

Linking Patient-Centered Medical Home and Asthma Measures Reduces Hospital Readmission Rates

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KEY WORDS

asthma, readmission, core measures, follow-up, patient-centered medical home, home management plan of care

ABBREVIATIONS

CAC—Children's Asthma Care
 CI—confidence interval
 EMR—electronic medical record
 ED—emergency department
 JC—Joint Commission
 HMPC—home management plan of care
 KMCWC—Kapi'olani Medical Center for Women and Children
 PGMH—patient-centered medical home
 PCP—primary care provider
 QI—quality improvement
 RT—respiratory therapy (therapist)

Dr Bergert conceptualized and designed the study, participated as an active member of the Asthma Task Force, and drafted the initial manuscript; Dr Zhang carried out statistical analysis and reviewed and revised the manuscript; Dr Kimata carried out the initial analysis and reviewed and revised the manuscript; Drs Matthews and Patel conceptualized and designed the study, participated as active members of the Asthma Task Force, and reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.

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abstract

OBJECTIVE: We sought to achieve 100% compliance with all 3 Children's Asthma Care (CAC; CAC-1, CAC-2, CAC-3) measures and track attendance at follow-up appointments with the patient-centered medical home. The impact of these measures on readmission and emergency department utilization rates was evaluated.

METHODS: This quality improvement study evaluated compliance with CAC measures in pediatric patients aged 2 to 18 years old hospitalized with a primary diagnosis of asthma from January 1, 2008, through June 30, 2012. A multidisciplinary Asthma Task Force was assembled to develop interventions. Attendance at the follow-up appointment was tracked monthly from January 1, 2009. Readmission and emergency department utilization rates were compared between the preimplementation period (January 1, 2006, through December 31, 2007) and the postimplementation period (January 1, 2008, through June 30, 2012).

RESULTS: The preimplementation period included 231 subjects and the postimplementation period included 532 subjects. Compliance with CAC-3 was 95% from October 1, 2009, through June 30, 2012. Compliance with the postdischarge follow-up appointment was 69% from January 1, 2009 through September 30, 2009, increasing significantly to 90% from October 1, 2009, through June 30, 2012 ($P < .001$). Postimplementation readmission rates significantly decreased in the 91- to 180-day postdischarge interval (odds ratio: 0.29; 95% confidence interval: 0.11–0.78).

CONCLUSIONS: In children hospitalized with asthma, compliance with the asthma core measures and the postdischarge follow-up appointment with the primary care provider was associated with reduced readmission rates at 91 to 180 days after discharge. We attribute our results to a comprehensive set of interventions designed by our multidisciplinary Asthma Task Force. *Pediatrics* 2014;134:e249–e256

Asthma, characterized by bronchospasm, airway inflammation, and airway remodeling, is the most common chronic disorder of childhood with a prevalence rate estimated at 9.4% for children <18 years.¹ As an ambulatory care-sensitive condition, appropriate and timely ambulatory care has been shown to reduce hospital admission rates.² Nevertheless, in the United States, asthma continues to be a leading cause of childhood hospital admissions with >150 000 hospitalizations and 640 000 emergency department (ED) visits documented in 2007.³ Readmission rates are also high, ranging from 10% to 40%.⁴⁻⁷ In the state of Hawaii, an estimated 100 000 individuals have been diagnosed with asthma, one-third of whom are children.⁸ Moreover, a 2009 report noted that the majority of ED visits for asthma occurred in children <5 years old, with children and adults of Native Hawaiian heritage bearing the greatest asthma burden.⁹

When The Joint Commission (JC) designated inpatient pediatric asthma care as an improvement area, the Children's Asthma Care (CAC) process measure set was developed in 2007 in collaboration with the JC, Children's Hospital Corporation of America, National Association of Children's Hospitals and Related Institutions, and Medical Management Planning, Inc. The objective of the CAC was to improve the care of pediatric patients admitted with asthma exacerbation.¹⁰

The 3 core process measures include the following:

CAC-1: bronchodilator/reliever medication use;

CAC-2: systemic corticosteroid use; and

CAC-3: completion of a home management plan of care (HMPG).

