Development of a Prioritized Anesthesiology Residency Critical Care Content Outline

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INTRODUCTION

Education in critical care medicine is an important and mandatory component of residency training in anesthesiology. The Accreditation Council for Graduate Medical Education (ACGME) and Anesthesiology Residency Review Committee (RRC) require that core residency education include a minimum of 4 months of critical care medicine and no more than 2 months during the intern year.[1] Despite the emphasis on education in critical care medicine, there is no standard curriculum for anesthesiology residency in the United States. Critical care educational experiences of anesthesiology residents vary substantially because of exposure to different hospitals, subspecialty critical care units, and local patient populations. Critical care topics are important for trainees even if they are not choosing a career in critical care as these topics are a significant fraction of the written and oral exam topics.[2] Previous work in developing a critical care curriculum for anesthesiology residents is limited. In 2004, Dorman et al.[3] published a general guideline for critical care education. We are aware of no further evidence or publications to establish a standardized critical care curriculum for anesthesiology residents.

The modified Delphi method is an evidence-based process for establishing consensus in medical education. Formal consensus group methods are defined as a systematic means to measure and develop consensus[4] and are valuable when there is insufficient available evidence.[5] Participants do not interact directly, so the modified Delphi method avoids concerns of halo or bandwagon effects often associated with other forms of consensus.

We strongly believe a pragmatic standardized critical care curriculum is needed for anesthesiology resident education. The first step in creating this curriculum is developing a prioritized consensus-derived content outline.

MATERIALS AND METHODS

National Consensus Panel (January through March 2020)

The national consensus panel was recruited by email to all members of the Association of Anesthesiology Subspecialty Program Directors in Critical Care (n = 55) and Association of Anesthesiology Core Program Directors (n = 132) through the Society of Academic Associations of Anesthesiology and Perioperative Medicine (SAAAPM), and all members of the Society of Critical Care Anesthesiologists (SOCCA; n = 1150). SAAAPM Program Directors were asked to volunteer a senior resident or fellow in training at their institutions. Participants were provided background information on the curriculum project, the plan for pragmatic standardized curriculum development, and the structure of the modified Delphi method used for topic identification.

Literature Search (April through June 2020) and Initial Content Development (July through September 2020)

A systematic literature review was performed to identify published critical care curricula or content outlines for residency training in anesthesiology. A PubMed database review was conducted using the terms "anesthesiology residency" and "critical care curriculum," "critical care education," "intensive care curriculum," or "intensive care education." These criteria yielded 359 publications; the abstracts were reviewed by the primary author (J.B.). Results not including curricula, guidelines, or critical care educational requirements for anesthesiology residency programs were excluded. After review there remained 1 result, a guideline for critical care medicine training and medical education published in 2004.[3] Given the limited literature, critical care topics included on the initial survey were selected from the ACGME Program Requirements for Graduate Medical Education in Anesthesiology[6] and the American Board of American Board of Anesthesiology (ABA) Content Outline for Initial Certification in Anesthesiology.[2] The primary author (J.B.) broadly selected all topics that related to critical care for inclusion in the initial survey.

Survey and Iterative Feedback (October 2020, February 2021, June 2021)

Survey Design

For each critical care knowledge topic, panel members answered 2 questions:

1. How important is the topic to be included in a standardized critical care core curriculum for anesthesiology residents? (Likert scale: *1 = not important for critical care curriculum, 3 = slightly important, 5 = moderately important, 7 = very important, and 9 = mandatory for critical care curriculum.* Likert scale options 2, 4, 6, and 8 were available choices for participants but were unanchored.)[7]

2. When should the critical care topic be delivered as part of a standardized critical care curriculum? (Foundational-Early Residency, Intermediate-Mid Residency, Advanced-Late Residency)

