

<i>Supplemental Digital Appendix 1: Examples of Patient Care Milestones From Each Specialty</i>	2-4
<i>Supplemental Digital Appendix 1A: Examples of Patient Care Milestones From Emergency Medicine</i>	2
<i>Supplemental Digital Appendix 1B: Examples of Patient Care Milestones From Family Medicine</i>	3
<i>Supplemental Digital Appendix 1C: Examples of Patient Care Milestones From Internal Medicine.</i>	4
<i>Supplemental Digital Appendix 2: Cross Classification Table of the Number of Residents by Outcome and Threshold Used to Calculate Odds Ratios, Positive Predictive Values, and Negative Predictive Values</i>	5
<i>Supplemental Digital Appendix 3: Milestones Ratings and Predictive Analytics for Each Specialty by Milestones Review Occasion</i>	6-20
<i>Supplemental Digital Appendix 3A: Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion for Family Medicine</i>	6-8
<i>Supplemental Digital Appendix 3B: Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion for Family Medicine</i>	9-10
<i>Supplemental Digital Appendix 3C: Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion for Emergency Medicine</i>	11-12
<i>Supplemental Digital Appendix 3D: Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion for Emergency Medicine</i>	13-14
<i>Supplemental Digital Appendix 3E: Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion for Internal Medicine</i>	15-17
<i>Supplemental Digital Appendix 3F: Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion for Internal Medicine</i>	18-20
<i>Supplemental Digital Appendix 4: Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years by Specialty</i>	21-51
<i>Supplemental Digital Appendix 4A: Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Emergency Medicine</i>	21-31
<i>Supplemental Digital Appendix 4B: Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Family Medicine</i>	31-41
<i>Supplemental Digital Appendix 4C: Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Internal Medicine</i>	41-51

Supplemental Digital Appendix 1
Examples of Patient Care Milestones From Each Specialty

Supplemental Digital Appendix 1A
Examples of Patient Care Milestones From Emergency Medicine*

Performance of Focused History and Physical Exam: Abstracts current findings in a patient with multiple chronic medical problems and, when appropriate, compares with a prior medical record and identifies significant differences between the current presentation and past presentations.					
Has not Achieved Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
	Performs and communicates a reliable, comprehensive history and physical exam	Performs and communicates a focused history and physical exam which effectively addresses the chief complaint and urgent patient issues	Prioritizes essential components of a history given a limited or dynamic circumstance -- Prioritizes essential components of a physical examination given a limited or dynamic circumstance	Synthesizes essential data necessary for the correct management of patients using all potential sources of data	Identifies obscure, occult or rare patient conditions based solely on historical and physical exam findings
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comments:					

*Accessed at <https://www.acgme.org/Portals/0/PDFs/Milestones/EmergencyMedicineMilestones.pdf?ver=2015-11-06-120531-877> on July 10, 2019.

Supplemental Digital Appendix 1B
Examples of Patient Care Milestones From Family Medicine*

Cares for acutely ill or injured patients in urgent and emergent situations and in all settings					
Has not achieved Level 1	Level 1	Level 2	Level 3	Level 4	Level 5
	<p>Gathers essential information about the patient (history, exam, diagnostic testing, psychosocial context)</p> <p>Generates differential diagnoses</p> <p>Recognizes role of clinical protocols and guidelines in acute situations</p>	<p>Consistently recognizes common situations that require urgent or emergent medical care</p> <p>Stabilizes the acutely ill patient utilizing appropriate clinical protocols and guidelines</p> <p>Generates appropriate differential diagnoses for any presenting complaint</p> <p>Develops appropriate diagnostic and therapeutic management plans for acute conditions</p>	<p>Consistently recognizes complex situations requiring urgent or emergent medical care</p> <p>Appropriately prioritizes the response to the acutely ill patient</p> <p>Develops appropriate diagnostic and therapeutic management plans for less common acute conditions</p> <p>Addresses the psychosocial implications of acute illness on patients and families</p> <p>Arranges appropriate transitions of care</p>	<p>Coordinates care of acutely ill patient with consultants and community services</p> <p>Demonstrates awareness of personal limitations regarding procedures, knowledge, and experience in the care of acutely ill patients</p>	<p>Provides and coordinates care for acutely ill patients within local and regional systems of care</p>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comments:					

*Accessed at <https://www.acgme.org/Portals/0/PDFs/Milestones/FamilyMedicineMilestones.pdf?ver=2017-01-20-103353-463> on July 10, 2019.

Supplemental Digital Appendix 1C

Examples of Patient Care Milestones From Internal Medicine*

Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s).				
Critical Deficiencies			Ready for unsupervised practice	Aspirational
<p>Does not collect accurate historical data</p> <p>Does not use physical exam to confirm history</p> <p>Relies exclusively on documentation of others to generate own database or differential diagnosis</p> <p>Fails to recognize patient's central clinical problems</p> <p>Fails to recognize potentially life threatening problems</p>	<p>Inconsistently able to acquire accurate historical information in an organized fashion</p> <p>Does not perform an appropriately thorough physical exam or misses key physical exam findings</p> <p>Does not seek or is overly reliant on secondary data</p> <p>Inconsistently recognizes patients' central clinical problem or develops limited differential diagnoses</p>	<p>Consistently acquires accurate and relevant histories from patients</p> <p>Seeks and obtains data from secondary sources when needed</p> <p>Consistently performs accurate and appropriately thorough physical exams</p> <p>Uses collected data to define a patient's central clinical problem(s)</p>	<p>Acquires accurate histories from patients in an efficient, prioritized, and hypothesis-driven fashion</p> <p>Performs accurate physical exams that are targeted to the patient's complaints</p> <p>Synthesizes data to generate a prioritized differential diagnosis and problem list</p> <p>Effectively uses history and physical examination skills to minimize the need for further diagnostic testing</p>	<p>Obtains relevant historical subtleties, including sensitive information that informs the differential diagnosis</p> <p>Identifies subtle or unusual physical exam findings</p> <p>Efficiently utilizes all sources of secondary data to inform differential diagnosis</p> <p>Role models and teaches the effective use of history and physical examination skills to minimize the need for further diagnostic testing</p>
<p>Comments:</p>				

*Accessed at: <https://www.acgme.org/Portals/0/PDFs/Milestones/InternalMedicineMilestones.pdf?ver=2017-07-28-090326-787> on July 10, 2019

Supplemental Digital Appendix 2

Cross Classification Table of the Number of Residents by Outcome and Threshold Used to Calculate Odds Ratios, Positive Predictive Values, and Negative Predictive Values*

		Outcome	
		Rated LESS THAN level 4 at the time of graduation (< Lev 4)	Rated GREATER THAN or EQUAL TO level 4 at the time of graduation (\geq Lev 4)
Predictor (threshold)	Rated LESS THAN or EQUAL TO level 2.5 (\leq Lev 2.5) during post-graduate year 2	a	b
	Rated GREATER THAN level 2.5 ($>$ Lev 2.5) during post-graduate year 2	c	d

* Definitions:

Sensitivity = number of residents rated \leq to level 2.5 during the second year out of those who were rated $<$ level 4 at the time of graduation ($a/(a+c)$);

Specificity = number of residents rated $>$ level 2.5 during the second year out of those who were rated \geq level 4 at the time of graduation ($d/(b+d)$);

Positive predictive value (PPV) = number of residents who were rated $<$ level 4 at the time of graduation out of those who were rated \leq level 2.5 during the second year ($a/(a+b)$);

Negative predictive value (NPV) = number of residents who were rated \geq level 4 at the time of graduation out of those who were rated $>$ level 2.5 during the second year ($d/(c+d)$).

Odds ratio = ratio of the odds for not reaching level 4 for those who are rated at or under level 2.5 to the odds for those who are rated greater than level 2.5 ($(a/b)/(c/d)$).

Supplemental Digital Appendix 3
Milestones Ratings and Predictive Analytics for Each Specialty by Milestones Review Occasion

Supplemental Digital Appendix 3A
Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion (December 2015 – January 2016 Reporting Period) for Family Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
PC01	Cares for acutely ill or injured patients in urgent and emergent situations and in all settings	601/3276 (18.3%)	1787	79.3%	51.4%	26.7%	92.7%	4.62* (2.99,7.12)
PC02	Cares for patients with chronic conditions	704/3276 (21.5%)	1884	79.4%	49.0%	28.8%	90.0%	3.65* (2.48,5.36)
PC03	Partners with the patient, family, and community to improve health through disease prevention and health promotion	1068/3276 (32.6%)	1955	72.3%	46.7%	38.8%	77.2%	2.15* (1.64,2.84)
PC04	Partners with the patient to address issues of ongoing signs, symptoms, or health concerns that remain over time without clear diagnosis despite evaluation and treatment, in a patient-centered, cost-effective manner	747/3276 (22.8%)	1970	80.3%	46.2%	30.9%	90.4%	4.21* (2.95,6.03)
PC05	Performs specialty-appropriate procedures to meet the health care needs of individual patients, families, and communities, and is knowledgeable about procedures performed by other specialists to guide their patients' care	977/3276 (29.8%)	1970	74.8%	45.9%	36.4%	81.3%	2.48* (1.80,3.43)
MK01	Demonstrates medical knowledge of sufficient breadth and depth to practice family medicine	623/3276 (19.0%)	2068	82.6%	42.3%	24.2%	91.5%	3.45* (2.30,5.16)
MK02	Applies critical thinking skills in patient care	952/3276 (29.1%)	1797	73.3%	52.9%	38.7%	82.4%	2.97* (2.16,4.07)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
SBP01	Provides cost-conscious medical care	881/3276 (26.9%)	1853	72.5%	50.3%	35.0%	84.9%	3.03* (2.14,4.29)
SBP02	Emphasizes patient safety	1262/3276 (38.5%)	2404	87.3%	34.6%	44.5%	78.9%	3.01* (2.16,4.20)
SBP03	Advocates for individual and community health	1497/3276 (45.7%)	2198	78.3%	41.5%	53.0%	70.2%	2.66* (1.97,3.59)
SBP04	Coordinates team-based care	586/3276 (17.9%)	1529	66.0%	58.3%	25.5%	89.8%	3.02* (2.05,4.46)
PBLI01	Locates, appraises, and assimilates evidence from scientific studies related to the patients' health problems	1069/3276 (32.6%)	2327	85.5%	35.9%	38.8%	83.2%	3.15* (2.20,4.50)
PBLI02	Demonstrates self-directed learning	967/3276 (29.5%)	1737	69.9%	54.0%	38.1%	81.4%	2.69* (1.98,3.64)
PBLI03	Improves systems in which the physician provides care	1737/3276 (53.0%)	2534	85.7%	32.1%	58.6%	63.4%	2.46* (1.79,3.38)
PROF01	Completes a process of professionalization	680/3276 (20.8%)	1609	72.5%	57.1%	32.1%	90.0%	4.27* (2.89,6.31)
PROF02	Demonstrates professional conduct and accountability	1088/3276 (33.2%)	1893	74.4%	50.5%	44.1%	81.4%	3.45* (2.55,4.68)
PROF03	Demonstrates humanism and cultural proficiency	631/3276 (19.3%)	1529	66.3%	58.8%	28.8%	89.1%	3.30* (2.26,4.82)
PROF04	Maintains emotional, physical, and mental health; and pursues continual personal and professional growth	794/3276 (24.2%)	1754	70.7%	52.3%	32.7%	85.6%	2.90* (2.09,4.02)
ICS01	Develops meaningful, therapeutic relationships with patients and families	528/3276 (16.1%)	1250	57.5%	66.6%	26.1%	90.9%	3.54* (2.41,5.20)
ICS02	Communicates effectively with patients, families, and the public	622/3276 (19.0%)	1659	72.3%	55.0%	27.7%	90.4%	3.62* (2.54,5.17)
ICS03	Develops relationships and effectively communicates with physicians, other health professionals, and health care teams	870/3276 (26.6%)	1504	63.2%	61.6%	38.1%	83.2%	3.04* (2.25,4.12)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
ICS04	Utilizes technology to optimize communication	766/3276 (23.4%)	1684	73.0%	56.2%	33.9%	88.7%	4.01* (2.73,5.90)

*Significant at $p < 0.00114$ [$0.05/(22*2)$].