Although the CAC measures mainly focus on inpatient asthma care, CAC-3 requires a postdischarge follow-up appointment and/or physician name

and contact number to be included at discharge. Many problems have been attributed to the lack of continuity from the inpatient to outpatient settings, reinforcing the value of good communication between hospital-based and primary care providers.¹¹⁻¹⁶ Moreover, the follow-up visit after hospitalization provides the primary care provider (PCP) with an opportunity to track the progress from admission to discharge, provide proper follow-up assessment and treatment, and reinforce asthma education initiated during hospitalization. Thus, CAC-3 provides linkage to the patient-centered medical home (PCMH) from the inpatient setting, which is particularly critical given the chronic nature of this disorder.

The aim of this quality improvement (QI) project was to achieve 100% compliance with the 3 core CAC measures in hospitalized children with asthma. An additional goal was to study the transition of care from the inpatient to the outpatient setting by tracking attendance at the posthospitalization follow-up appointment with the PCMH. To further evaluate the impact of asthma core measures and attendance at the follow-up appointment, secondary outcome measures included readmission and postdischarge ED utilization rates.

METHODS

Study Setting

This study setting was Kapi'olani Medical Center for Women and Children (KMCWC), a nonprofit pediatric hospital affiliated with the John A. Burns School of Medicine and the Department of Pediatrics. The facility is the only tertiary children's hospital in the Pacific Basin, with 207 beds, and serves children from the islands of Hawaii and the Pacific Basin, as well as visitors to the Islands.

The current hospital policy is to accept for admission any infant, child, or ad-

olescent requiring hospitalization regardless of insurance status. It is estimated that <10 000 children in Hawaii are uninsured, with a Medicaid participation rate of 89.9%, ranking 21st in the nation.¹⁷ Currently, 14 federally qualified health care centers serve as a safety net for those who are uninsured.¹⁸ This study used the Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines¹⁹ in its design as a QI project and was exempted from formal review by the Hawaii Pacific Health Institutional Review Board.

Study Design and Data Collection

An Asthma Task Force was established in September 2007 and was charged with the implementation of CAC core measures with a goal of reaching 100% compliance. This multidisciplinary group consisted of an administrative champion, hospital-based and community physicians, nursing leadership, respiratory therapists (RTs), the hospital Chief Operating Officer, and a QI officer. Historically, most of these individual disciplines provided independent, non-team-based asthma care to hospitalized children. The task force met monthly from January 2008 through June 2012 to review data from hospitalized pediatric patients with the primary diagnoses of asthma (International Classification of Diseases, Ninth Revision, code 493.XX). Only children identified by billing records between the ages of 2 and 18 years were included in this study, because this is the age group targeted for the CAC measures. The study encompassed 2 time periods: a pre-CAC implementation period (January 1, 2006 through December 31, 2007) and a post-CAC implementation period (January 1, 2008 through June 30, 2012). The post-CAC implementation period was additionally broken down into stages: stage 1A, initial electronic medical record

(EMR; January 1, 2008 through September 30, 2008); stage 1B, new EMR (October 1, 2008 through September 30, 2009); and stage 2, sustainability (October 1, 2009 through June 30, 2012). The study timeline is shown in Fig 1.

The children and adolescents included in the post-CAC implementation period were identified by 2 methods. On admission, an EMR best practice alert, triggered by the inclusion of asthma in the child's problem list or on the nursing admission form, prompted a manual chart review for compliance with the 3 core measures. The diagnosis of asthma was confirmed by a real-time EMR chart review by the asthma compliance officer from the KMCWC QI department who was also an Asthma Task Force member. Noncompliance with any component of the CAC measures prompted a call to the charge nurse, who then contacted the physician team for immediate action.

