Initial Implementation of Resident-Sensitive Quality Measures in the Pediatric Emergency Department

Initial Implementation of Resident-Sensitive Quality Measures in the Pediatric Emergency Department: A Wide Range of Performance

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Abstract

Purpose
A lack of quality measures aligned with residents' work led to the development of resident-sensitive quality measures (RSQMs). This study sought to describe how often residents complete RSQMs, both individually and collectively, when they are implemented in the clinical environment.

Method
During academic year 2017–2018, categorical pediatric residents in the Cincinnati Children's Hospital Medical Center pediatric emergency department were assessed using RSQMs for acute asthma exacerbation (21 RSQMs), bronchiolitis (23 RSQMs), and closed head injury (19 RSQMs). Following eligible patient encounters, all individual RSQMs for the illnesses of interest were extracted from the health record. Frequencies of 3 performance classifications (opportunity and met, opportunity and not met, or no opportunity) were detailed for each RSQM. A composite score for each encounter was calculated by determining the proportion of individual RSQMs performed out of the total possible RSQMs that could have been performed.

Results
Eighty-three residents cared for 110 patients with asthma, 112 with bronchiolitis, and 77 with closed head injury during the study period. Residents had the opportunity to meet the RSQMs in most encounters, but exceptions existed. There was a wide range in the frequency of residents meeting RSQMs in encounters in which the opportunity existed. One closed head injury measure was met in all encounters in which the opportunity existed. Across illnesses, some RSQMs were met in almost all encounters, while others were met in far fewer encounters. RSQM composite scores demonstrated significant range and variation as well—asthma: mean = 0.81 (standard deviation [SD] = 0.11) and range = 0.47–1.00, bronchiolitis: mean = 0.62 (SD = 0.12) and range = 0.35–0.91, and closed head injury: mean = 0.63 (SD = 0.10) and range = 0.44–0.89.

Conclusions
Individually and collectively, RSQMs can distinguish variations in the tasks residents perform across patient encounters.

Graduate medical education training is a time for service learning, with trainees impacting the care of the patients they serve. Yet, the relationship between residency training and patient care is only partially understood at best.[1] Evidence suggests residents can be positioned to improve care while in training,[2,3] and multiple large-scale studies show a lasting relationship between residency programs and the care provided by graduates of those programs.[4–8] However, which characteristics of training programs lead to better or worse patient care are not known. Furthermore, the relationship between the quality of care provided by residents in training and patient outcomes has been explored very little. Efforts to disentangle the complexities of the clinical learning environment to understand these relationships have been challenged, likely by the innate messiness of the real-world training environment.[9] Even so, these relationships deserve attention if medical educators hope to train a physician workforce that can achieve the Triple (or Quadruple) Aim.[10] Given the impact and scope of resident contributions to patient care outcomes, we believe that the link between the quality of care that residents deliver and patient care outcomes requires exploration. Therefore, this study sought to understand the operational use of quality measures in assessing the work that residents perform as a first step in linking trainee performance with patient care outcomes.

While some quality measures used for physicians in practice are appropriate for residents as well, many traditional quality measures are not aligned with the tasks that residents perform.[11,12] With limited previous efforts to fill this gap,[11,13–15] we have committed to developing quality measures that reflect the work performed by residents, called resident-sensitive quality measures (RSQMs).[16,17] To create an initial set of RSQMs for 3 common, acute illnesses (acute asthma exacerbation [hereafter simply asthma], bronchiolitis, and closed head injury [CHI]) that present to pediatric emergency departments (PEDs), we previously engaged residents as well as faculty and fellow supervisors to develop and prioritize RSQMs for these illnesses that met 2 criteria: (1) the measure is likely performed by the resident rather than another member of the team and (2) the measure is important to the care of a patient with the illness of interest.[16,17] Engaging individuals with content expertise in developing these measures helped us build validity evidence into the measures.[16,17] However, we do not know if these measures are aligned with

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Acad Med. 2020;95:1248–1255.
First published online January 7, 2020
doi: 10.1097/ACM.0000000000003147

tasks actually performed by residents and to what extent residents do or do not perform the measures. We believe it is important to understand this relationship, because residency programs have the potential to use RSQMs to both assess and provide feedback to trainees and to provide meaningful information that could help improve the residency program. Thus, this study sought to describe how often residents complete these RSQMs, both individually and collectively, when they are implemented in the actual learning environment. This work has implications for informing RSQM development and implementation in other settings and specialties.