Supplemental Digital Appendix 3B

Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion (May – June 2017 Reporting Period) for Family Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
PC01	Cares for acutely ill or injured patients in urgent and emergent situations and in all settings	601/3276 (18.3%)	710	52.4%	85.4%	43.2%	89.5%	6.48* (4.32,9.73)
PC02	Cares for patients with chronic conditions	704/3276 (21.5%)	703	46.6%	85.9%	45.2%	86.5%	5.31* (3.50,8.05)
PC03	Partners with the patient, family, and community to improve health through disease prevention and health promotion	1068/3276 (=32.6%)	766	38.6%	84.4%	52.9%	74.2%	3.23* (2.31,4.51)
PC04	Partners with the patient to address issues of ongoing signs, symptoms, or health concerns that remain over time without clear diagnosis despite evaluation and treatment, in a patient-centered, cost-effective manner	747/3276 (22.8%)	793	53.7%	85.0%	49.1%	87.0%	6.46* (4.46,9.37)
PC05	Performs specialty-appropriate procedures to meet the health care needs of individual patients, families, and communities, and is knowledgeable about procedures performed by other specialists to guide their patients' care	977/3276 (29.8%)	930	47.6%	80.2%	49.5%	78.9%	3.66* (2.62,5.09)
MK01	Demonstrates medical knowledge of sufficient breadth and depth to practice family medicine	623/3276 (19.0%)	1244	68.7%	69.3%	31.6%	90.3%	4.28* (3.01,6.08)
MK02	Applies critical thinking skills in patient care	952/3276 (29.1%)	759	45.0%	85.5%	53.1%	78.5%	4.12* (2.94,5.77)
SBP01	Provides cost-conscious medical care	881/3276 (26.9%)	776	43.6%	84.4%	49.2%	81.2%	4.18* (2.83,6.19)
SBP02	Emphasizes patient safety	1262/3276 (38.5%)	1371	61.9%	70.8%	56.4%	74.9%	3.86* (2.78,5.36)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
SBP03	Advocates for individual and community health	1497/3276 (45.7%)	1187	52.1%	77.0%	67.1%	67.0%	4.14* (3.01,5.70)
SBP04	Coordinates team-based care	586/3276 (17.9%)	604	44.7%	87.4%	40.3%	88.5%	5.21* (3.48,7.80)
PBLI01	Locates, appraises, and assimilates evidence from scientific studies related to the patients' health problems	1069/3276 (32.6%)	1256	60.7%	71.9%	51.7%	80.2%	4.34* (3.15,5.98)
PBLI02	Demonstrates self-directed learning	967/3276 (29.5%)	768	42.8%	84.3%	51.6%	78.3%	3.86* (2.70,5.53)
PBLI03	Improves systems in which the physician provides care	1737/3276 (53.0%)	1584	62.1%	65.8%	67.4%	59.5%	3.03* (2.28,4.04)
PROF01	Completes a process of professionalization	680/3276 (20.8%)	718	50.7%	85.7%	49.7%	87.6%	6.97* (4.78,10.14)
PROF02	Demonstrates professional conduct and accountability	1088/3276 (33.2%)	996	56.8%	82.3%	62.0%	79.6%	6.38* (4.70,8.66)
PROF03	Demonstrates humanism and cultural proficiency	631/3276 (19.3%)	566	39.6%	88.2%	46.3%	86.8%	5.70* (3.78,8.57)
PROF04	Maintains emotional, physical, and mental health; and pursues continual personal and professional growth	794/3276 (24.2%)	819	52.6%	83.4%	50.3%	85.0%	5.74* (4.11,8.02)
ICS01	Develops meaningful, therapeutic relationships with patients and families	528/3276 (16.1%)	452	34.7%	90.9%	43.6%	89.1%	6.34* (4.11,9.78)
ICS02	Communicates effectively with patients, families, and the public	622/3276 (19.0%)	645	49.2%	87.6%	46.0%	88.4%	6.49* (4.29,9.83)
ICS03	Develops relationships and effectively communicates with physicians, other health professionals, and health care teams	870/3276 (26.6%)	625	37.8%	87.9%	52.7%	80.0%	4.44* (3.13,6.30)
ICS04	Utilizes technology to optimize communication	766/3276 (23.4%)	736	50.5%	86.0%	48.9%	85.3%	5.57* (3.79,8.19)

*Significant at $p < 0.00114 [0.05/(22*2)]$.

Supplemental Digital Appendix 3C

Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion (December – January 2016 Reporting Period) for Emergency Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.891CI)
PC01	Emergency stabilization	199/1386 (14.4%)	707	72.5%	53.5%	23.7%	93.4%	4.35* (2.10,9.01)
PC02	Performance of focused history and physical exam	214/1386 (15.4%)	712	75.1%	51.9%	25.0%	93.0%	4.40* (2.04,9.49)
PC03	Diagnostic studies	260/1386 (18.8%)	732	71.1%	50.7%	26.0%	88.7%	2.75* (1.55,4.90)
PC04	Diagnosis	213/1386 (15.4%)	732	73.1%	51.4%	24.2%	92.6%	3.96* (2.02,7.78)
PC05	Pharmacotherapy	291/1386 (21.0%)	873	77.0%	40.6%	28.1%	87.7%	2.78* (1.42,5.44)
PC06	Observation and reassessment	292/1386 (21.1%)	698	65.5%	52.9%	28.9%	83.5%	2.06* (1.22,3.47)
PC07	Disposition	213/1386 (15.4%)	703	69.2%	53.3%	24.1%	91.8%	3.55* (2.01,6.25)
PC08	Task switching	245/1386 (17.7%)	718	75.8%	52.7%	28.2%	92.2%	4.60* (2.48,8.56)
PC09	General approach to procedures	226/1386 (16.3%)	724	70.0%	50.6%	23.6%	90.3%	2.86* (1.51,5.41)
PC10	Airway management	158/1386 (11.4%)	673	69.7%	54.1%	17.9%	94.3%	3.58* (1.47,8.72)
PC11	Anesthesia and acute pain management	232/1386 (16.7%)	875	72.3%	39.2%	20.6%	87.7%	1.84* (1.00,3.39)
PC12	Ultrasound	252/1386 (18.2%)	546	61.0%	64.6%	30.6%	89.9%	3.91* (1.95,7.85)
PC13	Wound management	314/1386 (22.7%)	816	69.2%	43.6%	27.8%	80.8%	1.62 (1.00,2.63)
PC14	Vascular access	184/1386 (13.3%)	672	66.3%	53.8%	19.5%	92.2%	2.88* (1.47,5.65)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.891CI)
MK01	Medical knowledge	428/1386 (30.9%)	1018	85.7%	32.5%	38.0%	87.2%	4.17* (2.13,8.16)
SBP01	Patient safety	302/1386 (21.8%)	795	69.4%	45.3%	28.7%	84.0%	2.11* (1.24,3.60)
SBP02	Systems-based management	290/1386 (20.9%)	839	69.1%	41.6%	26.8%	83.2%	1.82* (1.13,2.93)
SBP03	Technology	247/1386 (17.8%)	755	65.0%	47.6%	23.4%	87.1%	2.06* (1.08,3.92)
PBLI01	Practice-based performance improvement	342/1386 (24.7%)	805	71.9%	46.8%	31.9%	83.7%	2.40* (1.40,4.11)
PROF01	Professional values	255/1386 (18.4%)	620	63.3%	59.7%	28.6%	88.7%	3.15* (1.70,5.83)
PROF02	Accountability	382/1386 (27.6%)	680	65.1%	56.6%	36.7%	81.4%	2.54* (1.47,4.38)
ICS01	Patient-centered communication	212/1386 (15.3%)	666	68.4%	55.2%	24.5%	91.8%	3.64* (1.82,7.30)
ICS02	Team management	283/1386 (20.4%)	728	71.2%	53.2%	31.1%	88.3%	3.40* (1.91,6.04)

*Significant at $p < 0.0011$ [0.05/(23*2)].

