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# What Should Anaesthesia Technologists Do? Identifying Entrustable Professional Activities for Anaesthesia Technologists: An Exploratory Two-Round Modified Delphi Study

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# What Should Anaesthesia Technologists Do? Identifying Entrustable Professional Activities for Anaesthesia Technologists: An Exploratory Two-Round Modified Delphi Study

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## Abstract

### Background

Anaesthesia technologists are recognised in many countries and work under professional associations and regulatory bodies, yet there is no agreed set of Entrustable Professional Activities (EPAs) for the role. Bachelor of Science (BSc) programmes in anaesthesia technology began to appear in the mid-1990s and early 2000s, and anaesthesia practice has since extended past the operating theatre to sedation services, intensive care units and pain management clinics. This exploratory study aims to identify preliminary list of candidate EPAs for undergraduate anaesthesia technology education.

### Methods

We conducted a two-round modified Delphi study with practising anaesthesia technologists and anaesthesiologists from eight countries. In Round 1, an open-ended questionnaire generated task statements, which were analysed thematically and consolidated into Entrustable professional activities. In Round 2, panellists rated each EPA activity on a four-point importance scale. For each item, we calculated a normalised importance score, the percentage of panellists who rated it 3 or 4, and the median and interquartile range (IQR).

### Results

Twenty panellists (19 anaesthesia technologists and one anaesthesiologist) completed Round 1, and 14 completed Round 2. Round 1 produced 64 task statements, which were consolidated into 20 candidate EPAs. Eighteen of the 20 activities met the post consensus criterion of at least 75% of panellists rating the activity 3 or 4 on the four-point scale; conducting handover and documentation and assessing discharge criteria from the post-anaesthesia care unit did not (71.4% each). Five activities had a normalised importance score of 95% or higher: assisting with airway management (100%); assisting in the management of anaesthesia complications

during the operation, assisting in the management of airway complications during the operation, and preparing and administering intravenous fluids, blood and blood products (98.2% each); and preparing the operating theatre for different types of anaesthetic procedure (96.4%). One high-scoring activity, continuing education and knowledge update, was judged on conceptual grounds to be a professional responsibility and not an EPA.

**Conclusion**

This study offers a preliminary, practitioner-generated list of candidates entrustable professional activities for anaesthesia technologists. The items are not yet fully specified EPAs. Further consensus rounds with a broader, multidisciplinary panel, complete EPA descriptions and testing in the workplace are needed before the list is used for curriculum design or entrustment decisions.

**Keywords:** Entrustable professional activities; Anaesthesia technology; Competency-based education; Delphi technique; Curriculum development

## 1. Introduction

Entrustable professional activities (EPAs) have become an important part of competency-based education in the health professions. Over the past two decades, many specialty training programmes and undergraduate curricula have adopted EPAs to define and assess the essential work expected of their graduates (1,2).

Anaesthesia technologists are health professionals who usually complete a four-year undergraduate programme in the basic medical sciences and the anaesthesia sciences. Although the profession is recognised in many countries and is overseen by professional associations and regulatory bodies, there is no agreed set of EPAs for the role. BSc programmes in anaesthesia technology first appeared in the mid-1990s and early 2000s. Since then, anaesthesia practice has moved beyond the operating theatre and now includes conscious and procedural sedation, intensive care units and pain management clinics.

Ten Cate introduced the EPA concept in 2005 to connect competency frameworks with everyday clinical work (1). An EPA is a unit of professional practice that can be entrusted to a learner once he or she has shown the competence needed to carry it out without supervision (1,2). An EPA is therefore different from a competency or a single skill. A competency describes an ability of the person, such as communication or professionalism, whereas an EPA describes a piece of work that is observable, measurable, has a clear beginning and end, and is carried out in a defined context (2,3). A complete EPA description includes a title, its specification and limitations, the potential risks of failure, the knowledge, skills and attitudes required, the information sources used to judge progress, and the expected level of supervision at each stage of training (2).

Most published EPA frameworks in anaesthesia were written for anaesthesiologists in postgraduate training (4,5), and core EPAs have also been defined for medical graduates entering residency (6). These groups usually hold higher qualifications and broader clinical authority than anaesthesia technologists, who are prepared at undergraduate level and work within a defined scope in the anaesthesia team. Their routine work includes checking and troubleshooting anaesthesia machines and monitoring equipment, preparing the operating theatre, supporting airway management, and assisting with patient care before, during and after anaesthesia. A competency framework for anaesthesia technologists has recently been published (7), but we did not find a published EPA framework designed for this role.

Perioperative care depends on anaesthesiologists, nurse anaesthetists and anaesthesia technologists working closely together, and safe teamwork requires each professional to understand the limits of his or her role. Pathways for educating and certifying anaesthesia

technologists differ widely between countries. Some countries have well-established programmes and regulatory standards, while others have no clear statement of the skills and responsibilities expected of graduates. EPAs offer a practical way to make these expectations explicit. They support progressive entrustment, in which a learner moves from direct supervision to independent performance as proficiency grows (2,8), and they can be linked to competency frameworks such as CanMEDS or the Accreditation Council for Graduate Medical Education (ACGME) milestones, which helps to align curriculum objectives with workplace-based assessment (8,9).