The case was again reviewed after discharge for CAC compliance. CAC-3 compliance, the most problematic, included several components: follow-up appointment or PCP contact name and number (HMPC-1), identification of triggers (HMPC-2), method and timing of rescue medications (HMPC-3), use of controller medications (HMPC-4), and use of reliever medications (HMPC-5). Furthermore, a copy of the HMPC and documentation that it was given and reviewed with the caretakers must be included in the chart.¹⁰ Failure to

comply with all of the CAC-3 components was considered a failure with respect to the data analysis.

For secondary validation, the monthly list of children included in the post-CAC implementation period was compared with a list generated by an approved JC quality measure vendor. The vendor data were from billing logs, which included discharge diagnosis and age, matched to the internal list discussed above. Any discrepancies that were identified by the asthma compliance officer were appropriately reconciled.

Interventions

Meeting on a monthly basis, the Asthma Task Force's focus was on the CAC measures as well as the entire spectrum of care for hospitalized children with asthma. The task force addressed roadblocks and failures by using Plan, Do, Study, Act cycles to implement midstream changes to improve CAC compliance. Initial results documenting poor compliance with the use of the carbon-copy HMPC improved after assimilating the HMPC into the EMR, starting April 2008. Furthermore, in October 2008, a new EMR with improved functionality populated the HMPC with workflow improvements such as the following: dropdown menus for medications and triggers, sections from other areas of the EMR (ie, PCP's name and phone number), and links to best practice alerts. Documentation reminders regarding completion of HMPC and

asthma education were added to discharge templates for both physicians and nurses. In January 2009, the Asthma Task Force added attendance at the PCMH follow-up appointment as an additional measure to be tracked (Fig 1). To measure attendance at the follow-up appointment, RT department personnel called the PCP 1 week after discharge to confirm attendance at the postdischarge appointment and compiled the data monthly. By October 2009, the majority of the midstream changes had occurred and the process became more focused on sustainability rather than implementation.

The asthma admission order set incorporated asthma education by the RT; completion was subsequently documented by the RTs, nurses, and/or physicians. The asthma education consisted of an interactive power point presentation delivered to the caretakers by the RT, a fourth-grade-reading-level handout on asthma, and specific instructions on medication administration techniques. In addition, the RT and nursing staff emphasized the importance of controller medications and follow-up appointments. Physicians further reinforced asthma education with the family when reviewing the HMPC before discharge.

Nursing, RT, and physician education focusing on the core measures and compliance rates were disseminated via newsletters and quarterly medical staff meetings, at medical education conferences (eg, Grand Rounds), and at nursing and RT meetings. The Asthma Task Force educated medical staff about the importance of follow-up appointments and the need to personally facilitate follow-up scheduling during challenging discharge time periods, such as weekends.

Attending physicians and residents with compliance failures were personally contacted by physician members of the task force. In addition, these occurrences

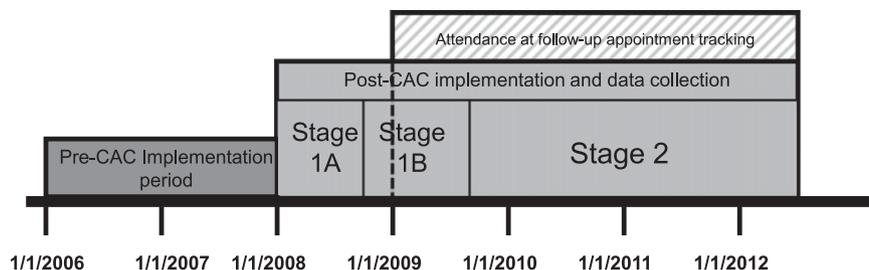


FIGURE 1
Study timeline. Stage 1A: initial EMR (January 1 through September 30, 2008); stage 1B: new EMR (October 1, 2008, through September 30, 2009); stage 2: sustainability (October 1, 2009, through June 30, 2012).

were part of each attending provider's Ongoing Professional Practice Evaluation report and used for recertification. The Pediatric Hospitalist Division also used compliance with the core measures as a component of physician performance evaluation.