Supplemental Digital Appendix 3D

Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion (May – June 2017 Reporting Period) for Emergency Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.891CI)
PC01	Emergency stabilization	199/1386 (14.4%)	253	53.2%	87.8%	44.9%	92.0%	9.34* (4.67,18.66)
PC02	Performance of focused history and physical exam	214/1386 (15.4%)	215	45.5%	90.4%	47.1%	89.8%	7.81* (3.61,16.93)
PC03	Diagnostic studies	260/1386 (18.8%)	231	46.2%	89.8%	45.2%	87.0%	5.52* (2.51,12.13)
PC04	Diagnosis	213/1386 (15.4%)	226	46.1%	89.5%	46.9%	90.2%	8.15* (3.82,17.36)
PC05	Pharmacotherapy	291/1386 (21.0%)	307	50.9%	84.8%	49.0%	85.8%	5.80* (2.46,13.65)
PC06	Observation and reassessment	292/1386 (21.1%)	211	38.5%	91.1%	50.3%	82.7%	4.82* (2.24,10.35)
PC07	Disposition	213/1386 (15.4%)	235	46.7%	88.7%	43.0%	89.7%	6.54* (3.20,13.35)
PC08	Task switching	245/1386 (17.7%)	267	52.8%	88.2%	49.7%	89.2%	8.16* (4.29,15.51)
PC09	General approach to procedures	226/1386 (16.3%)	256	44.2%	87.0%	43.0%	89.3%	6.33* (3.06,13.11)
PC10	Airway management	158/1386 (11.4%)	204	38.6%	89.2%	32.2%	92.3%	5.74* (2.36,13.96)
PC11	Anesthesia and acute pain management	232/1386 (16.7%)	343	50.9%	81.0%	36.4%	89.6%	4.96* (2.17,11.33)
PC12	Ultrasound	252/1386 (18.2%)	214	36.8%	89.8%	42.6%	86.4%	4.72* (2.05,10.89)
PC13	Wound management	314/1386 (22.7%)	330	47.9%	83.6%	42.6%	82.5%	3.49* (1.71,7.16)
PC14	Vascular access	184/1386 (13.3%)	246	42.9%	86.3%	31.3%	90.9%	4.57* (2.07,10.10)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.891CI)
MK01	Medical knowledge	428/1386 (30.9%)	400	52.8%	81.6%	56.1%	79.4%	4.93* (2.89,8.39)
SBP01	Patient safety	302/1386 (21.8%)	290	42.5%	85.6%	47.6%	83.9%	4.71* (2.42,9.18)
SBP02	Systems-based management	290/1386 (20.9%)	279	39.6%	85.1%	41.9%	82.5%	3.40* (1.76,6.59)
SBP03	Technology	247/1386 (17.8%)	233	41.1%	88.4%	43.0%	86.8%	4.96* (2.61,9.41)
PBLI01	Practice-based performance improvement	342/1386 (24.7%)	288	42.9%	87.6%	49.4%	81.4%	4.27* (2.50,7.27)
PROF01	Professional values	255/1386 (18.4%)	205	37.0%	90.7%	49.2%	86.4%	6.18* (3.40,11.26)
PROF02	Accountability	382/1386 (27.6%)	331	45.9%	85.6%	52.7%	80.2%	4.52* (2.60,7.87)
ICS01	Patient-centered communication	212/1386 (15.3%)	206	44.9%	90.3%	48.9%	90.3%	8.92* (4.59,17.32)
ICS02	Team management	283/1386 (20.4%)	249	45.1%	89.5%	52.3%	85.1%	6.26* (3.52,11.14)

*Significant at $p < 0.0011$ [0.05/(23*2)].

Supplemental Digital Appendix 3E

Milestones Ratings and Predictive Analytics for the Third Milestones Review Occasion (December – January 2016 Reporting Period) for Internal Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
PC01	Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s)	367/7399 (5.0%)	824	32.0%	89.5%	15.6%	96.0%	4.39* (2.53,7.62)
PC02	Develops and achieves comprehensive management plan for each patient	445/7399 (6.0%)	986	30.0%	87.1%	14.7%	94.8%	3.14* (1.95,5.05)
PC03	Manages patients with progressive responsibility and independence	429/7399 (5.8%)	961	33.0%	87.8%	15.6%	95.3%	3.78* (2.38,6.01)
PC04	Skill in performing procedures	1090/7399 (14.7%)	1956	39.3%	75.5%	21.8%	87.5%	1.96* (1.47,2.61)
PC05	Requests and provides consultative care	483/7399 (6.5%)	1281	27.2%	84.5%	12.6%	94.2%	2.36* (1.54,3.61)
MK01	Clinical knowledge	851/7399 (=11.5%)	1236	42.1%	85.8%	30.1%	91.4%	4.59* (3.19,6.61)
MK02	Knowledge of diagnostic testing and procedures	720/7399 (9.7%)	1159	33.3%	85.5%	21.3%	92.0%	3.11* (2.10,4.60)
SBP01	Works effectively within an	416/7399 (5.6%)	715	22.8%	91.1%	15.1%	94.9%	3.28* (1.97,5.48)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
	interprofessional team							
SBP02	Recognizes system error and advocates for system improvement	715/7399 (9.7%)	1255	27.6%	84.1%	17.4%	90.8%	2.09* (1.52,2.86)
SBP03	Identifies forces that impact the cost of health care, and advocates for, and practices cost-effective care	666/7399 (9.0%)	1169	27.1%	85.5%	16.5%	91.7%	2.20* (1.47,3.29)
SBP04	Transitions patients effectively within and across health delivery systems	384/7399 (5.2%)	830	22.3%	89.2%	11.7%	95.2%	2.63* (1.57,4.42)
PBLI01	Monitors practice with a goal for improvement	591/7399 (8.0%)	940	23.9%	88.0%	16.4%	92.6%	2.47* (1.50,4.07)
PBLI02	Learns and improves via performance audit	846/7399 (11.4%)	1698	32.9%	79.6%	18.7%	90.1%	2.10* (1.51,2.91)
PBLI03	Learns and improves via feedback	554/7399 (7.5%)	794	23.5%	90.4%	18.3%	93.1%	3.04* (1.88,4.91)
PBLI04	Learns and improves at the point of care	508/7399 (6.9%)	899	23.6%	88.9%	15.0%	93.4%	2.51* (1.64,3.85)
PROF01	Has professional and respectful interactions with patients, caregivers and members of the	387/7399 (5.2%)	597	20.2%	92.3%	14.5%	95.2%	3.32* (1.99,5.54)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
	interprofessional team							
PROF02	Accepts responsibility and follows through on tasks	627/7399 (8.5%)	837	27.5%	89.9%	21.8%	92.8%	3.57* (2.46,5.19)
PROF03	Responds to each patient's unique characteristics and needs	416/7399 (5.6%)	742	17.1%	90.3%	11.2%	94.6%	2.20* (1.15,4.21)
PROF04	Exhibits integrity and ethical behavior in professional conduct	436/7399 (5.9%)	626	19.3%	92.2%	14.9%	94.3%	2.92* (1.67,5.09)
ICS01	Communicates effectively with patients and caregivers	372/7399 (5.0%)	685	22.7%	91.4%	13.9%	95.5%	3.45* (2.14,5.56)
ICS02	Communicates effectively in interprofessional teams	412/7399 (5.6%)	681	20.0%	91.3%	13.5%	94.8%	2.83* (1.80,4.46)
ICS03	Appropriate utilization and completion of health records	434/7399 (5.9%)	734	19.7%	90.6%	12.6%	94.6%	2.51* (1.42,4.42)

*Significant at $p < 0.00114 [0.05/(22*2)]$.

Supplemental Digital Appendix 3F

Milestones Ratings and Predictive Analytics for the Fourth Milestones Review Occasion (May – June 2017 Reporting Period) for Internal Medicine

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
PC01	Gathers and synthesizes essential and accurate information to define each patient's clinical problem(s)	367/7399 (5.0%)	277	17.6%	96.6%	21.2%	95.4%	5.65* (2.49,12.79)
PC02	Develops and achieves comprehensive management plan for each patient	445/7399 (6.0%)	305	18.7%	96.3%	25.0%	94.5%	5.74* (3.28,10.03)
PC03	Manages patients with progressive responsibility and independence	429/7399 (5.8%)	350	18.8%	95.9%	21.8%	94.8%	5.04* (2.80,9.06)
PC04	Skill in performing procedures	1090/7399 (14.7%)	884	22.2%	89.9%	25.6%	86.7%	2.24* (1.66,3.03)
PC05	Requests and provides consultative care	483/7399 (6.5%)	485	17.9%	94.6%	20.0%	93.9%	3.88* (2.22,6.79)
MK01	Clinical knowledge	851/7399 (11.5%)	525	24.6%	94.5%	36.4%	89.9%	5.07* (3.42,7.50)
MK02	Knowledge of diagnostic testing and procedures	720/7399 (9.7%)	484	21.2%	94.5%	28.1%	91.3%	4.07* (2.62,6.33)
SBP01	Works effectively within an interprofessional team	416/7399 (5.6%)	266	14.6%	97.0%	23.1%	94.7%	5.33* (2.94,9.66)
SBP02	Recognizes system error and advocates for system improvement	715/7399 (9.7%)	561	15.7%	93.7%	21.8%	90.4%	2.63* (1.66,4.17)
SBP03	Identifies forces that impact the cost of health care, and advocates for,	666/7399 (9.0%)	483	13.1%	94.4%	18.7%	91.1%	2.35* (1.30,4.24)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
	and practices cost-effective care							
SBP04	Transitions patients effectively within and across health delivery systems	384/7399 (5.2%)	256	15.1%	96.9%	19.7%	95.1%	4.76* (2.38,9.52)
PBLI01	Monitors practice with a goal for improvement	591/7399 (8.0%)	362	14.2%	95.8%	23.1%	92.3%	3.61* (2.13,6.14)
PBLI02	Learns and improves via performance audit	846/7399 (11.4%)	785	20.8%	91.8%	25.7%	89.8%	3.03* (1.85,4.98)
PBLI03	Learns and improves via feedback	554/7399 (7.5%)	281	14.0%	96.7%	25.9%	92.8%	4.47* (2.65,7.56)
PBLI04	Learns and improves at the point of care	508/7399 (6.9%)	300	14.9%	96.6%	23.7%	93.1%	4.21* (2.59,6.82)
PROF01	Has professional and respectful interactions with patients, caregivers and members of the interprofessional team	387/7399 (5.2%)	244	14.9%	97.2%	23.8%	95.1%	6.03* (3.45,10.53)
PROF02	Accepts responsibility and follows through on tasks	627/7399 (8.5%)	417	19.7%	95.4%	28.1%	92.3%	4.71* (2.94,7.56)
PROF03	Responds to each patient's unique characteristics and needs	416/7399 (5.6%)	309	9.8%	96.3%	14.7%	94.4%	2.90* (1.17,7.17)
PROF04	Exhibits integrity and ethical behavior in professional conduct	436/7399 (5.9%)	246	13.0%	97.0%	22.8%	94.2%	4.78* (2.61,8.74)
ICS01	Communicates effectively with patients and caregivers	372/7399 (5.0%)	243	15.9%	97.1%	23.8%	95.4%	6.41* (3.46,11.87)

Subcompetency	Description of Subcompetency	# (%) residents not reaching L4 at graduation	# rated ≤ 2.5	Sensitivity	Specificity	PPV	NPV	OR with CI (99.886CI)
ICS02	Communicates effectively in interprofessional teams	412/7399 (5.6%)	261	16.8%	97.0%	26.3%	94.8%	6.54* (3.81,11.20)
ICS03	Appropriate utilization and completion of health records	434/7399 (5.9%)	283	12.2%	96.4%	17.7%	94.4%	3.60* (1.67,7.76)

*Significant at $p < 0.00114$ [$0.05/(22*2)$].

Supplemental Digital Appendix 4

Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years by Specialty

Legend: This supplemental digital appendix provides the positive predictive value (PPV) matrices of all subcompetencies by each specialty for each milestone rating threshold and milestone rating occasion by post graduate year (PGY).