Method

Setting, participants, and eligible patient encounters

During the 2017–2018 academic year, we recruited categorical (i.e., not in a combined training program, such as internal medicine and pediatrics) pediatric residents rotating through the Cincinnati Children's Hospital Medical Center (CCHMC) PED to be assessed using previously prioritized RSQMs (described below) for 3 illnesses of interest: asthma, bronchiolitis, and CHI.

Eligible patient encounters, the focus of analysis for this study, were those in which participating residents cared for patients from the beginning of their PED visit to the time of disposition in the electronic health record (EHR), as well as those with a discharge diagnosis of asthma, bronchiolitis, or CHI. Reactive airway disease in younger children that is treated in a manner that mirrors acute asthma exacerbation treatment in older children was included in eligible asthma encounters. For bronchiolitis encounters, patients were required to be 12 months old or younger for inclusion given that bronchiolitis has more overlap with reactive airway disease after this age.

Measures

We used the RSQMs (listed in Appendix 1) to assess resident performance (i.e., performed or not performed). The RSQMs were focused on common, acute diagnoses in the PED[18] and were previously developed and prioritized with both faculty and fellow supervisors[16] as well as residents.[17]

Data collection

Clinical research coordinators working in the PED determined which patient encounters with participating residents were eligible for inclusion in the study using the criteria given above. Following encounters that were included in this study, all individual RSQMs for the illnesses of interest were extracted from the EHR through manual chart review using a REDCap[19] survey (Vanderbilt, Nashville, Tennessee), hosted at CCHMC, to record applicable data. All EHR extractions were independently performed by 2 individuals (clinical research coordinators, including A.M., and lead investigator, D.J.S.) to ensure accuracy. Discrepancies were most often resolved by reviewing the encounter in the EHR again to verify accuracy of the initial coding of measures.

Data analysis

First, we determined whether residents had the opportunity to perform the RSQM in the encounter. Then, within encounters where residents had the opportunity to perform the RSQM, we determined whether the resident performed it. These determinations resulted in 3 performance classifications into which a patient encounter might fall: (1) the resident had the opportunity to perform the RSQM and did (opportunity and met), (2) the resident had the opportunity to perform the RSQM and did not (opportunity and not met), or (3) the resident did not have the opportunity to perform the RSQM (no opportunity). We detailed the frequencies of each individual RSQM for each encounter. Finally, we calculated an RSQM composite score (possible range: 0.00–1.00) for each encounter by determining the proportion of individual RSQMs performed out of the total possible RSQMs that could have been performed for that encounter. We used a proportion rather than the total number for 2 reasons. First, some individual RSQMs were not applicable to all encounters. Second, the illnesses of interest had different numbers of individual RSQMs: asthma had 21 RSQMs, bronchiolitis had 23 RSQMs, and CHI had 19 RSQMs. Using a proportion ameliorated the issue of varied scales between and within illnesses. Using these composite scores, we then calculated the mean, standard deviation (SD), median, and interquartile range (IQR) for each of the illnesses of interest.

This study was determined to be exempt by the CCHMC Institutional Review Board.

Results

A total of 83 categorical pediatric residents cared for 110 patients presenting with asthma, 112 patients presenting with bronchiolitis, and 77 patients presenting with CHI during academic year 2017–2018.

Frequencies of individual RSQMs across patient encounters

Appendix 1 details the frequency with which residents had the opportunity to meet a measure and met it, had the opportunity to meet a measure and did not meet it, and did not have the opportunity to meet a measure. Additionally, the last column of Appendix 1 details common reasons why residents did not have the opportunity to meet certain measures. As Appendix 1 shows, residents had the opportunity to meet the RSQMs in most encounters, with asthma presenting the most instances in which residents did not have the opportunity to meet measures.