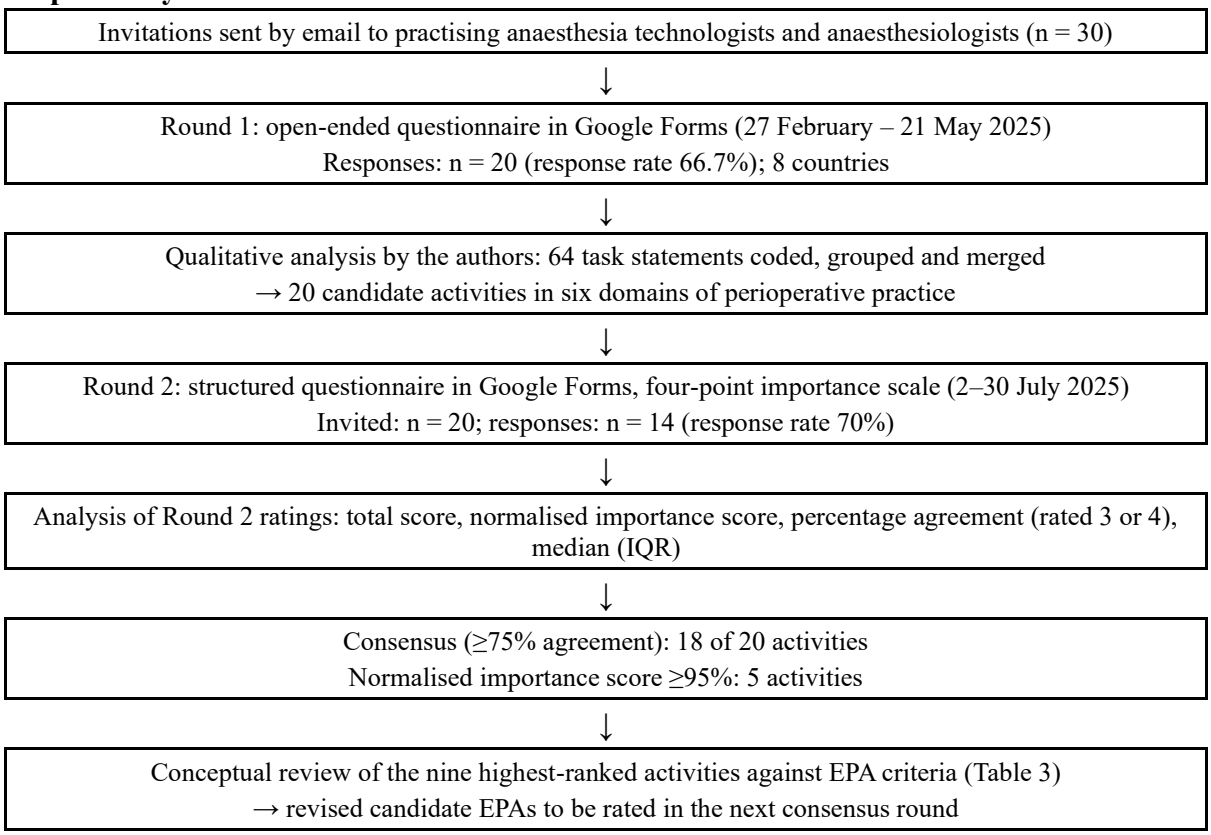
The first step in building an EPA framework is to decide which units of professional activity it should contain. The aim of this exploratory study was therefore to identify and prioritise a preliminary list of candidate EPAs for undergraduate anaesthesia technology education, using the views of practising anaesthesia technologists and anaesthesiologists from several countries. Writing full EPA descriptions and testing them in practice were outside the scope of this study and are planned as later stages of the work.

## 2. Methods

### 2.1 Study design

We conducted an exploratory two-round modified Delphi study. Round 1 used an open-ended questionnaire to generate items, and Round 2 used a structured questionnaire in which panellists rated the importance of each candidate activity. The design is described as modified because the items were generated by the panel in Round 1 and because the study ended after one rating round. In this report, the methods are described with reference to the Guidance on Conducting and Reporting DElphi Studies (CREDES) (10). The flow of panellists and items through the study is shown in Figure 1.

**Figure 1. Flow of panellists and candidate activities through the two-round modified Delphi study**




### 2.2 Theoretical perspective

The Delphi technique gathers expert opinion anonymously through a series of structured questionnaires. In its classic form, panellists receive controlled feedback on the group's responses after each round and can reconsider their ratings, so that the group moves gradually towards agreement (11–13). Modified Delphi designs are common in medical education research, but they vary in the number of rounds and in how feedback is given (12). In this study, the Round 2 questionnaire gave panellists anonymised feedback in the form of the list of candidate activities derived from the whole panel's Round 1 responses. Panellists did not

receive the group ratings from Round 2 and were not asked to rerate the items in a further round. The study is therefore best described as an exploratory consensus exercise and not as a complete iterative Delphi process. This is addressed in the limitations.

### 2.3 Study period

Data were collected between February and July 2025. Round 1 response were received between 27 February and 21 May 2025, and Round 2 responses between 2 and 30 July 2025.