Supplemental Digital Appendix 4A

Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Emergency Medicine

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
% Probability of Not Attaining Level 4 by Graduation*						
PC01	≤ Lev5.0					
PC01	≤ Lev4.5					
PC01	≤ Lev4.0					
PC01	≤ Lev3.5				16.4%	22.7%
PC01	≤ Lev3.0			16.3%	20.3%	45.9%
PC01	≤ Lev2.5	15.9%	16.4%	23.7%	44.9%	63.1%
PC01	≤ Lev2.0	16.5%	20.0%	39.2%	50.7%	
PC01	≤ Lev1.5	20.6%	35.3%	53.1%	47.1%	
PC01	≤ Lev1.0	35.4%	52.4%	34.4%		
PC01	= Lev0.0	46.1%				
PC02	≤ Lev5.0					
PC02	≤ Lev4.5					
PC02	≤ Lev4.0					
PC02	≤ Lev3.5					25.9%
PC02	≤ Lev3.0		16.8%	18.0%	21.4%	49.8%
PC02	≤ Lev2.5	16.8%	18.3%	25.0%	47.1%	53.3%

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC02	≤ Lev2.0	17.5%	22.1%	37.2%	43.9%	45.7%
PC02	≤ Lev1.5	21.0%	31.5%	42.6%	50.4%	
PC02	≤ Lev1.0	33.7%	60.1%	55.5%		
PC02	= Lev0.0	68.6%				
PC03	≤ Lev5.0					
PC03	≤ Lev4.5					
PC03	≤ Lev4.0					
PC03	≤ Lev3.5					25.7%
PC03	≤ Lev3.0		19.6%	20.8%	23.4%	48.4%
PC03	≤ Lev2.5	19.7%	20.1%	26.0%	45.2%	52.9%
PC03	≤ Lev2.0	19.7%	22.7%	37.4%	55.1%	56.3%
PC03	≤ Lev1.5	22.8%	42.7%	51.7%	46.8%	
PC03	≤ Lev1.0	31.0%	51.0%	57.0%		
PC03	= Lev0.0	52.8%				
PC04	≤ Lev5.0					
PC04	≤ Lev4.5					
PC04	≤ Lev4.0					
PC04	≤ Lev3.5				17.4%	24.4%
PC04	≤ Lev3.0			17.9%	21.3%	52.3%
PC04	≤ Lev2.5	16.9%	18.1%	24.2%	46.9%	83.5%
PC04	≤ Lev2.0	17.3%	22.9%	40.9%	52.0%	
PC04	≤ Lev1.5	20.1%	37.1%	53.7%	40.8%	
PC04	≤ Lev1.0	31.3%	46.3%	74.1%		
PC04	= Lev0.0	50.9%	67.9%			

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC05	≤ Lev5.0					
PC05	≤ Lev4.5					
PC05	≤ Lev4.0					
PC05	≤ Lev3.5				23.7%	28.1%
PC05	≤ Lev3.0			23.9%	25.5%	49.7%
PC05	≤ Lev2.5	22.7%	23.3%	28.1%	49.0%	64.5%
PC05	≤ Lev2.0	23.0%	24.8%	41.9%	55.0%	69.3%
PC05	≤ Lev1.5	24.6%	36.6%	47.3%	61.0%	80.1%
PC05	≤ Lev1.0	31.8%	47.4%	65.6%	61.6%	
PC05	= Lev0.0	47.4%	61.3%	37.0%	47.1%	
PC06	≤ Lev5.0					
PC06	≤ Lev4.5					
PC06	≤ Lev4.0				23.0%	
PC06	≤ Lev3.5			23.1%	23.5%	30.0%
PC06	≤ Lev3.0			23.7%	26.7%	50.6%
PC06	≤ Lev2.5	23.2%	24.3%	28.9%	50.3%	71.1%
PC06	≤ Lev2.0	23.6%	27.0%	46.9%	63.0%	
PC06	≤ Lev1.5	26.2%	38.3%	45.3%		
PC06	≤ Lev1.0	39.3%	45.7%			
PC06	= Lev0.0	42.2%				
PC07	≤ Lev5.0					
PC07	≤ Lev4.5					
PC07	≤ Lev4.0					16.9%
PC07	≤ Lev3.5			16.9%	17.1%	23.5%
PC07	≤ Lev3.0		16.6%	17.8%	19.8%	48.3%

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC07	≤ Lev2.5	16.4%	17.9%	24.1%	43.0%	60.4%
PC07	≤ Lev2.0	16.8%	21.6%	37.6%	51.9%	47.7%
PC07	≤ Lev1.5	19.4%	39.4%	52.3%	41.5%	
PC07	≤ Lev1.0	31.1%	50.7%	39.8%		
PC07	= Lev0.0	30.4%	48.4%			
PC08	≤ Lev5.0					
PC08	≤ Lev4.5					
PC08	≤ Lev4.0					
PC08	≤ Lev3.5				20.3%	28.6%
PC08	≤ Lev3.0		18.9%	20.1%	25.3%	55.1%
PC08	≤ Lev2.5	19.3%	20.2%	28.2%	49.7%	74.6%
PC08	≤ Lev2.0	19.7%	24.5%	45.7%	64.8%	54.9%
PC08	≤ Lev1.5	23.8%	42.4%	50.3%	62.4%	
PC08	≤ Lev1.0	41.9%	50.9%	38.8%		
PC08	= Lev0.0	43.5%				
PC09	≤ Lev5.0					
PC09	≤ Lev4.5					
PC09	≤ Lev4.0					
PC09	≤ Lev3.5		17.1%		17.9%	25.6%
PC09	≤ Lev3.0		17.1%	18.0%	22.0%	48.3%
PC09	≤ Lev2.5	17.4%	17.7%	23.6%	43.0%	54.8%
PC09	≤ Lev2.0	17.4%	19.4%	32.1%	46.8%	42.4%
PC09	≤ Lev1.5	19.1%	31.6%	38.2%	56.3%	15.3%
PC09	≤ Lev1.0	29.6%	37.2%	34.6%	20.8%	
PC09	= Lev0.0	34.4%			15.8%	

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC10	≤ Lev5.0					
PC10	≤ Lev4.5					
PC10	≤ Lev4.0					
PC10	≤ Lev3.5			12.6%	13.0%	20.1%
PC10	≤ Lev3.0			13.4%	16.3%	41.4%
PC10	≤ Lev2.5		13.1%	17.9%	32.2%	49.3%
PC10	≤ Lev2.0	12.7%	14.1%	26.2%	37.1%	54.2%
PC10	≤ Lev1.5	13.9%	21.6%	24.2%	37.7%	
PC10	≤ Lev1.0	20.7%	24.1%	40.2%	51.2%	
PC10	= Lev0.0	23.2%	30.4%			
PC11	≤ Lev5.0					
PC11	≤ Lev4.5					
PC11	≤ Lev4.0					
PC11	≤ Lev3.5	17.7%			18.3%	24.8%
PC11	≤ Lev3.0	17.7%		18.5%	19.6%	42.3%
PC11	≤ Lev2.5	17.6%	17.7%	20.6%	36.4%	58.2%
PC11	≤ Lev2.0	17.6%	19.5%	28.5%	44.0%	60.0%
PC11	≤ Lev1.5	19.3%	30.4%	43.0%	36.0%	72.1%
PC11	≤ Lev1.0	28.1%	43.4%	42.9%	54.5%	82.6%
PC11	= Lev0.0	35.6%	24.2%	5.1%	39.4%	38.1%
PC12	≤ Lev5.0					
PC12	≤ Lev4.5					
PC12	≤ Lev4.0					19.4%
PC12	≤ Lev3.5		19.7%	21.2%	25.0%	36.1%

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC12	≤ Lev3.0		20.1%	23.1%	30.2%	53.6%
PC12	≤ Lev2.5	19.1%	22.4%	30.6%	42.6%	58.7%
PC12	≤ Lev2.0	19.3%	23.2%	33.3%	49.4%	78.2%
PC12	≤ Lev1.5	20.4%	29.0%	36.2%	57.3%	
PC12	≤ Lev1.0	26.5%	28.3%	36.5%		
PC12	= Lev0.0	35.1%	47.0%	52.0%		
PC13	≤ Lev5.0					
PC13	≤ Lev4.5					
PC13	≤ Lev4.0					24.6%
PC13	≤ Lev3.5			24.7%		29.8%
PC13	≤ Lev3.0		24.4%	24.9%	26.4%	48.4%
PC13	≤ Lev2.5	24.6%	25.3%	27.8%	42.6%	55.5%
PC13	≤ Lev2.0	24.8%	26.3%	39.1%	47.8%	62.4%
PC13	≤ Lev1.5	27.4%	35.2%	49.5%	42.1%	51.3%
PC13	≤ Lev1.0	33.2%	52.3%	39.7%		
PC13	= Lev0.0	33.6%	54.0%			
PC14	≤ Lev5.0					
PC14	≤ Lev4.5					
PC14	≤ Lev4.0				14.1%	
PC14	≤ Lev3.5				16.7%	26.3%
PC14	≤ Lev3.0		14.3%	16.0%	19.0%	44.6%
PC14	≤ Lev2.5	14.2%	14.9%	19.5%	31.3%	50.0%
PC14	≤ Lev2.0	14.2%	15.9%	25.1%	35.1%	56.8%
PC14	≤ Lev1.5	15.9%	22.5%	39.0%	39.8%	52.6%
PC14	≤ Lev1.0	19.6%	24.8%	49.2%	46.6%	

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC14	= Lev0.0	33.1%	55.0%	38.9%	29.6%	
MK01	≤ Lev5.0					
MK01	≤ Lev4.5					
MK01	≤ Lev4.0					
MK01	≤ Lev3.5		31.6%	31.8%	33.6%	39.3%
MK01	≤ Lev3.0	31.3%	32.9%	33.1%	39.4%	53.0%
MK01	≤ Lev2.5	31.3%	33.9%	38.0%	56.1%	58.5%
MK01	≤ Lev2.0	31.4%	38.5%	46.1%	57.4%	60.9%
MK01	≤ Lev1.5	35.1%	53.0%	59.9%	59.9%	72.8%
MK01	≤ Lev1.0	39.9%	51.8%	64.0%		
	= Lev0.0					
SBP01	≤ Lev5.0					
SBP01	≤ Lev4.5				23.6%	
SBP01	≤ Lev4.0				23.7%	24.1%
SBP01	≤ Lev3.5			24.0%	24.1%	30.2%
SBP01	≤ Lev3.0		24.1%	25.1%	28.2%	50.5%
SBP01	≤ Lev2.5	24.0%	25.3%	28.7%	47.6%	56.3%
SBP01	≤ Lev2.0	23.9%	27.3%	38.8%	43.3%	56.0%
SBP01	≤ Lev1.5	26.1%	40.7%	50.4%	46.0%	65.3%
SBP01	≤ Lev1.0	36.3%	53.0%	39.8%	41.3%	36.1%
SBP01	= Lev0.0	30.4%	26.1%	28.3%	26.7%	
SBP02	≤ Lev5.0					

