The Joint Commission Children's Asthma Care Quality Measures and Asthma Readmissions

WHAT'S KNOWN ON THIS SUBJECT: Asthma is a major reason for pediatric hospital admission. The Joint Commission requires freestanding children's hospitals to report compliance with 3 Children's Asthma Care quality measures. High compliance with these measures should result in decreased admissions and emergency department visits.

WHAT THIS STUDY ADDS: Implementation of a standardized care process model for hospitalized asthmatic children resulted in high compliance with all 3 measures. Measures 1 and 2 did not provide an opportunity for improvement. Compliance with measure 3 resulted in significant decreases in readmission.

abstract

BACKGROUND AND OBJECTIVES: The Joint Commission introduced 3 Children's Asthma Care (CAC 1–3) measures to improve the quality of pediatric inpatient asthma care. Validity of the commission's measures has not yet been demonstrated. The objectives of this quality improvement study were to examine changes in provider compliance with CAC 1–3 and associated asthma hospitalization outcomes after full implementation of an asthma care process model (CPM).

METHODS: The study included children aged 2 to 17 years who were admitted to a tertiary care children's hospital for acute asthma between January 1, 2005, and December 31, 2010. The study was divided into 3 periods: preimplementation (January 1, 2005–December 31, 2007), implementation (January 1, 2008–March 31, 2009), and postimplementation (April 1, 2009–December 31, 2010) periods. Changes in provider compliance with CAC 1–3 and associated changes in hospitalization outcomes (length of stay, costs, PICU transfer, deaths, and asthma readmissions within 6 months) were measured. Logistic regression was used to control for age, gender, race, insurance type, and time.

RESULTS: A total of 1865 children were included. Compliance with quality measures before and after the CPM implementation was as follows: 99% versus 100%, CAC-1; 100% versus 100%, CAC-2; and 0% versus 87%, CAC-3 ($P < .01$). Increased compliance with CAC-3 was associated with a sustained decrease in readmissions from an average of 17% to 12% ($P = .01$) postimplementation. No change in other outcomes was observed.

CONCLUSIONS: Implementation of the asthma CPM was associated with improved compliance with CAC-3 and with a delayed, yet significant and sustained decrease in hospital asthma readmission rates, validating CAC-3 as a quality measure. Due to high baseline compliance, CAC-1 and CAC-2 are of questionable value as quality measures. *Pediatrics* 2012;130:482–491

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KEY WORDS

asthma, compliance, hospitalization, quality improvement, quality of care

ABBREVIATIONS

CAC—Children's Asthma Care

CPM—Care Process Model

EDOS—electronic discharge order set

ED—emergency department

EDW—enterprise data warehouse

HMPC—home management plan of care

LOS—length of stay

PCMC—Primary Children's Medical Center

QI—quality improvement

RRU—relative resource unit

TJC—The Joint Commission

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Asthma is the most common chronic childhood illness and 1 of the most common reasons for hospitalization. More than 6 million children in the United States are affected by asthma, with an associated 700 000 emergency department (ED) visits and 200 000 hospital admissions annually,^{1,2} contributing to significant health care expenditures.³ Despite availability of asthma guidelines, quality of care provided to children hospitalized for asthma remains suboptimal, especially with regard to initiation of chronic asthma control and prevention of asthma readmissions.^{4–7} Six-month hospital readmission rates for subsequent asthma attacks are reportedly as high as 40%.^{8,9}

To improve the quality of pediatric inpatient asthma care, The Joint Commission (TJC), in collaboration with the National Association of Children's Hospitals and Related Institutions, developed 3 Children's Asthma Care (CAC) measures in 2003.¹⁰ CAC-1 and CAC-2 determine provider compliance with evidence-based management of acute exacerbations and are defined as "percentage of patients who received beta agonists" and "percentage of patients who received systemic steroids" during their hospital stay. CAC-3, patient discharge with a home management plan of care (HMPC), is a composite measure of compliance with 5 different interventions, all of which have been shown to improve chronic asthma symptoms and prevent exacerbations.¹¹ CAC-3 requires all of the following elements to be documented: quick reliever and controller; follow-up appointment; environmental or other trigger control; and a written action plan. TJC does not define how information documented on the HMPC should be conveyed to patients/parents or what knowledge and skills competencies should be achieved. Recent research has suggested a lack of effect of CAC-3 on readmissions and raised concern that

CAC-3 may not be an appropriate quality measure for inpatient asthma.^{12,13}

To improve care quality for children with asthma at our facility, which was poor at baseline,⁴ we developed and implemented an asthma care process model (CPM), which was subsequently adapted to support compliance with CAC measures. The objectives of the current study were to report changes from baseline in: (1) provider compliance with CAC measures 1–3; (2) asthma hospitalization outcomes including PICU transfer after inpatient admission, death, length of stay (LOS), costs, and relative resource units (RRUs); and (3) asthma readmission to an ED or hospital within 6 months of discharge after full implementation of the CPM.