We made an a priori decision to conduct a minimum of 3 survey iterations with consensus defined as ≥ 75% of participants rating the topic as very important to mandatory for inclusion (Likert scale 7-9).[4,8] Topics with > 80% consensus were removed from subsequent surveys and included in the final list, and topics with < 50% were removed from subsequent survey iterations. We compared the ACGME Program Requirements for Graduate Medical Education in Anesthesiology and the ABA Content Outline for Initial Certification in Anesthesiology to the results of the prioritized list of critical care content topics. We defined the ideal time for topic delivery as the time (Foundational-Early Residency, Intermediate-Mid Residency, Advanced-Late Residency) selected most often by panel members. Panelists were informed that these categories were chosen in consideration of core Anesthesiology Residencies with both categorical postgraduate year (PGY) 1-4 programs and advanced PGY 2-4 programs. We used Surveymonkey® (SurveyMonkey, San Mateo, CA) to conduct the survey. Three of the authors (J.B., A.S., M.R.), who have expertise in the modified Delphi methodology and have published in this field, piloted the survey before dissemination. The phrasing of the questions was modified during the pilot phrase but there was no modification of topics. All discrepancies were resolved through consensus discussion.

Surveys (October 2020, February 2021, June 2021)

The initial survey included questions about the panelists' years of clinical practice since training and any role in formal medical education. We categorized years of clinical practice as current trainee, recent graduate (< 2 years from training), early career (2-5 years), mid-career (6-10 years), and late career (> 10 years). We defined a formal role in education as chief resident or chief fellow; core residency assistant, associate, or program director; assistant, associate, or critical care program director; or vice-chair of education. Panelists were also allowed to choose "other." Participants were categorized by region of the country based on their institution using US Census Bureau established regions. All panelists answered questions about the importance of each of the topics and the timing of delivery during residency. The critical care topics were grouped based on the ABA Primary Certification in Anesthesiology content outline categories[2]: central and peripheral nervous systems, cardiovascular system, respiratory system, renal and urinary systems/electrolyte balance, infectious disease, endocrine and metabolic systems, gastrointestinal/hepatic systems, obstetric critical care, hematologic systems, and miscellaneous for all other topics. Panelists could propose additional critical care topics that were not included in the initial survey.

At the beginning of the second and third surveys, panelists received summary data and comments from the prior survey for both the Likert scale question regarding importance of the topic and when the critical care topic should be delivered question. New topics were edited for clarity and added to subsequent survey iterations by 2 of the authors (J.B., M.R.). All discrepancies were resolved through consensus discussion. Responses to all 3 iterations of the survey were anonymous.

Ethical Considerations.

This study was reviewed and determined to be exempt by the Colorado Multiple Institutional Review Board.

Data Analysis

All analyses were performed using SPSS 28 (IBM SPSS, version 28, Armonk, NY).

RESULTS

Panelists

A total of 158 panelists participated in the initial round (October 2020), 119 (75%) completed the second iteration (February 2021), and 116 (73%) panelists completed the third iteration of the survey (June 2021). Response rate on the first survey was (22/55) 40% for anesthesiology critical care program directors, (18/132) 14% for core anesthesiology residency program directors, and (77/1150) 7% for the remaining respondents. Trainees (n = 41) were not included in response rate calculations. Most participants (103/158, 65%) had completed both core anesthesiology and subspecialty critical care medicine training and most (87/158, 55%) had formal roles in medical education. Forty-one (26%) of responders were currently in training. All panelists worked in institutions with graduate medical education (GME) learners. Geographical representation and number of years of clinical practice since training were evenly distributed (Table 1).

Consensus Critical Care Knowledge Topics for Anesthesiology Residency and Ideal Timing of Topic Delivery

Fifty-eight (43%) of 136 topics (116 initial topics and 20 suggested topics) met consensus for prioritization. Consensus topics, consensus percentages, and survey iteration met consensus and recommended time for delivery during residency are included in Table 2. Most of the topics that reached consensus for inclusion (50/58, 86%) were recommended to be delivered early during residency. The other 8 topics that reached consensus were suggested to be delivered in the middle of residency.

Topics that did not meet the consensus definition of > 75% for prioritization are listed in Table 3 with the percentage of respondents who recommended inclusion, mean Likert scale, and survey iteration when excluded. The panelists suggested 20 additional knowledge topics in the first

iteration. Of the 20 topics suggested by panelists, 6 (30%) reached consensus in subsequent survey iterations. These topics are identified in Table 2 with asterisks. The 14 additional suggested knowledge topics that did not reach consensus are identified with asterisks in Table 3. No additional topics were suggested in the second and third iterations of the survey. Fifty-two of 116 (45%) of the ACGME Program Requirements and ABA board content outline critical care topics met criteria for prioritization in the content outline (Table 4).