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
SBP02	≤ Lev4.5					
SBP02	≤ Lev4.0					
SBP02	≤ Lev3.5		23.2%			29.2%
SBP02	≤ Lev3.0		23.4%	24.4%	26.1%	53.5%
SBP02	≤ Lev2.5	23.4%	24.5%	26.8%	41.9%	59.2%
SBP02	≤ Lev2.0	23.5%	26.6%	41.3%	45.3%	
SBP02	≤ Lev1.5	24.8%	42.0%	46.0%	67.4%	
SBP02	≤ Lev1.0	33.8%	39.2%	47.7%		
SBP02	= Lev0.0	28.3%				
SBP03	≤ Lev5.0					
SBP03	≤ Lev4.5					
SBP03	≤ Lev4.0					
SBP03	≤ Lev3.5			19.6%	20.2%	26.7%
SBP03	≤ Lev3.0		19.6%	20.7%	22.7%	46.0%
SBP03	≤ Lev2.5	19.4%	20.2%	23.4%	43.0%	54.9%
SBP03	≤ Lev2.0	19.3%	22.6%	33.6%	49.1%	65.9%
SBP03	≤ Lev1.5	22.0%	34.6%	44.5%	55.8%	31.1%
SBP03	≤ Lev1.0	28.6%	42.0%	54.7%	53.8%	
SBP03	= Lev0.0	41.9%	21.6%		53.8%	
PBLI01	≤ Lev5.0					
PBLI01	≤ Lev4.5					
PBLI01	≤ Lev4.0				25.6%	26.2%
PBLI01	≤ Lev3.5				26.2%	31.9%

Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PBLI01	≤ Lev3.0		25.7%	26.3%	29.2%	49.3%
PBLI01	≤ Lev2.5	25.6%	26.1%	31.9%	49.4%	63.7%
PBLI01	≤ Lev2.0	25.9%	29.5%	39.3%	50.5%	48.8%
PBLI01	≤ Lev1.5	27.6%	37.6%	50.9%	56.8%	37.6%
PBLI01	≤ Lev1.0	34.6%	43.3%	58.5%	51.7%	
PBLI01	= Lev0.0	37.5%			41.0%	
PROF01	≤ Lev5.0					
PROF01	≤ Lev4.5					
PROF01	≤ Lev4.0					
PROF01	≤ Lev3.5			19.7%		31.4%
PROF01	≤ Lev3.0		19.9%	21.2%	25.9%	52.7%
PROF01	≤ Lev2.5	20.4%	22.8%	28.6%	49.2%	71.2%
PROF01	≤ Lev2.0	20.7%	26.7%	40.7%	53.5%	70.1%
PROF01	≤ Lev1.5	27.0%	40.4%	55.2%	60.4%	66.8%
PROF01	≤ Lev1.0	39.0%	49.8%			
PROF01	= Lev0.0	27.1%	24.6%			
PROF02	≤ Lev5.0					
PROF02	≤ Lev4.5				27.7%	
PROF02	≤ Lev4.0				27.9%	28.6%
PROF02	≤ Lev3.5		28.2%	28.1%	28.8%	38.0%
PROF02	≤ Lev3.0		28.8%	29.2%	33.8%	57.4%
PROF02	≤ Lev2.5	28.7%	30.9%	36.7%	52.7%	71.7%
PROF02	≤ Lev2.0	29.1%	32.9%	44.8%	50.6%	63.3%

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Subcompetency	Milestone Rating Threshold	PGY 1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PROF02	≤ Lev1.5	33.6%	46.8%	46.2%	53.1%	69.2%
PROF02	≤ Lev1.0	37.7%	51.2%	45.8%	53.0%	73.9%
PROF02	= Lev0.0	54.9%	85.8%	75.8%	64.4%	66.2%
ICS01	≤ Lev5.0					
ICS01	≤ Lev4.5					
ICS01	≤ Lev4.0					
ICS01	≤ Lev3.5					25.7%
ICS01	≤ Lev3.0		16.4%	17.4%	23.2%	52.3%
ICS01	≤ Lev2.5	16.8%	18.1%	24.5%	48.9%	71.2%
ICS01	≤ Lev2.0	17.1%	20.5%	37.0%	48.1%	63.8%
ICS01	≤ Lev1.5	19.6%	33.5%	52.5%	72.4%	48.7%
ICS01	≤ Lev1.0	30.5%	48.7%	70.3%		
ICS01	= Lev0.0	32.2%	29.0%	34.3%		
ICS02	≤ Lev5.0					
ICS02	≤ Lev4.5					
ICS02	≤ Lev4.0					
ICS02	≤ Lev3.5				23.5%	32.8%
ICS02	≤ Lev3.0		22.3%	23.3%	28.8%	58.4%
ICS02	≤ Lev2.5	22.7%	24.2%	31.1%	52.3%	91.5%
ICS02	≤ Lev2.0	23.6%	28.5%	41.6%	57.5%	70.6%
ICS02	≤ Lev1.5	25.9%	42.3%	58.9%	86.5%	
ICS02	≤ Lev1.0	36.1%	46.7%	55.3%		
ICS02	= Lev0.0	41.8%				

*Probability (%) of a resident not reaching Level 4 at the time of graduation based on the Milestones rating by the time of assessment (Academic Years 2015-18). Please refer to supplemental digital appendix 1 or the online milestones document for the description of each emergency medicine subcompetency: <https://www.acgme.org/Portals/0/PDFs/Milestones/EmergencyMedicineMilestones.pdf?ver=2015-11-06-120531-877>

Supplemental Digital Appendix 4B

Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Family Medicine

_Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
% Probability of Not Attaining Level 4 by Graduation*						
PC01	≤ Lev5.0					
PC01	≤ Lev4.5					18.5%
PC01	≤ Lev4.0			18.3%		19.4%
PC01	≤ Lev3.5	18.3%		18.9%	20.4%	31.3%
PC01	≤ Lev3.0	18.3%	18.7%	20.3%	26.0%	54.2%
PC01	≤ Lev2.5	18.5%	19.6%	26.7%	43.2%	63.1%
PC01	≤ Lev2.0	19.0%	23.1%	39.9%	52.3%	71.2%
PC01	≤ Lev1.5	21.2%	33.8%	43.1%	42.6%	
PC01	≤ Lev1.0	26.6%	37.4%	46.9%		
PC01	= Lev0.0	36.0%	19.8%	53.1%		
PC02	≤ Lev5.0					
PC02	≤ Lev4.5					
PC02	≤ Lev4.0			21.0%		22.5%
PC02	≤ Lev3.5	20.9%	21.0%	21.3%	22.6%	32.7%
PC02	≤ Lev3.0	21.0%	21.0%	23.0%	27.4%	54.1%
PC02	≤ Lev2.5	21.1%	21.8%	28.8%	45.2%	68.8%
PC02	≤ Lev2.0	21.5%	24.3%	39.7%	51.3%	70.0%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC02	≤ Lev1.5	23.6%	34.3%	47.0%	70.5%	
PC02	≤ Lev1.0	29.3%	44.3%	63.0%		
PC02	= Lev0.0	39.0%	43.2%	45.4%		
PC03	≤ Lev5.0					
PC03	≤ Lev4.5					32.7%
PC03	≤ Lev4.0					33.3%
PC03	≤ Lev3.5	32.6%		32.9%	33.5%	42.6%
PC03	≤ Lev3.0	32.6%	32.9%	34.3%	38.0%	60.5%
PC03	≤ Lev2.5	32.8%	33.4%	38.8%	52.9%	71.5%
PC03	≤ Lev2.0	33.4%	36.4%	48.7%	55.7%	
PC03	≤ Lev1.5	35.8%	48.1%	56.2%	43.2%	
PC03	≤ Lev1.0	42.2%	52.0%	75.6%		
PC03	= Lev0.0	45.4%	84.8%			
PC04	≤ Lev5.0					
PC04	≤ Lev4.5					22.5%
PC04	≤ Lev4.0					23.9%
PC04	≤ Lev3.5	22.5%		23.0%	24.6%	34.5%
PC04	≤ Lev3.0	22.5%	22.7%	24.7%	30.3%	56.4%
PC04	≤ Lev2.5	22.6%	23.3%	30.9%	49.1%	70.8%
PC04	≤ Lev2.0	23.1%	26.2%	41.1%	53.6%	
PC04	≤ Lev1.5	25.0%	33.6%	46.3%	44.2%	
PC04	≤ Lev1.0	29.2%	39.8%	60.3%		
PC04	= Lev0.0	36.9%	48.6%			

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC05	≤ Lev5.0					
PC05	≤ Lev4.5		29.6%		29.6%	29.7%
PC05	≤ Lev4.0	29.6%	29.6%	29.6%	29.6%	30.4%
PC05	≤ Lev3.5	29.6%	29.6%	29.8%	30.4%	37.4%
PC05	≤ Lev3.0	29.6%	29.8%	31.2%	35.6%	54.8%
PC05	≤ Lev2.5	29.9%	30.7%	36.4%	49.5%	67.0%
PC05	≤ Lev2.0	30.3%	32.9%	45.7%	57.3%	69.6%
PC05	≤ Lev1.5	32.7%	39.4%	52.7%	56.6%	
PC05	≤ Lev1.0	34.7%	44.0%	50.9%	38.3%	
PC05	= Lev0.0	40.0%	43.4%	57.8%	27.8%	
MK01	≤ Lev5.0					
MK01	≤ Lev4.5					18.5%
MK01	≤ Lev4.0					19.2%
MK01	≤ Lev3.5	18.4%		18.6%	19.5%	27.4%
MK01	≤ Lev3.0	18.4%	18.5%	20.0%	22.7%	36.1%
MK01	≤ Lev2.5	18.8%	19.7%	24.2%	31.6%	37.4%
MK01	≤ Lev2.0	19.0%	21.6%	27.7%	34.2%	41.4%
MK01	≤ Lev1.5	20.9%	29.5%	37.2%	37.8%	49.5%
MK01	≤ Lev1.0	25.3%	32.7%	33.4%	37.5%	36.1%
MK01	= Lev0.0	35.1%	38.6%	15.2%		
MK02	≤ Lev5.0					
MK02	≤ Lev4.5					29.4%
MK02	≤ Lev4.0					30.4%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
MK02	≤ Lev3.5	29.3%		29.6%	30.6%	39.2%
MK02	≤ Lev3.0	29.5%	29.7%	32.4%	37.1%	62.1%
MK02	≤ Lev2.5	29.8%	31.3%	38.7%	53.1%	70.7%
MK02	≤ Lev2.0	30.8%	34.7%	46.6%	60.0%	73.2%
MK02	≤ Lev1.5	33.8%	45.0%	50.9%	63.2%	88.2%
MK02	≤ Lev1.0	38.6%	52.8%	52.2%	28.3%	
MK02	= Lev0.0	53.7%	66.3%	66.6%		
SBP01	≤ Lev5.0					
SBP01	≤ Lev4.5					26.8%
SBP01	≤ Lev4.0					27.4%
SBP01	≤ Lev3.5	26.5%		26.8%	28.2%	36.5%
SBP01	≤ Lev3.0	26.6%	26.7%	28.2%	32.2%	52.7%
SBP01	≤ Lev2.5	26.9%	28.0%	35.0%	49.2%	69.2%
SBP01	≤ Lev2.0	27.5%	30.1%	41.2%	53.5%	66.1%
SBP01	≤ Lev1.5	28.6%	35.1%	48.7%	43.9%	35.9%
SBP01	≤ Lev1.0	31.9%	39.2%	48.0%	57.2%	
SBP01	= Lev0.0	32.8%	76.9%			
SBP02	≤ Lev5.0					
SBP02	≤ Lev4.5					38.9%
SBP02	≤ Lev4.0					39.7%
SBP02	≤ Lev3.5	38.7%	38.7%	39.0%	40.1%	47.7%
SBP02	≤ Lev3.0	38.8%	38.9%	40.2%	43.8%	63.5%
SBP02	≤ Lev2.5	39.0%	39.6%	44.5%	56.4%	73.4%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
SBP02	≤ Lev2.0	39.5%	41.2%	53.7%	60.1%	73.6%
SBP02	≤ Lev1.5	41.7%	52.2%	58.0%	57.2%	71.1%
SBP02	≤ Lev1.0	47.2%	58.7%	54.7%		
SBP02	= Lev0.0	55.0%	53.6%			
SBP03	≤ Lev5.0					
SBP03	≤ Lev4.5					45.9%
SBP03	≤ Lev4.0					46.9%
SBP03	≤ Lev3.5	45.5%		46.1%	47.7%	55.3%
SBP03	≤ Lev3.0	45.5%	45.9%	47.9%	51.9%	70.4%
SBP03	≤ Lev2.5	45.9%	47.2%	53.0%	67.1%	78.0%
SBP03	≤ Lev2.0	46.6%	50.9%	59.3%	69.6%	74.8%
SBP03	≤ Lev1.5	50.1%	59.6%	67.5%	70.7%	
SBP03	≤ Lev1.0	53.8%	63.2%	52.9%		
SBP03	= Lev0.0	54.3%	83.6%			
SBP04	≤ Lev5.0					
SBP04	≤ Lev4.5				17.5%	17.8%
SBP04	≤ Lev4.0				17.7%	18.8%
SBP04	≤ Lev3.5	17.5%	17.6%	18.3%	20.3%	31.5%
SBP04	≤ Lev3.0	17.6%	17.8%	19.6%	24.8%	50.1%
SBP04	≤ Lev2.5	17.9%	18.8%	25.5%	40.3%	65.3%
SBP04	≤ Lev2.0	18.1%	21.8%	35.1%	39.9%	63.8%
SBP04	≤ Lev1.5	20.3%	30.5%	48.6%	27.2%	
SBP04	≤ Lev1.0	25.2%	31.9%	54.6%	57.9%	

