two years or more experience in surgical residency training), a total of 125 surgical faculty members participated in this study (response rate = 91. 2%). Of them, 42 were attending surgeons (general and sub-specialist surgeons), 52 were OT nurses and 31 were anesthetists. Most faculty members were males (77.6%) and had 10 years or fewer work experience (81.6%). Furthermore, all 49 (M=48, F= 1) general surgery residents from the four residency training institutions took part in the study (Table 3.2.1).

Table 3.2.1.: Demographic characteristics of study participants by their residency training institutions

Variables		**Surgical faculty (n=125)**					**Graduating general surgery residents (n=49)**				
		SPHMMC	**UOG**	**JU**	**AMC**	**Total**	**SPHMMC**	**UOG**	**JU**	**AMC**	**Total**
Sex	M	41	22	18	16	97	8	15	17	8	48
	F	22	2	3	1	28	1	0	0	0	1
	Total	63	24	21	17	125	9	15	17	8	49
Year of experience	2-4	28	7	11	3	49					
	5-10	24	12	4	13	53					
	>10	11	5	6	1	23					
	Total	63	24	21	17	125					
Area of clinical specialization	Surgeons*	8	13	12	9	42					
	Anaesthetists	11	7	7	6	31					
	OT nurse	44	4	2	2	52					
	Total	63	24	21	17	125					

* Surgeons (General and sub-specialized), SPHMMC = St. Paul Hospital Medical Millennium College, UoG = University of Gondar, JU = Jimma University and AMC = Adama Medical Colleges

Both residents and surgical faculty members rated the perceived level of EPA performance with a minimum score of 1 and a maximum of 5, with a mean rating of 4.2 and 3.7, respectively (Figure 3.2.1).

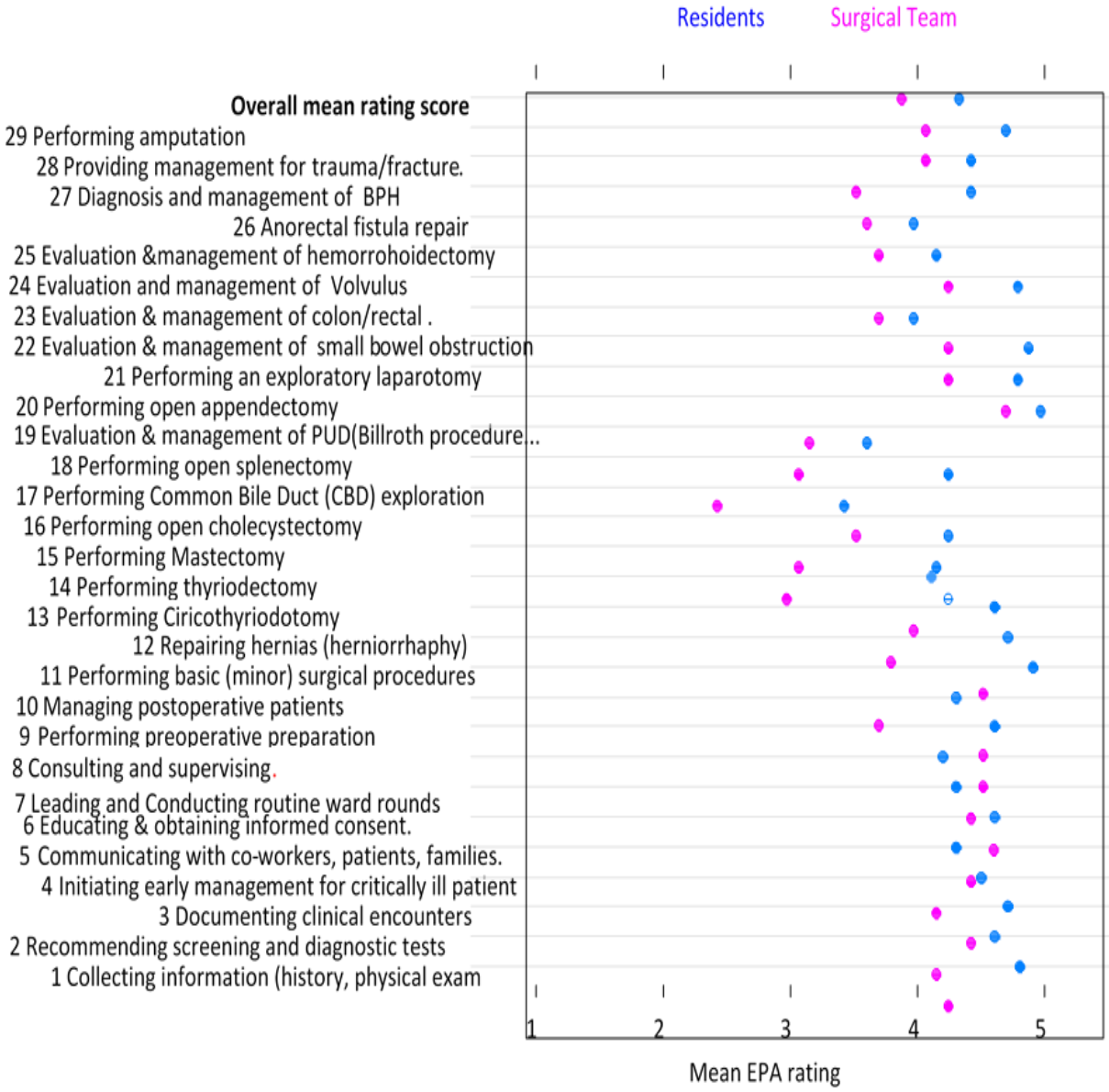

Figure 3.2.1: Mean rating of EPA performance of graduating general surgery residents by the study groups

A statistically significant difference was found between evaluations made by faculty members and residents in 23 out of 29 EPAs (four global performances and nineteen operative skill EPAs) (Table 3.2.2 in the appendex).

An independent two-sample t-test with unequal variance assumption (F = 0.57, numerator df = 48, denominator df = 124, p =.03) revealed a statistically significant difference between surgical team members and residents in the overall (composite) mean rating of resident's performance, with the size of the mean difference being intermediate (Effect Size Cohen's d = 0.6). (Table 3).

Table 3.2.3: Testing the differences in composite rating scores between the two groups of study using an independent samples t-test.

Study group	**N**	**Composite Mean score**	**Pooled SD**	**t-value at 133 df**	**P-value**	**95% CI**	Effect Size (Cohen's d)
Residents	49	4.2	0.63	6.57	.03	[0.51, 0.95]	0.6
Surgical team	125	3.7	0.90				

*Mean difference significant at .05 level

A one-way between-groups analysis of variance was conducted to explore the impact of clinical area of specialization on the rating of residents' performance in executing EPAs. Participants were divided into three groups according to their area of specialization (Group 1: attending surgeons; Group 2: ORT nurses; and Group 3: anesthetists /anesthesiologists). There was a statistically significant difference at the $p < .02$ (at Bonferroni adjusted alpha level of 0.02) level in mean scores for the three groups in a total of 17 EPAs (2 global performance and 15 Operating skill EPAs, (EPA # 1, 4, 8-12, 14,15, 18, 19, 21, 22, 24, 27-29).

Post-hoc comparisons using the Tukey HSD test revealed that the mean rating score for attending surgeons differed significantly from ORT nurses in 10 EPAs (2 global performance and 8 operative skill EPAs (EPA # 1, 4, 8, 10, 11, 12 14, 15, 19, 24) and from anesthetists in 7 operative skill EPAs (9, 18, 21,22, 27-29). Similarly, anesthetists' mean rating score differed significantly from ORT nurses' in 11 operative skill EPAs (# 8-12, 14, 15, 18, 19, 27, 28) (Table 3.2.4).

4. Discussion

4.1 Discussion (Study 1)

The goal of Paper A was to create “valid end-of-training EPAs for entry into beginning level surgical practice” (Amare et al., 2021). Ethiopia's postgraduate medical education programs will benefit from the results of this first-of-its-kind research to help mold curriculum, teaching, and assessment practices. “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.41 EPAs help training programs to move from fixed-length to variable-length programs and transform traditional assessment into entrustment decisions where the endpoint is defined by these entrustable activities. 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” (Amare et al., 2021).

As well as guiding the development of trainees and supervisors, EPAs can be used to structure the teaching process(Amare et al., 2021; Jarrett et al., 2018). Supervisors can make informed, safe decisions about entrustment through an EPA-based training program (Amare et al., 2021; Landzaat et al., 2017). “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. It also helps trainees develop learning plans by identifying the necessary knowledge, skills, and attitudes at each training level” (Amare et al., 2021). As a final benefit, EPAs assist trainees to reflect on their performance and to become more trustworthy (Amare et al., 2021; Rose et al., 2014).

Core EPAs are generally identified iteratively by professionals as units of professional practice (Amare et al., 2021; Ten Cate et al., 2015). The first step in the EPA identification process is to assemble a group 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” (Amare et al., 2021). A similar process to EPA identification was used in this study across a variety of settings (Amare et al., 2021; Boyce et al., 2011; Fink-Hafner et al., 2019; Moore et al., 2017; Myers et al., 2015; Shaughnessy et al., 2013; Touchie et al., 2014). We constructed our survey instrument based entirely on expert knowledge. “This allowed experts to express their views, share their experience, and provide information beyond what is available in the literature” (Amare et al., 2021).

An EPA set that is formed by seeking a few expert opinions may not be relevant enough.“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 futur” (Amare et al., 2021). A variety of techniques can be used to gather evidence on the content validity of EPAs. “The Delphi method survey 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” (Amare et al., 2021).

“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). 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, the American Board of Surgery, global resident performance and the Royal Australalian College of Surgeons for medical school graduates” (Amare et al., 2021). “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 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” (Amare et al., 2021). “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” (Amare et al., 2021).

“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, cholecystectomy, and hemicolectomy” (Amare et al., 2021). “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” (Amare et al., 2021). “This difference shows that the degree of complexity of an EPAs differs depending on the context in which it is practiced. These differences likely reflect differences in the medical practice of specific countries based on the availability of skill mix and technologies” (Amare et al., 2021).

“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.” 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,” “providing consultation,” “providing supervision,” “ repairing inguinal hernia,” and “repairing umbilical hernia, 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 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” (Amare et al., 2021).

“Finally, since the concept of EPA is relatively new, 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” (Amare et al., 2021). “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” (Amare et al., 2021).

4.1.1 Strengths and limitation 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” (Amare et al., 2021).

4.2 Discussion (Study 2)

The purpose of this study was to look into the perspectives of surgical team members and graduating general surgery residents on EPA performance in surgery residency programs in the context of Ethiopian medical education. The study builds on previous work that developed EPAs for surgical residency training in Ethiopia, making it relevant to systematically introduce and implement EPAs as an assessment methodology.

In this study, members of the surgical team were asked to rate the observed performance of a group of graduating surgical residents in each of the 29 EPAs. We discovered that surgical team members rated residents' competence in carrying out EPAs lower than residents did. The results of this study revealed that the average rating of resident performance by surgical team members was 3.7 (lower than summative entrustment decisions for an EPA at level 4).

According to the recommended standard framework of supervision levels(Ten Cate et al., 2015; Touchie & ten Cate, 2016), this means that residents perform EPAs under indirect supervision at the time of graduation (residents act with supervisor immediately available). This implies that surgical team members believe that a group of graduating surgical residents are not yet safe to perform these EPAs independently (without supervision) at the time of graduation, and that distant supervision is still required, and that surgical team members are concerned about graduate competencies in executing EPA autonomously.

The finding is consistent with other studies in which stakeholders have expressed concerns about graduating general surgery residents' ability to carry out EPAs (Friedell et al., 2014). Because we hypothesized that surgical team evaluations are more reliable(Gehringer, 2017), our research implies that program may produce graduates who are unprepared for independent practice and provide a privilege to practice independently without trust. The program/system allowed residents to graduate with the assumption that the amount of time spent in postgraduate training was sufficient. This affect the program, trainee, patient and poses a potential problem in the education and health care systems (Wagner et al., 2018).