DISCUSSION

Using the modified Delphi method, we prioritized critical care content topics in anesthesiology residency education. The content outline includes highly recommended knowledge topics and procedural skills, and ideal timing for inclusion in residency education.

The prioritization of critical care topics is an initial first step to address the issues of variability and inconsistency in critical care education. Despite the ACGME and Anesthesiology RRC requirement for 4 months of critical care training, there is no standardization of critical care topics that should be taught, resulting in inconsistent clinical learning between residency programs. The wide variation in training by region, hospital system, subspecialty intensive care unit, and patient population as well as variation in clinical exposure between individual residents also impacts resident education.[9,10] Residency programs complement experiential learning with didactic education, ranging from lectures to small group learning and simulation. This didactic education is similarly not standardized between programs. Our content outline provides a framework that may be applied to these types of learning.

The ACGME Program Requirements for Graduate Medical Education in Anesthesiology and the American Board of Anesthesiology Content Outline for board certification include 115 topics related to critical care. Similarly, the American College of Critical Care Medicine task force generated a list of more than 160 topics in their educational guidelines for critical care

medicine clinicians.[3] To our knowledge, other than board certification content lists for GME specialties and subspecialties, there are no prioritized content outlines for other anesthesiology subspecialties or prioritized critical care outlines for other specialties. Current opinion and practice suggest these lists may be overly broad, not evidence-based, and not pragmatic for the required efficiencies of current residency education. Residency educators require a streamlined content outline, with a focus on high-priority clinically relevant topics. Using the modified Delphi method, we were able to prioritize critical care content for anesthesiology residency education. By prioritizing slightly less than half of critical care topics, we are providing critical care educators and clinical teachers with an efficient and consensus-based list of topics to emphasize during their education of trainees.

Our prioritized content outline includes 45% of the critical care topics included in the ACGME program requirements and ABA content outline. Per direct correspondence with the ACGME, program requirements are developed by "a working group of review committee members and volunteers from the academic community." Following draft completion, requirements are posted for review and comment and then a final draft is revised and submitted to the ACGME Board of Directors for approval. Program requirements are reviewed formally every 10 years and follow a similar format. Per direct correspondence with the ABA, the ABA content was developed by expert opinion using residency training content and standards. Members of the Basic and Advanced Exam Committees use the content outline to write new items and build new exam forms and can recommend changes to the content outline every year. Any recommended changes are reviewed by the full committee before being forwarded to the ABA Assessments Committee and then the full board for approval. The ACGME and ABA processes and our modified Delphi process seek to establish consensus on topics. The modified Delphi process is advantageous because of its structured and systematic methodology, and its anonymity avoids concern of halo and bandwagon effects.

Differences in chosen topics are likely multifactorial and may be due to potential biases as described previously or variances in opinions. Our survey included 158 panelists in the initial survey and 116 panelists in the final round. Contrasting with ACGME and GME processes, we deliberately included in-training senior residents and critical care fellows, who made up 21% of our survey group. In addition, 45% of our panelists did not have formal roles in medical education. These differences provide a diverse perspective compared with more senior anesthesiologists serving on formal review committees within the ACGME and ABA and may mitigate affinity or similarity biases. Limiting the panel to only critical care experts risks prioritizing topics that may be better included in other training environments during anesthesiology training (e.g., pregnancy management). Diversity in clinical experience and proximity to residency training within our cohort imparts additional varying viewpoints on the relevance of topic inclusion within our content outline.

The content outline is divided into 9 systems as described in the methods. Reflecting real-world clinical practice in anesthesiology and critical care medicine, the topics are heavily weighted to the cardiovascular and respiratory systems with a secondary emphasis on infectious disease and hematologic topics. Iterative rounds resulted in the removal of multiple endocrine, metabolic, gastrointestinal, and hepatic topics and the addition of topics in renal and urinary systems, and electrolytes. The panelists also de-emphasized many topics listed in the miscellaneous category.

Most topics that reached consensus for importance (50/58, 86%) were recommended to be delivered early during residency. We believe this is likely a reflection on the overall significance of these topics in residency education, and the generalizability to future general anesthesiology (e.g., operating room) and subspecialty anesthesiology rotations (e.g., cardiac anesthesiology, transplant anesthesiology).

