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Appendix A: Sampling Units & Data

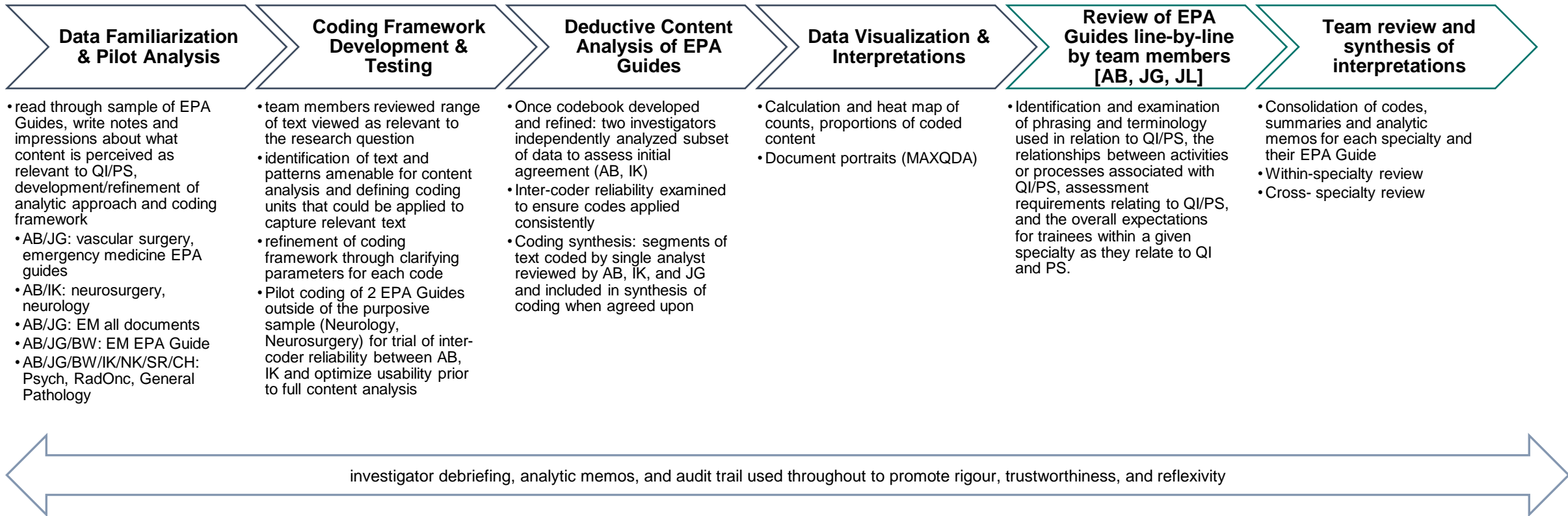|	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations*	Total
CBD Launch Year	2017	2019	2018	2019	2020	2019	2019	2020	2021	2020	2019	2018	
EPA Guide (Pages)	115	51	59	62	59	51	66	89	55	36	40	20	703
Total Number of EPAs	**49**	**30**	**28**	**36**	**31**	**29**	**33**	**47**	**32**	**20**	**15**	**16**	**366**
EPAs - Transition to Discipline	3	6	3	4	0	3	2	1	2	2	2	7	35
EPAs - Foundations of Discipline	16	7	4	6	5	7	10	10	11	5	4	9	94
EPAs - Core of Discipline	25	12	15	22	22	11	19	33	14	10	6	0	189
EPAs - Transition to Practice	5	5	6	4	4	8	2	3	5	3	3	0	48
Total Milestones in EPA Guide	**901**	**303**	**324**	**589**	**361**	**401**	**419**	**473**	**327**	**245**	**324**	**167**	**4834**
Collaborator (COL)	127	35	42	54	42	54	42	43	32	16	41	24	552
Communicator (COM)	146	34	65	44	38	86	89	46	64	58	67	29	766
Health Advocate (HA)	11	7	17	14	5	16	14	5	14	8	10	6	127
Leader (L)	51	29	14	49	14	18	16	15	19	9	19	4	257
Medical Expert (ME)	426	126	143	332	195	168	241	306	149	106	123	83	2398
Professional (P)	75	25	27	42	41	27	13	15	26	19	27	13	350
Scholar (S)	65	47	16	54	26	32	4	43	23	29	37	8	384
Average Milestones/EPA	18.4	10.1	11.6	16.4	11.6	13.8	12.7	10.1	10.2	12.3	21.6	10.4	13.2

