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Four Dimensions and Implementation Needs for Entrustable Professional Activities in Undergraduate Medical Education: Scoping Review

Oktarina Oktarina[1], Mohd Nasri Awang Besar[2], Zaleha Md Isa[3], Dede Renovaldi[4], Fika Ekayanti[5] and Cholis Abrori[6]

[1]Department of Medical Education, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Indonesia
[2]Department of Medical Education, Faculty of Medicine, Universiti Kebangsaan Malaysia, Malaysia
[3]Department of Public Health, Faculty of Medicine, Universiti Kebangsaan Malaysia, Malaysia
[4]Department of Biomedical Sciences, Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta, Indonesia
[5]Department of Medical Education, Faculty of Medicine, Universitas Islam Negeri Syarif Hidayatullah, Indonesia
[6]Department of Medical Education, Faculty of Medicine, Universitas Jember, Indonesia

Author Designation: [1,2,4,5,6]Lecturer, [3]Professor

*Corresponding author: Mohd. Nasri Awang Besar (e-mail: drmohdnasri@hctm.ukm.edu.my).

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Abstract **Objective:** Implementing Entrustable Professional Activities (EPAs) in the undergraduate setting requires guidance. This review aimed to identify evidence about the essential dimensions and needs for implementing EPAs. **Method:** This review followed Joanna Briggs Institute guidance and PRISMA-ScR standards. English articles (2020-2023) on EPA implementation in undergraduate medical programs were searched from WoS, Scopus and EBSCO. Four independent reviewers screened records using Rayyan.ai, excluding reviews, postgraduate programs and non-medical professions. Three reviewers independently extracted and coded data using NVivo, with all disagreements resolved through discussion. **Result:** There were 790 unique records and 19 studies were extracted. Four essential dimensions for EPA implementation, namely EPA development (n = 9), EPA application (n = 13), entrustment (n = 10) and change management (n = 13), were identified. From this review, it was found that EPA development needs conceptualization, determining the development method and aligning with the curriculum. Whilst the needs for EPA application were students' and teachers' factors, feedback provision, curriculum characteristics, etc. Entrustment decision entails raters' cognition, a competencies committee and an awarding process. Change management needs leadership, commitment, a task force, resources, etc. **Conclusion:** This review establishes a comprehensive framework of four essential dimensions and their specific requirements for EPA implementation in undergraduate medical education. These evidence-based findings serve as foundational guidance for institutions planning EPA implementation and provide a basis for developing assessment tools to evaluate institutional readiness.

Key Words Entrustable Professional, Medical Education, Undergraduate, Implementation, Needs, Competency-Based, Outcome-Based, EPA

INTRODUCTION

Entrustable Professional Activities (EPAs) are selected professional activities that construct professional critical elements and could be entrusted to a competent professional. Entrustable Professional Activities (EPAs) have emerged as a cornerstone in competency-based medical education (CBME), offering a practical framework to bridge the gap between theoretical learning and real-world clinical practice [1]. EPAs serve as educational outcomes at various stages of medical training. They encapsulate the knowledge, skills and attitudes required to perform specific professional activities, making them integral to learning and assessment processes.

As there are many routes and terminologies in medical education among countries, it is necessary to clarify the definition and scope used in this paper. Undergraduate medical program is an educational phase to obtain the first license to practice as a physician. Implementing EPAs in undergraduate settings differs fundamentally from postgraduate contexts. Undergraduate students lack professional autonomy and independent legal responsibility for patient care, requiring different supervision frameworks and entrustment levels compared to licensed postgraduate trainees who practice with greater independence [2]. These contextual differences necessitate careful adaptation of EPA frameworks, particularly regarding supervision requirements, scope of practice and the maximum appropriate levels of entrustment for pre-licensure learners. Moreover, implementing new methods in the workplace is challenging. Several conditions, such as teachers' understanding of EPAs, high clinical commitment and

availability of supporting facilities, can hinder the implementation of EPAs. In addition, change management can also be a barrier to implementation. Therefore, this study aimed to identify the distinct conceptual domains that encompass essential components, which were then named as "dimensions". The secondary objective was to determine the "needs" which refer to the specific prerequisites and resources required within each dimension for implementing EPAs in undergraduate medical programs. Regarding those aims, the review does not assess the effectiveness or learner outcomes of EPA implementation in undergraduate medical education.

METHODS

We chose a scoping review methodology because EPA implementation is diverse and context-dependent, requiring an exploratory approach to map the breadth of implementation strategies. The heterogeneity of implementation contexts, outcome measures and study designs makes a scoping review more appropriate at this stage of the field's development.