This study has several limitations. There was attrition between the first and second iterations with 75% completing the

second iteration and 73% completing the third iteration; however, participation remained high, so our sample size was likely reasonable. Our response rate was 40% (22/55) for critical care program directors, 14% (18/132) for core program directors and 7% (77/1150) for members of SOCCA. Our response rate may have introduced selection bias into our study's results. Using consensus may not address new and important topics that have not yet become standard of care across the country. We used a conservative definition of importance by focusing on topics evaluated between 7 and 9 on the Likert scale, which may have resulted in important topics not meeting our inclusion criteria. We included trainees, anesthesiologists without formal educational roles, and panelists who were not trained in critical care medicine. Although they may have provided an important perspective, none of these groups should be considered experts in the field of critical care medicine education. There may have been variable interpretation by our panelists of the definition of a topic. The emphasis on early residency training will complicate the delivery of a comprehensive critical care curriculum as critical care rotations and didactics are often dispersed over the 3 advanced clinical years to provide progressive responsibility in the later stages of residency.[11] Graded autonomy and responsibility are important elements of trainee education and timing of clinical rotations will need to be considered when implementing this outline within anesthesiology residency programs. Finally, our results may not reflect skills gained in multidisciplinary critical care environments, but this could be used in competency-based medical education to better address specific local experiences that have limited exposure.

We believe the next steps are to use this prioritized content outline to guide educators in the development of a pragmatic standardized critical care curriculum for anesthesiology residents. Increasing clinical obligations for academic faculty, stretched departmental resources, and increasing educational complexity are challenging residency programs to be more efficient and effective in medical education.[12] Program directors may also use this content outline to enhance local clinical learning, bridging any educational gaps and ensuring consistency in both intra-departmental and national inter-departmental education. A multi-departmental approach that shares resources from numerous academic departments and national societies is likely to be most successful in advancing and improving medical education for our anesthesiology learners.

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Abstract

Background: Critical care education is an important, mandatory component of residency training in anesthesiology. Currently, there is no accepted national standardized curriculum, and a prioritized critical care content outline would be beneficial to the creation of a pragmatic standardized residency curriculum. The modified Delphi method is a recognized method for establishing consensus in medical education.

Methods: We developed a prioritized critical care content outline using the modified Delphi method. Topics were selected from critical care topics included in the Program Requirements for Graduate Medical Education in Anesthesiology and the American Board of Anesthesiology Content Outline. Panel members rated critical care topics on a 9-point Likert scale (*1 = not important, 9 = mandatory*). Consensus was defined as ≥75% rating the topic as very important to mandatory for inclusion (Likert scale 7–9). Topics with >80% consensus were removed from subsequent surveys and included in the final list, and topics with <50% were removed. Members were asked to select the ideal timing of topic delivery during residency (Foundational-Early Residency, Intermediate-Mid Residency, Advanced-Late Residency).

Results: A total of 158 panel members who were contacted using national anesthesiology organization email lists completed the initial round, 119 (75%) completed the second iteration, and 116 (73%) completed the third. Response rate on the first survey was (22/55) 40% for anesthesiology critical care program directors, (18/132) 14% for core anesthesiology residency program directors, and (77/1150) 7% for the remaining respondents. Trainees (n = 41) were not included in response rate calculations. Most participants (103/158, 65%) had completed both core anesthesiology and subspecialty critical care medicine training and most (87/158, 55%) had formal roles in medical education. Forty-one (26%) responders were currently in training. All panelists worked in institutions with graduate medical education (GME) learners. Fifty-eight of 136 (43%) topics met consensus for inclusion. Most consensus topics (50/58, 86%) were recommended to be delivered early during residency with the other 8 topics to be delivered in the middle of residency.

Conclusions: We developed a prioritized critical care content outline for anesthesiology residents that includes highly recommended critical care topics with ideal timing for inclusion in residency. This outline provides the first step in developing a pragmatic standardized curriculum to guide faculty and programs in critical care education.