A body of research, on the other hand, found that residents rate their competence in carrying out EPAs higher than surgical team observation (Carraccio et al., 2016; Kouzmina et al., 2021; Stucke et al., 2020; Ten Cate et al., 2016; Ten Cate et al., 2020; Wagner JP, 2018 Apr). These findings are consistent with the findings of the present study. The self-assessment scores of residents were significantly higher than the assessments of surgical team members. In fact, students' self-evaluations are frequently higher than faculties' score (Basnet et al., 2012; Tejeiro et al., 2012). This could be due to residents' overconfidence in their abilities and/or a lack of mastery of self-assessment skill (Thawabieh, 2017). However, regardless of the rating, self-assessment allowed residents to develop self-perceptions. Self-perceptions of competence, which are a component of self-efficacy, refer to beliefs about one's general ability or knowledge and skills to perform well. Students' self-efficacy involves estimating what they can do and the likelihood of success (Basnet et al., 2012; McMillan & Hearn, 2008; Tejeiro et al., 2012; Thawabieh, 2017).

In this study, there was disagreement between the residents' and surgical team members' judgments in carrying out EPAs. Surgical team expected residents to still require supervision by graduation, whereas residents were more confident in carrying out EPAs. The discordance between resident and surgical team evaluations of resident performance has been the subject of research over the last ten years (Wagner JP, 2018 Apr). The disparity in EPA performance judgments observed in our study between resident and surgical teams has numerous implication.

First, this discordance may be due in part to either these EPAs' framework lacking sufficient detail in describing the scope, the necessary prerequisite knowledge/skill/attitudes, and performance criteria that form the basis for entrustment decision, or performance criteria that were not transparent and understandable, preventing them from effectively judging how well residents met the criteria. According to research, drawing attention to the performance criteria that are relevant for a particular learning task improves their understanding of the criteria, which leads to better task performance and self-assessment skills (Fastré et al., 2010).

Second , the discordance implies that either residents have an inaccurate self-perception and/or surgical team members do not assess senior residents critically, therefore not appropriately tailoring their instruction to the needs and competency of the resident (Alameddine et al., 2015; Spencer & Jordan, 1999) and not providing accurate assessment (Peyre et al., 2010). It is not very surprising those residents have some form of competence illusion regarding their own learning curve. Even specialists fail to acknowledge their limits sometimes (Kruger & Dunning, 1999).

Third, the discordance in judgment of EPA performance between resident and surgical teams also implies that residents did not receive feedback from surgical team members or the feedbacks was not accurately processed by the residents. Quality formative and summative feedback is essential for learning, and programs are expected to provide each fellow with evaluation of performance with feedback. In turn, fellows are expected to be able to incorporate formative feedback into daily practice. However, if a resident does not receive or accurately process surgical team formative or summative feedback then they can develop an inaccurate perception of their abilities (Ertmer & Newby, 1996; Peyre et al., 2010).

Furthermore, differences in the overall mean rating of residents' EPA performance were observed across surgical team members' areas of specialization. This could be due to surgical team members judging residents' performance based on their level of expertise rather than performance criteria. This implies that either there are no clearly defined performance criteria for basis for formal entrustment decisions, or the criteria were not transparent and understandable to surgical team members, preventing them from judging how well residents met the criteria effectively. Furthermore, the disparity in EPA performance judgments between resident and surgical teams may indicate that the program did not have standard protocols and practices in place among surgical team members to make formal entrustment decisions.

The finding assists the residency program to systematically introduce and implement EPA-based assessment, as well as informing decisions on resident performance that should be made on the basis of trust rather than the assumption that the amount of time spent in postgraduate training, and the need

for having clear performance criteria to form the basis for an entrustment decision. However, more work is needed to enable authentic summative entrustment in the Core EPAs framework

4.2.1 Strengths and limitation of the study

The study's most significant strength is that it used measuring tools completed by interdisciplinary surgical team members in a resident's sphere of influence. This interdisciplinary EPA assessment provides a more complete picture of residents' performance. The study's limitations include self-assessment of performance. Self-assessment can be subjective because residents may not be sincere and may even over-evaluate their own performance. The surgical team members are not assessing a single resident but rate the observed performance of a group of graduating surgical residents in each of the 29 EPAs. Furthermore, study participants were asked to rate the performance of the core EPA statement without providing a detailed description, which may have affected their rating.

5. Conclusions (Study 1 &2)

“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 outcomebased 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”(Amare et al., 2021).

Differences in perceptions of capacity, autonomy, and expectations between residents and surgical team members, as well as within faculty members, were seen in executing EPAs. Concerns about graduate surgical residents' competence to execute EPAs autonomously at the time of graduation. Surgical teams members perceived that a set of graduating surgical residents are not still safe to perform these EPAs independently (without supervision) and still requires distant supervision. Residents, on the other hand, were taught that they were ready to practice independently. The perception gap that exists between resident and surgical teams poses a potential problem in the education and health care systems.

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Appendix

Table 3.1.2 "All potential EPAs proposed by expert panelists in round 1"(Amare et al., 2021).

S.no	Proposed list of all potential end-of surgery residency EPAs	Expert panels Code
1.	Repairing of all types of surgical wounds	O1
2.	Incision and Drainage	
3.	Hydrocelectomy	
4.	Excision of superficial masses/tumors/scars	
5.	Posterior gutter application	
6.	Suprapubic cystostomy	
7.	Chest tube insertion	
8.	Epigastric herniorrhaphy	
9.	Inguinal hernia repair	
10.	Appendectomy	
11.	Orchidectomy	
12.	Manual reduction of fractures	
13.	Debridement of compound fractures	
14.	Excision of bigger superficial masses/tumors/scars	
15.	Drainage of appendiceal abscess	
16.	Laparotomy	
17.	Colostomy	
18.	Small bowel resection and anastomosis (19)	
19.	Sigmoid resection and anastomosis	
20.	Femoral hernia repair	
21.	Elevation of DSF	
22.	Reduction of joint displacements	
23.	External fixation	
24.	ORIF	
25.	Burr hole and evacuation of subdural hematoma	
26.	Skin graft	
27.	TVP	
28.	Hemicolectomy	

29.	APR	
30.	Thyroidectomy	
31.	Mastectomy	
32.	Cholecystectomy	
33.	CBD exploration	
34.	Craniotomy and evacuation of epidural hematoma	
35.	Flap	
36.	Intussusception	
37.	PPV repair	
38.	Pyloric myotomy	
	subtotal	38
39.	Preoperative patient workup	expert # 02
40.	Preoperative patient preparation	
41.	Postoperative care	
42.	Patient counseling	
43.	Communication with physicians, healthcare personnel, and patients	
44.	Appropriate referral	
45.	Interpretation of lab and imaging results	
46.	Abscess drainage, wound suturing, debridement and biopsy	
47.	Shock resuscitation	
48.	Appendectomy	
49.	Bowel resection and anatomoises	
50.	Right Hemicolectomy	
51.	Doing Colostomy	
52.	Colostomy Closure	
53.	Thyroidectomy for benign lesions	
54.	Burrhole for hematoma and elevation of depressed skull fracture	
55.	MRM	
56.	Open prostatectomy	
57.	Intubation, Chest tube insertion, and tracheotomy	
58.	Thoracotomy	

59.	Repair of perforated PUD	
60.	TV and Gastoojejunostomy	
61.	Rectal tube deflation of sigmoid volvulus	
62.	Simple open Cholecystectomy	
63.	Fracture splinting and POP application	
64.	Minor OR procedures(circumcision, lipoma excision etc.)	
	Subtotal	26
65.	History taking, physical examination, clinical diagnosis, and planning	Expert #03
66.	Minor operations, e.g., fibroadenoma excision, lipoma excision	
67.	Chest tube insertion	
68.	Emergency appendectomy	
69.	Decision for acute abdomen exploration	
70.	Abdominal trauma exploration (laparotomy)	
71.	Hernia repair	
72.	Resection and anastomosis	
73.	Splenectomy	
74.	Emergency nephrectomy	
75.	Cholecystectomy	
76.	Thyroidectomy	
77.	Mastectomy	
78.	Colectomy	
79.	CBD exploration	
80.	Colostomy closure	
81.	Burrhole	
82.	Craniotomy	
83.	Thoracotomy	
84.	External Fixation	
85.	Intramedullary nailing	
86.	Tracheostomy	
87.	Vascular repair	
88.	Esophagectomy	

89.	Gastrectomy	
	Sub-total	25
90.	Hernia repairs	Expert # 04
91.	Hemorrhoidectomy	
92.	Appendectomy	
93.	Fistulotomy	
94.	Fistulectomy	
95.	Cholecystectomy	
96.	CBD exploration and T tube insertion	
97.	Small intestinal resection and anastomosis	
98.	Colonic resection and anastomosis	
99.	Colonic resection and Colostomy	
100.	Subtotal gastrectomy	
101.	Gastrojejunostomy	
102.	Truncal vagotomy and gastrojejunostomy	
103.	Gastrostomy	
104.	Jejunostomy	
105.	Anoscopic biopsy	
106.	Proctoscopy	
107.	Sigmoidoscopy	
108.	Lateral anal sphincterotomy	
109.	Cholecystojejunostomy	
110.	Choledechojejunostomy	
111.	Volvulus derotation	
112.	Rectal tube deflation	
113.	Thyroidectomy	
114.	Mastectomy	
115.	Lumpectomy	
116.	Tube thoracostomy	
117.	Cricothyroidotomy	
118.	Tracheostomy	

119.	Lymph node biopsy	
120.	Suprapubic cystostomy	
121.	Transvesical Prostatectomy	
122.	Orchidectomy	
123.	Nephrectomy	
124.	Open nephropyelourterolithotomy	
125.	Operation for varicose vein	
126.	Venous cut down	
127.	Soft tissue mass excision	
128.	Burr hole for acute intracranial hematoma(epi-, sub- dural)	
129.	Depressed skull fracture elevation	
130.	Amputation for emergency Orthopedic conditions	
131.	POP and Skeletal traction	
132.	Emergency Caesarean section	
	Sub-total	43
133.	Appendectomy	Expert #05
134.	Abscess Drainage (intraabdominal, retroperitoneal/psoas, neck)	
135.	Billroth I, II Surgery	
136.	Cholecystectomy (Open	
137.	Cholecystectomy (Lap)	
138.	CBD Exploration	
139.	Colostomy Construction	
140.	Colostomy Reversal	
141.	Carotid Body Tumor Excision	
142.	Esophagectomy	
143.	Fistula in Ano Surgery	
144.	Gastrectomy (Near-total, Total) with reconstruction	
145.	Surgery of perforated PUD	
146.	Surgery of Bowel Obstruction (Viable or gangrenous)	
147.	Surgery of Pancreatic Pseudocyst	
148.	Splenectomy (Emergency Elective)	

149.	Emergency Thoracotomy	
150.	Tube Thoracostomy	
151.	Pneumonectomy	
152.	Open Pericardiocentesis	
153.	Ileostomy Construction And Reversal	
154.	Hemicolectomy, Sigmoidectomy	
155.	Hernia Repair (tissue, Mesh)	
156.	LAR (Low Anterior Resection)	
157.	APR (Abdominoperineal Resection)	
158.	Hemorrhoidectomy	
159.	Thyroidectomy (Total, Near-total, Subtotal)	
160.	Mastectomy (MRM, Total, Simple)	
161.	Parotidectomy	
162.	Burr Hole, Craniotomy, Elevation of DSF	
163.	Ex-Fix of Open Fracture	
	Sub-total	31
164.	Craniotomy for evacuation of hematoma, elevation of depressed skull fracture, burr hole	Expert# 06
165.	Thyroidectomy	
166.	Mastectomy, with axillary dissection	
167.	Tracheostomy	
168.	Neck exploration for penetrating neck trauma	
169.	Vascular injury exploration with repair/ ligation	
170.	Chest tube insertion	
171.	Thoracotomy for penetrating chest injury	
172.	Laparotomy	
173.	Repair of perforated PUD	
174.	Appendicectomy	
175.	Right / left hemicolectomy	
176.	Gastrectomy & Myotomy	
177.	Resection & anastomosis (intestine)	
178.	Exploratory laparotomy for trauma	