METHODS

Setting

The study was conducted at Primary Children's Medical Center (PCMC), an academic, freestanding children's hospital in Salt Lake City, Utah, that is affiliated with the Department of Pediatrics at the University of Utah. PCMC serves as both the community pediatric hospital for Salt Lake County and as the tertiary care pediatric hospital for Utah and 4 surrounding states. PCMC is a 289-bed facility and is owned and operated by Intermountain Healthcare, a regional, not-for-profit integrated health care delivery system.¹⁴ The study was approved by the PCMC privacy board and the University of Utah institutional review board.

Implementation and Evaluation of the Impact of the Asthma CPM

Based on national guidelines and existing asthma quality measures, an asthma CPM was developed with the primary goal of standardizing care and improving quality. Implementation was facilitated by paper-based decision support tools embedded in the clinical workflow,

including admission orders, discharge orders, criteria for specialist consultation, criteria for ICU transfer, and an asthma education module. To enhance knowledge and self-management skills in the ambulatory setting, a formal education program was introduced that used HMPC patient-specific instructions as a template for teaching. Admission and discharge order sets were designed to help providers comply with evidence-based recommendations for acute care (CAC-1 and CAC-2) and chronic asthma control (CAC-3), including documentation of elements required by the TJC.

CPM implementation was a complex process because asthma patients were admitted across 4 hospital floors and involved multidisciplinary teams, including rotating residents, nurses, respiratory therapists, and health unit coordinators. Implementation was started in January 2008, and we intended completion by August 2008 using Plan-Do-Study-Act rapid cycle strategies.^{15,16} CPM implementation was delayed, however, because clinical tools needed to be modified frequently to incorporate provider feedback. Implementation of the admission orders was completed in August 2008, and paper-based discharge orders were completed in October 2008 (Fig 1). Due to persistent challenges in determining and documenting chronic asthma severity, a key element to determine the need and type of controller medication, we transitioned to an electronic discharge order set (EDOS) in October 2008. The EDOS mandated completion of an algorithm for selection of preventive therapy based on the National Institutes of Health chronic asthma severity assessment score¹¹ and provided a prompt for the provider regarding which controllers to use. By using gap analyses and provider feedback, we made several substantial changes to the content of the EDOS to refine the application and address issues reported by providers.¹⁷ EDOS refinement with full

CAC-1, CAC-2, and CAC-3 compliance criteria were computed quarterly and displayed graphically to display the pattern of compliance over time.

Quantile regression was applied to compare the median LOS, costs, and RRU between the postimplementation and preimplementation periods with covariate adjustment for age, gender, race, and insurance type. Our primary outcome, readmission within 6 months, was compared between the postimplementation and preimplementation periods after adjustment for covariates by using logistic regression analysis. The primary outcomes are presented for the initial and revised definitions of the implementation and postimplementation phases.

RESULTS

A total of 1865 children were discharged from PCMC with acute asthma: 754 (40%) preimplementation, 438 (24%) during CPM implementation, and 673 (36%) during postimplementation. There were no significant differences among demographic characteristics for the preimplementation versus postimplementation populations (Table 1).

Baseline average compliance with CAC-1 and CAC-2 measures was high at 99%

and 100%. Postimplementation, average compliance with both measures was 100%. Preimplementation compliance with the CAC-3 measure was 0% and improved to an average of 87% ($P < .01$) postimplementation. Changes in compliance with measures CAC 1–3 and their relation with CPM implementation process changes are detailed in Fig 2.

Table 2 summarizes results of compliance and secondary hospitalization outcomes comparing the preimplementation and postimplementation periods. No statistically significant differences were observed for any of the secondary hospitalization outcomes. Two deaths (1 preimplementation, 1 during implementation) were reported. Both patients were directly admitted to the PICU and did not receive CPM-related asthma care.