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
SBP04	= Lev0.0	25.3%	18.8%	81.5%		
PBLI01	≤ Lev5.0					
PBLI01	≤ Lev4.5					32.9%
PBLI01	≤ Lev4.0			32.7%		33.7%
PBLI01	≤ Lev3.5	32.7%		33.1%	34.1%	42.5%
PBLI01	≤ Lev3.0	32.8%	32.9%	34.2%	37.7%	58.0%
PBLI01	≤ Lev2.5	33.0%	33.6%	38.8%	51.7%	67.4%
PBLI01	≤ Lev2.0	33.5%	35.7%	48.1%	61.8%	69.2%
PBLI01	≤ Lev1.5	35.0%	42.2%	54.2%	60.7%	72.0%
PBLI01	≤ Lev1.0	38.3%	49.0%	61.0%	56.5%	71.3%
PBLI01	= Lev0.0	42.0%	48.9%	36.1%		
PBLI02	≤ Lev5.0					
PBLI02	≤ Lev4.5					
PBLI02	≤ Lev4.0			29.1%		30.7%
PBLI02	≤ Lev3.5	29.1%		29.3%	30.8%	38.9%
PBLI02	≤ Lev3.0	29.2%	29.7%	32.1%	37.7%	57.0%
PBLI02	≤ Lev2.5	29.8%	31.2%	38.1%	51.6%	66.3%
PBLI02	≤ Lev2.0	30.4%	34.6%	48.2%	53.5%	60.8%
PBLI02	≤ Lev1.5	33.8%	43.6%	51.5%	58.1%	80.4%
PBLI02	≤ Lev1.0	40.4%	53.3%	65.1%	52.1%	
PBLI02	= Lev0.0	49.5%	69.1%	80.5%		

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

_Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PBLI03	≤ Lev5.0					
PBLI03	≤ Lev4.5					53.8%
PBLI03	≤ Lev4.0				53.7%	54.5%
PBLI03	≤ Lev3.5	53.6%	53.6%	53.9%	54.9%	62.0%
PBLI03	≤ Lev3.0	53.7%	53.8%	55.0%	58.1%	73.4%
PBLI03	≤ Lev2.5	53.9%	55.0%	58.6%	67.4%	77.6%
PBLI03	≤ Lev2.0	54.4%	56.8%	65.6%	72.5%	72.9%
PBLI03	≤ Lev1.5	55.6%	64.4%	67.4%	69.8%	60.9%
PBLI03	≤ Lev1.0	58.7%	65.8%	64.2%	75.4%	60.6%
PBLI03	= Lev0.0	71.4%	63.2%			
PROF01	≤ Lev5.0					
PROF01	≤ Lev4.5					21.2%
PROF01	≤ Lev4.0					23.4%
PROF01	≤ Lev3.5	21.1%	21.8%	23.3%	25.4%	38.8%
PROF01	≤ Lev3.0	21.4%	22.3%	24.7%	31.6%	55.7%
PROF01	≤ Lev2.5	22.2%	23.8%	32.1%	49.7%	72.6%
PROF01	≤ Lev2.0	22.5%	27.1%	45.4%	60.8%	81.0%
PROF01	≤ Lev1.5	23.7%	37.2%	53.5%	62.2%	84.7%
PROF01	≤ Lev1.0	30.4%	53.3%	53.3%	73.2%	88.5%
PROF01	= Lev0.0	45.3%	54.6%	40.0%	46.6%	

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_Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PROF02	≤ Lev5.0					
PROF02	≤ Lev4.5					33.8%
PROF02	≤ Lev4.0	33.5%		33.7%	34.3%	36.7%
PROF02	≤ Lev3.5	33.6%	33.8%	35.0%	37.8%	51.0%
PROF02	≤ Lev3.0	34.0%	34.4%	37.8%	44.6%	71.8%
PROF02	≤ Lev2.5	34.2%	36.4%	44.1%	62.0%	82.6%
PROF02	≤ Lev2.0	35.6%	40.6%	56.9%	73.9%	87.1%
PROF02	≤ Lev1.5	40.1%	57.4%	65.6%	75.1%	81.9%
PROF02	≤ Lev1.0	50.4%	65.6%	64.7%	69.6%	82.9%
PROF02	= Lev0.0	62.9%	71.8%	82.3%	87.7%	
PROF03	≤ Lev5.0					
PROF03	≤ Lev4.5					19.5%
PROF03	≤ Lev4.0			19.4%	19.5%	20.9%
PROF03	≤ Lev3.5	19.4%	19.3%	20.6%	22.8%	33.6%
PROF03	≤ Lev3.0	19.4%	19.7%	22.2%	27.8%	53.2%
PROF03	≤ Lev2.5	20.1%	21.1%	28.8%	46.3%	68.8%
PROF03	≤ Lev2.0	20.6%	25.1%	37.3%	50.4%	66.2%
PROF03	≤ Lev1.5	23.8%	35.9%	40.2%	54.3%	71.8%
PROF03	≤ Lev1.0	30.4%	43.4%	23.2%		
PROF03	= Lev0.0	38.6%	36.0%			
PROF04	≤ Lev5.0					

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

_Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PROF04	≤ Lev4.5		24.2%	24.2%		24.6%
PROF04	≤ Lev4.0		24.2%	24.3%	24.5%	26.4%
PROF04	≤ Lev3.5	24.4%	24.6%	25.7%	28.2%	40.5%
PROF04	≤ Lev3.0	24.4%	24.7%	26.9%	33.1%	55.8%
PROF04	≤ Lev2.5	24.9%	26.5%	32.7%	50.3%	70.7%
PROF04	≤ Lev2.0	25.8%	30.5%	42.6%	62.7%	74.0%
PROF04	≤ Lev1.5	29.5%	44.0%	54.7%	59.6%	74.3%
PROF04	≤ Lev1.0	33.2%	56.6%	59.0%		59.6%
PROF04	= Lev0.0	33.3%		55.3%		51.2%
ICS01	≤ Lev5.0					
ICS01	≤ Lev4.5					16.2%
ICS01	≤ Lev4.0		15.7%	15.8%		17.2%
ICS01	≤ Lev3.5	15.8%	16.0%	17.3%	19.3%	31.1%
ICS01	≤ Lev3.0	15.9%	16.6%	19.5%	25.0%	51.0%
ICS01	≤ Lev2.5	16.5%	18.5%	26.1%	43.6%	66.9%
ICS01	≤ Lev2.0	17.8%	22.0%	35.7%	42.2%	
ICS01	≤ Lev1.5	22.1%	34.8%	43.9%	42.7%	
ICS01	≤ Lev1.0	29.2%	43.2%	54.5%		
ICS01	= Lev0.0	42.6%				
ICS02	≤ Lev5.0					
ICS02	≤ Lev4.5					19.1%

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
ICS02	≤ Lev4.0			19.0%	19.2%	20.5%
ICS02	≤ Lev3.5	19.0%	19.0%	19.7%	21.2%	32.3%
ICS02	≤ Lev3.0	18.9%	19.4%	21.9%	27.7%	55.6%
ICS02	≤ Lev2.5	19.2%	20.6%	27.7%	46.0%	70.0%
ICS02	≤ Lev2.0	20.2%	23.3%	38.3%	45.7%	72.0%
ICS02	≤ Lev1.5	21.9%	33.8%	46.2%	43.2%	64.3%
ICS02	≤ Lev1.0	28.1%	39.1%	30.9%	62.8%	
ICS02	= Lev0.0	46.5%	33.1%			
ICS03	≤ Lev5.0					
ICS03	≤ Lev4.5				26.7%	27.0%
ICS03	≤ Lev4.0			26.7%	26.9%	28.5%
ICS03	≤ Lev3.5	26.7%	26.7%	27.3%	29.5%	41.7%
ICS03	≤ Lev3.0	26.8%	27.5%	29.4%	36.8%	60.8%
ICS03	≤ Lev2.5	27.7%	30.0%	38.1%	52.7%	73.7%
ICS03	≤ Lev2.0	29.0%	34.0%	46.6%	57.2%	87.4%
ICS03	≤ Lev1.5	30.8%	44.3%	50.9%	75.0%	77.7%
ICS03	≤ Lev1.0	38.6%	42.1%	43.0%		
ICS03	= Lev0.0	52.4%	24.9%			
ICS04	≤ Lev5.0					
ICS04	≤ Lev4.5			23.2%		23.6%
ICS04	≤ Lev4.0		23.0%	23.2%		24.9%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
ICS04	≤ Lev3.5	23.2%	23.5%	24.4%	26.3%	36.8%
ICS04	≤ Lev3.0	23.2%	23.9%	26.0%	32.5%	54.6%
ICS04	≤ Lev2.5	23.8%	25.4%	33.9%	48.9%	63.3%
ICS04	≤ Lev2.0	24.2%	27.7%	41.4%	55.5%	65.0%
ICS04	≤ Lev1.5	26.4%	36.2%	48.0%	52.1%	59.8%
ICS04	≤ Lev1.0	34.0%	37.2%	48.5%	33.1%	33.3%
ICS04	= Lev0.0	40.8%	29.7%	22.9%	42.3%	