When given the opportunity, there was a wide range in the frequency of residents meeting measures. For asthma, there were some measures that residents had the opportunity to meet that were met in nearly all encounters, such as noting patient acuity in documentation (A8), documenting work of breathing (A9), documenting aeration or air exchange (A10), documenting the presence or absence of wheezing (A11), and ensuring at least 3 descriptive words were used in respiratory exam documentation (A12). However, for other measures that residents had the opportunity to meet, residents met them in far fewer encounters, such as documenting previous intubation or bilevel positive airway pressure use (A7), which was met in 29/110 (26%) encounters, and documenting their own Pediatric Respiratory Assessment Measure (PRAM) score (A13), which was met in 65/110 (59%) encounters. As Appendix 1 shows, similar variations were also present across bronchiolitis and CHI encounters, with only one measure being met in all instances in which residents had the opportunity to meet it (C3, the CHI RSQM focused on documenting the mechanism of injury).

Distributions of RSQM composite scores

As Figure 1 shows, RSQM composite scores, which combine all eligible individual RSQMs for a given encounter (see above), demonstrated significant range and variation among the 3 illnesses of interest. Asthma had the highest mean (0.81, SD = 0.11) and median (0.81, IQR = 0.74–0.88) composite scores, while bronchiolitis (mean = 0.62, SD = 0.12; median = 0.61, IQR = 0.53–0.71) and CHI (mean = 0.63, SD = 0.10; median = 0.63, IQR = 0.56–0.68) had mean and median composite scores that were lower and similar to one another. Bronchiolitis had the lowest overall composite score, as well as the widest range of composite scores across encounters (bronchiolitis: 0.35–0.91 vs asthma: 0.47–1.00 and CHI: 0.44–0.89). Only asthma had any perfect (i.e., 1.00) composite scores.

Discussion

This study explored the initial implementation of RSQMs, both individually and collectively (via composite scores), in the clinical learning environment. Overall, we demonstrate that individual RSQMs capture tasks that residents are performing quite well when implemented in the actual clinical learning environment, as seen by the number of RSQMs that residents did perform in patient encounters when they had the opportunity to do so. Moreover, RSQMs can distinguish variations in the tasks residents perform across encounters, as demonstrated by our findings that some individual RSQMs were not met in many encounters, that there was wide variation across individual RSQMs in whether or not they were met when residents were given the opportunity, and that the RSQM composite scores for each illness also displayed considerable range across encounters. These findings support using individual RSQMs and RSQM composite scores to represent work performed by residents in the PED. However, we also uncovered limitations of RSQMs that could inform future development and implementation of RSQMs in other settings and specialties.

Defining the benefits of using individual RSQMs and RSQM composite scores

As work-based assessment efforts continue to evolve, sufficient data to inform defensible summative decisions regarding performance is a common shortcoming.[20] Additionally, getting assessors to complete assessment forms can be challenging, faculty development for optimizing assessment is lacking, and direct observation of residents by assessors is difficult to ensure.[21–23] Furthermore, traditional assessment efforts may suffer from range restriction, where assessors use only a small portion (often the upper portions) of the rating scale or framework provided.[24,25] Based on the findings in this study, using RSQMs for the purposes of resident assessment may help address some of these known challenges. We showed that residents often had the opportunity to complete the RSQMs in patient encounters, which

