

HMPC compliance and readmission rates

Association Between Pediatric Home Management Plan of Care Compliance and Asthma Readmission

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What's Known on This Subject: HMPC compliance was recently retired by The Joint Commission, based on insufficient evidence of its benefit. Compliance standards were based on a strict set of criteria, with no studies evaluating which components may have had an impact on readmissions.

What This Study Adds: Our study found that providing an HMPC upon discharge (including those without specific PCP follow-up information) is associated with decreased asthma readmission rates. This suggests that although HMPC is no longer a required measure, there may still be utility in continuing this practice.

Abstract

Objectives: In 2007, The Joint Commission implemented three children's asthma care (CAC) measures to help improve the quality of care for patients admitted with asthma. Due to lack of consistent evidence showing a relationship between home management plan of care (HMPC) compliance and readmission rates, CAC-3 was retired in 2016. We aimed to understand the

relationship between HMPC compliance and revisits to the hospital, and investigate which components of the HMPC, if any, were driving the effect.

Methods: This was a retrospective cohort study at a quaternary care freestanding children's hospital, including patients between 2 and 17 years of age admitted with a primary diagnosis of asthma between January 1, 2006 and July 1, 2013. Bivariate and multiple logistic regression analyses examined effects of HMPC provider compliance on hospital readmission and emergency department utilization for asthma within 180 days of initial discharge, controlling for admission to the intensive care unit, age, gender, ethnicity, insurance type and whether inhaled corticosteroids were prescribed.

Results: 1,176 patients were included. Patients discharged with an HMPC (n=756, of which 84% were fully compliant) were found to have significantly lower readmission rates (7% vs. 11.9%; aOR=0.63; 95% CI, 0.41-0.95) and ED revisit rates (aOR=0.73; 95% CI, 0.56-0.96) within 180 days of discharge.

Conclusions: Providing an HMPC upon discharge was found to be associated with decreased asthma readmission and ED utilization rates. This suggests that although HMPC is no longer a required measure, there may still be utility in continuing this practice.

Keywords

Asthma, Children, Home Management Plan of Care, Readmission, Compliance

Abbreviations

TJC: The Joint Commission

CAC: Children's Asthma Care

HMPC: Home Management Plan of Care

CHLA: Children's Hospital Los Angeles

PMD: Primary Medical Doctor

EMR: Electronic medical record

MAP: Multidisciplinary Action Plan

ICU: Intensive Care Unit

ED: Emergency Department

Introduction:

Asthma is one of the most common chronic diseases of childhood¹, and the second most common cause of hospitalization for children under 15.² Over 10 million school days each year are missed due to asthma.^{2,3} Prior hospitalizations for asthma and poor medication adherence have been shown to be independent predictors for readmission within 12 months.⁴⁻⁶ Minority race/ethnicity and low-income status have been associated with higher readmission rates for asthma.⁷⁻⁹

In 2007, The Joint Commission (TJC) introduced three children's asthma care (CAC) quality measures.¹⁰ CAC-1 and CAC-2 focused on administration of reliever medications and systemic corticosteroids, respectively. CAC-3 focused on self-management, by providing the patient or caregiver a comprehensive home management plan of care (HMPC) prior to discharge. After implementation, there was insufficient evidence to determine whether overall patient outcomes

(per TJC, as measured by emergency department (ED) utilization or readmissions) had improved.^{11,12} One cross-sectional study looking at administrative data from 30 US children's hospitals found no significant association between CAC-3 compliance and ED utilization or readmission rates at the 7-, 30-, or 90-day post discharge marks.¹³ However, aggregate institutional-level, rather than individual-level, compliance and readmission rates were used, and verification that individual patients received an HMPC upon discharge could not be determined. Another quality improvement study looking at the effects of an asthma task force on improving CAC-3 compliance as well as post-discharge follow-up appointments found a significant decrease in readmission rates between 90-180 days after discharge.¹⁴ However, it was difficult to determine whether CAC-3 compliance itself led to improved outcomes.

Fassl et al. studied the effects of an asthma care process model on provider CAC-3 compliance and readmissions within 6 months post-discharge. This model introduced a formal educational program which specifically focused on elements of the HMPC required by TJC. They found a decrease in readmissions from 17% to 12%, starting 9 months after final implementation, which correlated with sustained CAC-3 compliance greater than 87%.¹⁵ While an evidence-based approach to standardize care and improve quality is achievable, this study was not designed to determine which specific components of the care process model were associated with a decrease in asthma readmissions. Therefore, it is difficult to assume that the decrease in readmission rates was attributable to improvement in overall CAC-3 compliance. Due to the lack of consistent evidence showing continued patient benefit within the literature, CAC-3 was retired in January 2016.

The CAC-3 measure was an all-or-none measure. As outlined by TJC prior to January 1, 2016, in order to meet compliance standards, the HMPC must have included five distinct components: (1) arrangements for primary care physician (PCP) follow-up including date, time and physician's name and phone number, (2) environmental triggers, (3) method and timing of rescue actions, (4) how and when to use controller medications, and (5) how and when to use reliever medications.¹⁰ The specific components of the HMPC have not been studied, and it is not known whether adherence to each or any of these recommended elements is necessary to impact patient outcomes. Therefore, previous studies evaluating HMPC compliance using the strict TJC definition may have under-estimated the effect, by not including those patients who received an HMPC without all the required elements. We hypothesize that patients given an HMPC upon discharge will have decreased readmission and ED utilization rates within 180 days of initial discharge. We chose 180 days to best approximate outcomes from previous studies, and provide a reasonable period of time for which monitoring could be accomplished.