Statistical Analysis of Outcome Measures

All data were de-identified. The monthly compliance rates for the 54-month CAC-3 data and the 42-month follow-up appointment data were summarized by descriptive statistics (means and SDs). Comparisons between groups were tested by independent *t* tests for continuous variables (eg, age) and Fisher's exact tests for categorical variables (eg, insurance status). An interrupted time-series analysis was used to further examine the trend and variation of monthly compliance rates during stages 1A/B as compared with stage 2, as well as separately with the follow-up data. This approach incorporates a segmented regression analysis that factors in pre-intervention level and trend when estimating expected changes in outcome measures due to the intervention.^{20–22} Outcomes measured included readmission and ED utilization rates for the pre- and post-CAC implementation time periods from billing data for 30-, 90-, and 180-days postdischarge using the principal diagnosis of asthma (International Classification of Diseases, Ninth Revision, code 493.XX). Fisher's exact tests examining the significance of odds ratios and 95% confidence intervals (CIs) were also calculated. All statistical analyses were conducted by using SAS version 9.3 (SAS Institute, Cary, NC), and a 2-sided *P* value <.05 was regarded as statistically significant.

RESULTS

During the study period, 763 children and adolescents between the ages of 2 and 18 years were discharged with

a primary diagnosis of asthma, qualifying them for inclusion in the study. The pre-CAC implementation period included 231 subjects and the post-CAC implementation period included 532. The ethnic breakdown of the study cohort mirrored the multiethnic composition of admissions to KMCWC and the community in general.

Compliance with the first 2 core measures (CAC-1 and CAC-2) remained >99% during the entire study. The overall CAC-3 compliance rate was 86.8% (462 of 532 subjects). CAC-3 compliance increased significantly from a mean of 74% in stage 1A/B to 95% in stage 2 (Fig 2, Table 1) (absolute difference = 21.6%; 95% CI: 13.3%–29.9%, *P* < .001).

The trajectory of CAC-3 toward 100% compliance is best illustrated using the interrupted time-series model shown in Fig 2. Similar trends are noted in follow-up appointment attendance. In the initial nine months (January 1, 2009 through September 30, 2009), 69% of children attended their follow-up appointment, which increased significantly to 90% in stage 2 (Fig 3, Table 1) (difference = 20.3%; 95% CI: 9.7%–31.0%; *P* < .001). Unfortunately, in 21 discharged children, there was no follow-up appointment attendance data documented or available. Of note, the slightly negative slope of –0.10% in the follow-up appointment attendance during stage 2 (Fig 3) was due to a few months of lower compliance rates, a finding that is not unexpected given the prolonged study period; this trend was not statistically significant.

Table 2 shows readmission and ED utilization rates comparing pre- and post-CAC implementation time periods (Fig 1). Although readmission rates were numerically lower in the post-CAC implementation period, the only significant difference was found during the 91- to 180-day period, which was 71% lower than in the pre-CAC period

(Table 2). There were no differences in ED utilization rates found between periods. Finally, neither age nor medical insurance coverage significantly affected our results. CAC-3 was completed in 462 children and not completed in 70. The mean age of children with completed CAC-3 was 5.8 ± 3.6 years compared with 4.9 ± 3.3 years for those with incomplete CAC-3 (*P* = .06). In addition, except for 4 children whose insurance status could not be determined, 87.7% (265 of 302) with government-subsidized medical insurance versus 85.8% (194 of 226) with private insurance had completed CAC-3 (*P* = .52).