Notes:
*Surgical Foundations is a shared curriculum that runs parallel to specialty training between Transition to Discipline and Foundations of Discipline; all surgical residents must achieve the Surgical Foundations EPAs simultaneously with their primary discipline's EPA requirements

The above table offers various options for denominators that were used to standardize cross-specialty comparisons to account.
Conditional formatting for colour based on specialty (column). Green = high, red = low.

Appendix B: Overview of Data Analysis Procedures

Summative Content Analysis	Interpretive Analysis

Data Familiarization & Pilot Analysis	Coding Framework Development & Testing	Deductive Content Analysis of EPA Guides	Data Visualization & Interpretations	Review of EPA Guides line-by-line by team members [AB, JG, JL]	Team review and synthesis of interpretations
• read through sample of EPA Guides, write notes and impressions about what content is perceived as relevant to QI/PS, development/refinement of analytic approach and coding framework • AB/JG: vascular surgery, emergency medicine EPA guides • AB/IK: neurosurgery, neurology • AB/JG: EM all documents • AB/JG/BW: EM EPA Guide • AB/JG/BW/IK/NK/SR/CH: Psych, RadOnc, General Pathology	• team members reviewed range of text viewed as relevant to the research question • identification of text and patterns amenable for content analysis and defining coding units that could be applied to capture relevant text • refinement of coding framework through clarifying parameters for each code • Pilot coding of 2 EPA Guides outside of the purposive sample (Neurology, Neurosurgery) for trial of inter-coder reliability between AB, IK and optimize usability prior to full content analysis	• Once codebook developed and refined: two investigators independently analyzed subset of data to assess initial agreement (AB, IK) • Inter-coder reliability examined to ensure codes applied consistently • Coding synthesis: segments of text coded by single analyst reviewed by AB, IK, and JG and included in synthesis of coding when agreed upon	• Calculation and heat map of counts, proportions of coded content • Document portraits (MAXQDA)	• Identification and examination of phrasing and terminology used in relation to QI/PS, the relationships between activities or processes associated with QI/PS, assessment requirements relating to QI/PS, and the overall expectations for trainees within a given specialty as they relate to QI and PS.	• Consolidation of codes, summaries and analytic memos for each specialty and their EPA Guide • Within-specialty review • Cross- specialty review

investigator debriefing, analytic memos, and audit trail used throughout to promote rigour, trustworthiness, and reflexivity

Appendix C: Coded EPAs & Milestones

Table C.1: Coded EPAs by Category

Coded EPAs by Category

COUNTS	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. QI/PS core competencies	3	3	2	1	2	2		2	2				17
2. QI/PS activities		2		3	2		2		1	1	2		13
3. Clinical activities associated with QI/PS	3	3	5	4	3	4			5	1	3	1	32
4. Professional practices linked to QI/PS				1	1			1	3	1	1		8
5. Educational activities linked to QI/PS			2			1		1				1	5
6. Aspirational references to quality & safety	3		4		2			17		1		2	29
Total	9	8	13	9	10	7	2	21	11	4	6	4	104

Notes: The above table provides the total number of coded EPAs across each of the categories. Coded EPAs do not reflect the extent that the code is the primary focus of the EPA (ex: disclosing an adverse event or error), or referenced in the description of an EPA as part of an EPA focused on something else (ex: EPA focused on performing XYZ procedure that references disclosing any adverse events and errors in the description)