Table 3 summarizes the logistic regression analyses comparing readmissions within 6 months between the preimplementation and postimplementation periods by using our initial and revised definitions for the respective periods. No significant change in readmissions postimplementation were found in the initial analysis. After extending the implementation and postimplementation periods to conform to our actual QI experience, 6-month

asthma readmission rates declined from an average of 17% to 12% between the preimplementation and postimplementation periods ($P = .01$). Figure 3 presents the quarterly percentages of patients readmitted within 6 months in a run chart, including the initial and revised postimplementation analysis periods. Reduction in asthma readmissions was not observed until after 9 months of sustained high CAC-3 compliance. During the study period, overall admission rates for the hospital and for nonasthma patients did not change.

DISCUSSION

Our study demonstrates that implementation of a CPM primarily designed to standardize asthma care while simultaneously supporting compliance with TJC CAC measures is associated with a delayed yet significant and sustained reduction in asthma readmissions, with no change in other hospitalization outcomes. To our knowledge, this is the first study to report a sustained reduction in pediatric asthma readmissions after introduction of the TJC CAC measures and contradicts the results reported by a recent study, which examined pooled data from 30 US children's hospitals with a shorter outcomes observation period of 7, 30, or 90 days.¹¹

Our hospital's compliance with CAC-3 was initially low. This finding is consistent with previous reports of poor quality of inpatient asthma care regarding interventions to prevent subsequent hospital admissions.^{4–6} Although standardization of asthma care is not a novel concept, previous studies primarily focused on assessing the impact on direct hospitalization outcomes such as hospital LOS and cost.^{23–32} These studies have been criticized for a lack of focus on interventions targeting long-term asthma control and readmission prevention.³³ Our study provides evidence that an inpatient asthma CPM,

TABLE 1 Patient Demographic Characteristics

Characteristic	Intervention N (months)			<i>P</i> ^b
	Preimplementation (Before 1/1/2008, <i>n</i> = 754 [40.4%]) ^a	Implementation (1/1/2008 to 3/31/2009, <i>n</i> = 438 [23.5%])	Postimplementation (After 3/31/2009, <i>n</i> = 673 [36.1%])	
Age at admission (median, IQR), y	5.2 (3.3–8.2)	4.9 (3.2–7.6)	5.4 (3.5–8.4)	.14
Gender, <i>n</i> (%)				.28
Male	424 (56.2)	246 (56.2)	404 (60.0)	
Female	330 (43.8)	192 (43.8)	269 (40.0)	
Race/ethnicity, <i>n</i> (%)				.68
White	543 (72.0)	306 (69.9)	496 (73.7)	
Hispanic	131 (17.4)	82 (18.7)	115 (17.1)	
Other	80 (10.6)	50 (11.5)	62 (9.2)	
Insurance, <i>n</i> (%)				.98
Medicaid	203 (27.0)	123 (28.1)	188 (27.9)	
Private	504 (66.9)	290 (66.2)	442 (65.7)	
Self-pay	46 (6.1)	25 (5.7)	43 (6.4)	

IQR, interquartile range.

^a 1 subject had missing insurance information.

^b *P* values compare the revised postimplementation and preimplementation periods without covariate adjustment.

FIGURE 2
Monthly (%) CAC 1–3 compliance before, during, and after implementation of CPM.

including components targeting readmission, can decrease asthma readmissions when implemented by using standard QI strategies. Several factors

contributed to our successful CPM implementation, including the culture of QI within the organization, a multidisciplinary implementation team, leadership

support, and the CPM design itself.^{34–37} Our CPM ensured that standardized education was provided to enhance patient knowledge and skills on the basis of