*Probability (%) of a resident not reaching Level 4 at the time of graduation based on the Milestones rating by the time of assessment (Academic Years 2015-18). Please refer to supplemental digital appendix 1 or the online milestones document for the description of each family medicine subcompetency: <https://www.acgme.org/Portals/0/PDFs/Milestones/FamilyMedicineMilestones.pdf?ver=2017-01-20-103353-463>

Supplemental Digital Appendix 4C

Positive Predictive Value Matrix for All Subcompetencies by Milestone Rating Threshold and Milestone Review Occasion Across Post-Graduate Years for Internal Medicine

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC01	≤ Lev5.0					
PC01	≤ Lev4.5	5.3%		5.3%	5.3%	5.3%
PC01	≤ Lev4.0	5.3%	5.3%	5.4%	5.4%	5.7%
PC01	≤ Lev3.5	5.3%	5.4%	5.8%	6.6%	10.8%
PC01	≤ Lev3.0	5.5%	6.2%	7.9%	11.2%	23.7%
PC01	≤ Lev2.5	7.3%	9.7%	15.6%	21.2%	46.3%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC01	≤ Lev2.0	9.9%	14.6%	25.6%	30.1%	29.9%
PC01	≤ Lev1.5	15.5%	22.9%	27.2%	11.4%	
PC01	≤ Lev1.0	19.1%	8.9%		19.7%	
PC01	= Lev0.0	6.2%	16.0%		19.7%	
PC02	≤ Lev5.0					
PC02	≤ Lev4.5	6.4%		6.4%	6.5%	6.5%
PC02	≤ Lev4.0	6.4%	6.5%	6.5%	6.5%	6.9%
PC02	≤ Lev3.5	6.5%	6.5%	6.8%	7.5%	12.0%
PC02	≤ Lev3.0	6.7%	7.4%	9.0%	12.1%	26.6%
PC02	≤ Lev2.5	8.4%	10.7%	14.7%	25.0%	40.5%
PC02	≤ Lev2.0	10.8%	15.1%	20.3%	33.5%	22.0%
PC02	≤ Lev1.5	14.1%	17.7%	28.0%	16.5%	
PC02	≤ Lev1.0	12.7%	8.8%		36.2%	
PC02	= Lev0.0	12.6%			36.2%	
PC03	≤ Lev5.0					
PC03	≤ Lev4.5	6.0%		6.1%	6.1%	6.1%
PC03	≤ Lev4.0	6.0%	6.0%	6.1%	6.1%	6.4%
PC03	≤ Lev3.5	6.1%	6.1%	6.6%	7.0%	11.7%
PC03	≤ Lev3.0	6.3%	6.9%	8.4%	11.0%	25.0%
PC03	≤ Lev2.5	7.5%	10.3%	15.6%	21.8%	29.9%
PC03	≤ Lev2.0	9.9%	15.5%	17.0%	21.6%	18.0%
PC03	≤ Lev1.5	12.4%	21.7%	21.4%	8.4%	6.6%
PC03	≤ Lev1.0	12.2%	25.3%	12.0%		6.7%
PC03	= Lev0.0	9.9%	27.1%	5.9%		6.7%
PC04	≤ Lev5.0					

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PC04	≤ Lev4.5		14.9%	14.9%	15.0%	15.1%
PC04	≤ Lev4.0		15.0%	15.0%	15.1%	15.7%
PC04	≤ Lev3.5	15.0%	15.1%	15.7%	16.4%	21.4%
PC04	≤ Lev3.0	15.2%	15.8%	17.3%	19.9%	29.0%
PC04	≤ Lev2.5	15.9%	17.4%	21.8%	25.6%	30.7%
PC04	≤ Lev2.0	16.6%	19.8%	24.1%	26.7%	27.5%
PC04	≤ Lev1.5	17.8%	20.2%	24.8%	22.6%	24.0%
PC04	≤ Lev1.0	17.1%	19.8%	23.2%	22.4%	23.6%
PC04	= Lev0.0	17.2%	19.2%	22.5%	19.0%	23.0%
PC05	≤ Lev5.0					
PC05	≤ Lev4.5		6.9%	6.9%	6.9%	7.0%
PC05	≤ Lev4.0	6.9%	7.0%	7.0%	7.0%	7.5%
PC05	≤ Lev3.5	7.0%	7.1%	7.4%	8.0%	12.3%
PC05	≤ Lev3.0	7.1%	7.5%	9.0%	11.1%	21.6%
PC05	≤ Lev2.5	8.0%	9.8%	12.6%	20.0%	26.1%
PC05	≤ Lev2.0	8.5%	11.2%	18.0%	19.1%	15.2%
PC05	≤ Lev1.5	9.6%	11.6%	16.1%	13.0%	14.9%
PC05	≤ Lev1.0	9.3%	9.7%	15.6%	12.4%	15.0%
PC05	= Lev0.0	9.6%	9.9%	15.6%	12.6%	15.0%
MK01	≤ Lev5.0					
MK01	≤ Lev4.5	12.1%		12.1%		12.2%
MK01	≤ Lev4.0	12.1%	12.1%	12.3%	12.3%	13.0%
MK01	≤ Lev3.5	12.2%	12.3%	13.2%	14.5%	21.0%
MK01	≤ Lev3.0	12.9%	14.0%	17.4%	22.8%	43.4%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
MK01	≤ Lev2.5	16.7%	21.6%	30.1%	36.4%	57.9%
MK01	≤ Lev2.0	21.2%	28.0%	30.9%	39.8%	58.9%
MK01	≤ Lev1.5	24.9%	36.5%	37.5%	39.6%	48.5%
MK01	≤ Lev1.0	24.7%	19.7%	34.4%	34.2%	45.4%
MK01	= Lev0.0	5.5%		61.4%	31.2%	27.1%
MK02	≤ Lev5.0					
MK02	≤ Lev4.5	10.2%		10.2%	10.2%	10.3%
MK02	≤ Lev4.0	10.2%	10.2%	10.3%	10.3%	10.7%
MK02	≤ Lev3.5	10.2%	10.3%	10.7%	11.8%	17.1%
MK02	≤ Lev3.0	10.5%	11.2%	13.6%	17.2%	30.8%
MK02	≤ Lev2.5	13.1%	15.3%	21.3%	28.1%	41.4%
MK02	≤ Lev2.0	14.4%	21.4%	29.0%	35.3%	50.5%
MK02	≤ Lev1.5	19.9%	24.0%	26.8%	37.1%	35.4%
MK02	≤ Lev1.0	15.4%	15.8%	16.9%	22.7%	33.0%
MK02	= Lev0.0	12.2%	13.8%	49.6%	22.7%	34.0%
SBP01	≤ Lev5.0					
SBP01	≤ Lev4.5	6.1%		6.1%	6.1%	6.2%
SBP01	≤ Lev4.0	6.1%	6.1%	6.2%	6.4%	7.0%
SBP01	≤ Lev3.5	6.2%	6.5%	7.1%	8.1%	13.5%
SBP01	≤ Lev3.0	6.8%	8.0%	9.2%	12.8%	26.4%
SBP01	≤ Lev2.5	9.2%	10.6%	15.1%	23.1%	36.6%
SBP01	≤ Lev2.0	9.2%	14.4%	23.3%	21.5%	15.3%
SBP01	≤ Lev1.5	12.0%	18.7%	13.1%	13.1%	11.2%
SBP01	≤ Lev1.0	10.1%	17.0%	6.3%	3.6%	8.9%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
SBP01	= Lev0.0	9.6%	15.6%	7.1%	3.7%	8.9%
SBP02	≤ Lev5.0					
SBP02	≤ Lev4.5	10.6%	10.6%	10.7%	10.7%	10.7%
SBP02	≤ Lev4.0	10.7%	10.6%	10.7%	10.9%	11.3%
SBP02	≤ Lev3.5	10.6%	10.9%	11.1%	12.0%	17.7%
SBP02	≤ Lev3.0	11.0%	11.7%	13.1%	15.8%	28.9%
SBP02	≤ Lev2.5	12.1%	13.9%	17.4%	21.8%	28.3%
SBP02	≤ Lev2.0	11.7%	14.4%	18.9%	16.4%	23.6%
SBP02	≤ Lev1.5	11.8%	14.8%	17.4%	11.6%	22.2%
SBP02	≤ Lev1.0	11.3%	14.8%	14.6%	10.4%	22.8%
SBP02	= Lev0.0	11.1%	15.4%	14.6%	10.4%	22.8%
SBP03	≤ Lev5.0					
SBP03	≤ Lev4.5	9.6%		9.7%	9.7%	9.7%
SBP03	≤ Lev4.0	9.7%	9.7%	9.7%	9.8%	10.0%
SBP03	≤ Lev3.5	9.7%	9.7%	10.1%	10.8%	14.7%
SBP03	≤ Lev3.0	10.0%	10.0%	11.7%	14.4%	24.3%
SBP03	≤ Lev2.5	11.2%	12.6%	16.5%	18.7%	28.9%
SBP03	≤ Lev2.0	11.7%	15.0%	20.5%	13.7%	20.6%
SBP03	≤ Lev1.5	12.5%	17.3%	17.2%	5.0%	10.8%
SBP03	≤ Lev1.0	12.0%	16.2%	15.8%	5.0%	11.8%
SBP03	= Lev0.0	11.4%	16.2%	15.8%	5.0%	11.8%
SBP04	≤ Lev5.0					
SBP04	≤ Lev4.5			5.7%	5.6%	5.7%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
SBP04	≤ Lev4.0	5.7%	5.7%	5.7%	5.7%	6.1%
SBP04	≤ Lev3.5	5.7%	5.8%	6.0%	6.9%	11.2%
SBP04	≤ Lev3.0	6.2%	6.5%	8.0%	10.7%	23.1%
SBP04	≤ Lev2.5	7.7%	9.9%	11.7%	19.7%	29.0%
SBP04	≤ Lev2.0	8.4%	12.7%	20.6%	13.9%	5.1%
SBP04	≤ Lev1.5	7.9%	8.1%	22.2%	15.5%	
SBP04	≤ Lev1.0	5.1%	7.0%	16.1%	14.2%	
SBP04	= Lev0.0	5.7%	5.9%	17.0%	14.2%	
PBLI01	≤ Lev5.0					
PBLI01	≤ Lev4.5	8.5%		8.6%	8.6%	8.6%
PBLI01	≤ Lev4.0	8.6%	8.6%	8.7%	8.8%	9.1%
PBLI01	≤ Lev3.5	8.7%	8.9%	9.4%	10.6%	15.9%
PBLI01	≤ Lev3.0	9.2%	10.2%	11.9%	14.7%	29.9%
PBLI01	≤ Lev2.5	10.8%	12.4%	16.4%	23.1%	32.2%
PBLI01	≤ Lev2.0	11.1%	15.0%	17.5%	21.6%	21.3%
PBLI01	≤ Lev1.5	10.9%	16.9%	14.7%	16.4%	24.2%
PBLI01	≤ Lev1.0	9.6%	10.8%	12.4%	14.6%	20.4%
PBLI01	= Lev0.0	9.9%	10.6%	11.7%	14.6%	19.4%
PBLI02	≤ Lev5.0					
PBLI02	≤ Lev4.5		12.0%	12.0%	12.0%	12.0%
PBLI02	≤ Lev4.0		12.0%	12.1%	12.2%	12.6%
PBLI02	≤ Lev3.5	12.0%	12.3%	12.8%	13.6%	18.9%
PBLI02	≤ Lev3.0	12.1%	12.6%	14.6%	17.4%	29.2%
PBLI02	≤ Lev2.5	12.9%	14.6%	18.7%	25.7%	31.8%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PBLI02	≤ Lev2.0	13.1%	17.4%	22.5%	29.0%	31.8%
PBLI02	≤ Lev1.5	14.3%	18.0%	20.7%	20.5%	32.1%
PBLI02	≤ Lev1.0	13.3%	16.2%	18.9%	19.9%	31.0%
PBLI02	= Lev0.0	13.3%	15.7%	18.9%	19.4%	30.7%
PBLI03	≤ Lev5.0					
PBLI03	≤ Lev4.5	8.1%		8.1%	8.1%	8.1%
PBLI03	≤ Lev4.0	8.1%	8.1%	8.2%	8.2%	8.7%
PBLI03	≤ Lev3.5	8.3%	8.5%	9.2%	10.1%	15.9%
PBLI03	≤ Lev3.0	9.0%	9.7%	12.1%	14.4%	27.3%
PBLI03	≤ Lev2.5	11.6%	12.1%	18.3%	25.9%	37.1%
PBLI03	≤ Lev2.0	11.7%	16.4%	25.6%	30.0%	29.2%
PBLI03	≤ Lev1.5	13.7%	26.2%	23.3%	26.2%	22.1%
PBLI03	≤ Lev1.0	11.4%	13.7%	20.1%	27.7%	18.9%
PBLI03	= Lev0.0	12.2%	18.6%	21.0%	26.5%	20.0%
PBLI04	≤ Lev5.0					
PBLI04	≤ Lev4.5			7.7%	7.7%	
PBLI04	≤ Lev4.0		7.7%	7.8%	7.8%	8.3%
PBLI04	≤ Lev3.5	7.7%	7.8%	8.2%	9.1%	14.7%
PBLI04	≤ Lev3.0	8.2%	8.9%	10.5%	13.1%	25.3%
PBLI04	≤ Lev2.5	9.6%	11.0%	15.0%	23.7%	40.6%
PBLI04	≤ Lev2.0	10.0%	14.5%	22.1%	26.6%	31.0%
PBLI04	≤ Lev1.5	9.7%	21.0%	17.0%	27.0%	22.7%
PBLI04	≤ Lev1.0	7.3%	8.3%	16.1%	24.6%	15.6%
PBLI04	= Lev0.0	6.6%	9.5%	16.8%	25.6%	15.6%