PROPORTIONS [Denominator: Total # EPAs]	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. QI/PS core competencies	6.1%	10.0%	7.1%	2.8%	6.5%	6.9%	0.0%	4.3%	6.3%	0.0%	0.0%	0.0%	4.6%
2. QI/PS activities	0.0%	6.7%	0.0%	8.3%	6.5%	0.0%	6.1%	0.0%	3.1%	5.0%	13.3%	0.0%	3.6%
3. Clinical activities associated with QI/PS	6.1%	10.0%	17.9%	11.1%	9.7%	13.8%	0.0%	0.0%	15.6%	5.0%	20.0%	6.3%	8.7%
4. Professional practices linked to QI/PS	0.0%	0.0%	0.0%	2.8%	3.2%	0.0%	0.0%	2.1%	9.4%	5.0%	6.7%	0.0%	2.2%
5. Educational activities linked to QI/PS	0.0%	0.0%	7.1%	0.0%	0.0%	3.4%	0.0%	2.1%	0.0%	0.0%	0.0%	6.3%	1.4%
6. Aspirational references to quality & safety	6.1%	0.0%	14.3%	0.0%	6.5%	0.0%	0.0%	36.2%	0.0%	5.0%	0.0%	12.5%	7.9%
Total	18.4%	26.7%	46.4%	25.0%	32.3%	24.1%	6.1%	44.7%	34.4%	20.0%	40.0%	25.0%	28.4%

Notes: The above table provides the total number of all EPAS coded to any coding category and the proportion of EPAs coded across the 6 coding categories This shows us that while 44.7% of all EPAs in the Orthopedic Surgery EPA Guide may have been coded, the vast majority of those EPAs were coded to category #6 as.
Conditional formatting for colour based on total row (cross-specialty) and columns (cross-coding category). Green = highest, red = lowest.

Table C.2: Coded EPAs by Stage of Training

Coded EPAs by Stage of Training

COUNTS	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. Transition to Discipline	2	1	2								1	3	9
2. Foundations of Discipline	3		1	1	3	3		4	2	2	2	1	22
3. Core of Discipline	3	3	5	5	5	2	1	17	6	1	1		49
4. Transition to Practice	1	4	5	3	2	2	1		3	1	2		24
Total	9	8	13	9	10	7	2	21	11	4	6	4	104

PROPORTIONS Denominator: Total # EPAs in CBD Stage for Specialty	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. Transition to Discipline	66.7%	16.7%	66.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%	42.9%	25.7%
2. Foundations of Discipline	18.8%	0.0%	25.0%	16.7%	60.0%	42.9%	0.0%	40.0%	18.2%	40.0%	50.0%	11.1%	23.4%
3. Core of Discipline	12.0%	25.0%	33.3%	22.7%	22.7%	18.2%	5.3%	51.5%	42.9%	10.0%	16.7%	0.0%	25.9%
4. Transition to Practice	20.0%	80.0%	83.3%	75.0%	50.0%	25.0%	50.0%	0.0%	60.0%	33.3%	66.7%	0.0%	50.0%

Notes: The above table tells us where the coded EPAs [coded to any category] are in terms of the stage of training along the CBD Continuum [proportions calculated within specialty/column]. We see that Anesthesia, Emergency Medicine, and Radiation Oncology have EPAs that code to any category throughout all 4 stages. OBGYN does not have any EPAs that map to any codes until the later stage of training, which warrants a closer look.

Supplemental Files

Table C.3: Coded Milestones by Category

Milestones by Coding Category

Number of Coded Milestones	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. QI/PS core competencies	44	10	7	16		12	5	2	4	2	14	5	121
2. QI/PS activities	38	15	6	24	16	4	20	6	7		15	3	154
3. Clinical activities associated with QI/PS	56	15	40	24	7	40	28	35	25	13	39	20	342
4. Professional practices linked to QI/PS	24	4	4	3	3	4	3	3	3	2			53
5. Educational activities linked to QI/PS	24	6	6	6	1	5	1	3	2	5	4	1	64
6. Aspirational references to quality / safety	40	2	12	15	23	12	27	21	7	5	4	6	174
Total	226	52	75	88	50	77	84	70	48	27	76	35	908