We conducted this scoping review following the Joanna Briggs Institute guidance, using Rayyan.ai to accelerate the approach and reported it according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews [3].

Identification of Research Questions

The research questions for this scoping review were "What are the essential dimensions and the needs for implementing EPAs in undergraduate medical programs?"

Search Strategy

We searched three electronic databases: WoS, Scopus and EBSCO, because these three databases are also adequate references for this topic. They have broader disciplinary coverage, making them relevant to medical education and citation tracking features that can facilitate scoping reviews. The keywords used in the literature search were: Entrustable professional activities, medical and undergraduate. The inclusion criteria were (1) An article published between 1st January 2020 and 31st December 2023, (2) Restricted to English language articles and (3) Original articles on EPA implementation in undergraduate medical programs.

This scoping review focused on literature from 2020-2023 for several reasons. This period represents the experience of EPA implementation practices in undergraduate medical programs. While acknowledging that foundational EPA development occurred earlier, this temporal focus enables examination of current implementation approaches and emerging best practices.

Eligibility Criteria

We included studies focusing on EPA implementation and reporting data on undergraduate medical education. Exclusion criteria were (1) Publication type of reviews and guidelines; (2) Applied in post-graduate programs or describing EPAs for other professions, e.g., physician assistants; (3) The full article could not be accessed by researchers and (4) Only focused on the impact of EPA and not the implementation findings.

Study Selection

Following the search, all identified citations were collated and uploaded to Rayyan.ai and duplicates were removed. Four independent reviewers (OR, DR, FE, CA) screened titles and abstracts for assessment against the inclusion criteria using a standardized screening form. Conflicts were coded as "maybe" during blind screening to ensure a comprehensive full-text review. Potentially relevant sources were retrieved in full text.

The same four independent reviewers assessed full texts in detail against the inclusion criteria. For studies involving mixed learner populations (both undergraduate and postgraduate), we included only those that reported undergraduate data separately or where undergraduate students comprised the majority of participants. Reasons for exclusion at the full-text stage were documented in Rayyan.ai.

Inter-rater agreement was managed through a consensus process: disagreements at both screening stages were first discussed between the two reviewers with conflicting decisions. If consensus could not be reached, cases were escalated to senior reviewers (MNAB and ZMI) for final adjudication. The structured consensus process ensured consistent application of inclusion criteria (Figure 1).

Data Extraction

Data were extracted from articles included in the scoping review by three independent reviewers (OR, FE, CA), which resulted in the key findings relevant to the research questions. The findings were taken as quotes, then open coding by OR and FE for three early-read documents. Three independent reviewers (OR, FE, CA) extracted data from included articles, capturing key findings relevant to the research questions. Extracted data were recorded as direct quotations with source citations to maintain traceability. Any disagreements between reviewers were resolved through discussion with MNAB and ZMI. When information was unclear or potentially missing from primary studies, we did not contact authors but coded this as "not reported" to maintain transparency about data limitations. Rayyan.ai (blind mode enabled) and NVivo were used to document the review process (Table 1).

Data Synthesis

Data synthesis followed an iterative qualitative content analysis approach. After codes were generated inductively from the data, related codes were grouped into broader categories representing coherent implementation themes through constant comparison. These categories were then analysed to identify overarching conceptual dimensions, which became the four dimensions reported in this review: EPA development, EPA application, entrustment decision-making and change management (Table 2).