TABLE 2 Asthma CPM Implementation Process and Outcome Measures

Variable	Intervention			<i>P</i> ^a
	Preimplementation (Before 1/01/2008, <i>n</i> = 754 [40.4%])	Implementation (1/1/2008 to 3/31/2009, <i>n</i> = 438 [23.5%])	Postimplementation (After 3/31/2009, <i>n</i> = 673 [36.1%])	
TJC CAC measures				
CAC-1: Quick relievers, <i>n</i> (%)	746 (98.9)	436 (99.5)	670 (99.6)	.35
CAC-2: Systemic corticosteroids, <i>n</i> (%)	754 (100.0)	435 (99.5)	673 (100.0)	.48
CAC-3: HMPC complete, <i>n</i> (%)	3 (0.4)	275 (63.2)	572 (86.5)	<.0001
Controllers, <i>n</i> (%)	182 (24.2)	366 (84.1)	619 (93.6)	<.0001
Written action plan ^b , <i>n</i> (%)	65 (8.7)	368 (84.6)	636 (96.2)	<.0001
Follow-up appointment, <i>n</i> (%)	194 (26.1)	319 (73.3)	609 (92.1)	<.0001
Secondary outcomes measures				
LOS in hospital, h	52.0 (37.0–79.0)	47.0 (34.0–72.0)	48.0 (35.0–76.0)	.14
Hospitalization variable cost, \$ (unadjusted for inflation)	1616.8 (1172.3–2207.3)	1641.5 (1216.5–2434.5)	1618.0 (1181.6–2566.5)	.47
RRU	23.3 (17.3–33.7)	22.0 (16.6–31.2)	22.1 (16.3–34.5)	.16
PICU transfer after hospitalization	2	7	2	—
Death	1	1	0	—

Data are presented as *n* (% compliance), median (interquartile range [IQR]), or *n*.

^a *P* values in the TJC CAC measures section compare the postimplementation and preimplementation periods without covariate adjustment. In the secondary outcomes measures section, the *P* values were computed using quantile regression to compare median levels between the postimplementation and preimplementation periods after adjustment for age, gender, race, and insurance type. The revised implementation and postimplementation periods were used for all sections.

^b Written action plan contains instructions about use of quick reliever medications and trigger control education.

TABLE 3 Primary Analysis of 6-month Readmission Rate

No. of Readmissions Total No. of Admissions % Readmissions				Adjusted Odds Ratio ^a 95% CI <i>P</i>	
Preimplementation (Before 1/1/2008)	Initially Specified Implementation (1/1/2008 to 7/31/2008)	Added Implementation Component (8/1/2008 to 3/31/2009)	Final Postimplementation (After 3/31/2009)	Initial Analysis (A) Comparing 8/1/2008–12/31/2009 With Preimplementation Period	Final Analysis (B) Comparing 4/1/2009–12/31/2010 With Preimplementation
129	26	60	83	1.04	0.67
754	196	241	673	0.78–1.40	0.50–0.91
17.1	13.3	24.9	12.3	.78	.01

^a Adjusted odds ratios compare the 6-month readmission rates between the indicated initial and final postimplementation and preimplementation periods after covariate adjustment for age, gender, race, and insurance type.

patient-specific content outlined in the HMPC. Our team regarded a hospitalization for asthma as an opportunity not only to support evidence-based inpatient treatment of acute symptoms but also to initiate preventive measures to reduce the risk for future asthma exacerbations and readmission.^{38,39} Our results demonstrate that preventive measures can be implemented during a brief inpatient stay and achieve lasting effects on asthma readmissions. None of our patients discharged was followed up by a case manager or with an additional telephone intervention or something similar. We believe that further reductions in readmissions could be possible if barriers to adequate outpatient care after hospital discharge could simultaneously be addressed.^{40–44}

Several factors may have contributed to the different findings between our study and results reported by Morse et al⁴⁵. First, immediately after an increase in CAC-3 compliance we did not observe any change in 6-month asthma readmission rates. However, after a lag time of 9 months with high (>80%) CAC-3 compliance, asthma readmission rates showed decreased variability between measurement intervals, and a sustained decline from baseline. There may be a minimum sustained compliance threshold, which must be exceeded to see a change in readmissions.^{46–48} In addition, a lag time between improvement in process measures after QI interventions and observed changes in outcome measures is commonly reported.^{49–52} We believe that the study

by Morse et al might have yielded different results if higher CAC-3 compliance was sustained over a longer period of time. Second, there may have been significant variability of the education provided along with the HMPC. Individualized asthma instructions, as done in our facility, have been shown to improve asthma control and reduce subsequent exacerbations.^{53–55} Third, Morse et al looked at readmission rates over time periods of 7, 30, and 90 days (while our time window was 6 months) and included pooled data from 30 hospitals that may have a great deal of individual variability in their compliance with CAC-3 and with changes in the measured outcomes.