% of Milestones in EPA Guide Coded by Category

Proportions of Coded Milestones — Denominator: Total # Milestones in Specialty EPA Guide	Anesthesiology	Critical Care	Emergency Medicine	General Pathology	General Surgery	Internal Medicine	OBGYN	Orthopedic Surgery	Pediatrics	Psychiatry	Radiation Oncology	Surgical Foundations	Total
1. QI/PS core competencies	4.9%	3.3%	2.2%	2.7%	0.0%	3.0%	1.2%	0.4%	1.2%	0.8%	4.3%	3.0%	2.5%
2. QI/PS activities	4.2%	5.0%	1.9%	4.1%	4.4%	1.0%	4.8%	1.3%	2.1%	0.0%	4.6%	1.8%	3.2%
3. Clinical activities associated with QI/PS	6.2%	5.0%	12.3%	4.1%	1.9%	10.0%	6.7%	7.4%	7.6%	5.3%	12.0%	12.0%	7.1%
4. Professional practices linked to QI/PS	2.7%	1.3%	1.2%	0.5%	0.8%	1.0%	0.7%	0.6%	0.9%	0.8%	0.0%	0.0%	1.1%
5. Educational activities linked to QI/PS	2.7%	2.0%	1.9%	1.0%	0.3%	1.2%	0.2%	0.6%	0.6%	2.0%	1.2%	0.6%	1.3%
6. Aspirational references to quality / safety	4.4%	0.7%	3.7%	2.5%	6.4%	3.0%	6.4%	4.4%	2.1%	2.0%	1.2%	3.6%	3.6%
Total*	25.1%	17.2%	23.1%	14.9%	13.9%	19.2%	20.0%	14.8%	14.7%	11.0%	23.5%	21.0%	18.8%

Notes: The above table provides the number of coded milestones by coding category, and then the proportion of milestones coded [= coded milestones for that category / total milestones]. Within each specialty we can see where milestones are most commonly coded, which would be under coding category #3 for all specialties except General Surgery, where milestones are most commonly coded to category #6.

Colour coding by column [specialty] except for the row % milestones coded, where colour coding is by row (green = highest, red = lowest)