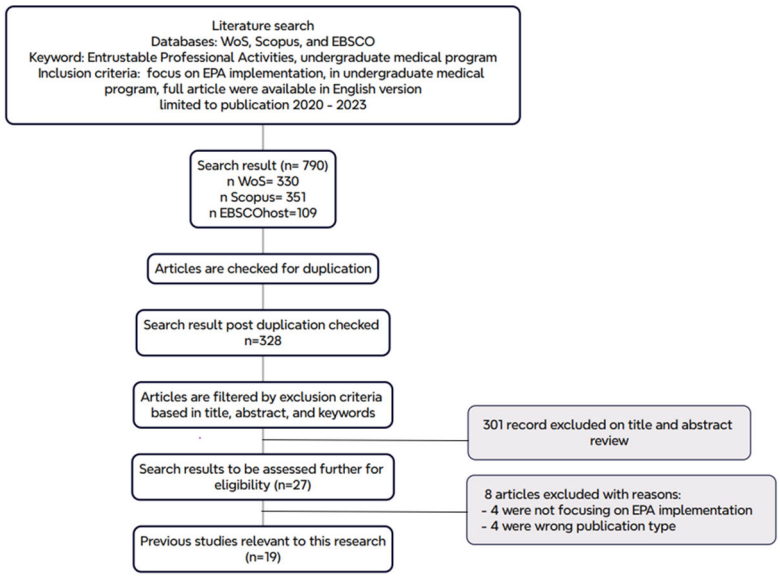

Figure 1: Flowchart of the Article Selection Process

Table 1: Sample Characteristics

No.	Authors	Selected Articles	Place
1	Bratz *et al.* [31]	Assessment of final-year medical students' entrustable professional activities after education on an interprofessional training ward - A case-control study	Germany
2	Bray *et al.* [20]	Implementing Systematic Faculty Development to Support an EPAs-Based Program of Assessment - Strategies, Outcomes and Lessons Learned	US
3	Brown *et al.* [12]	Comparing Entrustment Decision-Making Outcomes of the Core Entrustable Professional Activities Pilot, 2019-2020	US
4	Brown *et al.* [17]	Entrustment Decision Making in the Core Entrustable Professional Activities: Results of a Multi-Institutional Study	US
5	Butani *et al.* [14]	Entrustable Professional Activity-Based Assessments in Undergraduate Medical Education - A Survey of Pediatric Educators	US and Canada
6	Caro Monroig *et al.* [13]	Medical Students Perspectives on Entrustment	US
7	Duggan *et al.* [15]	Using mobile technology in assessment of entrustable professional activities in undergraduate medical education	Canada
8	Dunne *et al.* [8]	WBAs in UME" How Many Are Needed? A Reliability Analysis of 5 AAMC Core EPAs Implemented in the Internal Medicine Clerkship	US
9	Encandela *et al.* [5]	Entrustable professional activities as a training and assessment framework in undergraduate medical education: A case study of a multi-institutional pilot	US
10	Francischetti *et al.* [6]	Entrustable professional activities for Junior Brazilian Medical Students in community medicine	Brazil
11	Gummesson *et al.* [4]	Entrustable professional activities (EPAs) for undergraduate medical education - development and exploration of social validity	Sweden
12	Hanna *et al.* [11]	Specialty-Specific Entrustable Professional Activities: A Bridge to Internship.	US
13	Harvey *et al.* [9]	How much is enough? Proposing achievement thresholds for core EPAs of graduating medical students in Canada	Canada
14	Meyer *et al.* [19]	A Pilot Study of the Generalizability of Preclinical Entrustment Assessments in Undergraduate Medical Education	US
15	Meyer *et al.* [18]	Pre-clerkship EPAs assessments~ a thematic analysis of rater cognition	US
16	Oktarina *et al.* [10]	Development of Core Entrustable Professional Activities for Indonesian Undergraduate Medical Education: The Experience of Universitas Muhammadiyah Jakarta.	Indonesia
17	Pinilla *et al.* [16]	Workplace-based assessments of entrustable professional activities in a psychiatry core clerkship~ an observational study	Switzerland
18	Postmes *et al.* [22]	EPAs-based assessment Clinical teachers challenges	Netherlands
19	Weissenbacher *et al.* [7]	Development and consensus of entrustable professional activities for final-year medical students in anesthesiology	Germany

The progression from codes to dimensions involved both inductive analysis (allowing themes to emerge from data) and deductive refinement (ensuring alignment with established EPA implementation theory). Specific codes within each dimension represent the essential needs identified across studies. Regular team meetings ensured consistency in coding and interpretation throughout the analysis process. We did not weight themes by frequency or evidence strength, as quality appraisal was not conducted. Therefore, all identified needs are reported as equally relevant, though future research should examine their relative importance.

Table 2: Studies Per Dimension

No.	Dimension	Studies
1	EPA Development	Bray *et al.* [20]; Dunne *et al.* [8]; Encandela *et al.* [5]; Francischetti *et al.* [6]; Gummesson *et al.* [4]; Hanna *et al.* [11]; Harvey *et al.* [9]; Oktarina *et al.* [10]; Weissenbacher *et al.* [7]
2	EPA Application	Bratz *et al.* [31]; Brown *et al.* [12]; Brown *et al.* [17]; Butani *et al.* [14]; Caro Monroig *et al.* [13]; Duggan *et al.* [15]; Dunne *et al.* [8]; Encandela *et al.* [5]; Gummesson *et al.* [4]; Meyer *et al.* [18]; Meyer *et al.* [19]; Pinilla *et al.* [21]; Weissenbacher *et al.* [7]
3	Entrustment Decision	Bray *et al.* [20]; Brown *et al.* [12], Brown *et al.* [17]; Caro Monroig *et al.* [13]; Encandela *et al.* [5]; Gummesson *et al.* [4]; Meyer *et al.* [18]; Meyer *et al.* [19]; Pinilla *et al.* [21]; Postmes *et al.* [22]
4	Change Management	Bray *et al.* [20]; Brown *et al.* [12]; Brown *et al.* [17]; Butani *et al.* [14]; Duggan *et al.* [15]; Dunne *et al.* [8]; Encandela *et al.* [5]; Gummesson *et al.* [4]; Meyer *et al.* [18]; Postmes *et al.* [22]; Weissenbacher *et al.* [7]