Keywords: Education in anesthesia, critical care medicine, curriculum development, training, clinical competency

Tables

Table 1. Characteristics of Consensus Panel Members

	n = 158 (%)
Level of Training	
Anesthesiology Resident	32 (20)
Completed Anesthesiology Residency, currently Anesthesiology Critical Care Fellow	9 (6)
Completed Anesthesiology Residency	14 (9)
Completed Both Anesthesiology Residency and Critical Care Fellowship	103 (65)
Years of Clinical Practice Since Training	
Current Trainee	41 (26)
Recent Graduate (< 2 years)	20 (12)
Early Career (2-5 years)	33 (21)
Mid-Career (6-10 years)	28 (18)
Late Career (> 10 years)	36 (23)
Formal Role in Medical Education Leadership	
Core Residency Program Director (including Assistant or Associate role)	18 (11)
Critical Care Fellowship Program Director (including Assistant or Associate role)	22 (14)
Vice-Chair of Education or Similar	1 (1)
Chief Resident or Chief Fellow	10 (6)
Other Role	36 (23)
No Formal Role	71 (45)
Region	
Midwest	38 (24)
Northeast	41 (26)
West	35 (22)
South	44 (28)

Tables *continued*

Table 2. Critical Care Topics Meeting Consensus for Prioritization in Anesthesiology Residency Education Grouped by Organ System

System	Consensus Percentage for Inclusion, %	Survey Iteration When Met Inclusion Criteria	When Topic Should Be Delivered in Residency
Central and Peripheral Nervous Systems (5)			
Pain Management and Sedation	92	1	Foundational - Early
Altered Mental Status	92	1	Foundational - Early
Intracranial Pressure and Compliance	88	1	Foundational - Early
Traumatic Brain Injury	86	1	Intermediate - Mid
Cerebral Blood Flow	83	3	Foundational - Early
Cardiovascular System (13)			
Hypovolemic Shock	98	1	Foundational - Early
Cardiogenic Shock	97	1	Foundational - Early
Distributive Shock	96	1	Foundational - Early
Hemodynamic Monitoring	96	1	Foundational - Early
Cardiac Arrest and Advanced Cardiac Life Support	95	1	Foundational - Early
Obstructive Shock	93	1	Foundational - Early
Arrhythmias	91	1	Foundational - Early
Heart Failure (Left and Right Sided)	91	1	Foundational - Early
Acute Coronary Syndromes	91	1	Foundational - Early
Tamponade [a]	86	2	Foundational - Early
Bedside Transesophageal Echocardiography Performance and Interpretation [a]	84	2	Intermediate - Mid
Pulmonary Embolisms and Deep Vein Thrombosis	84	1	Intermediate - Mid
Pacemakers and Automatic Implantable Cardioverter Defibrillators	83	3	Intermediate - Mid
Respiratory System (15)			
Acute Respiratory Failure	96	1	Foundational - Early
Acute Respiratory Distress Syndrome	95	1	Foundational - Early
Mechanical Ventilation	95	1	Foundational - Early
Complications of Mechanical Ventilation	93	1	Foundational - Early
Mechanical Ventilation Weaning	90	1	Foundational - Early
Noninvasive Ventilation	89	1	Foundational - Early
Pulmonary Mechanics	88	1	Foundational - Early
Pneumothorax	88	1	Foundational - Early
CXR and Chest Computerized Tomography Interpretation	88	1	Foundational - Early
Airway Management	85	1	Foundational - Early
Aspiration	84	1	Foundational - Early
Pulmonary Edema	83	1	Foundational - Early