Supplemental Files

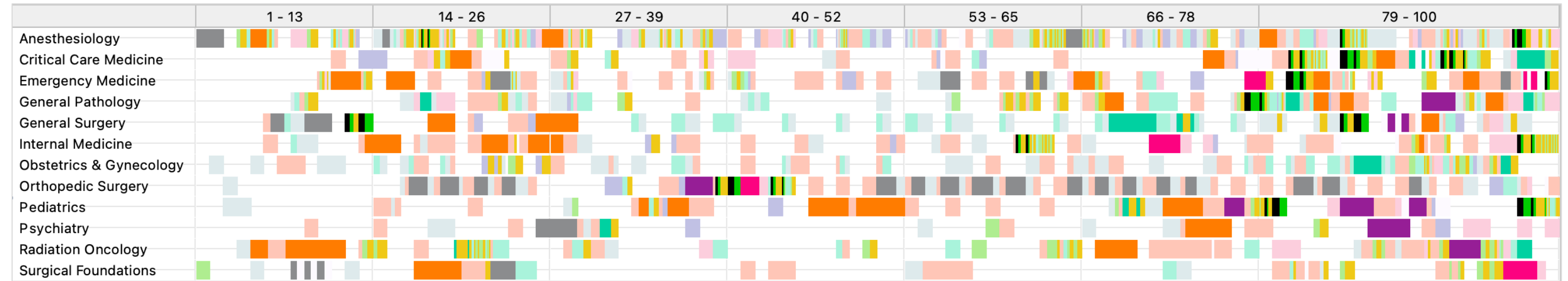**Figure C.1: Visualization of Coded EPAs and Milestones by Specialty**
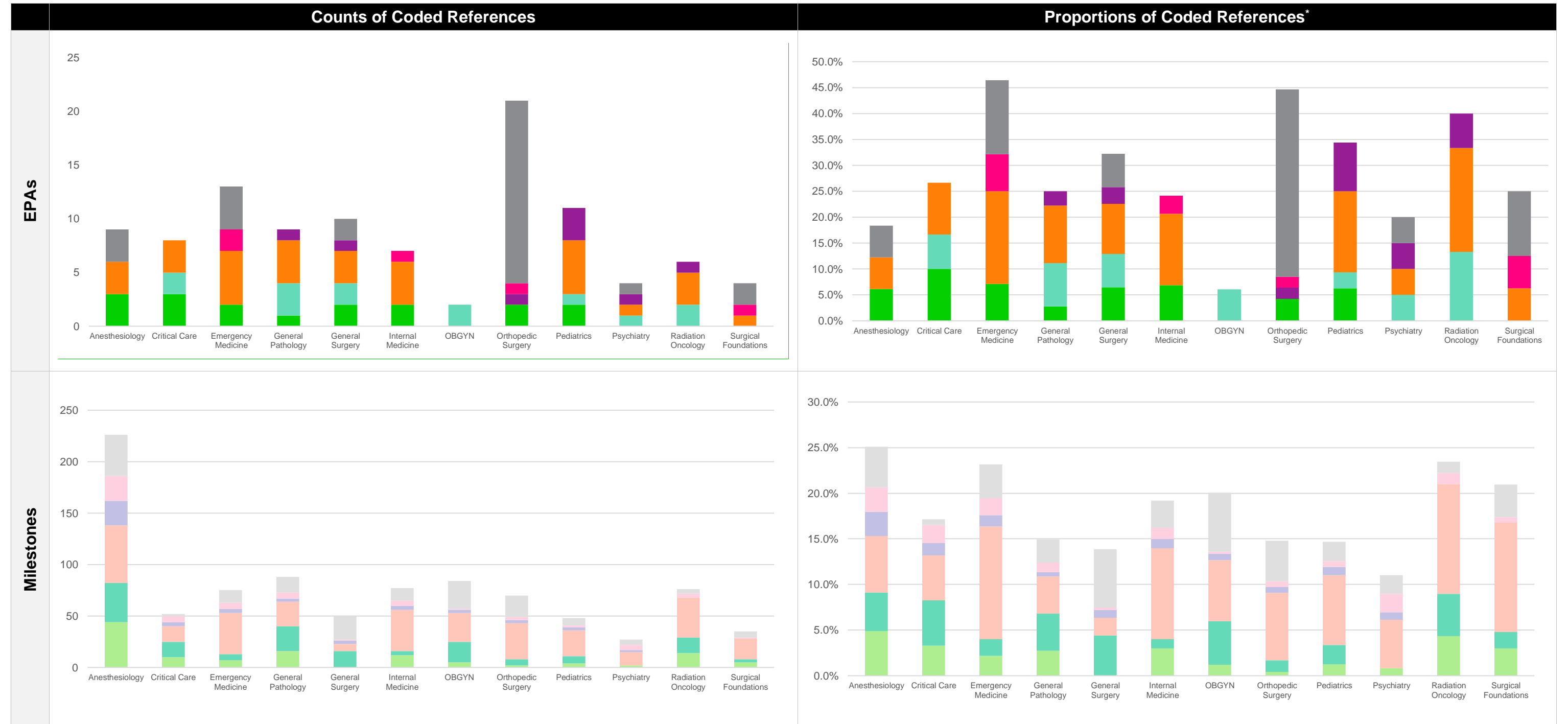
*Denominator: Total # EPAs or Milestones in Specialty EPA Guide

Coding Category	QI/PS applications and core competencies		Activities associated or linked to QI/PS			References
	1. QI/PS core	2. QI/PS activities	3. Clinical activities	4. Professional practices	5. Education	6. Quality/safety
EPA	1A	2A	3A	4A	5A	6A
Milestone	1B	2B	3B	4B	5B	6B

Supplemental Files

Appendix D: Standardized Document Portraits for Cross-Specialty Comparisons of Coded EPAs and Milestones

Figure D-1: Distribution of Coded EPAs and Milestones

	1 – 13	14 – 26	27 – 39	40 – 52	53 – 65	66 – 78	79 – 100
Anesthesiology							
Critical Care Medicine							
Emergency Medicine							
General Pathology							
General Surgery							
Internal Medicine							
Obstetrics & Gynecology							
Orthopedic Surgery							
Pediatrics							
Psychiatry							
Radiation Oncology							
Surgical Foundations							

Notes: Coloured bar size proportional to coded segments in document; visualization standardized for document length