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PROF01	≤ Lev5.0					
PROF01	≤ Lev4.5	5.6%		5.6%	5.7%	5.8%
PROF01	≤ Lev4.0	5.6%	5.7%	5.8%	6.0%	6.7%
PROF01	≤ Lev3.5	5.9%	6.3%	6.7%	8.4%	15.1%
PROF01	≤ Lev3.0	6.6%	7.9%	9.0%	13.8%	30.3%
PROF01	≤ Lev2.5	8.1%	10.6%	14.5%	23.8%	46.9%
PROF01	≤ Lev2.0	8.9%	12.2%	19.9%	22.2%	71.2%
PROF01	≤ Lev1.5	9.7%	16.8%	23.9%	24.4%	73.2%
PROF01	≤ Lev1.0	10.3%	23.4%	13.3%	17.6%	64.6%
PROF01	= Lev0.0	9.0%	27.3%	7.4%	14.4%	58.8%
PROF02	≤ Lev5.0					
PROF02	≤ Lev4.5	9.0%		9.1%	9.1%	9.2%
PROF02	≤ Lev4.0	9.1%	9.1%	9.2%	9.5%	10.4%
PROF02	≤ Lev3.5	9.4%	9.8%	10.7%	12.1%	19.2%
PROF02	≤ Lev3.0	10.3%	11.5%	14.3%	19.0%	33.9%
PROF02	≤ Lev2.5	12.8%	16.1%	21.8%	28.1%	44.9%
PROF02	≤ Lev2.0	15.1%	20.1%	28.4%	37.0%	37.9%
PROF02	≤ Lev1.5	19.5%	25.2%	23.7%	26.1%	29.7%
PROF02	≤ Lev1.0	19.5%	10.9%	15.5%	5.2%	27.3%
PROF02	= Lev0.0	19.0%	12.3%	10.0%	8.2%	9.3%
PROF03	≤ Lev5.0					
PROF03	≤ Lev4.5	6.1%		6.1%		6.3%
PROF03	≤ Lev4.0	6.2%	6.1%	6.2%	6.4%	6.9%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
PROF03	≤ Lev3.5	6.3%	6.5%	6.9%	7.7%	13.2%
PROF03	≤ Lev3.0	6.7%	7.5%	8.8%	10.8%	24.8%
PROF03	≤ Lev2.5	8.1%	9.9%	11.2%	14.7%	21.7%
PROF03	≤ Lev2.0	8.4%	11.3%	9.3%	7.5%	13.8%
PROF03	≤ Lev1.5	8.1%	8.4%	3.2%	6.6%	9.6%
PROF03	≤ Lev1.0	7.4%	3.3%	3.1%	12.7%	6.1%
PROF03	= Lev0.0	7.4%	2.1%	3.1%	12.7%	4.3%
PROF04	≤ Lev5.0					
PROF04	≤ Lev4.5	6.5%	6.5%	6.5%	6.6%	6.7%
PROF04	≤ Lev4.0	6.5%	6.6%	6.6%	6.8%	7.4%
PROF04	≤ Lev3.5	6.8%	7.1%	7.9%	8.9%	15.6%
PROF04	≤ Lev3.0	7.5%	8.3%	9.6%	12.9%	31.0%
PROF04	≤ Lev2.5	8.4%	12.3%	14.9%	22.8%	46.9%
PROF04	≤ Lev2.0	9.4%	14.3%	20.0%	21.5%	46.7%
PROF04	≤ Lev1.5	11.3%	15.6%	23.6%	16.9%	32.9%
PROF04	≤ Lev1.0	8.2%	10.2%	11.8%	11.0%	30.6%
PROF04	= Lev0.0	7.2%		10.3%	2.4%	7.2%
ICS01	≤ Lev5.0					
ICS01	≤ Lev4.5	5.3%	5.3%	5.3%	5.3%	5.4%
ICS01	≤ Lev4.0	5.3%	5.3%	5.4%	5.5%	5.9%
ICS01	≤ Lev3.5	5.4%	5.7%	6.3%	7.5%	13.2%
ICS01	≤ Lev3.0	6.1%	7.0%	9.2%	12.0%	25.8%
ICS01	≤ Lev2.5	7.4%	9.3%	13.9%	23.8%	22.1%
ICS01	≤ Lev2.0	7.7%	11.6%	14.3%	19.8%	15.7%

Subcompetency	Milestone Rating Threshold	PGY1		PGY2		PGY3
		Mid-Year 1	Year-End 1	Mid-Year 2	Year-End 2	Mid-Year 3
		% Probability of Not Attaining Level 4 by Graduation*				
ICS01	≤ Lev1.5	10.3%	13.6%	3.4%	14.8%	8.0%
ICS01	≤ Lev1.0	5.2%			6.7%	2.7%
ICS01	= Lev0.0	4.5%			6.7%	2.7%
ICS02	≤ Lev5.0					
ICS02	≤ Lev4.5	6.0%		6.0%	6.0%	6.1%
ICS02	≤ Lev4.0	6.0%	6.1%	6.0%	6.2%	7.0%
ICS02	≤ Lev3.5	6.2%	6.4%	7.1%	8.4%	14.5%
ICS02	≤ Lev3.0	7.0%	8.3%	9.5%	13.4%	31.3%
ICS02	≤ Lev2.5	8.4%	10.7%	13.5%	26.3%	32.4%
ICS02	≤ Lev2.0	9.6%	15.7%	25.0%	31.0%	32.4%
ICS02	≤ Lev1.5	10.9%	15.6%	27.3%	41.4%	31.0%
ICS02	≤ Lev1.0	6.2%	12.9%	17.7%	19.3%	25.6%
ICS02	= Lev0.0	3.5%	11.7%	10.7%	13.7%	21.5%
ICS03	≤ Lev5.0					
ICS03	≤ Lev4.5	6.1%		6.1%	6.1%	6.2%
ICS03	≤ Lev4.0	6.1%	6.2%	6.2%	6.3%	6.6%
ICS03	≤ Lev3.5	6.3%	6.4%	6.9%	8.0%	13.4%
ICS03	≤ Lev3.0	7.0%	7.8%	9.2%	11.1%	23.7%
ICS03	≤ Lev2.5	8.2%	10.3%	12.6%	17.7%	26.8%
ICS03	≤ Lev2.0	9.1%	11.9%	15.6%	17.3%	21.2%
ICS03	≤ Lev1.5	9.4%	19.9%	7.1%	16.3%	20.0%
ICS03	≤ Lev1.0	6.5%	5.3%	5.3%	10.1%	20.3%
ICS03	= Lev0.0	2.6%	13.3%	5.3%	9.3%	19.4%

Supplemental digital content for Holmboe ES, Yamazaki K, Nasca TJ, Hamstra SJ. Using longitudinal milestones data and learning analytics to facilitate the professional development of residents: Early lessons from three specialties. Acad Med.

*Probability (%) of a resident not reaching Level 4 at the time of graduation based on the Milestones rating by the time of assessment (Academic Years 2015-18). Please refer to supplemental digital appendix 1 or the online milestones document for the description of each internal medicine subcompetency:
<https://www.acgme.org/Portals/0/PDFs/Milestones/InternalMedicineMilestones.pdf?ver=2017-07-28-090326-787>