179.	Nephrectomy	
180.	Sigmoid resection	
181.	Abscess drainage	
182.	Debridement	
183.	Cystostomy	
184.	Colostomy & Colostomy reversal	
185.	Herniorrhaphy	
186.	Closed fracture & dislocation management	
187.	Splenectomy	
188.	Prostatectomy	
	Sub-total	25
189.	Evaluate emergency patients (history and physical examination)	Experts # 07
190.	Evaluate elective patients (history and physical examination)	
191.	Order appropriate investigations for emergency patients	
192.	Preoperative management of emergency patients	
193.	Perform lifesaving emergency procedures	
194.	Monitor response to life-saving interventions	
195.	Diagnostic workup of elective patient	
196.	Preoperative preparation and optimization of elective patients	
197.	Appropriate communication to other departments/consultation	
198.	Write and document all the patient data properly	
199.	Communicate effectively with patients and family –(informed consent, break bad news, etc.)	
200.	Communicate effectively with co-workers (interns, nurses, other residents, attending physicians)	
201.	consultation and supervision	
202.	Recognize urgent or emergent situation	
203.	Perform emergency surgical procedures	
204.	Perform elective surgical procedures	
205.	Demonstrate and coach procedures to junior residents	
206.	Present patient case in rounds and during consultation	
207.	Tarsotomy, tarsrrhaphy, enucleation, evisceration	

	Subtotal	19
208.	Foreign body removal from the nose, ear	Expert # 08
209.	Perform minor procedures like lipoma excision, dermoid cyst excision, repair of lacerations, Lymph node biopsy, and epigastric hernia repair	
210.	Tonsillectomy	
211.	Tracheostomy, cricothyroidotomy	
212.	Mastectomy (MRM)	
213.	Excision of Benign Breast Lesion	
214.	Thyroidectomy	
215.	Parathyroidectomy	
216.	Adrenalectomy	
217.	Tube thoracostomy	
218.	Thoracotomy, Decortication	
219.	Bronchoscopic procedures	
220.	Appendectomy and Appendiceal Abscess drainage	
221.	Small bowel resection and anastomosis	
222.	Cholecystectomy	
223.	CBD exploration with T-tube placement or Choledochoduodenostomy /jejunostomy	
224.	Liver repair	
225.	Gastrectomy	
226.	Graham's omental patch	
227.	Vagotomy with bypass procedures (e.g., TV +GJ anastomosis)	
228.	Cystogastrostomy	
229.	Hemorrhoidectomy	
230.	Anorectal abscess drainage	
231.	Lateral sphincterotomy	
232.	Colostomy	
233.	Colectomy (Rt. Hemicolectomy Lt. Hemicolectomy …)	
234.	Anterior and Low Anterior Resection of the Rectum	
235.	Rectal tube defilation	
236.	Rectal biopsy	
237.	Fistulectomy/ fistulotomy	

238.	Splenectomy	
239.	Herniorrhaphy (Femoral, Inguinal, Umbilical	
240.	Suprapubic catheterization, circumcisions, hydrocelectomy, orchidectomy	
241.	Prostatectomy	
242.	Nephrolithotomy, pyelolithotomy, ureterolithotomy,	
243.	Cystolithotomy	
244.	Nephrostomy	
245.	Nephrectomy	
246.	Urethral dilatation,	
247.	Urethroplasty	
248.	Skin graft	
249.	Flaps	
250.	PPV ligation	
251.	Ramstad's pyloromyotomy	
252.	Hypospadias repair	
253.	Pull through (soave…	
254.	Anoplasty (PSARP)	
255.	Burr hole	
256.	Craniotomy	
257.	Simple spinal bifida repair	
258.	Amputation (below knee, above upper knee limb.	
259.	Hip disarticulation	
260.	Fracture management (non-operative)	
261.	External fixator	
262.	Plate, screw, intramedullary nail…	
263.	Dislocation reduction	
264.	Sequestrectomy	
265.	Parotidectomy	
266.	Cleft lip	
267.	Lobectomy, pneumonectomy	
268.	Esophagectomy	

269.	Emergency Caesarean section, emergency salpingio-oophorectomy, emergency hysterectomy, uterine repair	
270.	Multiple ligation	
271.	Upper and lower gastrointestinal endoscopic procedures	
272.	Cystoscopy	
	Sub-total	65
	Total	272

Table 3.2.2.: Mean difference between study groups in the rating of perceived performance of EPAs

EPA #	*Study group*	*N*	*Mean*	*SD*	*Mean difference*	*t-value*	*P-value*	*95%CI*
1.	Resident	49	4.76	.43	0.62	6.01	0.001*	[0.41, 0.82]
	Surgical Team	125	4.14	.92				
	Total	174						
2.	Resident	49	4.55	.61	0.52	3.59*	0.001*	[0.23, 0.80]
	Surgical Team	125	4.03	.93				
	Total	174						
3.	Resident	49	4.71	.46	0.43	4.99	0.001*	[0.26, 0.60]
	Surgical Team	125	4.28	.64				
	Total	174						
4.	Resident	49	4.47	.50	0.50	3.93*	0.001*	[0.25, 0.75]
	Surgical Team	125	3.97	.83				
	Total	174						
5.	Resident	49	4.33	.47	0.05	0.46	0.64	[-0.15, 0.24]
	Surgical Team	125	4.28	.84				
	Total	174						
6.	Resident	49	4.63	.49	0.10	1.08	0.28	[-0.08,0.27]
	Surgical Team	125	4.54	.63				
	Total	174						
7.	Resident	49	4.33	.55	0.08	0.68	0.49	[-0.14, 0.30]
	Surgical Team	125	4.25	.93				
	Total	174						
8.	Resident	49	4.22	.74	-0.14	-1.08*	0.28	[-0.40,0.11]
	Surgical Team	125	4.37	.80				

	Total	174						
	Resident	49	4.55	.61	0.19	1.64	0.10	[-0.03, 0.42]
9.	Surgical Team	125	4.36	.85				
	Total	174						
	Resident	49	4.31	.94	0.80	4.63*	0.001*	[0.46, 1.14]
10.	Surgical Team	125	3.50	1.06				
	Total	174						
	Resident	49	4.88	.33	0.51	6.55	0.001*	[0.35, 0.66]
11.	Surgical Team	125	4.37	.69				
	Total	174						
	Resident	49	4.67	.52	1.03	8.12	0.001*	[0.78, 1.28]
12.	Surgical Team	125	3.64	1.16				
	Total	174						
	Resident	49	4.63	.49	0.83	7.06	0.001*	[0.60, 1.06]
13.	Surgical Team	125	3.80	1.06				
	Total	174						
	Resident	49	4.08	.64	1.34	10.67	0.001*	[1.08, 1.58]
14.	Surgical Team	125	2.74	.96				
	Total	174						
	Resident	49	3.96	.64	1.19	9.54	0.001*	[0.94, 1.43]
15.	Surgical Team	125	2.77	.94				
	Total	174						
	Resident	49	4.14	.82	0.89	5.75*	0.001*	[0.58, 1.19]
16.	Surgical Team	125	3.26	.95				
	Total	174						
	Resident	49	3.16	1.14	1.03	5.82	0.001*	[0.67, 1.37]
17.	Surgical Team	125	2.14	.74				
	Total	174						
	Resident	49	4.08	.89	1.32	8.32*	0.001*	[1.00, 1.63]
18.	Surgical Team	125	2.76	.96				
	Total	174						
	Resident	49	3.43	1.02	0.53	2.84*	0.005*	[0.16, 0.90]
19.	Surgical Team	125	2.90	1.14				
	Total	174						

	Resident	49	4.86	.35	0.23	2.94	0.004*	[0.17, 0.88]
20.	Surgical Team	125	4.62	.68				
	Total	174						
	Resident	49	4.71	.46	0.63	5.22*	0.001*	[0.39, 0.87]
21.	Surgical Team	125	4.08	.80				
	Total	174						
	Resident	49	4.76	.43	0.69	5.59*	0.001*	[0.44, 0.93]
22.	Surgical Team	125	4.06	.82				
	Total	174						
	Resident	49	3.84	1.03	0.34	2.01*	0.046	[0.00, 0.67]
23.	Surgical Team	125	3.50	1.00				
	Total	174						
	Resident	49	4.65	.48	0.61	4.55*	0.001*	[0.34, 0.86]
24.	Surgical Team	125	4.05	.88				
	Total	174						
	Resident	49	3.96	.50	0.47	4.03	0.001*	[0.24, 0.70]
25.	Surgical Team	125	3.49	1.04				
	Total	174						
	Resident	49	3.84	.59	0.40	3.09	0.002*	[0.14, 0.65]
26.	Surgical Team	125	3.44	1.08				
	Total	174						
	Resident	49	4.33	.92	1.00	6.25*	0.001*	[0.68, 1.31]
27.	Surgical Team	125	3.33	.96				
	Total	174						
	Resident	49	4.27	.70	0.35	2.46*	0.015*	[0.06, 0.62]
28.	Surgical Team	125	3.92	.88				
	Total	174						
	Resident	49	4.57	.50	0.70	6.14	0.001*	[0.47, 0.92]
29.	Surgical Team	125	3.87	.99				
	Total	174						

EPA # 1 to 8: Global performance EPAs

EPA# 9-29: Operative skills EPAs

* *0.05 is the significance level for the mean difference*

*t-value: equal variance assumed

Table 3.2.4: The post-hoc tests show exactly where the differences among the groups

Tukey HSD

Dependent Variable	(I) surgical team of 3 groups	(J) surgical team of 3 groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
**EPA # 1 Collecting information(history ,physical examination) in an organized fashion	attending surgeons	ORT nurse	.82601*	.17703	.000	.4060	1.2460
		Anesthesiologist & anesthetist	.46621	.20205	.059	-.0132	.9456
	ORT nurse	attending surgeons	-.82601*	.17703	.000	-1.2460	-.4060
		Anesthsiologist & anesthethist	-.35980	.19363	.155	-.8192	.0996
	Anesthsiologist & anesthethist	attending surgeons	-.46621	.20205	.059	-.9456	.0132
		ORT nurse	.35980	.19363	.155	-.0996	.8192
**EPA # 4 Identifying urgencies/emergencies and initiating early management for critically ill surgical patients	attending surgeons	ORT nurse	.59707*	.16080	.001	.2155	.9786
		Anesthsiologist & anesthethist	.75960*	.18353	.000	.3241	1.1951
	ORT nurse	attending surgeons	-.59707*	.16080	.001	-.9786	-.2155
		Anesthsiologist & anesthethist	.16253	.17588	.626	-.2548	.5798
	Anesthsiologist & anesthethist	attending surgeons	-.75960*	.18353	.000	-1.1951	-.3241
		ORT nurse	-.16253	.17588	.626	-.5798	.2548
**EPA # 8 Consulting health care providers and supervising resident students caring for surgical patients	attending surgeons	ORT nurse	-.50183*	.15650	.005	-.8732	-.1305
		Anesthsiologist & anesthethist	.12596	.17862	.761	-.2978	.5498
	ORT nurse	attending surgeons	.50183*	.15650	.005	.1305	.8732
		Anesthsiologist & anesthethist	.62779*	.17117	.001	.2217	1.0339
	Anesthsiologist & anesthethist	attending surgeons	-.12596	.17862	.761	-.5498	.2978
		ORT nurse	-.62779*	.17117	.001	-1.0339	-.2217
***EPA # 9 Performing preoperative preparation and optimization of patients for surgical procedures	attending surgeons	ORT nurse	-.27289	.16360	.222	-.6611	.1153
		Anesthsiologist & anesthethist	.54224*	.18673	.012	.0992	.9853
	ORT nurse	attending surgeons	.27289	.16360	.222	-.1153	.6611
		Anesthsiologist & anesthethist	.81514*	.17894	.000	.3906	1.2397
	Anesthsiologist & anesthethist	attending surgeons	-.54224*	.18673	.012	-.9853	-.0992
		ORT nurse	-.81514*	.17894	.000	-1.2397	-.3906
	attending surgeons	ORT nurse	1.14377*	.19324	.000	.6853	1.6023