Figure D-2: Cross-Specialty Comparison - QI/PS Activities and Applications (Categories 1-2)
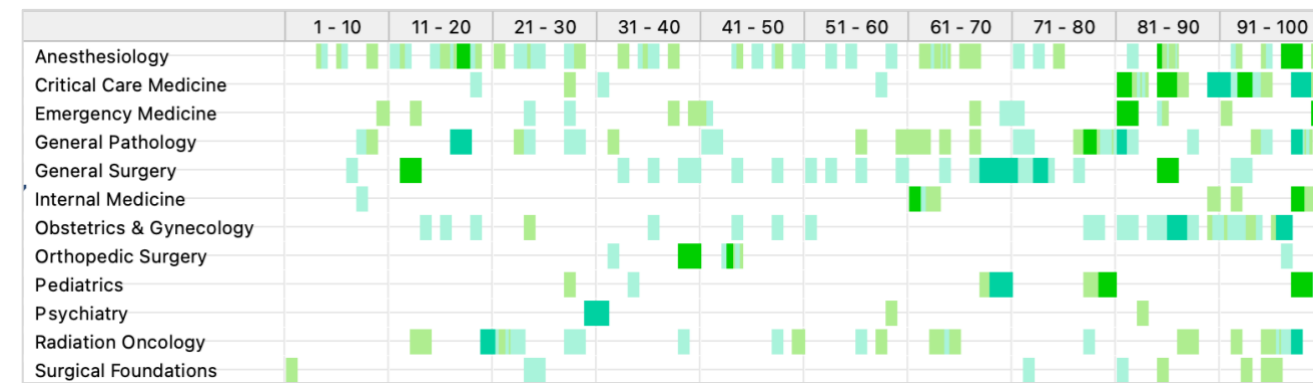
**standardized for document length

Figure D-3: Cross-Specialty Comparison - Coded EPAs
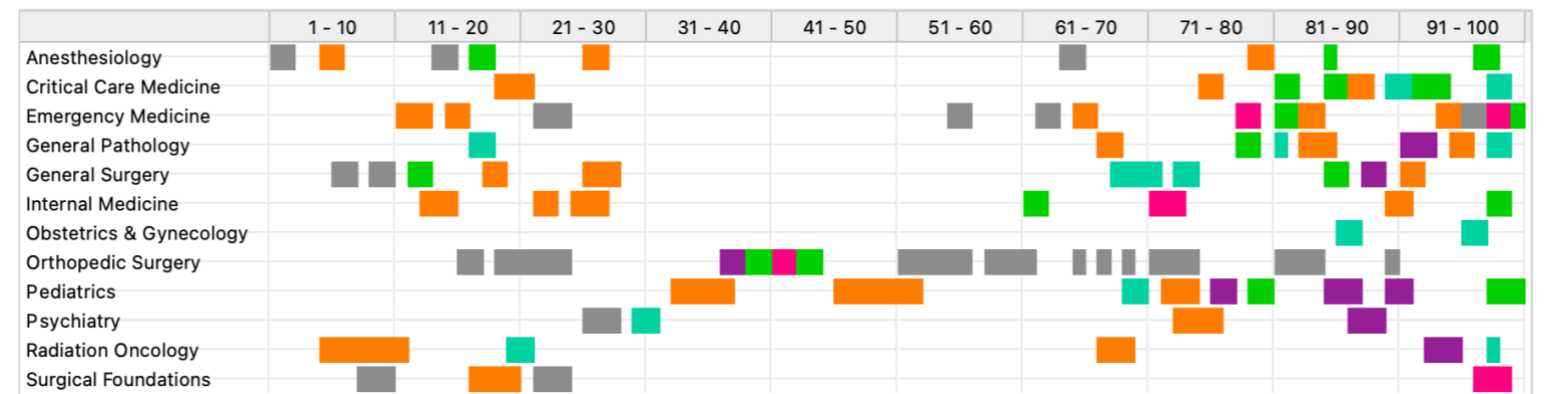
Legend:

Coding Category	QI/PS applications and core competencies		Activities associated or linked to QI/PS			References
	1. QI/PS core	2. QI/PS activities	3. Clinical activities	4. Professional practices	5. Education	6. Quality/safety
EPA	1A	2A	3A	4A	5A	6A
Milestone	1B	2B	3B	4B	5B	6B

Appendix E: Example EPAs for Qualty Improvement & Patient Safety

Notes: In this supplement, we present three example Entrustable Professional Activities (EPAs) drawn from our dataset, selected to offer valuable insights into the diverse ways in which Quality Improvement (QI) and Patient Safety (PS) can be integrated into specialty-specific training.