### 2.4 Panel selection

Panellists were recruited by purposive sampling through the professional networks of the research team. Invitations containing a link to the online questionnaire were sent by email to 30 practising anaesthesia technologists and anaesthesiologists. To be eligible, a panellist had to be working in clinical anaesthesia practice as an anaesthesia technologist (including those with the job title of anaesthesia technician or anaesthetic practitioner) or as an anaesthesiologist. No minimum length of experience was set, and panellists' experience ranged from less than one year to more than ten years. We aimed to include panellists from different countries, practice settings and levels of experience so that the candidate activities would reflect a range of professional perspectives. Reasons for non-participation were not recorded. The characteristics of the panellists in each round, including country, profession, highest qualification and years of experience, are shown in Table 1.

### 2.5 Data collection

Both questionnaires were developed by the authors for this study and have not been published elsewhere. They were created in Google Forms and sent to panellists by email, so that panellists in different countries could take part. The English-language versions of the Round 1 and Round 2 questionnaires are provided in Supplementary File 1.

Round 1: The open-ended questionnaire asked panellists what an anaesthesia technologist should and should not be, and what an anaesthesia technologist should and should not do. For the last two questions, panellists were asked to list three to five tasks (Supplementary File 1, Part A).

Round 2: All 20 Round 1 respondents were invited by email to complete the structured questionnaire, which listed the 20 candidate activities derived from Round 1. Panellists rated the importance of each activity for an anaesthesia technologist on a four-point scale: 4 = most important, 3 = somewhat important, 2 = less important and 1 = not important (Supplementary File 1, Part B). The questionnaire did not include a free-text field for comments on wording, overlap or missing activities. Reminder emails were sent to panellists who had not responded.

### 2.6 Data analysis

Round 1: Responses were exported to Microsoft Excel. The unit of analysis was the individual task statement; the 64 entries analysed were the tasks listed by panellists, not complete participant responses or quotations. The authors read all statements independently and coded them following the phases of thematic analysis (14,15). Statements that described the same activity were grouped, and overlapping statements were merged. Each group was then written as an activity title beginning with an action verb, following published guidance on writing EPAs (2,16,17). Disagreements were resolved by discussion among the authors until agreement was reached. A coding spreadsheet linking each candidate activity to its source statements was kept as an audit trail. This process produced 20 candidate activities, which were grouped into six domains of perioperative practice.

Round 2: Ratings were analysed in Microsoft Excel (18). Because Likert-type ratings are ordinal, we report medians and IQRs together with frequencies (18). For each candidate activity, we calculated (a) the total score; (b) the normalised importance score, defined as the total score divided by the maximum possible score (number of respondents × 4) and multiplied by 100 and (c) percentage agreement, defined as the proportion of panellists who rated the activity 3 or 4.

In the original analysis, items with a normalised importance score of 95% or higher were shortlisted. This score summarises average importance and does not show what proportion of panellists agreed. Following peer review, we therefore added an explicit consensus criterion based on percentage agreement. Consensus was defined as at least 75% of panellists rating an activity 3 or 4, which is the median threshold reported in a systematic review of Delphi studies (19). Because this criterion was set after data collection, it is reported as a post consensus criterion. The normalised importance score is used only to rank the activities. The full distribution of ratings for every item is reported in Table 2. During this re-analysis, all Round 2 scores were recalculated from the raw response file, and several values reported in the original submission were corrected.

### 2.7 Ethical approval and informed consent

The study was approved by the Gulf Medical University Institutional Review Board, Ref. no. IRB-COM-MHPE-STD-35-Jan-2025. Participation was voluntary. The first page of each online questionnaire explained the purpose of the study, the time required, the voluntary nature of participation and the right to withdraw (Supplementary File 1). Informed consent was recorded electronically through a consent item in the Google Form, which panellists completed before answering the questions.

### 2.8 Data confidentiality and storage

The Google Forms questionnaires were accessible only through a link sent to invited panellists. Responses were held in the authors' password-protected Google account, and only the authors had access to the data. Names and email addresses were used only to send the Round 2 invitation and reminders and were removed before analysis, and panellists' identities were not disclosed to other panellists. The data are stored securely by the authors.

## 3. Results

### 3.1 Panel characteristics and response rates

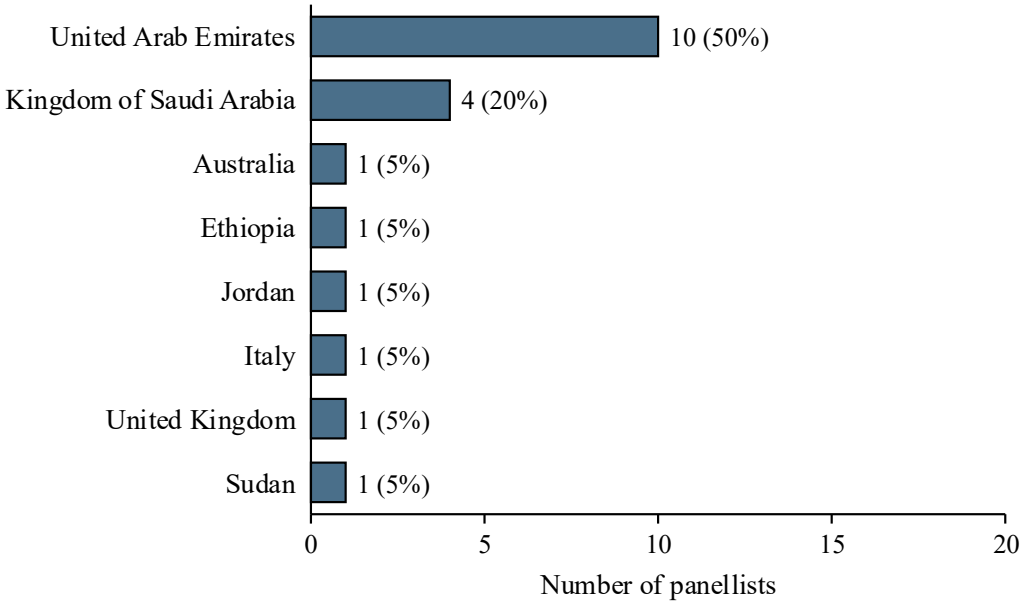
Of the 30 people invited, 20 completed Round 1 (response rate 66.7%). The panel comprised 19 anaesthesia technologists and one anaesthesiologist from eight countries: the United Arab Emirates, the Kingdom of Saudi Arabia, Australia, Ethiopia, Jordan, Italy, the United Kingdom and Sudan. Sixteen panellists held a bachelor's degree, two a master's degree, one a doctorate and one a diploma. All 20 Round 1 respondents were invited to Round 2, and 14 completed it (retention 70%). The maximum possible score for each item in Round 2 was therefore 56 (14 × 4), which is why the highest total score in Table 2 is 56 and not 80. The characteristics of the panellists in each round, including the number from each country, are given in Table 1, and the Round 1 panel's country of practice, highest qualification and years of experience are shown in Figures 2, 3 and 4, respectively.