***EPA # 10 Managing postoperative patients(complicated and uncomplicated		Anesthsiologist & anesthethist	.27343	.22055	.432	-.2499	.7967
	ORT nurse	attending surgeons	-1.14377*	.19324	.000	-1.6023	-.6853
		Anesthsiologist & anesthethist	-.87035*	.21135	.000	-1.3718	-.3689
	Anesthsiologist & anesthethist	attending surgeons	-.27343	.22055	.432	-.7967	.2499
		ORT nurse	.87035*	.21135	.000	.3689	1.3718
***EPA # 11 Performing basic (minor) surgical procedures**	attending surgeons	ORT nurse	.64286*	.12876	.000	.3373	.9484
		Anesthsiologist & anesthethist	.02995	.14697	.977	-.3187	.3787
	ORT nurse	attending surgeons	-.64286*	.12876	.000	-.9484	-.3373
		Anesthsiologist & anesthethist	-.61290*	.14084	.000	-.9471	-.2787
	Anesthsiologist & anesthethist	attending surgeons	-.02995	.14697	.977	-.3787	.3187
		ORT nurse	.61290*	.14084	.000	.2787	.9471
***EPA # 12 Repairing Hernias (Herniorrhaphy	attending surgeons	ORT nurse	1.41026*	.20380	.000	.9267	1.8938
		Anesthsiologist & anesthethist	.43011	.23261	.158	-.1218	.9820
	ORT nurse	attending surgeons	-1.41026*	.20380	.000	-1.8938	-.9267
		Anesthsiologist & anesthethist	-.98015*	.22291	.000	-1.5090	-.4513
	Anesthsiologist & anesthethist	attending surgeons	-.43011	.23261	.158	-.9820	.1218
		ORT nurse	.98015*	.22291	.000	.4513	1.5090
***EPA # 14 Performing removal of part or all of the thyroid gland (Thyroidectomy	attending surgeons	ORT nurse	1.06960*	.17333	.000	.6583	1.4809
		Anesthsiologist & anesthethist	.29416	.19784	.301	-.1752	.7636
	ORT nurse	attending surgeons	-1.06960*	.17333	.000	-1.4809	-.6583
		Anesthsiologist & anesthethist	-.77543*	.18958	.000	-1.2253	-.3256
	Anesthsiologist & anesthethist	attending surgeons	-.29416	.19784	.301	-.7636	.1752
		ORT nurse	.77543*	.18958	.000	.3256	1.2253
***EPA # 15 Performing removal of some or all breast tissue, one	attending surgeons	ORT nurse	.94963*	.17636	.000	.5312	1.3681
		Anesthsiologist & anesthethist	.30261	.20129	.293	-.1750	.7802

or both breasts, axillary lymph nodes,(Mastectomy	ORT nurse	attending surgeons	-.94963*	.17636	.000	-1.3681	-.5312
		Anesthsiologist & anesthethist	-.64702*	.19289	.003	-1.1047	-.1893
	Anesthsiologist & anesthethist	attending surgeons	-.30261	.20129	.293	-.7802	.1750
		ORT nurse	.64702*	.19289	.003	.1893	1.1047
***EPA # 18 Performing partial or complete removal of spleen(Open splenectomy)**	attending surgeons	ORT nurse	.18223	.18858	.599	-.2652	.6297
		Anesthsiologist & anesthethist	.85407*	.21523	.000	.3434	1.3647
	ORT nurse	attending surgeons	-.18223	.18858	.599	-.6297	.2652
		Anesthsiologist & anesthethist	.67184*	.20626	.004	.1825	1.1612
	Anesthsiologist & anesthethist	attending surgeons	-.85407*	.21523	.000	-1.3647	-.3434
		ORT nurse	-.67184*	.20626	.004	-1.1612	-.1825
***EPA # 19 management of patient with perforated Peptic Ulcer	attending surgeons	ORT nurse	-.72711*	.22493	.004	-1.2608	-.1934
		Anesthsiologist & anesthethist	.10292	.25673	.915	-.5062	.7120
	ORT nurse	attending surgeons	.72711*	.22493	.004	.1934	1.2608
		Anesthsiologist & anesthethist	.83002*	.24602	.003	.2463	1.4138
	Anesthsiologist & anesthethist	attending surgeons	-.10292	.25673	.915	-.7120	.5062
		ORT nurse	-.83002*	.24602	.003	-1.4138	-.2463
***EPA # 21 Performing an exploratory laparotomy for trauma	attending surgeons	ORT nurse	.40018*	.16057	.037	.0192	.7812
		Anesthsiologist & anesthethist	.54224*	.18326	.010	.1074	.9771
	ORT nurse	attending surgeons	-.40018*	.16057	.037	-.7812	-.0192
		Anesthsiologist & anesthethist	.14206	.17562	.698	-.2746	.5587
	Anesthsiologist & anesthethist	attending surgeons	-.54224*	.18326	.010	-.9771	-.1074
		ORT nurse	-.14206	.17562	.698	-.5587	.2746
***EPA # 22 Evaluation and surgical management patient with small bowel ob-	attending surgeons	ORT nurse	.41941*	.16446	.032	.0292	.8096
		Anesthsiologist & anesthethist	.57450*	.18771	.008	.1291	1.0199
	ORT nurse	attending surgeons	-.41941*	.16446	.032	-.8096	-.0292

struction. (resection & anastomosis		Anesthsiologist & anesthethist	.15509	.17988	.665	-.2717	.5819
	Anesthsiologist & anesthethist	attending surgeons	-.57450*	.18771	.008	-1.0199	-.1291
		ORT nurse	-.15509	.17988	.665	-.5819	.2717
***EPA # 24 Evaluation and management of abnormal twisting of small intestine, cecum, and sigmoid colon (Volvulus	attending surgeons	ORT nurse	.61538*	.17029	.001	.2114	1.0194
		Anesthsiologist & anesthethist	.79032*	.19436	.000	.3292	1.2515
	ORT nurse	attending surgeons	-.61538*	.17029	.001	-1.0194	-.2114
		Anesthsiologist & anesthethist	.17494	.18625	.617	-.2670	.6168
	Anesthsiologist & anesthethist	attending surgeons	-.79032*	.19436	.000	-1.2515	-.3292
		ORT nurse	-.17494	.18625	.617	-.6168	.2670
***EPA # 27 Diagnosis and management of patient with Benign prostatic hyperplasia, benign prostatic hypertrophy (BPH	attending surgeons	ORT nurse	.23901	.18743	.412	-.2057	.6837
		Anesthsiologist & anesthethist	.86866*	.21393	.000	.3611	1.3762
	ORT nurse	attending surgeons	-.23901	.18743	.412	-.6837	.2057
		Anesthsiologist & anesthethist	.62965*	.20501	.007	.1432	1.1161
	Anesthsiologist & anesthethist	attending surgeons	-.86866*	.21393	.000	-1.3762	-.3611
		ORT nurse	-.62965*	.20501	.007	-1.1161	-.1432
***EPA # 28 Providing initial management for trauma /fracture patients	attending surgeons	ORT nurse	.31960	.17060	.151	-.0852	.7244
		Anesthsiologist & anesthethist	.84255*	.19471	.000	.3806	1.3045
	ORT nurse	attending surgeons	-.31960	.17060	.151	-.7244	.0852
		Anesthsiologist & anesthethist	.52295*	.18659	.016	.0802	.9657
	Anesthsiologist & anesthethist	attending surgeons	-.84255*	.19471	.000	-1.3045	-.3806
		ORT nurse	-.52295*	.18659	.016	-.9657	-.0802
***EPA # 29 Performing below knee, above knee, and upper limb amputation	attending surgeons	ORT nurse	.29121	.19478	.297	-.1709	.7533
		Anesthsiologist & anesthethist	.89171*	.22231	.000	.3642	1.4192
	ORT nurse	attending surgeons	-.29121	.19478	.297	-.7533	.1709
		Anesthsiologist & anesthethist	.60050*	.21304	.015	.0950	1.1060

	Anesthsiologist & anesthethist	attending surgeons	-.89171*	.22231	.000	-1.4192	-.3642
		ORT nurse	-.60050*	.21304	.015	-1.1060	-.0950

*. The mean difference is significant at Bonferroni adjusted alpha level of 0.02

** Global Performance EPAs

*** Operative skill EPAs

Manuscript that was published during Ph.D. study.

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ORIGINAL REPORTS

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

Equlinet Misganaw Amare, MPH, MHPE, PhD,[,] Matthias Siebeck, MD, MME, PhD,[†] Tegbar Yigzaw Sendekie, MD, MPH, PhD,[‡] Martin R. Fischer, MD, MME, PhD,[†] and Markus Berndt, PhD[†]*

[*]CIHLMU, Center for International Health, University Hospital, Munich, Germany; [†]Institute of Medical Education, University Hospital, LMU Munich, Munich, Germany; and [‡]Jhpiego – Ethiopia (an affiliate of John Hopkins University), Addis Ababa, Ethiopia

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 Ehtiopia. (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

KEW 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.[1,2] To positively

Correspondence: Inquiries to Equlinet Misganaw, Wollo Sefer (near Mina Building), P. O. Box 2881, Code 1250, Addis Ababa, Ethiopia; fax: +251 115 508814; e-mail: equlinetm@gmail.com

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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.[1]

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.[1,2] Thus, over the past 5 to 10 years, many undergraduate and postgraduate medical education programs have undergone significant reforms to adopt this approach.[3-5] Various frameworks for competency-based medical education, such as CanMEDS (Canadian Medical Education Directives for Specialist),[6] ACGME (Accreditation Council for Graduate Medical Education),[7] Saudi MEDS,[8] and General Medical Council (GMC)[9] 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.[10-12]

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.[13-14] As such, these competencies are too complex to translate into a realistic training program,[6] making them too theoretical to train and validly assess.[13-14]

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.[10,15] Summative judgment about a trainee's performance is made by informal observation, often assuming the amount of time spent in training.[16-17]

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).[5,12,13,16,18-20]

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''.[18] Therefore, EPAs constitute a translation of competencies into tangible tasks in clinical practice and makes competencies meaningful, trainable, and assessable for clinical teachers.[5,12,13,16,18-20]

Although a number of medical education providers are using EPAs in their training programs,[21-24] and core EPAs have become available worldwide, 1 set of core EPAs cannot automatically be transferred from one context to another.[19] 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.[19] 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.[25-27] 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.[28-30]

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[13] 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.[31]

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

Two weeks after the first Delphi round,[33] 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).[30-33] The 4-point rating scale was preferable because it does not include the neutral middle rating common in odd number rating scales.[33] 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,[33] Davis,[34] Polit and Beck,[35] and Polit *et al.*[36] 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.[31,33,37] 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 $1+ 8(1.96)^2\ (1-p)^2 \frac{(1+p)^2}{2w^2p}$.[38,39] 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.[40] 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'').[4,33] 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).[27, 33]

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)
	Perfroming 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.