RESULTS

Overview of Included Studies

Using the above search strategy, 27 studies were included. Four articles were excluded based on the exclusion criteria "wrong publication" and four articles with "wrong population". According to the process, 19 articles were eligible for analysis (Figure 1). Studies originated from diverse geographical contexts, with the majority from the United States (n = 9), followed by European countries (n = 5), Canada (n = 2) and other regions including Brazil, Indonesia and Switzerland. Study designs varied, including descriptive case studies, qualitative analyses, development studies using Delphi or consensus methods, observational studies and multi-institutional evaluations. While most studies reported positive implementation experiences and facilitating factors, several also documented challenges, barriers and instances where EPA implementation did not proceed as planned. These mixed findings are integrated throughout the dimensional framework below.

Essential Dimensions for Implementing Entrustable Professional Activities (EPAs) in Undergraduate Medical Programs (RQ1)

There are several ideas related to EPAs, which are then referred to as dimensions. Firstly, preparing EPAs is the phase of determining activities that will be used as EPAs in medical education, involving both core and specific EPAs. Nine articles had relevant results in this dimension. The second dimension, EPA application, encompasses the intention to administer EPAs to a program. In this dimension, it is assumed that EPAs have been defined and are ready for technical implementation. In this review, there were 13 articles containing components of this dimension. The third focus is the entrustment decision, which includes the assessor and granting entrustment in a program. There were ten articles covering this topic dimension. Eleven articles described the last dimension, change management, that needs to be carried out by institutions that plan to implement the EPAs. In this review, the term academic staff is interchangeable with teacher, faculty, rater, assessor or supervisor, depending on the discussed role.

The Need for Implementing Entrustable Professional Activities (EPA) in Undergraduate Medical Programs

EPA Development

Conceptualization and Standardization: The development of EPAs requires a centralized approach [4], reinforced by the national level [5] and alignment with regulations in each country [4]. Determining the level of entrustment to be used and the highest level that can be achieved by undergraduate programs is also a concern in articles by Francischetti *et al.* [6] and Weissenbacher *et al.* [7]. Clarity of EPA result position in graduation or promotion, preparation of milestones, competencies and competency-based objectives is also necessary in this dimension [5]. Although research by Dunne *et al.* [8] argued that a reliability index of 0.7 is achieved when EPAs ranged between 9 and 11, it is advisable to create a standard protocol to determine EPA achievement thresholds [9]. The development of EPAs needs to be continued with validation by various parties, including the government [4].

Development Team and Stakeholder Involvement

The development process requires a team of developers [6,7,10,11]. This development team consists of experts from the related department, education experts, authorities related to the medical education program and the director of the relevant residency program to ensure the continuity of EPAs for entering residency [6,7,10,11]. Stakeholder involvement is also mentioned in several articles to support the EPA development process, such as students, to avoid the gap between the expectations of the curriculum developers and students [7].

Identify and Describe EPAs

The initial EPA definition needs to be undertaken as the first stage in identifying EPAs [7]. Then, it is necessary to provide a detailed description of each EPA, including limitations, clarifying levels of supervision and so on [4,6,11]. Moreover, in this development process, it is necessary to identify core EPAs and nested or specialty-specific ones required in the intended program [7,11]. Moreover, the challenge of entrustment level determination for each activity, considering legal liability and patient safety, was reported by Weissenbacher *et al.* [7] and Oktarina *et al.* [10]. Despite structured development processes, challenges emerged in several studies. Weissenbacher *et al.* [7] reported difficulty determining appropriate entrustment levels for undergraduate students, particularly balancing educational goals with legal liability and patient safety concerns. Additionally, achieving consensus among diverse stakeholder groups proved time-consuming, with some development teams experiencing disagreements about which activities were truly "entrustable" for pre-licensure learners.