**Table 1. Characteristics of the panellists in Round 1 and Round 2**

| Characteristic | Round 1 (n = 20), n | Round 2 (n = 14), n† |
|---|---|---|
| Profession: anaesthesia technologist | 16 | 10 |
| Profession: anaesthesiologist | 1 | 1 |
| Profession: Anaesthesia Practitioner | 1 | 1 |
| Profession: Anaesthesia Head Department | 2 | 2 |
| Highest qualification: diploma | 1 | 1 |
| Highest qualification: bachelor's degree | 16 | 11 |
| Highest qualification: master's degree | 2 | 1 |
| Highest qualification: doctorate | 1 | 1 |
| Country: United Arab Emirates | 10 | 10 |
| Country: Kingdom of Saudi Arabia | 4 | 2 |
| Country: Australia | 1 | 1 |
| Country: Ethiopia | 1 | 0 |
| Country: Jordan | 1 | 0 |
| Country: Italy | 1 | 1 |
| Country: United Kingdom | 1 | 0 |
| Country: Sudan | 1 | 0 |

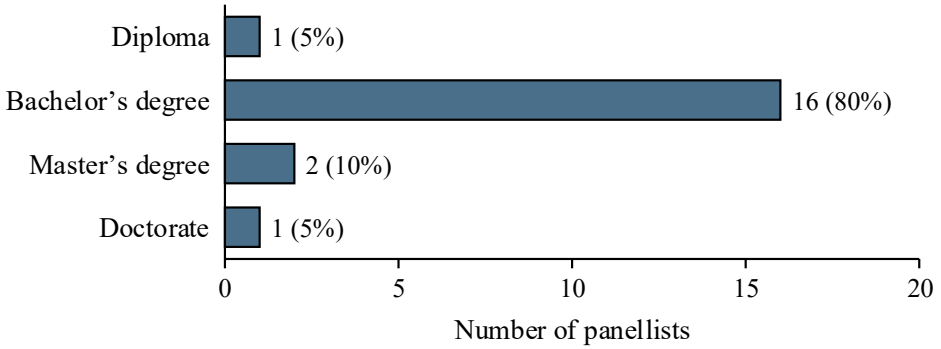
Round 2 values are for the 14 panellists who completed Round 2.

**Figure 2. Country of practice of the 20 Round 1 panellists**



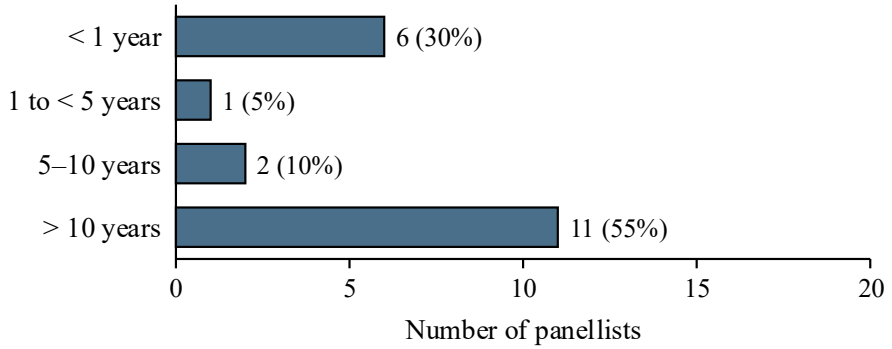

Values are numbers of panellists (percentage of the 20 Round 1 respondents). Data are the same as those in Table 1.

**Figure 3. Highest qualification of the 20 Round 1 panellists**




Values are numbers of panellists (percentage of the 20 Round 1 respondents). Data are the same as those in Table 1.

**Figure 4. Years of experience in anaesthesia of the 20 Round 1 panellists**



Values are numbers of panellists (percentage of the 20 Round 1 respondents). Data are the same as those in Table 1.