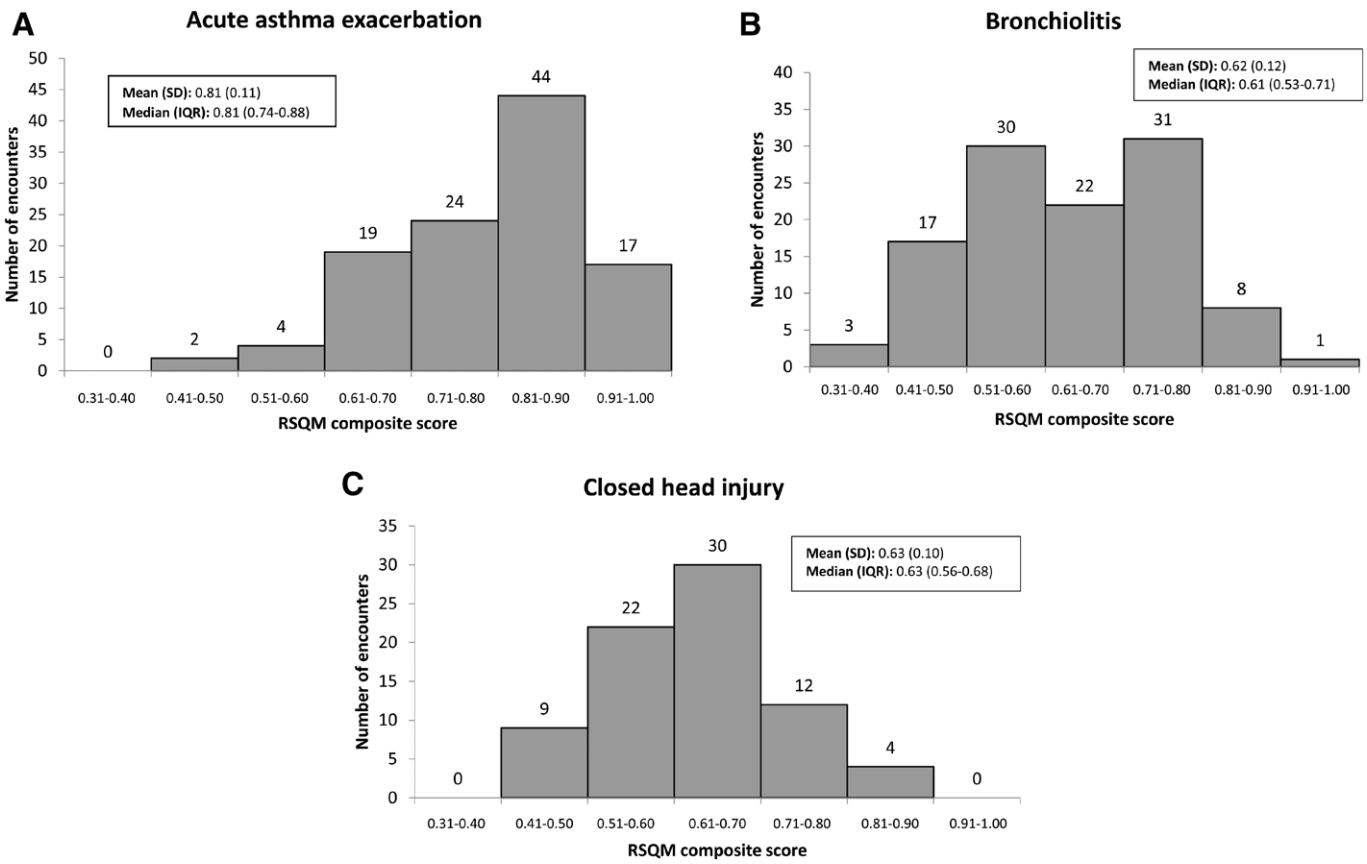

Figure 1 Distribution of RSQM composite scores for (Panel A) acute asthma exacerbation, (Panel B) bronchiolitis, and (Panel C) closed head injury patient encounters, Cincinnati Children's Hospital Medical Center pediatric emergency department, academic year 2017–2018. The authors calculated a composite score for each encounter by determining the proportion of individual RSQMs performed out of the total possible RSQMs that could have been performed for that encounter. See Appendix 1 for a full list of the RSQMs. Abbreviations: RSQM, resident-sensitive quality measure; SD, standard deviation; IQR, interquartile range.

could provide resident performance data to augment a supervisor's assessment with meaningful clinical data. However, the most significant benefit of RSQMs may be in their ability to distinguish a wide range of differences in the quality of care provided by residents (via the number of possible tasks that were or were not performed) across encounters. For example, the RSQM composite scores for asthma (0.47–1.00) and bronchiolitis (0.35–0.91) spanned more than half of the possible range, while the span for CHI scores was close to half of the range (0.44–0.89). Moreover, for both bronchiolitis and CHI, the IQR of composite scores approached 0.50 on the lower bound. Traditional assessment data displaying this range is uncommon. Thus, RSQM data may be useful for formative and summative assessment decisions as they provide the ability to distinguish variations in the tasks residents perform across encounters. Further work will be needed, though, to assess whether the variation we observed in RSQM data corresponds with other measures of resident performance and to define and study RSQMs in other settings and specialties.