Method for Developing

Seven articles described the method for developing EPAs, including subthemes such as references, technique, participants, piloting and validation. Reference framework as the foundation to develop EPAs was also highlighted in two articles. National competency standards and national qualification frameworks were used in the study by Oktarina *et al.* [10]. Meanwhile, Francischetti *et al.* [6] referred to the national health policies, the national curriculum guidelines, the Medical Pedagogical Project and medical course notebooks, which have been used for undergraduate medical education. The next step that needs to be determined is the planned technique for EPA development, such as the Modified Delphi technique [6,7,9,10] and iterative consensus [11]. Panels/participants for developing EPAs were one of the issues explained in two articles in this dimension. Process definition and recruitment of participants were argued by Weissenbacher *et al.* [7]. Francischetti *et al.* [6] mentioned involving multiprofessional panels of 15 content experts. Piloting of Core EPAs was a step recommended by a study by Encandela *et al.* [5]. Validation of Core EPAs was explained by Gummesson *et al.* [4] by using EQual (EPA Quality) measuring score rubric.

Aligning to the Curriculum

Having identified the EPAs in detail, the alignment of the EPAs to the curriculum needed to be explained in the EPA development process [5,12]. Hanna *et al.* [11] mentioned applying Kern's framework to develop a curricular blueprint in formulating nested EPAs.

EPA Application

In this dimension, students, medical teachers/supervisors, curriculum and supporting systems were found to be essential needs to be prepared.

Students' Factors

Students should understand fundamental concepts in the EPAs framework as cited in Gummesson [4].

It is important for the students and supervisors to understand the fundamental difference between an EPA and the complete set of knowledge, skills and attitudes the individual must possess to be able to carry out the specific activity (EPA) independently [4].

Self-directed learning, agency and action-oriented discernment were potential enablers to EPA application [13]. It needs to be strengthened for the EPA framework to be well implemented. Feedback-seeking behavior should also be empowered to reduce contextual barriers in the completion of EPA-based assessments [14]. Although in the research of Dunne *et al.* [8] it was mentioned that students tend to seek feedback from assessors who do not directly contribute to the final grades. A challenge that needs to be anticipated in EPA application is students' enthusiasm, which was conveyed in a study by Encandela *et al.* [5].

Teachers' Factors

Teachers have varied roles in the dimensions of EPA implementation, as panels or participants or development team members in the EPA development, as supervisors or coaches in EPA application and also as assessors in the entrustment decision dimension. Understanding of EPAs framework, key concepts of learner competencies and feedback for improvement were found in this review as requirements to facilitate workplace learning and students' development according to milestones [4].

Providing feedback is critical in EPA applications, including quantity, quality, i.e., immediate, specific feedback, not only corrective but also highlighting performance done well, including suggestions on how students may enhance performance and methods such as narrative or text [4,5,7,15,16]. However, time constraints for giving feedback were a challenge reported by Encandela *et al.* [5], leading to a "performative way".

Besides, faculty perception about the assessments in a clinical setting and the usefulness of EPAs affect teachers' support in EPA application, as cited below.

Buy-in from front-line faculty assessors varied within and between schools depending on several related conditions: (1) Levels of enthusiasm and persuasion that curriculum leaders exhibited for EPAs, affecting earlier or later adoption by others; (2) Faculty perceptions of 'intrusion' that assessments would have in conducting clinical and other teaching activities and (3) Faculty perspectives regarding relevance and usefulness of EPAs for training students relative to current approaches [5].

According to students' perspectives, one characteristic of teachers that influences EPA application was the level of experience; more experience provided less direct supervision [13].

Curriculum Aspect

Curriculum reform to facilitate EPA implementation was explained in Encandela *et al.* [5]. Longitudinal integrated clerkship is suggested to be prepared in the curriculum to provide a continuity effect that can facilitate the entrustment process [16,17]. Gummesson *et al.* [4] argued that the curriculum encompasses more integrated clinical training and early introduction to students. Encandela *et al.* [5] explained a coaching model focusing on longitudinal academic progression, whilst longitudinal relationships to increase assessor familiarity with students that influence entrustment decisions were argued by Caro Monroig *et al.* [13] and Meyer *et al.* [17]. According to Encandela *et al.* [5], preclinical placement EPAs allow increasing students' self-awareness and ability to value the skill observation and feedback. A model of shared responsibility for driving feedback also provides an advantage for applying EPA [4]. In a study by Bratz *et al.* [31] training in an interprofessional training ward has a positive impact on practicing competencies relevant to future entrustment decisions. Encandela [5] explained the implementation of simulations and case-based discussions during the preclinical phase in the pilot study to familiarize students with EPA.