Tables *continued*

System	Consensus Percentage for Inclusion, %	Survey Iteration When Met Inclusion Criteria	When Topic Should Be Delivered in Residency
Atelectasis	82	1	Foundational - Early
Lung Ultrasound Performance and Interpretation [a]	81	2	Foundational - Early
Obstructive Lung Disease	81	3	Intermediate - Mid
Renal and Urinary Systems/Electrolyte Balance (7)			
Acid-Base Disorders	97	1	Foundational - Early
Intravascular Volume Assessment	95	1	Foundational - Early
Fluid Management	95	1	Foundational - Early
Electrolyte Disorders	88	1	Foundational - Early
Acute Renal Failure	88	1	Foundational - Early
Acute Kidney Injury and Oliguria	87	1	Foundational - Early
Renal Replacement Therapy	82	2	Intermediate - Mid
Infectious Diseases (6)			
Septic Shock	98	1	Foundational - Early
Multi-organ Dysfunction	98	1	Foundational - Early
Systemic Inflammatory Response and Sepsis	92	1	Foundational - Early
Pulmonary Infections	82	1	Foundational - Early
Antimicrobial Selection	81	3	Foundational - Early
Bacteremia and Catheter Related Infections	81	3	Foundational - Early
Endocrine and Metabolic Systems (1)			
Diabetic Ketoacidosis [a]	84	2	Foundational - Early
Gastrointestinal and Hepatic Systems (1)			
Gastrointestinal Hemorrhage [a]	89	2	Foundational - Early
Hematologic System (8)			
Hemorrhage and Massive Transfusion	95	1	Foundational - Early
Blood Products and Factor Replacement	93	1	Foundational - Early
Transfusion Indications	92	1	Foundational - Early
Anticoagulants and Thrombolytics	92	1	Intermediate - Mid
Transfusion Reactions and Complications	90	1	Foundational - Early
Deep Vein Thrombosis Prophylaxis	84	1	Foundational - Early
Coagulopathies	83	1	Foundational - Early
Thromboembolic Disease	81	1	Intermediate - Mid
Miscellaneous (2)			
Conducting a Family Meeting [a]	84	2	Foundational - Early
Palliative Care	83	1	Foundational - Early

[a] Topics suggested by panelists.

Tables *continued*

Table 3. Critical Care Topics Not Meeting Consensus for Prioritization in Anesthesiology Residency Education Grouped by Organ System

System	Percentage of Respondents Who Recommended Inclusion, %	Mean Likert Scale (range, 1-9)	Survey Iteration When Met Exclusion Criteria
Central and Peripheral Nervous Systems (8)			
Brain Death	73	6.8	3
Cerebrovascular Disease	63	5.9	3
Spinal Cord Injury	56	5.2	3
Seizures and Status Epilepticus	49	4.9	2
External Ventricular Drain [a]	44	4.3	2
Head Computerized Tomography Interpretation [a]	36	3.3	3
Toxicology and Drug Intoxication	30	2.3	3
Neuromuscular Disorders	28	2.1	2
Cardiovascular System (13)			
Aortic Dissection and Aneurysm	74	6.9	3
Pulmonary Artery Catheter Interpretation [a]	74	6.9	3
Pulmonary Hypertension	70	6.6	3
Valvular and Structural Heart Disease	70	6.5	3
Mechanical Circulatory Support	68	6.3	3
Hypertensive Disorders	64	6.0	3
Cardiomyopathies	40	3.8	3
Bedside Echocardiography Performance	36	3.3	3
Bedside Echocardiograph Interpretation	36	3.3	3
Heart Transplant	35	2.8	2
Peripheral Vascular Disease	28	2.1	2
Cardiac Contusion	23	1.6	2
Congenital Heart Disease	20	1.4	2
Respiratory System (9)			
Tracheostomy Indications and Management [a]	72	6.8	3
Chest Tube Management [a]	63	6.0	2
Restrictive Lung Disease	62	5.9	3
Obstructive Sleep Apnea	62	5.8	3
Pleural Effusion	59	5.4	3
Pulmonary Function Test Assessment	48	4.7	2
Chest Trauma	47	4.6	2
Hemoptysis [a]	38	3.4	2
Lung Transplant	25	1.8	2

Tables *continued*

System	Percentage of Respondents Who Recommended Inclusion, %	Mean Likert Scale (range, 1-9)	Survey Iteration When Met Exclusion Criteria
Renal and Urinary Systems/Electrolyte Balance (1)			
Chronic Kidney Disease/Failure [a]	43	4.1	3
Infectious Diseases (8)			
COVID-19 [a]	59	5.3	3
Antibiotic Stewardship [a]	57	5.2	3
Antimicrobial Resistance	55	5.1	3
Genitourinary Infections	49	4.9	2
Skin and Soft Tissue Infections	49	4.8	2
Immunocompromised and Opportunistic Infections [a]	49	4.8	2
Hospital Infection Control	44	4.3	3
Cardiovascular Infections	36	3.0	2
Endocrine and Metabolic Systems (6)			
Diabetes Mellitus	65	6.1	3
Thyroid Disorders	48	4.7	2
Primary and Secondary Adrenal Disorders	40	3.8	2
Carcinoid Syndrome	28	2.1	2
Pituitary Disorders	25	1.9	2
Parathyroid Disorders	19	1.3	2
Gastrointestinal and Hepatic Systems (8)			
Ileus and Gastrointestinal Obstruction	60	5.6	3
Nutritional Support (Total Enteral Nutrition and Total Parenteral Nutrition)	58	5.3	3
Cirrhosis [a]	54	5.1	3
Pancreatitis	52	5.0	3
Portal Hypertension	49	4.9	2
Hepatorenal Syndrome	43	4.1	3
Liver Transplant	43	4.1	3
Hepatitis	41	4.0	2
Obstetric Critical Care (6)			
Pre-Eclampsia and Eclampsia	74	6.9	3
Physiologic Changes in Pregnancy [a]	65	6.1	3
Embolic Disorders of Pregnancy (including amniotic fluid and thromboembolic)	60	5.5	3
Coagulopathy and Bleeding Disorders in Pregnancy	60	5.5	3