This study did not seek to understand the potential benefits of RSQMs in providing residents with actionable feedback about their performance. Given that only one RSQM was met by all residents in this study, future efforts should seek to understand how, and under what circumstances, RSQMs may benefit residents' personal quality improvement efforts. Furthermore, future efforts should consider how RSQMs with poorer performance across residents might inform curricular changes or systems-level quality improvement initiatives.

Defining the limits of using individual RSQMs and RSQM composite scores

While this study supports the use of RSQMs to capture resident performance, limitations of their use were also encountered. Residents did not always have the opportunity to meet all measures in all patient encounters. Measures that cannot be met in given encounters could be treated in 1 of 2 ways. First, they could be treated as we have done, by developing RSQM composite scores, in which a measure can be included if it applies (i.e., if the resident had the opportunity to perform the measure) and, conversely, not included when it does not apply (i.e., if the resident did not have the opportunity to perform the measure). This means that the total possible number of applicable RSQMs will vary from one encounter to another and that a proportion of completed RSQMs will be used to compare performance from one encounter to another. The drawback to this approach is that it prevents direct comparisons of performance across encounters, making comparisons more nuanced. However, these imperfect comparisons may be less important when using RSQM composite scores for formative rather than summative purposes. The benefit to this approach is that it uses all available RSQMs to inform an RSQM composite score for each encounter. The second way to handle RSQMs that cannot be met in an encounter is to simply use RSQMs only in encounters where all measures can be met. Given that residents are typically provided with a paucity of quality metrics relevant to their performance, we believe using any available RSQMs whenever possible is paramount (i.e., that option 1 is preferable to option 2).

Beyond the clinical context precluding residents from meeting an individual RSQM, one asthma RSQM was contingent on completing another RSQM. That is, residents could only complete the RSQM focused on their PRAM score matching the initial medication orders placed for the patient if they had documented their own PRAM score, another asthma RSQM. In 45 encounters, residents did not document their own PRAM score and thus did not receive credit for completing that individual RSQM. However, it also meant that they could not complete the subsequent RSQM regarding the initial medication orders matching their PRAM score for the patient. Should residents also not receive credit for this individual RSQM or should this measure not be included in their RSQM composite score? We believe the latter option is most prudent because it avoids penalizing residents twice if they do not document their own PRAM score.

These limitations, which we encountered when implementing our RSQMs in the PED, can and should inform the development and implementation of RSQMs in other settings and specialties. Furthermore, identifying which residents provided care to patients may be easier in the PED than in other settings, such as the inpatient environment, where multiple residents may have touchpoints of care on a given day. Future RSQM development will need to consider this as it expands to other contexts.

Study limitations

There are limitations to consider in this implementation study. First, this study was performed at a single department at a single institution and involved the roles assigned to residents and others at that institution, as well as the site-specific EHR. Thus, our findings may not be generalizable to other settings. However, we believe that our implementation experiences can aid efforts to develop and implement RSQMs in other settings and specialties. Second, the individual RSQMs were obtained via manual chart review. Therefore, human extraction errors are possible. We sought to minimize this through employing 2 individuals to perform data extraction. Manual extraction was chosen because some of the RSQMs cannot be automatically extracted from the EHR. This could be viewed as a limitation of some of the RSQMs, which may not be easy to extract from the chart and thus might have limited usability beyond the study setting. However, natural language processing is likely a ready solution for obtaining these items from the EHR. Third, we considered patient encounters and not overall resident performance in our implementation analysis. This was by design because resident performance varies by encounter, and we wanted to know how well the RSQMs captured resident performance for each encounter. Yet, there may be certain measures that individual residents consistently do or do not perform, suggesting that residents could influence encounter-based data. Future studies should explore this area.