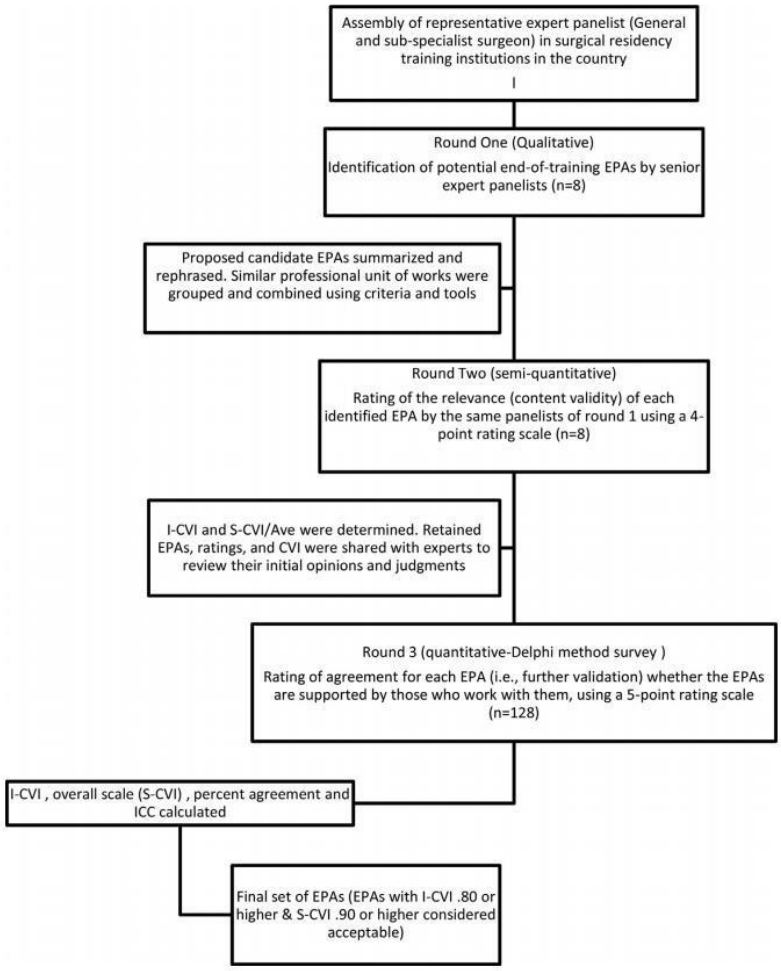

FIGURE 1. Schematic representation of data collection methods and procedure.

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.[41] EPAs help training programs to move from fixed-length to variable-length programs[42] and transform traditional assessment into entrustment decisions where the endpoint is defined by these entrustable activities.[12] 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.[4,43]

EPAs can also be used to structure teaching[44] and provide assessment guidelines for both trainees and supervisors. An EPA-based training programmed can equip supervisors to make an informed, safe entrustment decision.[41] 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.[12,17-18,45-46] 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 Representativness 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†	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†	128	1.00	100	1
3	Documenting clinical encounters†	128	1.00	100	1
4	Identifying urgencies/emergencies and initiating early management for critically ill surgical patients†	128	1.00	100	1
5	Communicating with co-workers, patients, and families including braeaking bad news†	128	1.00	100	1
6	Educating patient and obtaining informed consent in preparation for surgical care†	128	1.00	100	1
7	Leading and Conducting routine ward rounds in collaboration with interprofessional teams†	128	1.00	100	1
8	Consulting health care providers and supervising resident students caring for surgical patients†	128	1.00	100	1
9	Performing preoperative preparation and optimization of patients for surgical procedures†	128	1.00	100	1
10	Managing postoperative patients (complicated and uncomplicated)†	128	1.00	100	1
11	Performing basic (minor) surgical procedures†	128	1.00	100	1
12	Repairing Hernias (Herniorrhaphy)†	124	0.97	97	0
13	Performing craniotomy to elevate depressed skull and remove subdural hematoma (burhole)*	25	0.20*	20%	0
14	Performing creation of an opening (stoma) into the windpipe (tracheostomy, cricothyroidotomy)§	128	1.00	100%	1
15	Performing removal of part or all of the thyroid gland (Thyroidectomy)§	124	0.97	97%	0
16	Performing thoracotomy for patient with blunt/penetrating thoracic trauma*	26	0.20*	20%	0
17	Performing removal of some or all breast tissue, 1 or both breasts, axillary lymph nodes,(Mastectomy)§	126	0.98	98%	0
18	Performing removal of stone from gallbladder (open Cholecystectomy) ‡	126	0.98	98%	0
19	Perfroming Common Bile Duct (CBD) exploration§	127	0.99	98%	0
20	Performing partial or complete removal of spleen(Open splenectomy)§	127	0.99	99%	0
21	Evaluation and surgical management of patient with Peptic Ulcer Disease (Performing vagotomy, pyloroplasty, antrectomy, and gastrojejunostomy (Billroth procedure)‡	127	0.99	99%	0
22	Performing removal of appendix, appendiceal mass, and appendiceal Abscess (Open appendectomy)‡	127	0.99	99%	0
23	Performing an exploratory laparotomy for trauma†	128	1.00	100%	1
24	Evaluation and surgical management patient with partial or complete blockage of the small intestine†	128	1.00	100%	1
25	Evaluation and surgical management of patient with the colonic and /or rectal disease‡	128	1.00	100%	1
26	Evaluation and management of abnormal twisting of part of the large or small intestine (Volvulus)†	128	1.00	100%	1
27	Evaluation and surgical management of patient with hemorrhoid (Hemorrhoidectomy)§	128	1.00	100%	1
28	Rectal/anal fistula Reapir§	127	0.99	99%	0
29	Diagnosis and management of patient with Benign prostatic hyperplasia, benign prostatic hypertrophy (BPH)§	123	0.96	96%	0
30	Performing ob/gyne surgery (salpingo-oophorectomy, hysterectomy, and uterine repair)*	10	0.08*	8%	0
31	Providing initial management for trauma /fracture patients†	128	1.00	100%	1
32	Performing below knee, above knee, and upper limb amputation§	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
		S-CVI/Ave	0.92	92%	
	EPAs achieved 100% experts in agreement				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.[47]

Identifying core EPAs as suitable units of professional practice is usually an iterative process among professionals.[17] 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.[3,24,48-51] 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.[51]

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.[17,52] Evidence for content validity of EPAs can be gathered with several techniques. The Delphi method survey[17] 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.[53,54]

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).[18,42,55] 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,[21] the American Board of Surgery,[22] global resident performance[23] and the Royal Australalian College of Surgeons[24] 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. Inter-rater 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.[20,31]

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,[23,24] cholecystectomy,[23] and hemicolectomy".[23] 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.[19] 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."[23] 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,"[21] "providing consultation,"[22] "providing supervision,"[22] " repairing inguinal hernia,"[23,24] and "repairing umbilical hernia,"[23,24] 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[19] 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,[20] 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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MEETING REPORT Open Access

Proceedings from the CIH-LMU 2021 Symposium: "Global Health Perspectives: Climate Change & Migration"

Wandini Lutchmun[1,2*], Aikins Ablorde[1,2], Han-Wen Chang[1,2], Guenter Froeschl[1,2], Equlinet Misganaw[1,2], Bhim Prasad Sapkota[1,2], Sarah Scholze[1,2], Josephine Singo[1,2] and Lisa Hoffaeller[1,2]

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Abstract

Climate change shapes human migration through the interaction of environmental changes with political, social, economic, and demographic drivers of mobility. Low-and middle-income countries bear the brunt of the health impacts of climate change and migration, despite their overall low contribution to greenhouse gas emissions. The CIH[LMU] Symposium 2021 aimed to explore the complex interconnections between climate change, migration and health from diverse global perspectives. A number of themes, such as the relationship between climate and trade, the role of technology, and the issue of responsibility were tackled. The speakers also highlighted the need for climate resilient health-systems, gender mainstreaming in climate strategies, collaboration between the Global North and South and urgently defining the 'climate refugee'. It is crucial that the narrative around climate change moves from an environmental framing to encompass human health and migration within climate discussions and strategies.

Keywords: Climate Change, Climate migration, Global Health, Climate resilience, Climate justice

Introduction

By 2050, 200 million people globally are projected to be displaced as a result of climate change [1]. Slow onset climate processes, such as sea-level rise, food and water insecurity and desertification; and fast climate events, such as floods and hurricanes [2]; impose direct and indirect risks to human health. These risks interact with pre-existing low resilience and adaptive capacity, lack of development and low preparedness, to drive human migration. The relationship between climate change, migration and health is heterogenous [3] and mediated by context-dependent political, social, economic, and demographic drivers of mobility [4]. While migration is often an adaptive solution to climate change, it can also be maladaptive, and negatively impact human health [5]. The climate-migration-health nexus was explored from diverse perspectives at the Center for International Health of the Ludwig Maximilians Universität (CIH[LMU]) 2021 Symposium "Global Health Perspectives: Climate Change and Migration" on March 12th, 2021.

* Correspondence: wandini.lutchmun@lrz.uni-muenchen.de
[1]Teaching & Training Unit, Division of Infectious Diseases and Tropical Medicine, University Hospital, LMU, Munich, Germany
[2]Center for International Health, Ludwig-Maximilians-Universität, Munich, Germany

Methods

Institutional framework

The symposium "Global Health Perspectives: Climate Change & Migration" was conceived as an event in a

series of symposia in the field of International Health conducted annually since 2012 at CIH[LMU] in Munich, Germany. The series serves both as scientific events tackling current topics in International Health, and as part of the study curriculum for students of the PhD Program Medical Research-International Health and the MSc Program in International Health. The majority of the students originate from low- and middle-income countries (LMICs) and conduct research projects targeting health challenges in their home countries. For the successful conception, organization and delivery of the symposium, students gain European Credit Transfer System (ECTS) points.

Organizational framework

The organizational group consisted of four PhD candidates and two MSc students. The group was facilitated by the PhD and MSc coordinators and administrative staff of the CIH[LMU] and received coaching by an expert in Project Management and Intercultural Communication throughout the preparatory process.

Content selection

Health in the context of climate change and migration was considered a topic of high relevance and importance by the students at the time of topic selection. A pool of prospective speakers was prepared based on professional expertise and geographical background, and the speakers were invited to suggest a contribution based on the thematic objectives of the event.

Event delivery

Until 2020 the symposium was conducted in person in the auditorium of the LMU in Munich. Due to the COVID-19 pandemic, this event was held online on March 12, 2021, using the online communication tool 'Zoom Meetings'. Registration was free of charge and open from the 4th of February to the 11th of March 2021. During the event, each speaker delivered a 30-min presentation, followed by a 15-min 'Question & Answer' session where participants' questions, delivered via the chat function, were answered. This was followed by a panel discussion moderated by a guest speaker. MSc and PhD students of the organising committee also shared their research projects via 5-min presentations. Symposium attendees holding a medical license were eligible for 6 Continuous Medical Education (CME) credit points.

Summary of presentations

"Climate change on the move"

Peter van den hazel, MD, PhD, MPH

Environmental health consultant in Arnhem, Netherlands, President of the Health and Environmental Alliance (HEAL), Brussels, Belgium, and Chair of the International Network on Children's Health and Safety (INCHES), Ellecom, Netherlands.

Overview The health impacts of climate change are unequally distributed at three levels. At the macro, or global level, LMICs and disadvantaged minority settings bear the highest burden of disease, predominantly from extreme weather events and air pollution. At the meso, or local level, residents of ecologically fragile areas and rapidly growing urban cities suffer higher health risks, often as a result of air and water pollution. At the micro level, health risks are determined by individual factors and personal environment, one particularly vulnerable population being children.