Tables *continued*

System	Percentage of Respondents Who Recommended Inclusion, %	Mean Likert Scale (range, 1-9)	Survey Iteration When Met Exclusion Criteria
Acute Liver Dysfunction in Pregnancy (Including acute fatty liver and HELLP: Hemolysis Elevated Liver Enzymes Low Platelet Syndrome)	56	5.2	3
Cardiac Complications in Pregnancy [a]	55	5.1	3
Hematologic System (4)			
Hypercoagulable States	57	5.2	3
Platelet Disorders	57	5.2	3
Hemoglobinopathies	40	3.7	3
Oncologic Emergencies [a]	39	3.6	3
Miscellaneous (15)			
Critical Care Ethics	66	6.1	3
Crush Injuries	59	5.3	3
Critical Care Patient Safety	48	4.6	2
Injury Severity Scores	45	4.5	3
Burn and Inhalation Injury	45	4.5	3
Critical Care Quality Improvement	39	3.6	2
Organ Donation	36	3.0	2
Hypothermia	34	2.7	2
Disaster Management	32	2.5	2
Critical Care Medicolegal Issues	29	2.2	2
Dermatologic Allergic Reaction	28	2.1	2
Drowning	28	2.1	2
Critical Care Biostatistics	25	1.9	2
Bioterrorism	19	1.3	2
Critical Care Healthcare Administration	19	1.2	2

[a] Topics suggested by panelists.

Tables *continued*

Table 4. *First Survey Iteration Critical Care Topics From the Accreditation Council for Graduate Medical Education Program Requirements for Graduate Medical Education in Anesthesiology[6] and the American Board of Anesthesiology Content Outline for Initial Board Certification[2] Grouped by Organ System*

System	Critical Care Topics Meeting Consensus for Prioritization
Central and Peripheral Nervous Systems (11)	**5/11 = 45%**
Cerebral Blood Flow	Yes
Intracranial Pressure and Compliance	Yes
Traumatic Brain Injury	Yes
Altered Mental Status	Yes
Pain Management and Sedation	Yes
Brain Death	No
Cerebrovascular Disease	No
Seizures and Status Epilepticus	No
Neuromuscular Disorders	No
Spinal Cord Injury	No
Toxicology and Drug Intoxication	No
Cardiovascular System (23)	**11/23 = 48%**
Hemodynamic Monitoring	Yes
Acute Coronary Syndromes and Ischemic Heart Disease	Yes
Arrhythmias	Yes
Pacemakers and Automatic Implantable Cardioverter Defibrillators	Yes
Cardiac Arrest and Advanced Cardiac Life Support	Yes
Heart Failure (Left and Right Sided)	Yes
Pulmonary Embolism and Deep Vein Thrombosis	Yes
Cardiogenic Shock	Yes
Obstructive Shock	Yes
Hypovolemic Shock	Yes
Distributive Shock	Yes
Bedside Echocardiography (Cardiac Ultrasound) Performance and Interpretation	No
Pulmonary Hypertension	No
Aortic Dissection and Aneurysm	No
Peripheral Vascular Disease	No
Hypertensive Disorders (including hypertensive emergency)	No
Valvular and Structural Heart Disease	No
Congenital Heart Disease	No
Cardiac Contusion	No
Cardiomyopathies	No
Mechanical Circulatory Support	No
Heart Transplant	No