Furthermore, assessment adjustment is also needed to set up the implementation of EPA [5]. It was found in the study by Gummesson *et al.* [4] that concerns regarding practice, feedback and assessments were raised. The assessment

adjustment strategy is carried out in a way that does not rely only on the WBA related to the EPA to make decisions about student performance and progress in the clerkship [4,5,7,12], using the WBA for EPA as a formative assessment [5,7,16], making it a complement to existing assessment mechanisms, as well as a substitute for assessments that 'do not work properly [5]. More WBAs encourage a higher perceived self-entrusted supervision level to be more independent [16] and results in higher readiness [12]. There is a need to identify and anticipate difficulties in assessing some EPAs and this encourages a focus on their implementation, as cited from Gummesson *et al.* [4].

Concerns about the difficulties in assessing some of the EPAs prompted a focus on their implementation.

Development of longitudinal assessment evaluators to encourage positive emotions among this group of educators towards the completion of workplace-based assessments is recommended by Butani *et al.* [5].

Support System

The implementation of EPAs also requires an adequate support system. This process begins by clarifying the concept of EPA for students, teachers and supervisors [4]. A supportive learning culture is necessary to provide the development of trusting relationships and promote an openness to feedback [7]. Caro Monroig *et al.* [13] and Meyer *et al.* [19] mentioned that assessor familiarity with a student appeared to influence several aspects directly. This relationship makes students feel comfortable building confidence in accepting responsibility and makes them more at ease asking for help [13,18]. However, faculty familiarity with students also significantly affects entrustment assessment reliability. Meyer *et al.* [19] found that assessments by unfamiliar faculty showed better generalizability ($\varphi = 0.75$) compared to familiar faculty ($\varphi = 0.27$), though familiar faculty's assessments were more strongly correlated with objective performance measures [19]. Since students spend the majority of their learning with resident trainees who do not affect the final grade, this needs to be balanced according to Dunne *et al.* [8]. Coaching or other structures that provide longitudinal coaching or continuity across clinical supervisors contribute to tracking student professional development and successful EPA implementation [5,13,14].

In addition, the workplace provides an experience that supports the accomplishment of EPAs. However, according to Brown *et al.* [12], there is a lack of workplace roles for students in some essential clinical tasks.

Entrustment Decision

Entrustment Mechanism: Entrustment in EPA-related curriculum is given based on assessments and the theoretical entrustment process. Entrustment decisions can be formative or summative. Gummesson *et al.* [4] recommended that entrustment decisions be determined by a committee. Whilst Bray *et al.* [20] explained the involvement of the Master assessor. Pinilla *et al.* [2] found that entrustment decisions in clinical settings emerge as multilateral and dynamic processes involving multiple entrusting supervisors including residents, nurses, psychologists and other healthcare team members, not just faculty physicians.[21] However, in the study by Brown *et al.* [12], there was a failure of entrustment decisions in 28% of data sets. This was due to several reasons, including a lack of data quality or quantity, a system for programmatic assessment that does not work well and an unsatisfactory system of data analysis and student dashboards [17]. These findings were corroborated by Brown *et al.* [12], who reported that trained entrustment groups could not make decisions for 28.4% of EPA-specific determinations due to lack of data, with workplace-based assessment availability significantly associated with the ability to make (versus not make) entrustment decisions [17]. Therefore, it demonstrated the need to prepare an adequate information technology system for programmatic assessment [5,17].

Rater's Cognition

Assessors could be frontline clinical staff, residents, community doctors and advanced healthcare providers [5]. Pinilla *et al.* [16] demonstrated that entrustment in clinical clerkships involves a multifaceted supervisor network including nurses, residents and psychologists who actively negotiate entrustment decisions both with and for students, either facilitating or hindering opportunities [21]. Regardless of the rater, challenges and factors that influence rater judgment need to be anticipated and prepared before EPA implementation. Challenges to rater cognition described by Meyer *et al.* [18] were the use of “rater preference”, “training phase”, “comparison with other students” and prospective vs retrospective entrustment determination. The challenges of the prospective nature of the entrustment-supervision scale and rater cognition about the level of entrustment were reported by Postmes *et al.* [22]. Cognition about trust and entrustment functions in EPA was also a concern in Caro Monroig *et al.* [13]. Other factors that influence rater judgment include the clinical task and poor previous performance, which negatively impact the recent assessment [18]. The clinical context affected supervisors’ decisions to entrust, as they were likely to have less direct supervision in the context of non-acute care [13]. Less observation, more compromised entrustment accuracy and fairness were given [13]. Beyond, acute versus non-acute care contexts, the broader assessment setting also matters for entrustment reliability. Meyer *et al.* [19] demonstrated that entrustment assessments in non-workplace settings using standardized patients had different psychometric properties than workplace-based assessments, with faculty-student familiarity creating complex tradeoffs between assessment generalizability and scoring validity." This suggests that the authenticity of the assessment environment and the nature of assessor-student relationships interact to influence the reliability and validity of entrustment decisions.