DISCUSSION

As one of the most frequent indications for admission among pediatric patients, the chronic disease of asthma has a substantial impact on health care resource utilization.^{3,23} Readmission rates are being targeted by Hospital Engagement Networks and government insurers, leaving institutions searching for ways to improve performance in this area. Our QI efforts revealed that in children hospitalized with an acute asthma exacerbation, compliance with both the asthma core measures and attendance at the postdischarge follow-up appointment with the PCMH was associated with reduced readmission rates at 91 to 180 days postdischarge. We continue to analyze our results to understand why our ED utilization rates and shorter interval readmission rates were not affected. One possible explanation is that these were low at baseline compared with other published results.^{4–7,24}

Several institutions have been developing strategies to improve compliance with JC asthma core measures.^{25,26} CAC-3, the HMPC, has been the most problematic. A large cross-sectional study using administrative data from 30 children's hospitals revealed high compliance with the CAC-1 and CAC-2 but not with CAC-3 (72.9% in the last

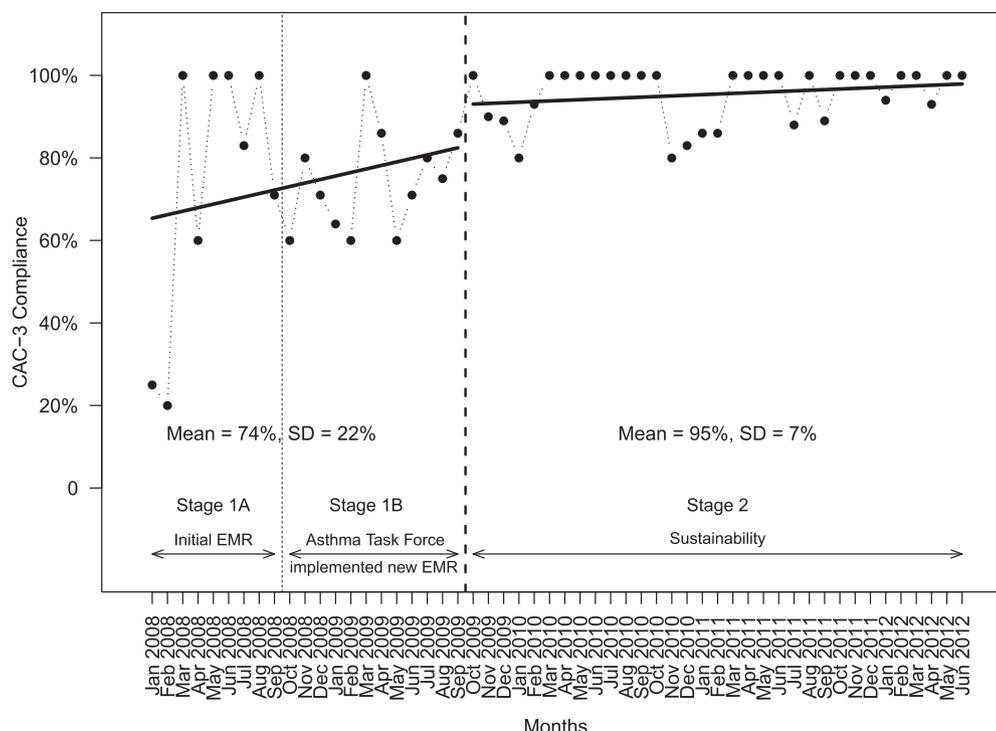


FIGURE 2

Percentage of compliance with the HMPC (CAC-3) from January 1, 2008, through June 30, 2012 (54 months). Solid circles indicate monthly data points. The solid line indicates the segmented regression line estimated by the interrupted time-series model.

three-quarters of the study).²⁴ In addition, there were no changes in readmission or ED utilization rates.²⁴ A single-site study from Utah showed a reduction in readmission rates with improved long-term compliance with all 3 core measures, although the authors did not track attendance at the follow-up appointment with the PCP.²⁵ We found that our multidisciplinary Asthma Task Force interventions resulted in sustained CAC-3 compliance

rates of nearly 100% for almost 3 years (33 months) and increased attendance with PCP follow-up appointments for the same time period. Taken together, we believe these efforts to improve asthma care resulted in reduced readmission rates at 91 to 180 days postdischarge.