At our institution, baseline compliance with CAC-1 and CAC-2 measures was

FIGURE 3

Quarterly percentage of patients readmitted within 6 months. A, Postimplementation period: initial analysis. B, Postimplementation period: second analysis.

already optimal, with no room for improvement. High baseline compliance with CAC-1 and CAC-2 has also been reported in other institutions,⁵⁶ suggesting that CAC-1 and CAC-2 may not be ideal measures.²⁰ We propose a review of these measures and potential replacement with other validated Level A evidence acute care measures published in the literature.^{4,57} These might include measures such as mode of administration of systemic corticosteroids (oral versus intravenous) and short-acting β_2 -agonists delivered via metered-dose inhaler in children aged ≥ 5 years, for whom compliance is generally reported to be low, yet the potential to reduce costs is high.⁴ Measure CAC-3 was designed to ensure that hospitals provide a minimum standard of discharge instructions to improve chronic asthma symptom control and reduce the risk of future exacerbations.^{58–66} Our study demonstrated the effectiveness of CAC-3 on asthma readmissions under prolonged observation with high compliance and validates its inclusion as a quality indicator for asthma care. Our study also validates bundling of interventions in the form of an HMPC when detailed instructions are provided to the patient/family. In a subanalysis of the individual interventions, neither isolated presence of a follow-up appointment, discharge of controller medications, and completed asthma education in the preintervention period were associated with decreased readmissions.

Whereas previous studies documented cost savings or decreases in hospital LOS after CPM implementation,^{25,26,28,67} we observed no change in cost or LOS. This difference could be explained by an already high baseline compliance with CAC-1 and CAC-2, both of which are associated with the speed of reversal of airflow obstruction and symptom improvement. Implementation of a CPM to improve compliance with asthma quality

measures did not result in increased direct cost for the patient or insurance companies but did place a financial burden on the hospital. Costs associated with CPM development, implementation and maintenance, data collection, and reporting are not reflected in inpatient costs assessed to patients.

There are limitations in our study. Our study was conducted at a single center, and therefore our CPM implementation strategies and findings may not be generalizable.⁶⁸ Although ascertainment of asthma readmission information was evaluated at 22 Intermountain Healthcare facilities in Utah (Intermountain Healthcare covers 85% of pediatric care in the state of Utah), we were unable to capture readmissions that occurred outside the company's system. Because Intermountain Healthcare operates the majority of hospitals and inpatient pediatric services in Utah (Scott Lloyd, personal communication, Strategic Planning, Intermountain Healthcare, August 24, 2010), we do not believe that missed readmissions would be significant enough to influence the results presented. Our CPM included components not defined by TJC CAC measures such as asthma education by using the HMPC as a patient-specific template. If effective, asthma education in itself may have influenced readmission rates. In addition, we did not collect information about ambulatory asthma care after discharge. Although we were unable to describe how outpatient care might have affected readmissions, no concurrent outpatient asthma QI interventions took place during the study period. Due to changes in analysis plans, including post-hoc adjustments of the implementation and postimplementation periods, we might have introduced bias toward detection of a change in readmissions. *P* values comparing outcomes between the revised periods may represent the bias. CPM implementation was a complex process in a real-world

clinical setting and included frequent modifications of the implementation tools and processes, including an unplanned transition to the EDOS; it was difficult to determine the exact length of the implementation period a priori, but we believe that correcting those time periods presents more accurate results. Due to the nature of the evaluation conducted, we cannot presume a causal relationship between CPM implementation and reduced asthma readmissions. The CPM was introduced into a dynamic health care setting, in which many other unmeasured confounding factors may have affected the results. Our study was not designed to determine which specific elements of the CPM were associated with reduction in asthma readmissions. Per TJC requirements, we included only children with the primary diagnosis of asthma. Children with other primary diagnoses, especially viral infections such as respiratory syncytial virus and influenza, who also had an asthma exacerbation were excluded if asthma was not recorded in the primary position, and their outcomes are not reflected in our results. Furthermore, our postimplementation period covers the H1N1 outbreak. Review of our data suggested that the number of children admitted for acute asthma during the H1N1 outbreaks actually exceeded the numbers normally seen. In addition, we included children with medical complexity⁶⁹ if their primary diagnosis was asthma but in analysis, we did not control for their impact on asthma outcomes.

CONCLUSIONS

Implementation of an asthma CPM was associated with an increase in compliance with TJC CAC-3 and a delayed yet significant and sustained decrease in asthma readmissions without a change in direct hospitalization costs, hospital LOS, or complications. A sustained high CAC-3 compliance and prolonged observation may be required to observe

a significant reduction in readmissions. Baseline compliance with TJC CAC-1 and CAC-2 measures at our institution, as for many US hospitals, was already high with little opportunity for improvement, making these measures of questionable value to determine asthma care quality.

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