We intentionally chose EPAs from three different specialties. Furthermore, these EPAs span different stages of the Competence by Design continuum to show how EPAs can be incorporated at various points in training rather than at the later stage of training.

To illustrate the varied approaches to QI and PS integration, we have included an EPA primarily focused on PS, another with a stronger QI emphasis, and a third that blends PS with a reflective component on improvement. This selection aims to highlight the interconnectedness of QI and PS within medical training and to demonstrate the potential for diverse applications across different specialties."

Finally, it is important to note that the EPAs featured here are based on the version of the EPA guide included in our dataset and may be subject to revisions by the respective programs. Readers should be aware that the examples provided may not precisely reflect the current requirements of these programs at the time of reading.

E1: Example EPA for Patient Safety – Anesthesiology Core EPA #24
E2: Example EPA for Patient Safety (with reflection on QI) – Radiation Oncology Foundations EPA #3
E3: Example EPA for Quality Improvement – Internal Medicine Transition to Practice EPA #8

Appendix E-1: Example EPA for Patient Safety – Anesthesiology Core EPA #24

Anesthesiology: Core EPA #24

Providing care for patients who have experienced a patient safety incident

Key Features:
- No patient identification data should be part of the documentation of the observation.
- This EPA includes diagnosis, further investigations if indicated and management of a patient safety incident (adverse event or near miss).
- This EPA also includes contributing to a culture of safety.
- Full disclosure to the patient and family is included in this EPA (may be observed in simulation setting), as well as debriefing and reporting to appropriate authorities if indicated.
- Detailed documentation and appropriate reporting of the incident to administrative personnel.
- Key points of discussion with patient and/or family should include
  - Planned interventions to mitigate the effects of the complication and anticipated outcome
  - An intention to formally review the case, if appropriate, to assess strategies for future prevention of similar events
  - Opening of lines of communication with the patient/family, with a promise of further discussion as more information becomes available on review of the case
  - An expression of sympathy and, if appropriate, an apology
- The documentation of the observation of this EPA must include narrative comments.

Assessment plan - **recommendations**

Direct observation or chart review and debrief by supervisor

Use Form 1 or local alternative. Form collects information on:
- Event type [write in]:
- Disclosure observed: yes; no

Collect 1 observation of achievement

Relevant milestones

1 **ME 5.1 Identify a patient safety incident (adverse event or near miss) in a timely manner**

2 **ME 2.2** Synthesize patient information to determine diagnosis

3 **ME 2.4** Establish a patient-centered management plan

4 **ME 5.1** Identify the clinical circumstances contributing to an adverse event

5 **ME 5.1** Report patient safety incidents to appropriate institutional representatives

6 **ME 5.1** Participate in an analysis of patient safety incidents

7 **ME 5.1 Prioritize the initial medical response to adverse events to mitigate further injury**

8 **ME 5.1.** Identify changes in practice/clinical care to prevent similar events

9 **COM 1.5** Manage the flow of challenging patient encounters, including those with angry, anxious or distressed individuals

10 **COM 3.1** Convey the diagnosis, prognosis and plan of care in a clear, compassionate, respectful, and accurate manner to the patient and/or family

11 **COM 3.2 Communicate the reasons for unanticipated clinical outcomes to patients and disclose patient safety incident**s

12 **COM 3.2** Apologize appropriately for a harmful patient safety incident

13 **COM 5.1 Document harmful patient safety incidents as per institutional processes**

14 **L 1.1** Participate in a patient safety and/or quality improvement initiative

15 **L 1.1** Seek data to inform practice and engage in an iterative process of improvement

16 **HA 2.2** Improve individual and discipline clinical practice by applying a process of continuous quality improvement to prevent complications

17 **P 2.2** Demonstrate a commitment to patient safety and quality improvement through adherence to institutional policies and procedures

18 **P 3.3** Prepare a morbidity and mortality report or chart review

19 **P 4.1 Recognize the effect of a patient safety incident on one's own emotional well-being, and use strategies to mitigate them**