### 3.2 Round 1

The 20 panellists listed 64 task statements. After coding and merging overlapping statements, these were consolidated into 20 candidate activities in six domains of perioperative practice: airway management, preoperative patient care, intraoperative patient care, postoperative patient care, emergencies, and resuscitation (Table 2).

### 3.3 Round 2

Table 2 shows the total score, normalised importance score, percentage agreement and median (IQR) for all 20 candidate activities, recalculated from the raw Round 2 responses, and Figure 5 shows percentage agreement for each activity against the 75% consensus criterion. Five activities had a normalised importance score of 95% or higher. Assisting with airway management using appropriate equipment ranked highest (100%), with all 14 panellists rating it 4. It was followed by assisting in the management of anaesthesia complications during the operation, assisting in the management of airway complications during the operation, and preparing and administering intravenous fluids, blood and blood products (98.2% each), and then by preparing the operating theatre for different types of anaesthetic procedure (96.4%). Performing intravenous cannulation and assisting in the management of airway complications after the operation scored 94.6%, and continuing education and knowledge update and preparing and administering anaesthetic drugs under supervision scored 92.9%. These nine highest-ranked activities are the same nine that were shortlisted in the original submission, but on recalculation four of them fall just below the 95% cut-off. Monitoring patients intraoperatively had the same total score as the activities ranked eighth and ninth.

Eighteen of the 20 activities met the post consensus criterion of at least 75% agreement. The two that did not were conducting handover and documentation, which four panellists rated as less important (71.4% agreement), and assessing discharge criteria from the post-anaesthesia care unit (71.4%). Several activities that are central to everyday practice but ranked outside the top nine, including intraoperative patient monitoring, life-support procedures and patient positioning (92.9% agreement each), patient transport (85.7%) and preoperative airway and anaesthesia assessment (78.6%), reached consensus. Among the nine highest-ranked activities, only one rating of 1 (not important) was given, for preparing and administering anaesthetic drugs under supervision. The Round 2 questionnaire did not include a free-text comment field.

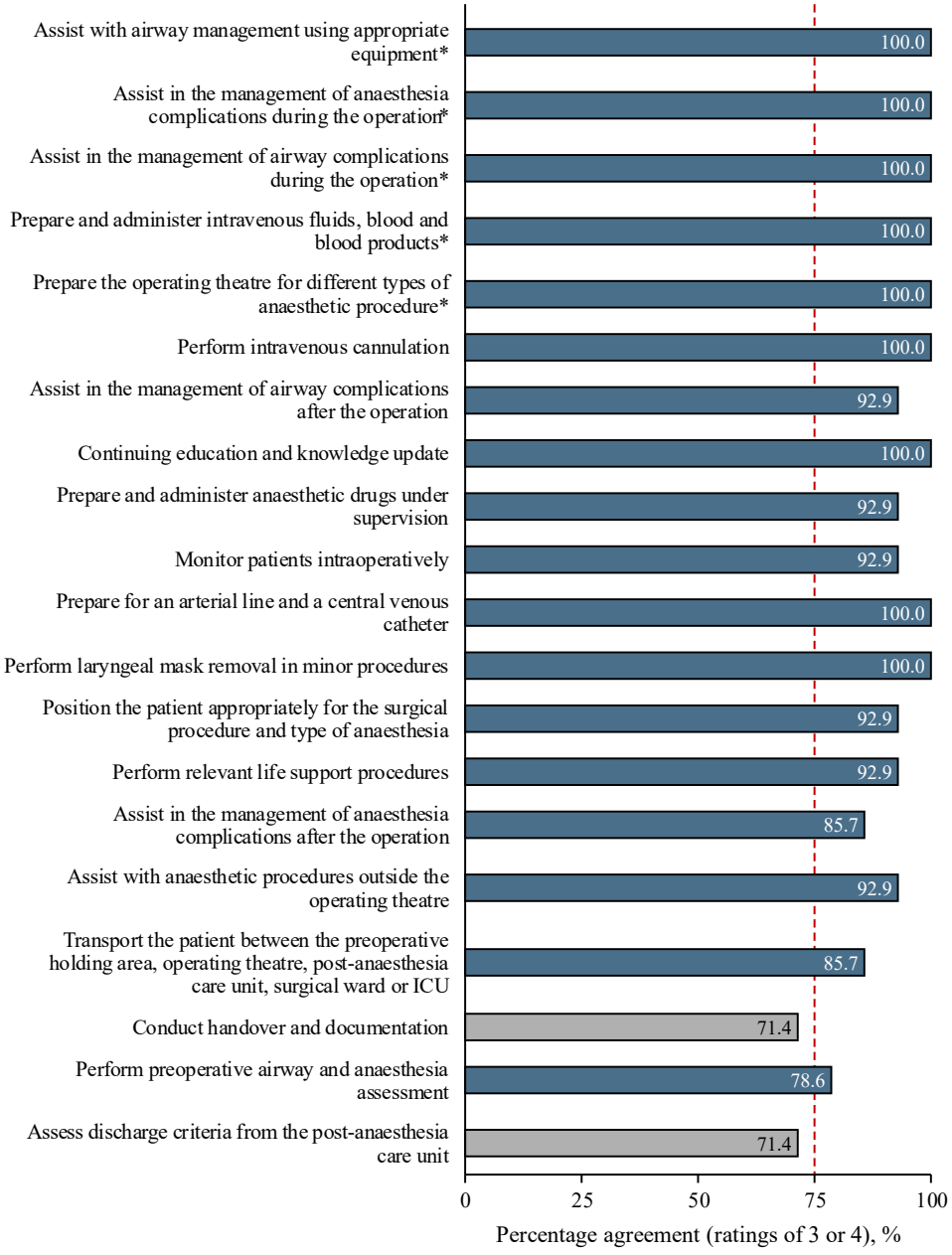
## Table 2. Round 2 ratings for the 20 candidate activities