Tables *continued*

System	Critical Care Topics Meeting Consensus for Prioritization
Respiratory System (20)	**14/20 = 70%**
Airway Management	Yes
Acute Respiratory Failure (Hypoxic and Hypercapnic)	Yes
Mechanical Ventilation (including modes and settings)	Yes
Complications of Mechanical Ventilation	Yes
Mechanical Ventilation Weaning and Extubation Criteria	Yes
Noninvasive Ventilation	Yes
Pulmonary Mechanics (including flow-volume loops)	Yes
Obstructive Lung Disease (including upper and lower airway)	Yes
Acute Respiratory Distress Syndrome	Yes
Aspiration	Yes
Pulmonary Edema	Yes
Atelectasis	Yes
Pneumothorax	Yes
Chest X-ray and Chest Computerized Tomography Scan Interpretation	Yes
Lung Ultrasound Performance and Interpretation	No
Obstructive Sleep Apnea	No
Restrictive Lung Disease	No
Pleural Effusion	No
Chest Trauma (including pulmonary contusion and hemothorax)	No
Lung Transplant	No
Pulmonary Function Test Assessment	No
Renal and Urinary Systems/Electrolyte Balance (7)	**7/7 = 100%**
Acute Renal Failure	Yes
Acute Kidney Injury and Oliguria	Yes
Renal Replacement Therapy	Yes
Electrolyte Disorders	Yes
Acid-Base Disorders	Yes
Intravascular Volume Assessment	Yes
Fluid Management	Yes
Infectious Diseases (11)	**6/11 = 55%**
Pulmonary Infections (including upper airway and pneumonia)	Yes
Bacteremia and Catheter Related Blood Stream Infections	Yes
Systemic Inflammatory Response and Sepsis	Yes
Septic Shock	Yes
Multi-Organ Dysfunction	Yes

Tables *continued*

System	Critical Care Topics Meeting Consensus for Prioritization
Antimicrobial Selection	Yes
Cardiovascular Infections (including endocarditis and myocarditis)	No
Genitourinary Infections	No
Skin and Soft Tissue Infections	No
Antimicrobial Resistance	No
Hospital Infection Control	No
Endocrine and Metabolic Systems (6)	**0/6 = 0%**
Diabetes Mellitus	No
Thyroid Disorders	No
Parathyroid Disorders	No
Primary Adrenal Disorders	No
Pituitary Disorders	No
Carcinoid Syndrome	No
Gastrointestinal and Hepatic Systems (7)	**0/7 = 0%**
Ileus and Gastrointestinal Obstruction	No
Pancreatitis	No
Hepatitis	No
Portal Hypertension	No
Hepatorenal Syndrome	No
Liver Transplant	No
Nutritional Support (Total Enteral Nutrition and Total Parenteral Nutrition)	No
Obstetric Critical Care (4)	**0/4 = 0%**
Coagulopathy and Bleeding Disorders in Pregnancy	No
Embolic Disorders of Pregnancy (including amniotic fluid and thromboembolic)	No
Acute Liver Dysfunction in Pregnancy (Including acute fatty liver and HELLP: Hemolysis Elevated Liver Enzymes Low Platelet Syndrome)	No
Pre-Eclampsia and Eclampsia	No
Hematologic System (11)	**8/11 = 73%**
Coagulopathies	Yes
Transfusion Indications	Yes
Transfusion Reactions and Complications	Yes
Blood Products and Factor Replacement	Yes
Massive Hemorrhage and Massive Transfusion Protocols	Yes
Anticoagulants and Thrombolytics	Yes
Thromboembolic Disease	Yes

Tables *continued*

System	Critical Care Topics Meeting Consensus for Prioritization
Deep Vein Thrombosis Prophylaxis	Yes
Hemoglobinopathies	No
Platelet Disorders	No
Hypercoagulable States	No
Miscellaneous (16)	**1/16 = 6%**
Palliative Care	Yes
Burn and Inhalation Injury	No
Crush Injuries (including rhabdomyolysis)	No
Dermatologic Allergic Reaction	No
Hypothermia	No
Drowning	No
Organ Donation	No
Disaster Management	No
Bioterrorism	No
Injury Severity Scores	No
Critical Care Biostatistics	No
Critical Care Ethics	No
Critical Care Quality Improvement	No
Critical Care Patient Safety	No
Critical Care Healthcare Administration	No
Critical Care Medicolegal Issues	No