Our findings support the concept that continuity of care with the PCMH is beneficial in reducing medical resource utilization by children with asthma.

Recent studies have highlighted the importance of a quality medical home for asthma patients, with lower readmission rates achieved for children with private insurance and easy access to a PCP.²⁷ In contrast, a study in adults revealed a 10-fold higher readmission rate without timely PCP follow-up when compared with those with timely follow-up.²⁸ Our study also supports the idea that the CAC-3 process measure may be related to improved patient outcomes, as gauged by hospital readmission rates.

Coordination of care between the inpatient setting and PCMH, especially for children and adolescents with chronic diseases, makes good sense and is widely supported in the literature, as well as by the American Academy of Pediatrics and other medical societies.^{13,29–31} Indeed, pediatric patients with asthma benefit from the utilization of a comprehensive medical home that provides continuity of care.^{27,32–35} Recent multi-center data have shown that asthma

TABLE 1 CAC-3 and Follow-up Appointment Compliance Rates

	No. of Months	Monthly Compliance Rate		
		Mean ^a , %	SD, %	Difference (95% CI) ^b , %
CAC-3 compliance rate				
Stage 1A/B (n = 181)	21	73.9	22.4	21.6 (13.3–29.9)
Stage 2 (n = 351 ^c)	33	95.5	6.7	
Follow-up attendance rate				
Stage 1B (n = 99)	9	69.4	26.3	20.3 (9.7–31.0)
Stage 2 (n = 330 ^c)	33	89.7	8.5	

Stage 1A/B, January 1, 2008, through September 30, 2008; stage 1B, October 1, 2008, through September 30, 2009; stage 2, October 1, 2009, through June 30, 2012.

^a Arithmetic average of monthly compliance.

^b Calculated by independent 2-sample *t* tests.

^c There were 21 children without follow-up data, which explains the difference between these numbers.

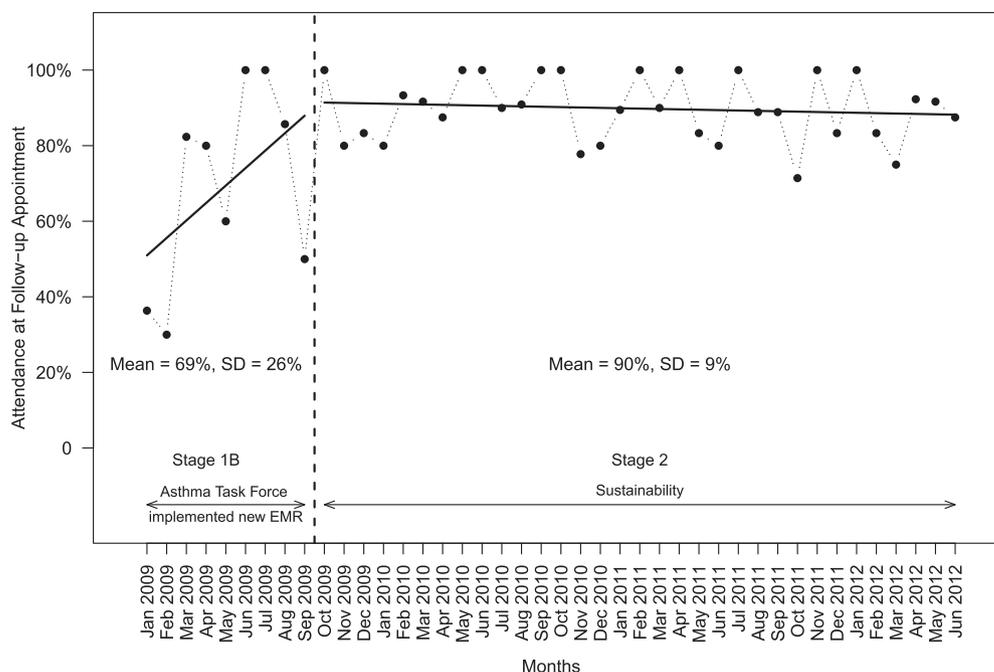


FIGURE 3 Percentage of compliance with the prearranged follow-up appointment with the PCMH from January 1, 2009, through June 30, 2012 (42 months). Solid circles indicate monthly data points. The solid line indicates the segmented regression line estimated by the interrupted time-series model.