| Rank | Candidate activity | Total score* | Normalised importance score (%) | Rated 3 or 4, n (%) | Median (IQR) |
|---|---|---|---|---|---|
| 1 | Assist with airway management using appropriate equipment | 56 | 100.0 | 14 (100.0) | 4 (4–4) |
| 2 | Assist in the management of anaesthesia complications during the operation | 55 | 98.2 | 14 (100.0) | 4 (4–4) |
| 3 | Assist in the management of airway complications during the operation | 55 | 98.2 | 14 (100.0) | 4 (4–4) |
| 4 | Prepare and administer intravenous fluids, blood and blood products | 55 | 98.2 | 14 (100.0) | 4 (4–4) |
| 5 | Prepare the operating theatre for different types of anaesthetic procedure | 54 | 96.4 | 14 (100.0) | 4 (4–4) |
| 6 | Perform intravenous cannulation | 53 | 94.6 | 14 (100.0) | 4 (4–4) |
| 7 | Assist in the management of airway complications after the operation | 53 | 94.6 | 13 (92.9) | 4 (4–4) |
| 8 | Continuing education and knowledge update | 52 | 92.9 | 14 (100.0) | 4 (3.25–4) |
| 9 | Prepare and administer anaesthetic drugs under supervision | 52 | 92.9 | 13 (92.9) | 4 (4–4) |
| 10 | Monitor patients intraoperatively | 52 | 92.9 | 13 (92.9) | 4 (4–4) |
| 11 | Prepare for an arterial line and a central venous catheter | 51 | 91.1 | 14 (100.0) | 4 (3–4) |
| 12 | Perform laryngeal mask removal in minor procedures | 51 | 91.1 | 14 (100.0) | 4 (3–4) |
| 13 | Position the patient appropriately for the surgical procedure and type of anaesthesia | 51 | 91.1 | 13 (92.9) | 4 (3.25–4) |
| 14 | Perform relevant life support procedures | 51 | 91.1 | 13 (92.9) | 4 (3.25–4) |
| 15 | Assist in the management of anaesthesia complications after the operation | 51 | 91.1 | 12 (85.7) | 4 (4–4) |
| 16 | Assist with anaesthetic procedures outside the operating theatre | 48 | 85.7 | 13 (92.9) | 3.5 (3–4) |
| 17 | Transport the patient between the preoperative holding area, operating theatre, post-anaesthesia care unit, surgical ward or ICU | 48 | 85.7 | 12 (85.7) | 4 (3–4) |
| 18 | Conduct handover and documentation | 48 | 85.7 | 10 (71.4) | 4 (2.5–4) |
| 19 | Perform preoperative airway and anaesthesia assessment | 47 | 83.9 | 11 (78.6) | 4 (3–4) |

| Rank | Candidate activity | Total score* | Normalised importance score (%) | Rated 3 or 4, n (%) | Median (IQR) |
|---|---|---|---|---|---|
| 20 | Assess discharge criteria from the post-anaesthesia care unit | 43 | 76.8 | 10 (71.4) | 3 (2.25–4) |

Maximum possible score = number of Round 2 respondents × 4 (14 × 4 = 56). All values were calculated from the raw Round 2 responses. Normalised importance score = total score ÷ maximum possible score × 100; it is used for ranking only. Consensus = at least 75% of panellists rating the activity 3 (somewhat important) or 4 (most important). Activities with equal total scores are ordered by percentage agreement. IQR, interquartile range.

## Figure 5. Percentage agreement (proportion of the 14 Round 2 panellists rating the activity 3 or 4) for the 20 candidate activities




Activities are ordered by total score, as in Table 2. Bars show percentage agreement; the dashed line marks the post consensus criterion of 75%, and grey bars show activities that did not reach it. *Normalised importance score (NIS) of 95% or higher. ICU, intensive care unit.

### 3.4 Conceptual review of the highest-ranked activities

After Round 2, and in response to peer review, the research team reviewed the nine highest-ranked activities against published criteria for EPAs (2,16). Four problems were found. One item described a professional responsibility and not a unit of work; several items described a broad area of practice with unclear limits of responsibility; one item combined distinct activities that carry different risks; and three items about the management of complications overlapped. Table 3 lists each problem and the revised title proposed for the next consensus round. These revised titles were written by the research team and have not yet been rated by panel.