Change Management

Effective change management to organize smooth transitions is needed to ensure the implementation of EPAs in the program can be appropriately conducted.

Rationale of Change

Institutional commitment needs to be prepared to generate positive emotions for change [14]. One of the opportunities to precede the change for implementing EPA is in the major curriculum reform [5]. To determine their ability to make changes in the form of EPA implementation, medical school leaders need to consider resource availability and situational factors related to change as an effort to assess the readiness for change [5]. As this implementation is a pilot program, predicting precise needs is more difficult. However, it is recommended by Encandela *et al.* [5] that the team learns by doing. The uncertainty regarding the resources and strategies required at the start of the pilot made it difficult to fully assess the ability to initiate and sustain the EPA framework.

Faculty Development

With several fundamental changes for implementing EPA, a culture change is needed for students and faculty [17]. Faculty development is an effective strategy for preparing for change [5,7,18,20]. Although it might occur in the early stages of local implementation, the change plan is underestimated, especially regarding supervisor training and infrastructure [7]. A systematic approach for faculty development was suggested by Bray *et al.* [20]. The leadership driver plans the implementation of faculty development activities as cited in Bray *et al.* [20].

The EPA Leadership Group has the expertise and responsibility (LD) to plan implementation of faculty development activities, address challenges and to use data to ensure the effectiveness of the training activities in order to sustain change and institutionalize [20].

To prepare for EPA implementation, it is necessary to plan three sets of faculty development, namely, for the development team [5], the delivery team [5,18] and the competency drivers [18,20]. The challenge that needs to be anticipated is the faculty's perspectives on the usefulness of EPAs [8]. Faculty development to foster self-assessment, reflective practice, providing feedback and coaching skills is essential for the delivery team [20]. Faculty development for competency drivers should empower observation and assessment skills in authentic settings, skill enhancement and consensus building, promote trust and enable decision-making in a variety of clinical settings. Performance dimension training, frame of reference training, the pitfalls in raters' cognition and direct observation should be addressed with faculty development [18].

Conducting faculty development with a willingness to be flexible and reaching potential participants to facilitate raters' engagement was explained by Bray *et al.* [20]. Interactions among participants of faculty development could promote learning and encourage community building [20]. Strategies for effective faculty development include aligning training sessions with best practices in faculty development and delivering them in regularly scheduled meetings, including grand rounds, faculty meetings and department conferences. Also part of the strategy, Dunne *et al.* [8] mentioned that it is beneficial to produce faculty development videos about CBME, EPAs, formative feedback and mobile platform instruction.

Identify and Overcome Resistance

Willingness to accept the concept, both institutional and personal, as well as the commitment of all parties involved in EPA implementation, are essential for its success [5,14]. Therefore, identifying and overcoming resistance is a necessary part of change management, as it can manifest and cause obstacles in the implementation of EPA. Some of the reasons for resistance are dissatisfaction due to the amount of time needed to conduct EPA EPA-based assessment [14], too much administrative time [13,16], the need for training to improve the reliability of the assessments [14], lack of perceived benefit of EPA compared to the current assessment [14] and too many technological resources [14].

Task Force

Leadership, commitment and the dean's involvement were found to contribute to adequate change [5]. The task force, as a leadership group, is an integral part of change management. This team plays a role in socializing changes, enacting changes and maintaining changes until a new culture is formed [20]. This team needs to include educational experts who are capable of strategically planning faculty development to internalize change [20]. Bray *et al.* [20] suggested Organizational Drivers (OD) as the infrastructure that enables Competency Drivers (CD) to be effective. Challenges in administrators' enthusiasm and the importance of collaborative spirit among teams were reported by Encandela *et al.* [5]. Overall, faculty buy-in must be prepared by this team within the framework of change management [5]. Interschool collaboration was suggested by Encandela *et al.* [5] to support progress.

Requirement Resources

The implementation of the EPA as a change requires the preparation of relevant resources and infrastructure [4]. The availability of technology, such as online applications for submitting EPA assessments, portfolios, management systems, data compilation and presentation, was required to support the EPA curriculum [4,12,15,17,20]. Moreover, technically skilled data teams are indispensable for operating existing systems [5]. Nevertheless, resource limitations are certainly a challenge for some medical schools [4,12].