Conclusions

RSQMs, both individually and collectively, provide some promise for addressing known challenges in work-based assessment and in meaningfully involving residents in quality improvement efforts.[20–25] Having established that the RSQMs we used largely apply in clinical encounters involving pediatric residents, future

efforts should consider the validity and reliability of RSQMs when used for resident assessment, as well as their relationship to other measures of patient care quality and outcomes. Furthermore, individuals undertaking the work of developing RSQMs in other settings and specialties should continue to attend to and share what works and does not work in various contexts to continue advancing this field.

Acknowledgments: The authors wish to thank the pediatric residents at Cincinnati Children's Hospital Medical Center who participated in this study.

Funding/Support: This study was funded by the Place Outcomes Award from Cincinnati Children's Hospital Medical Center.

Other disclosures: None reported.

Ethical approval: This study was deemed exempt by the Cincinnati Children's Hospital Medical Center Institutional Review Board.

Previous presentations: Part of the data presented in this paper was presented as a poster presentation at the Association of Pediatric Program Directors' Annual Spring Meeting in New Orleans, Louisiana, on March 29, 2019, and as a platform presentation at the Pediatric Academic Societies Annual Meeting in Baltimore, Maryland, on April 28, 2019.

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Appendix 1

Individual Resident-Sensitive Quality Measures (RSQMs) Performance for Acute Asthma Exacerbation, Bronchiolitis, and Closed Head Injury Patient Encounters, Cincinnati Children's Hospital Medical Center Pediatric Emergency Department, Academic Year 2017–2018

RSQM no.[a]	RSQM	Performance classification,[b] no.			Common reasons why residents did not have opportunity to perform RSQM
		Opportunity and met	Opportunity and not met	No opportunity	
Acute asthma exacerbation (110 patient encounters total)					
A1	Use asthma order set	64	20	26	Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context
A2	Correct medication dose ordered for albuterol	59	22	29	Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context
A3	Use of dexamethasone as steroid	71	5	34	Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context
A4	Correct medication dose ordered for dexamethasone	68	3	39	Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context
A5	Time from resident assigning self to patient to resident entering steroid order	44	27	39	Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context
A6	Correct medication dose ordered for ipratropium	51	1	58	• Patient presented through trauma or resuscitation bay and initial orders placed by attending in this context • Medication not given during encounter
A7	Documentation of previous intubation or bilevel positive airway pressure for asthma	29	81	0	
A8	Note the acuity of the patient in documentation	109	1	0	
A9	Documentation of work of breathing	104	6	0	
A10	Documentation of aeration or air exchange	104	6	0	
A11	Presence or absence of wheezing documented	108	2	0	
A12	Ensure at least 3 descriptive words used in respiratory exam documentation	109	1	0	
A13	Resident documents own Pediatric Respiratory Assessment Measure (PRAM) score	65	45	0	
A14	Resident-assigned PRAM score matches resident-placed initial medication orders	55	10	45	Resident did not document own PRAM score
A15	Document patient response to intervention	93	10	7	No intervention
A16	Documentation of disposition decision	100	10	0	
A17	Use of standardized dosing for discharge medication (i.e., dexamethasone)	57	2	51	• Patient admitted • Patient not given dexamethasone for home
A18	Home dexamethasone instructions documented in written discharge instructions	44	15	51	• Patient admitted • Patient not given dexamethasone for home
A19	State who to follow up with and provide their contact information in discharge papers	53	12	45	Patient admitted
A20	Documentation of needing albuterol more often than every 4 hours as a reason to return in written discharge instructions	24	41	45	Patient admitted
A21	Documentation of worsening respiratory symptoms as a reason to return in written discharge instructions	29	36	45	Patient admitted

(*Appendix continues*)

Appendix 1
(Continued)