**Table 3. Conceptual review of the nine highest-ranked activities and proposed revisions for the next consensus round**

| Round 2 activity | Problem identified | Proposed candidate EPA title (not yet rated by the panel) |
|---|---|---|
| Assist with airway management using appropriate equipment | Broad; level of responsibility not stated | Prepare airway equipment and assist the anaesthesiologist during routine airway management |
| Prepare the operating theatre for different types of anaesthetic procedure | Suitable as an EPA; scope needs to be specified | Prepare and check the operating theatre, anaesthesia workstation and monitoring equipment for a planned anaesthetic |
| Prepare and administer anaesthetic drugs under supervision | Suitable as an EPA; supervision and legal limits differ between countries | Prepare, label and administer anaesthetic drugs under the direct supervision of an anaesthesiologist, within local regulations |
| Assist in managing anaesthesia complications during the operation; assist in managing airway complications during and after the operation | Broad and overlapping; required actions and limits unclear | Recognise perioperative anaesthesia and airway emergencies, call for help and assist the anaesthesiologist in managing them |
| Prepare and administer intravenous fluids, blood and blood products | Combines distinct activities with different risks | (a) Prepare and administer prescribed intravenous fluids; (b) check, prepare and administer blood and blood products following transfusion safety procedures |
| Perform intravenous cannulation | Discrete procedural skill | Insert and secure a peripheral intravenous cannula, or include it as a component of a broader EPA on preparing a patient for anaesthesia |
| Continuing education and knowledge update | Professional responsibility and competency; not an observable, entrustable unit of work | Removed from the EPA list; retained as a lifelong-learning competency that underpins all EPAs |

EPA, entrustable professional activity.

## 4. Discussion

### 4.1 Principal findings

This exploratory study produced a practitioner-generated list of 20 candidate activities for anaesthesia technologists. Eighteen met the 75% agreement criterion, and five reached a

normalised importance score of 95% or higher. The highest-ranked activities related to airway management, preparation of the operating theatre and equipment, drug and fluid administration under supervision, and support during anaesthesia and airway complications. These activities are consistent with the technologist's role as a member of the anaesthesia team who works with, and under the direction of, the anaesthesiologist. The findings should be read as a starting point for building an EPA framework and not as a validated set of EPAs.

### 4.2 Tasks, competencies and EPAs

Round 1 statements described tasks and not units of professional work. This is common in the early stages of EPA development, because practitioners tend to describe their work as skills and duties (2,16). An EPA should be a unit of work that can be observed and measured, can be carried out independently once entrusted, and draws on several competencies at the same time (2,3). Judged against these criteria, continuing education and knowledge update is better described as a professional responsibility and as an attribute of a lifelong learner. It cannot be observed and entrusted as a discrete activity, although it provides the up-to-date knowledge on which every EPA depends. We have therefore removed it from the list of candidate EPAs and kept it as a competency that underpins all of them (Table 3).

The same review showed that some items were too broad, overlapped with each other, or combined activities with different risks, such as giving intravenous fluids and transfusing blood products. The revised titles in Table 3 are intended to address these problems, but the panel will need to rate them before they can be adopted.

### 4.3 Comparison with existing frameworks

The candidate activities share common ground with existing frameworks, although they work at a different level. Maroufi et al. defined 61 educational competencies for anaesthesia technologists in five domains: ethics and professionalism, collaboration and communication, evidence-based practice and professional learning, safety and risk management, and technical competencies (7). Most of our highest-ranked activities fall within the technical and safety domains of that framework, whereas domains such as professionalism and professional learning correspond to the competencies that support EPAs. This fits the view that EPAs and competencies are complementary, with each EPA integrating several competencies (3,8).

In anaesthesiology, Moll-Khosrawi et al. developed a core curriculum of 39 EPAs for postgraduate trainees and mapped each one to the year of training in which entrustment should take place (5). Some of their EPAs, such as airway management and the management of anaesthesia emergencies, overlap with our items, but for physicians the scope extends to independent clinical decisions that lie outside the technologist's role. Burkhart et al. found that

few anaesthesiology training programmes in Europe and North America used EPAs to make entrustment decisions, even though most respondents supported their use (4). In orthopaedics, Watson et al. used two Delphi rounds to reduce 285 candidate EPAs to 49 for residency training (20). In nursing, Zhou et al. developed nine core EPAs for advanced practice nurses and pilot-tested them with preceptors and interns before wider use (17). This staged approach, moving from identifying activities to writing full descriptions and testing them in practice, is the model we intend to follow.

**4.4 Differences in scope of practice between countries**

The legal authority, clinical responsibilities and autonomy of anaesthesia technologists differ considerably between health systems. In some countries, technologists administer drugs and insert intravenous cannulas as part of routine practice, whereas in others these activities are restricted to physicians or nurses. Such differences may explain why some activities were rated highly by almost all panellists while others were rated less consistently. Because the panel was small and the number of panellists per country was uneven, we could not compare ratings between countries. A future framework will need a core set of EPAs that apply across settings, with scope statements that can be adapted to local regulations.

**4.5 Activities that did not reach the cut-off**

Some activities that are fundamental to the role, including intraoperative patient monitoring, preoperative assessment, life-support procedures, patient handover, documentation, patient transport and postoperative care, did not reach the original 95% cut-off. This does not mean that panellists considered them unimportant: all of them except handover and documentation, and assessment of discharge criteria from the post-anaesthesia care unit, met the 75% agreement criterion. With 14 panellists and a four-point scale, a single rating of 3 instead of 4 lowers an item's score by about 1.8 percentage points, so the very high cut-off risked excluding activities on numerical grounds alone; four of the nine highest-ranked activities fell just below 95% on recalculation. Decisions about which activities belong in an EPA framework should rest on conceptual and clinical analysis as well as on rating scores (2,16).