Globally, three leading causes of under 5 mortality are diarrheal illness, respiratory tract infections and malaria [6], 98% of which occur in low-income countries [7], and all of which are heavily impacted by a changing climate. Changes in temperature and rainfall patterns and the resulting changes in vector ecology; contaminated drinking water as a result of extreme weather events; and air pollution, all contribute to the increased rates of the aforementioned diseases, exacerbated by food and water scarcity and resulting malnutrition. Children are not only physiologically vulnerable to the effects of climate change, but their vulnerability is exacerbated by their reliance on adults for survival and development [8]. Up to 175 million children are affected by climate disasters every year, and children make up a third of refugees, internally displaced people (IDPs) and asylum-seekers [7]. Illness and climate-related displacement at a young age can have devastating impacts on a child's education, development, safety and psychological well-being, the burden of which they may carry for the rest of their lives.

Discussion -Research on the mental health consequences of climate change and climate migration, especially in children, is lacking severely, possibly due to the complexity of this field.

-Small island states (SISs) are particularly vulnerable to the impacts of rising sea levels and the increase in intensity and frequency of extreme weather events. The Paris agreement recognises these vulnerabilities and has set out plans for a global fund for developing countries and SISs to plan and implement their climate adaptation and mitigation strategies [9].

"Climate change, migration and health: an African perspective"

Chukwumerije Okereke, PhD

Director of the Centre for Climate Change and Development at the Alex Ekwueme Federal University, Ndufu-

Alike, Nigeria and visiting lecturer at the University of Reading and the Oxford University Centre for the Environment (OUCE), United Kingdom.

Overview A moral approach to climate change identifies three main asymmetries. An asymmetry in contribution results from disproportionate Greenhouse Gas (GHG) emissions across countries. For example, in 2016, the average US citizen emitted about 16 tons of carbon/day while the average Congolese emitted less than 0.1 [10]. The asymmetry in the power to decide, is often exemplified by the underrepresentation of some countries during climate negotiations; for example, at United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) in 2007, Germany was represented by 101 delegates while Ethiopia's interests were covered by only 2 delegates, despite similar populations. An asymmetry in impact is observed in the disproportionate impacts of climate change across countries, the highest impacts often felt by those contributing the least to GHG emissions.

Africa contributes less than 4% to global GHG emissions [11], yet is one of the most vulnerable continents to the effects of climate change. Coastal nations of West and Central Africa, home to many rapidly growing economic hubs, have low-lying lagoons threatened by sea level rise and therefore erosion, inundation and flooding [12]. Flooding events in Nigeria have already led to large displacements, such as the Niger Delta Flood Disaster in 2012, which forced 2.1 million people to flee their homes [13]. Furthermore, the vulnerability of food production systems in Africa to climate change will result in a decline in important economic crops such as Banana and Plantain in West Africa, while Southern Africa is estimated to suffer crop yield losses of 18% by 2050 [12]. Desertification, as in the case of the drastic shrinkage of the Lake Chad basin, has led to the southern migration of cattle herders and farmers in search of greener pastures, causing issues of conflict. Pre-existing inadequate health and sanitation infrastructure, water systems and access to health services also exacerbate the health risks of climate change. The growing population, rapid rates of urbanisation, especially in coastal areas, coupled with a heavy reliance on agriculture, poor infrastructure, and poor governance all act to reduce Africa's adaptive capacity to a changing climate [12].

Discussion -China is currently the global leader in total GHG emissions, followed by the United States [14]. It is important to recognise the increasing contribution to GHG emissions from LMICs in the past decades and encourage collaboration between LMICs and HICs in planning and implementing mitigation and adaptation strategies and sustainable development.

-Technology has long been contested as either an important contributor to climate change or part of the climate solution. However, technological innovations in the past 10 years have been the most important developments in tackling climate change.

Developing climate resilient health systems in developing countries

Meghnath Dhimal, PhD

Chief Research Officer at the Nepal Health Research Council and Coordinator of the Young Scientists Forum of Nepal.

Overview Nepal is highly vulnerable to the effects of climate change, due to its complex topography, climate variability, high risk of climate disasters and low socio-economic status [15]. The NAP (National Adaptation Plan) is a government-led process, established in Nepal after the COP 2010 in Cancun, to facilitate the planning and implementation of sustainable medium- and long-term adaptation programmes [16]. In 2016, Nepal ratified the Paris Climate agreement and its Nationally Determined Contribution (NDC) and implemented the H-NAP, the health component of the NAP, guided by the "WHO operational framework for building climate resilient health systems" [15]. Furthermore, by signing the Male Declaration at the 70th WHO Regional Committee for South-East Asia in 2017, along with the other 10 member states of the WHO South-East Asia Region, Nepal made a regional commitment to building a climate change resilient health system. Nepal is involved in regional projects such as "Delivering climate-resilient water and sanitation in Africa and Asia", and "Building resilience of health systems in Asian LDCs (least-developed countries) to climate change". National capacity building is key for adaptation and developing resilience to climate change through implementation of climate resilient health systems and increasing capacity for disaster preparedness and response.

Discussion -The Green Climate Fund (GCF) has made commitments to fund climate adaptation projects in Nepal, with some additional financial support from the European Union and the United Kingdom. However, the overall support from developed nations remains low.

-The effects of climate change are not gender neutral and perspectives from the sphere of social sciences are often lacking in climate discussions and solutions, especially in LMICs. Nepal has recently established a thematic group for gender mainstreaming in climate change adaptation and mitigation strategies.

- Consumption behaviours at the societal but also individual level need to be challenged and shifted to more sustainable practices. A standard cup of coffee, for

example, has a water footprint of 130 l [17], while the production of just one cotton shirt requires approximately 3000 l of water [18].

Trends, magnitude and distribution of the effects of climate change & migration: a Canadian perspective

Shelby Yamamoto, PhD
Assistant Professor at the School of Public Health, University of Alberta, Canada and Principal Investigator of the projects "Climate change, older adults and immigrants: exploring community vulnerability and resilience" and "Climate change surveillance for chronic health effects in vulnerable populations".

Overview Canada is warming at twice the global rate [19], resulting in a wide range of health effects and changing patterns of migration. One particularly affected group are the Indigenous peoples of Canada that include Inuit, Métis, First Nations, and all First Peoples [20]. Indigenous communities face unique challenges as their livelihoods depend on their spiritual, cultural and environmental ties to the land [21]. This is also exacerbated by marginalization, living in remote, inaccessible areas, often with poor surrounding infrastructure, and an ageing population, which can be among the drivers of relocation to other communities or urban areas [20]. The warming climate has also affected the migratory patterns of animal species and led to changes in harvesting patterns, fueling food insecurity among the Indigenous populations who may rely on subsistence hunting and traditional foods. Another important group to consider in terms of climate-change related health impacts in Canada are immigrants, a significant proportion of whom originate from LMICs. Many contextual factors, such as the nature of the migration process, the capacity of the receiving community, and other push-pull factors, influence the health outcomes of immigrant populations [22]. Research in this area is heterogenous and lacking. While demographic studies have highlighted "the healthy immigrant-effect", due to the positive selection of healthier people to migrate, this converges to host country levels over time [22]. Research has shown that immigrants, especially those migrating from rural to urban areas, have higher rates of chronic illness [22]. Immigrants, a heterogenous group, often face numerous challenges such as cultural and language barriers, discrimination, socioeconomic differences, lifestyle changes, changes in their living arrangements, occupational exposures as well as barriers to accessing healthcare, which can result in poor health. While migration can pose significant health risks, it is an important adaptation response to the effects of a changing climate. The health needs of migrant and Indigenous populations should be at the forefront of climate adaptation strategies in Canada.

Discussion -History and background are important considerations when developing climate change interventions and strategies that promote climate change adaptation and resilience.

-Indigenous-led research and partnerships are key in addressing climate change. This helps set priorities and needs as determined by communities and capture indigenous knowledge.

-More focus needs to be put on potential mental health challenges faced by the immigrant populations in Canada and addressing stigma as a barrier to seeking help.

Panel discussion

Moderator: Martin Herrmann, MD

Founder and spokesperson of the German Alliance for Climate Change and Health (*Deutsche Allianz Klimawandel und Gesundheit*).

Panelists: Peter van den hazel, Chukwumerije Okereke, Shelby Yamamoto, Meghnath Dhimal

-Migration is a global phenomenon and while estimates show that the majority of global migration occurs between or within LMICs, the dialogue, and research, tends to focus almost entirely on migration from LMICs to high income countries (HICs) [23].

-At the policy level, the Intergovernmental Panel on Climate Change (IPCC) will be crucial in pushing the migration and health agenda. It is important to integrate migration and health not just within adaptation regimes but also within the Loss and Damage (L&D) regime of the IPCC, however, political awareness, and interests, are often lacking.

- The "climate refugee" is currently not defined by International Law, due to its hermeneutic difficulty, and vast political implications, one being the obligation of developed countries to confer the same protection to climate refugees as to political refugees. A 'refugee' also crosses international borders, which does not recognise IDPs, who make up the majority of climate migrants. Furthermore, since climate change is often interwoven amongst other drivers of mobility, the decision of who is a climate refugee or not can be extremely difficult to make [2].

-Trade and climate change are closely linked. Trade affects emissions through its influence on consumption and investment patterns, relocation of production (often to LMICs) and international transport but also on transfer of technology [24]. China ranks as the highest global contributor to pollution by total emissions per annum, however as a net exporter of emissions, a large amount

of China's emissions is embedded in produced goods exported and consumed by developed countries such as the United States [14]. Trade rules need to tackle the issue of embedded carbon, without compromising the rights of developing countries towards economic development.

-While GHG emissions incurred a drop during the COVID-19 pandemic in 2020, the effects are negligible on the larger scale of climate change [25]. The economic impacts of COVID-19 in Africa will be catastrophic; projections show that millions of Nigerians will be pushed into poverty endangering Nigeria's chance of reaching its Sustainable Development Goals (SDGs).

-The COVID-19 pandemic has also shown that governments are able to make drastic decisions in acute situations. Lessons learnt from the pandemic, such as avoiding delayed action, enhancing community engagement, addressing inequality and promoting international collaboration [26], can help guide climate mitigation strategies.

-The integration of climate change into medical education is essential in forming health professionals knowledgeable of the changing patterns of disease caused by climate change and migration.

Conclusion

The climate-migration-health nexus is complex and heterogeneous. Children are particularly vulnerable both to the short- and long-term consequences of climate change and should be at the core of climate adaptation strategies. Furthermore, the definition of a climate refugee is critical for the protection of the vulnerable populations displaced nationally and globally as a consequence of climate change. LMICs bear the highest burden of impacts despite their overall low contribution to GHG emissions but are still lacking the technical competencies and the necessary bargaining powers to mitigate, and adapt to, the effects of changing climate. Concurrently, the growing GHG emissions from LMICs in the last few decades has highlighted the need for sustainable economic development using green solutions and energy, through collaboration with HICs.

Abbreviations

CIH^{LMU}: Center for International Health of the Ludwig Maximilians Universität; CME: Continuous Medical Education; COP: Conference of Parties; ECTS: European Credit Transfer System; GCF: Green Climate Fund; GHG: Greenhouse Gas; HEAL: Health and Environmental Alliance; HIC: High-income country; HNAP: Health National Adaptation Plan; IDP: Internally Displaced Person; INCHES: International Network on Children's Health and Safety; IPCC: Intergovernmental Panel on Climate Change; L&D: Loss and Damage; LDC: least-developed country; LMIC: Low-and middle-income country; NAP: National Adaptation Plan; NCD: Nationally Determined Contribution; OUCE: Oxford University Centre for the Environment; SDG: Sustainable Development Goal; SIS: Small Island State; UNFCCC: United Nations Framework Convention on Climate Change; WHO: World Health Organization

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Authors' contributions

All authors were engaged in the conception, planning and conduct of the symposium. The main event was chaired by WL and AA and co-chaired by EM and BPS. WL, JS, BPS and EM kept notes throughout the event. WL, LH, BPS, HC and GF wrote the final manuscript. All authors revised and agreed with the final manuscript. The author(s) read and approved the final manuscript.