DISCUSSION

The concept of EPAs emerged in 2005 as a practical approach to operationalize competency-based medical education, initially focused on postgraduate training where learners possess professional licensure and legal authority to practice [23]. Early EPA frameworks emphasized the importance of identifying discrete professional activities, establishing appropriate supervision levels and making entrustment decisions based on demonstrated competence [24]. Planning the implementation of EPA, the needs of the EPA development dimension, the EPA application, the entrustment decision and change management need to be fulfilled. EPA development includes defining the EPAs that will be used in a program, as explained by Cate and Taylor [25]. This dimension needs conceptualization and standardization as the starting point, forming a development

team, identifying and describing EPAs, determining methods for development and aligning with the curriculum. It is also recommended by Cate *et al.* [1] that the expert panel, method, breadth and appropriateness of the features of the activities to be EPAs are an important part of preparing for EPA implementation at the development stage.

In the EPA application dimension, technical preparation for running EPAs in a program, preparing students, teachers, curriculum adjustment and supporting systems are needs that must be addressed. The concept of EPAs is more of a student-driven assessment rather than a teacher/supervisor-driven assessment request. Therefore, students need to have a sense of ownership over their progress. For implementing EPAs, students should have adequate self-directed learning, agency, feedback-seeking behavior and responsibility. This is also explained by Cate and Chen [26] that agency (proactive towards work, team, safety, personal development) and humility (recognizing limits, asking for help, accepting feedback) are crucial student factors for EPAs implementation.

The factors that must be prepared for teachers are an understanding of the EPAs framework, learner competencies and feedback for improvement. This is in line with Peters *et al.* [27] and Shorey *et al.* [28] that supervisor characteristics are essential elements in the application stage, including the relationship between supervisors and trainees. The needs in the curriculum aspect for implementing EPAs are the curriculum that provides learning opportunities to gain entrustment, longitudinal integrated clerkship, with early introduction to students. The curriculum should prepare students for understanding the EPAs framework. In teaching and learning, case-based learning, problem-based learning, teaching clinical skills across clinical rotations and interprofessional education should be adequate. The assessment program is one of the needs that must be prepared for the implementation of EPAs, including programmatic assessments and WBA for EPA. Those aspects are in accordance with Peters *et al.* [27] and Shorey *et al.* [28]. Support systems should be prepared, including efforts to clarify the EPA concept for all parties, a supportive learning culture, the availability of clinical task exposures and a longitudinal supervision system. The results are consistent with the findings presented in prior review articles, which emphasize the critical role of the learning environment [29,30].

Entrustment decision is indeed part of the technical application, which Cate and Chen [26] underscores the significant difference when the assessment orientation changes to prospective or contains prediction. In this review, entrustment mechanism and raters' cognition were found as subthemes that should be prepared. The entrustment mechanism in ad hoc and summative decisions requires sufficient data, a data management system and the existence of a summative decision assessment team. The awarding process of entrustment decisions was part of the discussion in Cate and Taylor [25]. Raters' fundamental cognition is understanding the EPA framework, the assessments used, the changing perception of prospective and longitudinal assessments and the potential ethical and legal issues. Furthermore, it is required to address the factors influencing entrustment decisions, such as distrust in the results of previous entrustment assessments and the clinical context. Factors affecting the entrustment decision and what is required to provide an entrustment decision are also discussed in Shorey *et al.* [26], Cate *et al.* [1] and Cate and Taylor [25].

Change management is discussed separately from technical preparation because it manages all change processes so that they can run well, including task force and resource management [1]. It requires justification of change, faculty development, forming a task force and resources. Identifying resistance among faculty staff is a part of the initiative strategies. Luke [30] has covered this in more depth in his review of managing change.

CONCLUSIONS

This scoping review identified four essential dimensions for EPA implementation in undergraduate medical education: EPA development, EPA application, entrustment decision-making and change management. Each dimension encompasses specific prerequisites that institutions must systematically address for successful implementation.

These findings should be interpreted as preliminary guidance rather than definitive best practices. The framework represents current implementation approaches rather than validated standards.

Despite these limitations of the restriction search strategy, the review provides a practical starting point for institutions planning EPA adoption in undergraduate programs. The framework can inform institutional readiness assessments by identifying essential prerequisites across all four dimensions.

Future research should validate this four-dimensional framework across diverse educational settings, examine implementation differences between resource-rich and resource-limited institutions, develop practical tools aligned with identified dimensions (e.g., readiness checklists, faculty development curricula) and investigate whether EPA implementation achieves intended outcomes in learner competence and patient care quality.

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