**4.6 Panel composition and attrition**

The panel consisted almost entirely of anaesthesia technologists, with one anaesthesiologist. It did not include educators without clinical roles, regulators, clinical supervisors from other professions, recent graduates or patient representatives. A panel of this kind is well placed to describe the daily work of technologists, but it may give less weight to the views of those who supervise, employ and regulate them. About 30% of Round 1 panellists did not complete Round 2 (6 of 20). Attrition between rounds is a recognised problem in Delphi studies (13) and may

introduce bias if those who withdrew held different views. Most respondents in Round 2 were technologists from the United Arab Emirates and Saudi Arabia, and none of the panellists from Ethiopia, Jordan, Sudan or the United Kingdom could be identified in Round 2, so the final ratings may give less weight to views from these countries.

### 4.7 Limitations

To our knowledge, this is the first study to identify candidate EPAs for anaesthesia technologists. Because there was no earlier work, there were no published activity lists to compare with or to use as a starting point. This lack of previous data was a challenge, but it is also an opportunity, as the list produced here gives future studies a baseline to refine and test.

The study has several important limitations. First, the panel was small, and the number of panellists from each country was small and unequal. Second, almost all panellists were anaesthesia technologists, so multidisciplinary input was limited, and because no minimum level of experience was required, six panellists had worked in anaesthesia for less than one year. Third, the panel did not include countries that are active in developing and using EPAs, such as Canada and the United States, which limits the international relevance of the findings. Fourth, about 30% of panellists did not complete Round 2. Fifth, there was only one rating round, and panellists did not receive controlled feedback on group ratings or a chance to rerate items, so the study does not meet the full definition of a Delphi process. Sixth, the original cut-off was based on a normalised importance score, and the consensus criterion used in this revision was defined after data collection. Finally, the activities have not been tested for clarity, feasibility or reliability, and they have not been used in the workplace to make entrustment decisions.

### 4.8 Educational implications and next steps

The candidate activities are a first step and need further development before they can guide education. We recommend the following stages of further study.

#### Creating a roadmap for competence

Listing activities is not enough; each EPA needs a full description. For educators, these descriptions will define precise learning outcomes and will also inform curriculum design and development. They can be used to map where in the programme each activity is taught and practised, to sequence learning from simulation to supervised clinical placements, to plan clinical rotations and to choose workplace-based assessment methods (16). For students, clear descriptions show what is expected at each stage of training, from novice to entrusted practitioner.

**Further consensus and validation**

The revised activities in Table 3, together with the activities carried forward from Round 2, should be presented to a larger panel that includes anaesthesiologists, educators, clinical supervisors, regulators and recent graduates from more countries, including countries with established EPA programmes. Future studies should include at least two further rounds with controlled feedback and rerating, using a consensus definition set before data collection (10,19).

**Writing complete EPA descriptions**

For each EPA that reaches consensus, a full description should be written following AMEE Guide No. 140. This should include its specification and limitations, potential risks of failure, required competencies, sources of information for assessment and the expected level of supervision at the end of training (2).

**Testing in practice**

The EPAs should then be piloted in undergraduate programmes to examine their clarity, their feasibility and the reliability of entrustment decisions. Supervision-based rating scales, which have produced more reliable workplace-based assessment in anaesthesia (21), are one option for this stage. Only after such testing can the framework be considered for wider use or for aligning programmes in different countries.

## 5. Conclusion

This exploratory study identified a preliminary list of candidate professional activities for anaesthesia technologists, based on the views of practitioners in eight countries. The highest-ranked activities concerned airway management, theatre and equipment preparation, drug and fluid administration under supervision, and support during anaesthesia and airway complications. These items are not yet fully developed EPAs, and the small, mainly single-profession panel and the single rating round limit the conclusions that can be drawn. With further consensus rounds, complete EPA descriptions and testing in the workplace, the list could form the basis of a shared framework for anaesthesia technology education.

## List of Abbreviations

ACGME: Accreditation Council for Graduate Medical Education

AMEE: Association for Medical Education in Europe

BSc: Bachelor of Science

CanMEDS: Canadian Medical Education Directives for Specialists

CREDES: Guidance on Conducting and REporting DElphi Studies

EPA: Entrustable Professional Activity

IQR: Interquartile range

IRB: Institutional Review Board

## Declarations

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### Consent for publication

Not applicable

### Supplementary information

Supplementary File 1: English-language versions of the Round 1 (open-ended) and Round 2 (structured rating) questionnaires used in this study.

### Conflict of interest

The authors declare that they have no conflicts of interest.

### Ethical approval

The study was approved by the Gulf Medical University Institutional Review Board (Ref. no. IRB-COM-MHPE-STD-35-Jan-2025) in accordance with the Declaration of Helsinki. All panellists gave informed consent before taking part.

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### Availability of data and materials

The anonymised data supporting the findings of this study are available from the corresponding author on reasonable request.

**Authors' contributions**

All authors contributed equally to the conception and design of the study, data collection, data analysis and interpretation, and the drafting and revision of the manuscript. Professor Eraky supervised the study. All authors read and approved the final manuscript.

**Use of artificial intelligence**

During the preparation and revision of this manuscript, the authors used Claude (Anthropic), a large language model, solely for language editing to improve grammar, clarity and readability. The tool was not used to generate data, analyse results or draw conclusions. The authors reviewed and edited all output and take full responsibility for the content of the manuscript.

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## Supplementary Files

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- SupplementaryFile1.docx