RSQM no.[a]	RSQM	Performance classification,[b] no. Opportunity and met	Opportunity and not met	No opportunity	Common reasons why residents did not have opportunity to perform RSQM
Bronchiolitis (112 patient encounters total)					
B1	Follow bronchiolitis pathway	66	46	0	
B2	Document birth history (preemie or not a preemie)	69	43	0	
B3	Day of illness clearly documented	111	1	0	
B4	Documentation of previous wheezing	19	93	0	
B5	Assessment of severity documented	108	4	0	
B6	Effort of breathing documented	109	3	0	
B7	Documented quality of air entry (normal, decreased, etc.)	78	34	0	
B8	Documentation of wheezing	90	22	0	
B9	Documentation of crackles	94	18	0	
B10	Documented presence or absence of subcostal retractions	60	52	0	
B11	Documented presence or absence of intercostal retractions	29	83	0	
B12	Documented presence or absence of suprasternal retractions	28	84	0	
B13	Oxygen saturation clearly documented	62	50	0	
B14	Hydration status clearly documented	38	74	0	
B15	Documentation of patient response to specific therapeutics (i.e., how they responded to suctioning, how they responded to breathing treatment, how they responded to normal saline bolus, etc.)	82	23	7	No intervention
B16	Oral feeding tolerance clearly documented	47	65	0	
B17	Documentation of justification for appropriate disposition (sent home vs admitted)	98	14	0	
B18	Documentation of worsening respiratory symptoms as a reason to return in written discharge instructions	27	25	60	Patient admitted
B19	Use standard or premade discharge instructions for bronchiolitis	48	4	60	Patient admitted
B20	Documentation of poor feeding as a reason to return in written discharge instructions	22	30	60	Patient admitted
B21	Bulb suction teaching for home ordered	14	38	60	Patient admitted
B22	State who to follow up with and provide their contact information in discharge papers	43	9	60	Patient admitted
B23	State appropriate number of days to follow up in discharge papers	30	22	60	Patient admitted
Closed head injury (77 patient encounters total)					
C1	Closed head injury or PECARN[c] best practice advisory used	32	45	0	
C2	Appropriate closed head injury or PECARN[c] pathway used	11	62	4	Patient arrived from outlying hospital with computed tomography scan of head already completed
C3	Mechanism of injury documented	77	0	0	
C4	Documentation of time of injury	67	10	0	
C5	Documentation of presence or absence of loss of consciousness	61	16	0	
C6	Documentation of presence or absence of emesis	70	7	0	

(*Appendix continues*)

Appendix 1
(Continued)

RSQM no.[a]	RSQM	Performance classification,[b] no.			Common reasons why residents did not have opportunity to perform RSQM
		Opportunity and met	Opportunity and not met	No opportunity	
C7	Documentation of whether patient is back to baseline or not	61	16	0	
C8	Documentation of presence or absence of other head injury in the history	31	46	0	
C9	Assessment of severity documented	76	1	0	
C10	Documentation of presence or absence of hematoma on physical exam (if present, location and size also documented)	41	36	0	
C11	Thorough head exam (head, eyes, skull) documented	25	52	0	
C12	Documentation of Glasgow Coma Scale score	25	52	0	
C13	Full neurologic exam documented	2	75	0	
C14	Documentation of presence or absence of other non-head injury on physical exam	53	24	0	
C15	Appropriate differential diagnosis and medical decision making documented	73	4	0	
C16	Reassessments of patient documented	40	37	0	
C17	Return to school or play recommendations in discharge papers	20	22	35	Patient younger than school age
C18	Use of standard or premade discharge instructions for diagnosis	62	9	6	Patient admitted
C19	Appropriate follow-up (sports medicine, rehabilitation, neurology, etc.) recommended	62	9	6	Patient admitted

[a]For these numbers: A, acute asthma exacerbation; B, bronchiolitis; C, closed head injury.
[b]See the "Data analysis" section of the main text for more information on the performance classifications.
[c]PECARN is the Pediatric Emergency Care Applied Research Network, which conducted a study that delineated a decision rule for managing closed head injury in Kuppermann N, Holmes JF, Dayan PS, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: A prospective cohort study. Lancet. 2009;374:1160–1170.