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NA

Declarations

Ethics approval and consent to participate

NA

Consent for publication

NA

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

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ORIGINAL RESEARCH

The Promise of the New Educational Strategy for Curriculum Development (SPICES) Model on the Development of Students' Clinical Reasoning Ability. A Comparative Cross-Sectional Study

Equlinet Misganaw[1]
Tegbar Yigzaw[2]
Robel Tezera[3]
Awoke Gelitew[4]
Shewatatek Gedamu[5]

[1]CIH[LMU] Center for International Health, University Hospital, LMU Munich, Munich, Germany; [2]Jhpiego – Ethiopia, Addis Ababa, 1250, Ethiopia; [3]Addis Ababa University, College of Medicine and Health Science, Addis Ababa, Ethiopia; [4]Debre-Tabor University, College of Medicine and Health Science, Debre-Tabor, Ethiopia; [5]Jimma University, Institute of Health Sciences, Jimma, Ethiopia

Introduction: Clinical reasoning skills are a core competency that must be taught at all levels of health-care education. In the last decade, several health professional education curricula in Ethiopia have been redesigned with the goal of improving student competence in key health-care delivery skills. Despite the fact that some academic programs followed the conventional educational strategy, a significant number of academic programs adopted a new educational strategy for curriculum development: Student-centered, Problem-based, Integrated, Community-based, Elective, and Systematic (SPICES) model. More empirical evidence, however, is required to determine whether the new curricular approach is effective in improving students' clinical reasoning. The purpose of this study is to determine whether the new educational strategy for curriculum development improves the clinical reasoning ability of midwifery students when compared to a peer institution that follows a traditional curriculum.

Methods: A comparative cross-sectional study was conducted to compare the clinical reasoning skills of midwifery students who completed the new curricular approach versus students who completed a traditional curriculum. A Script Concordance Test (SCT) was used to collect data. The mean SCT score and an independent two-sample *t*-test were calculated to see if the two groups differed significantly in terms of clinical reasoning skills in managing Post-Partum hemorrhage (PPH).

Results: A total of 77 final-year midwifery students participated (38 from the new and 39 from the traditional curriculum approach). Midwifery students who completed the new and conventional curriculum approaches had mean clinical reasoning SCT scores of 0.7 (SD = 0.35) and 0.53 (SD = 0.37), respectively. There was a statistically significant difference in the overall mean SCT score between the two study groups in terms of clinical reasoning skills ($p = 0.008$).

Conclusion: Our study found that the new SPICES model curricular approach is promising in fostering the development of clinical reasoning skills of Midwifery students in managing PPH.

Keywords: clinical reasoning skills, Ethiopia, midwifery, post-partum hemorrhage, SPICES model Curriculum

Introduction

Competent professional practice requires not only affective and psychomotor skills but also sophisticated thinking, reasoning, and decision-making skills.[1] Effective clinical reasoning skills improve accurate and safe diagnosis and management which prevent diagnostic errors and positively impact patient outcomes.

Correspondence: Equlinet Misganaw
Tel +251 913173351
Email equlinetm@gmail.com

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Conversely, poor clinical reasoning skills negatively impact effectiveness in clinical practice, quality of care and patients' experiences.[2] Developing clinical reasoning skills is, therefore, a core competency expected to be acquired by all health-care professionals and must be taught at all levels of healthcare training.[3]

Clinical reasoning is a learned skill and requires both good educational setting and strategy to teach it.[4] Clinical case presentations, case-based discussions, clinical problem-solving exercises and structured case presentation are the good settings for teaching clinical reasoning skills. A deliberate practice which includes finding opportunities for repeated practice, requesting honest feedback on performance at frequent intervals, maximizing learning from each case, reflecting on feedback and errors are also a good strategy for teaching clinical reasoning skills.[4–7]

In recent years, a number of studies have emerged providing evidence on the structure and content of a curriculum for fostering the development of students' clinical reasoning skills. The findings of a comprehensive evaluation of the effects of curricular approach on students' learning showed that an institution's curricular approach, practices and policies affect student clinical reasoning abilities, shape students' educational experiences and influence learning outcomes.[8] The fragmented course sequencing which separates theory and practice in a traditional curriculum is considered to be one factor contributing to deficient clinical reasoning skills.[9] There are well-documented weaknesses in the traditional content-based teaching approach in developing key health professional's skills. These include a lack of relevance to actual health practice and insufficient attention given to teaching communication skills, problem-solving skills, clinical reasoning skills and other social aspects of health.[10,11] This leads to the existence of gaps in the competency of health workers, graduates' ability to deal effectively with real-life health situations.[12]

In the last decade, several health professional education curricula in Ethiopia have been redesigned with the goal of improving student competence in key health-care delivery skills. Despite the fact that some academic programs adhered to the traditional educational strategy, which is subject-centered, employs a didactic content-based teaching approach, and is distinguished by late clinical and community exposure of students, a significant number of academic programs adopted a new educational strategy for curriculum development: Student-centered, Problem-based, Integrated, Community-based, Elective, and Systematic (SPICES) model. For instance, Debre Tabor University (DTU), one of the newly established higher education institutions in Ethiopia, adopted a new educational strategy for curriculum development (SPICES) model as a remedy for the weaknesses of the conventional curriculum in the development of key health-care delivery skills including clinical reasoning skills.[10–13] The new educational strategy for curriculum development incorporated developments in the field of medical education, which include: (1) competency-based curriculum design; (2) vertical and horizontal integration of the courses and clinical experiences into a conceptually meaningful structure; (3) use of innovative educational strategies like Problem Based Learning (PBL); and (4) early and longitudinal clinical and community exposure.[14]

More empirical evidence is needed, however, to determine whether the new educational strategy for curriculum development is effective in improving student competence, including students' clinical reasoning skills on priority health problems in the country such as postpartum hemorrhage (PPH), an obstetric emergency and the leading cause of maternal mortality, accounting for 10% of all pregnancy-related deaths in Ethiopia.[15,16] Therefore, the objective of this study is to assess whether the new educational strategy for curriculum development improves clinical reasoning ability of midwifery students comparing with a peer institution that follows a conventional curriculum.

Materials and Methods

Study Design

A cross-sectional study was conducted to compare the clinical reasoning skills of midwifery students from the new educational strategy for curriculum development (SPICES model) versus traditional curricular groups in the management of PPH.

Study Setting and Population

This study was conducted in Debre Tabor University and Woldia University, third generation universities located in Amhara National Regional State, Ethiopia. The study population was fourth-year midwifery students enrolled in regular baccalaureate degree program at Debre Tabor and Woldia University. Both Higher Education Institutions (HEIs) had similar student population, faculty and educational resources. The DTU midwifery department had a total of 188 students, 26 active faculty members, two clinical skill development labs, three classrooms, seven

clinical practice sites and one library/information technology center. Similarly, WU midwifery department had 184 students, 25 active faculty members, two clinical skill development labs, three classrooms, five clinical practice sites and one library/information technology center. We invited all graduating class (final year) midwifery students in both training institutions to participate in the study. This study was conducted with the approval of Jimma University institutional review board. Survey respondents provided informed consent to participate in this study.

Data Collection Methods

Data were collected from June to July, 2017. A Script Concordance Test (SCT) was applied to assess clinical reasoning skills in the management of PPH. The SCT is a written test for assessing the reasoning skill under conditions of uncertainty. It has demonstrated favorable psychometric qualities (predictive validity of 0.721)[17] and reliability (Cronbach's alpha of 0.78) in research conducted across a variety of health disciplines and across the spectrum of education, from undergraduate through postgraduate to continuing professional development.[18]

Data Collection Instrument and Quality Control

The authors who were familiar with the purpose, target audience and content domain of the test were involved in developing items for the SCT. Careful quality-control measures were taken at whether the SCT test addresses a challenging situation or not, the inclusion of all judgment types (diagnosis, investigation, treatment, etc.) and all medical settings using quality Grid for SCT items criteria.[19] Clear instructions and training were given to item writers and the quality of items was checked. The first version of the test was reviewed by five experienced midwives. Reviewers were asked to verify the relevance of questions and clarity of the wording. Low-quality questions were replaced, discarded or rewritten. The final version of the test included SCT involving 24 cases with three questions nested within each case and with testing times of 60 to 90 minutes which was administered to junior (third-year) and senior (fourth-year) midwifery students to assess the validity of the test. The score of the senior students was significantly greater than those of the less-trained juniors (Mean SCT score difference was 0.15, P-value 0.003). Furthermore, the mean SCT score of the expert panel members (19.2(SD= 1.2) out of a maximum 24 points) was significantly higher than that of senior year midwifery students enrolled in both the new curriculum and the conventional approach (Mean = 16.91(SD= 4.5), $P = 0.003$ and 13.5(SD=2.8), $P < 0.001$), respectively. This validated the SCT items.

Administering the Test

The SCT was developed for a paper-based self-administered questionnaire. Because the test format was unusual for most students, the lead author provided an explanatory introduction and a few practice items to familiarize both study groups in a consistent manner.

Scoring the Test

Fifteen-panel members, all expert midwives with Master's degree in clinical midwifery and greater than five years of clinical experience, were selected to complete the test independently in order to set the response keys. Their answers were used to develop the scoring key. A maximum score of 1 was given for the response chosen by most of the experts (ie, the modal response). Other responses were given partial credit, depending on the fraction of experts choosing them. Responses not selected by experts received zero.[20] Scores obtained on each question were added to obtain a total score for the test. We used an aggregate scoring method - an examinee's total score for the test was the sum of the credit obtained for each of the questions, divided by the total obtainable credit for the test.[17–19] The examinee's responses to each question are compared with those of a reference panel. The panels mean thus serves as a reference value. The final score is meant to reflect how closely the examinee's judgments match with those of panel members faced with the same set of ill-defined clinical problems.[20]

Data Analysis

The overall mean SCT score and SD of midwifery students who went through both the new and conventional curriculum approach were calculated. An independent two-sample *t*-test was used to determine whether the two groups differed significantly in each and overall mean SCT item score.

Results

A total of 77 final year midwifery students participated in this study. Of them, thirty-eight attended the new curricular approach (were from DTU) and thirty-nine attended the conventional curricular approach (were from WU). Nearly, all were under 25 years of age and males accounted for

Table 1 Demographic Characteristics of Participants in the Study Based on Their Curriculum Enrollment

Characteristics		Study Group	
		Midwifery Students Attend New SPICES Model Curricular Approach (n = 38)	Midwifery Students Attend Conventional Curricular Approach (n = 39)
Sex	Male	28 (73.7%)	21 (53.8%)
	Female	10 (26.3%)	18 (46.2%)
	Total	38	39
Age	20–24	36 (94.7%)	38 (97.4%)
	25–29	2 (5.3%	1 (2.6%)
	Total	38	39

73% of the study participants from DTU and 53% of WU group (Table 1).

The overall mean SCT score of midwifery students who went through the new curricular approach was 0.70 (range: 0.44–0.88) while midwifery students who went through the conventional curriculum scored 0.53 (range: 0.28–0.71) (Figure 1).

A statistically significant difference in mean clinical reasoning skills SCT score was found between the two groups in 12 out of 24 SCT items (Table 2).

An independent two-sample *t*-test with equal variance assumption (F = 1.09, numerator *df* = 37, denominator *df* = 38, p = 0.78) indicated a statistically significant difference in the overall (composite) mean SCT score between the two groups of study (Table 3).

Discussion

Our study is the first to generate empirical evidence and observe the outcome of different curricular approaches on midwifery students' learning outcomes in Ethiopian context.

In our study, more than one-third of midwifery students in the innovative curricular approach achieved scores above or equal to the panel mean, reflecting a mastery of knowledge in these domains that suggests a reasoning capacity compatible with autonomous professional practice.