Radiation Oncology: Foundations EPA #3

Managing medical error and adverse events

Key Features:
- This EPA includes identifying, responding to, disclosing, and documenting an adverse event, as well as analyzing the event and potential improvements in health care delivery
- The observation of this EPA is divided into two parts: managing the medical error or adverse event; and written reflection on the causes of the event and potential changes for improvement or prevention

Assessment Plan:

Part A: Managing the medical error or adverse event
Direct or indirect observation by senior resident, staff, other health professionals

Use Form 1. Form collects information on:
- Type of observation: direct; indirect
- Setting: inpatient; clinic; operating room; emergency department; other

Collect 1 observation of achievement

Part B: Self-reflection
Faculty advisor review of resident's submission of a self-reflection

Use Form 4

Relevant Milestones:

Part A: Managing the medical error or adverse event
1 **ME 3.4 Seek assistance as needed when unanticipated findings or changing clinical circumstances are encountered**

2 **ME 5.1 Prioritize the initial medical response to adverse events to mitigate further injury**

3 **ME 5.1 Identify a patient safety incident in a timely manner**

4 **COM 3.2 Communicate the reasons for unanticipated clinical outcomes and disclose patient safety incidents**

5 **COM 4.3 Answer questions from the patient and family about next steps**

6 **ME 5.1 Report harmful patient safety incidents as per institutional processes**

7 **COL 2.2 Communicate clearly and directly with team/colleagues to promote understanding and resolve conflicts**

8 **COL 3.2 Communicate with interprofessional team members to help address issues during transitions in care, clarifying issues after transfer as needed**

Part B: Self-Reflection
1 **ME 5.1** Consider harm from health care delivery in a differential diagnosis, when appropriate

2 **ME 5.1** Identify safety issues that may arise, including systemic therapy, surgical oncology, and palliative care

3 **ME 5.1** Describe an approach to analyzing an adverse medical event

4 **ME 5.1** Identify what measures should be taken after an incident to contribute to process improvement

5 **ME 5.2** Describe strategies to address the effects of human and system factors on clinical practice

6 **S 2.1** Identify behaviours associated with positive and negative role-modeling by learners and teachers

7 **P 4.1** Manage the impact of physical and environmental factors on health professionals' performance

8 **P 4.1** Demonstrate an awareness of the importance of personal health and emotional well-being while delivering care to patients

Internal Medicine: Transition to Practice EPA #8

Identifying and analyzing system-level safety, quality, or resource stewardship concerns in healthcare delivery

Key Features:
- This task focuses on quality improvement at the level of the system of health care delivery and/or a group of patients. Examples may include: a project, a course of advanced study; longitudinal participation in a patient safety committee
- It includes the review and analysis of a set of events, or data, to identify potential areas for improvement in health care delivery (which may be related to safety, quality or resource stewardship)
- It focuses on an analysis of the reasons for the gap in desired outcomes, and may include suggestions for processes to improve health care delivery
- The observation of this EPA, requires that the resident complete the analysis, but it is not necessary for the resident to implement or participate in the implementation of any changes

Assessment Plan:

Review of resident submission by Competence Committee

Resident submission must include all of the following:
- For Project: Summary of data identifying the concern(s) in safety, quality or resource stewardship; Analysis of the human and system factors related to that concern
- For advanced course: syllabus and evidence of participation
- For committee: Summary of participation including examples of the concern(s) in safety, quality or resource stewardship and analysis of the human and system factors related to that concern

Use Form 4.

Relevant Milestones:

1   **L 1.1** Participate in a patient safety or quality improvement initiative

2   **L 1.3** Analyze harmful patient safety incidents and near misses

3   **L 1.3** Employ a systems-based approach to develop solutions for quality improvement and patient safety issues

4   **ME 5.1** Identify human and systems factors contributing to patient safety incidents

5   **S 3.3** Critically evaluate the integrity, reliability, and applicability of health-related research and literature

6   **ME 5.2** Adopt strategies that promote patient safety and address human and system factors

7   **P 3.1** Respond to, cope with, and constructively learn from a complaint

8   **P 4.3** Support colleagues in mitigating the impact of patient safety incidents on personal wellbeing, and responding to these incidents as opportunities for practice improvement