was in the top 10 admission diagnoses in pediatric patients, with the highest readmission rate of 10.6% within the first year after discharge.^{5,36} These studies suggest that targeting care coordination for ambulatory care-sensitive conditions, such as asthma, may also have an impact on health care expenditures. At KMCWC, the Pediatric Hospitalist Division cares for ~85% of all inpatients. They are committed to providing timely communication with the PCP at discharge³⁷ and facilitating continuity at the transition of care to the outpatient setting. Children without an

identified PCP on admission are provided with a follow-up appointment with a new PCP before discharge.

In our study, the Asthma Task Force is credited with achieving meaningful QI in asthma care. We attribute this improvement to both the incorporation of the HMPC into the EMR as well as the multidisciplinary team approach that focused on transition of care, resulting in a more streamlined, consistent message to families, closely resembling the interactions of the PCMH. Notably, the Asthma Task Force was built almost entirely from disciplines that are already involved in the

care of hospitalized children with asthma (RT, nursing, physicians). The contribution of the asthma compliance officer to the team, a crucial component of successful QI projects,³⁸ required hospital administration commitment and financial support. Finally, the approach taken by the task force to position physicians with the responsibility for the final review of the HMPC with the caretaker was considered vital to the success of this QI project because it consolidated the information provided by other team members with the highest level of authority.

The limitations of this study reflect limitations of any single-site study. A modest sample size and a unique population of children and adolescents that includes Asian and Pacific Island influence likely preclude the study results from being generalizable. In addition, because our community has a high rate of medical resource utilization for asthma, the effect of follow-up appointment compliance may have been more pronounced.⁹ Recent physician

TABLE 2 Asthma-Related ED Utilization and Readmission Rates

	Pre-CAC Implementation (January 2006–December 2007) (n = 231), %	Post-CAC Implementation (January 2008–June 2012) (n = 532), %	OR	95% CI
ED visits				
0–30 days	0.0	1.1	N/A	N/A
31–90 days	1.3	2.1	1.60	(0.44–5.81)
91–180 days	2.6	1.5	0.57	(0.20–1.67)
Readmission				
0–30 days	1.3	0.38	0.29	(0.05–1.73)
31–90 days	1.3	1.1	0.87	(0.21–3.50)
91–180 days	4.3	1.3	0.29	(0.11–0.78)

N/A, not applicable; OR, odds ratio.

workforce data places Hawaii ninth highest in the nation with 1 general pediatrician per 1005 children.³⁹ When combined with a low uninsured pediatric population served by a safety net of 14 federally qualified health care centers, the abundant access to medical care sets it apart from most other states.^{17,18} Another limitation is the potentially confounding activity of the Asthma Task Force, which not only focused on compliance with asthma core measures but also on asthma education of the caretakers, which has been shown to reduce ED visits and hospitalizations.³⁴ It is therefore difficult to ascertain the individual effect of compliance with core measures without considering this additional component. Finally, reported ED utilization rates are only for the KMCWC and do not include ED visits to other hospitals in the Honolulu area.

CONCLUSIONS

We have shown that long-term compliance with JC asthma core measures as well as attendance at the predischARGE scheduled PCP follow-up appointment is associated with reduced readmission rates for asthma. This finding supports the notion that a smooth transition from the inpatient setting to the PCMH leads to an improvement in outcomes. We attribute our results to the efforts of a multidisciplinary Asthma Task Force in providing comprehensive medical care for children hospitalized with asthma.

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