Our result revealed that there was a statistically significant difference in the mean SCT scores between the two groups of students. In other words, the new curricular approach has a significant effect in fostering the development of midwifery students' clinical reasoning ability in managing PPH as compared to the conventional curriculum.

A high SCT score by midwifery students taught using the innovative curricular approach, therefore, indicates that an examinee interprets information pertaining to ill-defined clinical problems similar to a majority of experienced midwives.[20] Higher SCT scores also reflect a high degree of concordance with decisions made by the panel of experienced midwives. The high degree of concordance corresponds to the optimal use of information by students to solve authentic clinical problems and to the interconnected knowledge the students have accumulated through learning.[17] The higher SCT score despite the two groups being similar in terms of their background characteristics, pre-admission GPA, and the educational environment indicate that the difference is likely to be due to the new curricular approach and educational strategies.

Our result is consistent with recent studies that have shown that curricular approach, practice, and the kinds of pedagogies institutions implement affect student learning, shape students' educational experiences, and influence learning outcomes.[8,23]

The curricular approaches that most likely contributed for the higher performance in clinical reasoning skills by the innovative curriculum students are the integration of courses with clinical experience, the use of innovative educational strategies like PBL and the structure of clinical experiences. Evidence from the literature suggests that integrated courses enable students to learn meaningful sets of information that are more easily retained and applied to other situations. Structuring learning in an integrated and reinforced manner can encourage the development of higher-level objectives, such as the application of knowledge, reasoning, and problem-solving skills.[8] In contrast, the fragmented course sequencing which separates theory and practice in a traditional curriculum is considered to be one factor contributing to a deficient in clinical reasoning skills.[9]

PBL is also believed to improve the problem-solving skills of students by focusing on the development of a hypothetical-deductive reasoning process. There are also reported benefits of PBL in terms of students' ability to think critically and deal with clinical uncertainty and ambiguity. PBL has positive effects on medical competencies, particularly for improving professional and clinical diagnostic skills. Students taught in a problem-based curriculum have demonstrated improved clinical reasoning skills.[9,21]

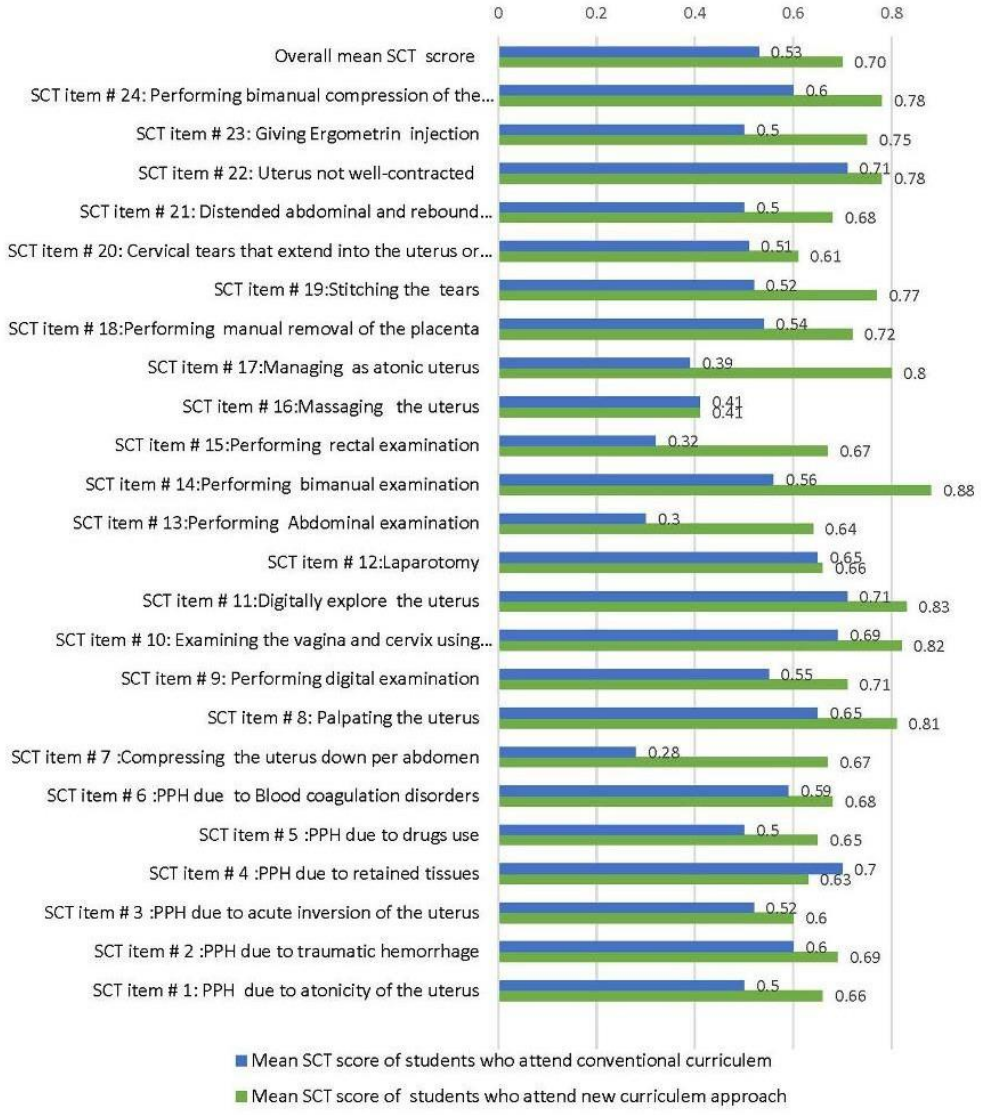

Figure 1 Mean clinical reasoning skills score of each SCT items by their study groups.

Another key feature of the new innovative curricular approach which offers potential for the higher performance of students in clinical reasoning skills could be the early and longitudinal structure of clinical experience. Several researchers have concluded that early and longitudinal clinical exposure is an important aspect in the development of diagnostic reasoning skills to expert level which improves with a number of clinical encounters.[22,23]

Table 2 Differences in Mean Clinical Reasoning Skills of Each SCT Item by Study Group

SCT Item #	Study Group	N	Mean	SD	Mean Difference	t-value at 75 df	P-value	95% CI
1.	Attend the SPICES model curricular approach	38	0.60	0.33	0.08	2.20	0.03*	[0.01, 0.28]
	Attend the conventional approach	39	0.52	0.33				
	Total	77						
2.	Attend the SPICES model curricular approach	38	0.67	0.39	0.39	4.74	0.001*	[0.19, 0.48]
	Attend the conventional approach	39	0.28	0.27				
	Total	77						
3.	Attend the SPICES model curricular approach	38	0.81	0.12	0.16	4.82	0.001*	[0.10,0.24]
	Attend the conventional approach	39	0.65	0.19				
	Total	77						
4.	Attend the SPICES model curricular approach	38	0.71	0.17	0.16	2.66	0.009*	[0.03, 0.24]
	Attend the conventional approach	39	0.55	0.27				
	Total	77						
5.	Attend the SPICES model curricular approach	38	0.82	0.33	0.13	1.98	0.05*	[−0.00, 0.27]
	Attend the conventional approach	39	0.69	0.39				
	Total	77						
6.	Attend the SPICES model curricular approach	38	0.64	0.42	0.34	1.96	0.05*	[−0.002, 0.31]
	Attend the conventional approach	39	0.30	0.26				
	Total	77						
7.	Attend the SPICES model curricular approach	38	0.88	0.24	0.32	5.00	0.001*	[0.19, 0.44]
	Attend the conventional approach	39	0.56	0.36				
	Total	77						
8.	Attend the SPICES model curricular approach	38	0.67	0.36	0.35	5.16	0.001*	[0.21, 0.48]
	Attend the conventional approach	39	0.32	0.31				
	Total	77						
9.	Attend the SPICES model curricular approach	38	0.80	0.36	0.41	5.28	0.001*	[0.29, 0.64]
	Attend the conventional approach	39	0.39	0.41				
	Total	77						

(*Continued*)

Table 2 (Continued).

SCT Item #	Study Group	N	Mean	SD	Mean Difference	t-value at 75 df	P-value	95% CI
10.	Attend the SPICES model curricular approach	38	0.72	0.43	0.18	2.12	0.03*	[0.01, 0.45]
	Attend the conventional approach	39	0.54	0.47				
	Total	77						
11.	Attend the SPICES model curricular approach	38	0.77	0.41	0.25	2.61	0.01*	[0.06, 0.48]
	Attend the conventional approach	39	0.52	0.48				
	Total	77						
12.	Attend the SPICES model curricular approach	38	0.75	0.29	0.25	3.26	0.001*	[0.09, 0.41]
	Attend the conventional approach	39	0.50	0.36				
	Total	77						

Notes: *Mean difference significant at 0.05 level. Mean difference significant at 0.05 level.

Table 3 Independent Samples *t*-Test Comparing Composite the Mean Clinical Reasoning Skills SCT Score Between the Two Groups of Study

Study Group	N	Composite Mean Score	Pooled SD	t-value at 75 df	P-value	95% CI
Attend SPICES model curriculum approach	38	0.70	0.35	2.70	0.008*	[0.04, 0.28]
Attend conventional curriculum approach	39	0.53	0.37			

Note: *Mean difference significant at 0.05 level.

Strengths and Limitations of the Study

This study has much strength. It generated empirical evidence on the effectiveness of innovative curriculum design in improving student learning outcomes. We selected comparable institutions in all aspects except for the curricular approach. Clinical reasoning skills were assessed using SCT, which has favorable psychometric qualities. Furthermore, the higher composite mean scores in the fourth-year than third year midwifery students show that the SCT questions supported the construct validity of the SCT scores.

This study was limited as it did not explore the contextual factors like teachers and student characteristics that may impact the findings. Also, there was no pre-test conducted and hence we would not know if the two groups had equal baseline abilities. Moreover, this study only evaluated clinical reasoning skills in managing PPH and this may not be generalizable to other clinical problems and other health-care delivery skills.

Conclusion

Our results concluded that the new curricular approach has a statistically significant effect in fostering the development of midwifery students' clinical reasoning ability in managing PPH as compared to the conventional curriculum. Hence, the innovative curricular approach promises to improve the attainment of essential competencies for health professionals. We recommend more rigorous evaluation studies to replicate these findings with other clinical problems and health-care delivery skills.

Finally, the study built additional knowledge by extending previous work on the effect of curricular approach and practice in fostering the development of students' clinical reasoning skills and influence learning outcomes particularly in resource constrained setting.[8]

Abbreviations

CRS, Clinical reasoning skills; DTU, Debre-Tabour University; GPA, Grade Point Average; HEIs, Higher

Education Institution; PPH, Post-Partum hemorrhage; PBL, Problem Based Learning; SCT, Script Concordance Test; SPICES, Student centered, Problem Based, Integrated, Community based, Elective and Systematic; WU, Woldeya University.

Ethics Approval

Approval was granted by the Ethics Committee of Jimma University, Ethiopia.

Consent to Participate

Informed oral consent was obtained from all individual participants included in the study.

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Author Contributions

EM contributed to the overall design, analysis and writing of the study. All authors contributed to writing and revision of the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work

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Statement on Pre-release and Contribution

This statement declares that parts of the study or theses have been published and that my contributions to these publications are as follows:

- Conceived, designed, executed, acquired, analyzed and interpreted the work reported
- Contributed to the writing of the article and critically reviewed it
- Review all versions of the article and any significant changes introduced at the proofing stage before submission, during revision, and at the time of publication.
- Responsible for the content of the article.

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1. **Misganaw et al**. The Promise of the New Educational Strategy for Curriculum Development (SPICES) Model on the Development of Students' Clinical Reasoning Ability. A Comparative Cross-Sectional Study. Advances in Medical Education and Practice 2022:13 71–79
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