We aimed to evaluate the relationship between any amount of HMPC provider compliance and readmission and emergency department (ED) utilization rates. By focusing on individual level data and implementing an HMPC into a system that already had an established educational component for the patient and family, we hoped to provide more clarity regarding whether providing an HMPC given to patients upon discharge can help reduce unnecessary readmissions, despite the recent retirement of the CAC-3 metric.

Patients and Methods:*Background:*

An evidence-based care plan for asthma, known locally as a multidisciplinary action plan (MAP), was implemented in January 2006. It was intended to help in the management of acute asthma exacerbations unresponsive to outpatient treatment. The recommendations within the MAP were formulated by a working group that included community and hospital based physicians, asthma specialists, pharmacists, nurses and respiratory therapists. They were incorporated into an electronic order entry care set, and included guidance on the use of systemic corticosteroids, inhaled bronchodilators, appropriate oxygen weaning protocols, and being discharged home with inhaled corticosteroids. Patient and family education consisted of video education, hands on teaching regarding delivery system and spacer use, as well as nursing review of all prescribed medications. The HMPC (available in English and Spanish) was also recommended by the MAP; however, this component was not implemented until May 2008. Prior to 2008, patients and families received inconsistent information regarding discharge follow-up, with no monitoring of this process. Providing an HMPC upon discharge also included additional education regarding proper medication use, trigger avoidance and assessment of disease severity. Individual patient chart review from the first two years of MAP implementation revealed that the presence of a MAP order in the EMR directly correlated with suggested recommendations by our expert panel and, thus, was an appropriate proxy for evidence-based guideline adherence and compliance.

After written HMPC implementation in 2008, we performed four separate plan-do-study-act cycles over the course of the following 3 years, including implementation of an HMPC in the

electronic medical record (EMR) (Cerner Millennium, Kansas City, MO) in October 2010. HMPC compliance improved from 39% to over 90%, which was maintained throughout the course of our study period. Details of the electronic HMPC and HMPC process have been published previously.¹⁶

HMPC Compliance and Scoring:

Although the HMPC focuses on five distinct components, we found that only the first component (physician/clinic follow-up) had inconsistent adherence; all remaining components were auto-populated from the EMR and consistently met 100% compliance. In order to be consistent with TJC standards, forms were coded as “fully compliant” if the primary medical doctor (PMD)/clinic name, phone number and follow-up appointment timeframe or PMD/clinic name and exact follow-up date/time were provided in addition to the other 4 required components. Forms where the PMD/clinic name, phone number or follow-up information were provided but not in the correct combination per The Joint Commission requirements were termed “partially compliant” in order to study whether they still provided benefit based on our primary outcome. Those without an HMPC in the chart were identified as “non-compliant”.

Study Design:

We performed a retrospective cohort study at a single quaternary care freestanding pediatric academic center located in an urban setting. We compared patients admitted with a primary diagnosis of asthma (*International Classification of Diseases, Ninth Revision* [ICD-9] code 493.xx) discharged with an HMPC, to patients discharged with no HMPC.

Patients between 2 and 17 years of age admitted from our emergency department between January 1, 2006 and July 1, 2013 with a primary diagnosis of asthma were included.

Patients transferred from outside facilities were excluded, since we were unable to verify the type of treatment they received. Additionally, patients with the following conditions were also excluded: chronic respiratory failure, pre-existing chronic lung and/or cardiac disease (e.g., bronchopulmonary dysplasia, cystic fibrosis, congenital heart disease), or underlying metabolic disorder. Our hospital does not recognize observation status separately from inpatient status. The primary outcome was hospital readmission or ED utilization to the same facility for asthma within 180 days of initial discharge. For patients with multiple asthma related admissions during the study period, only the second admission was included as a readmission of the index hospitalization. Subsequent related admissions were not included as “new” admissions from which to monitor another 180 day period.

Through direct chart review of all included patients by a single registered health information technician reviewer, clinical and demographic information was collected for all index admissions and readmissions occurring to the same facility (see Measures). During the study period, 95% of patients admitted with a primary diagnosis of asthma were cared for on the general medical ward by one of the pediatric house staff teaching teams. The remaining 5% were cared for by pediatric hospitalists without residents, when census was high. To verify that all included patients met inclusion criteria, we performed chart reviews on a random sample of 30% of all primary asthma admissions between January 1, 2010 and January 1, 2012 (n=107). We were able to verify a primary diagnosis of asthma in 105 of 107 charts reviewed (98%). The same queries (based on ICD-9 codes) were then applied to our study population in order to obtain the list of all included patients. The study protocol was approved by the Institutional Review Board at CHLA, who determined that informed consent was not required.

Measures:

HMPC compliance was initially recoded into a single indicator variable representing “any vs. no HMPC” (fully compliant=1, partially compliant=1, no HMPC=0). For a subsequent analysis examining TJC standards, we also created an indicator variable representing the effect of “full compliance” (fully compliant=1, partially compliant=0, no HMPC=0). Additional covariates measured included age in years, length of stay in days, gender (male vs. female), ethnicity (Hispanic vs. non-Hispanic), primary language (English vs. other), insurance type (public vs. other), and a binary indicator of whether the patient had an ICU stay at any point during the hospitalization, or was discharged with an inhaled corticosteroid (budesonide, fluticasone, beclomethasone or fluticasone/salmeterol, comprising 100% of prescribed controllers upon discharge). In order to be comparable to studies mentioned previously, binary outcomes included whether the patient had a repeat inpatient admission or return visit to the ED (which included less acute urgent care visits) for asthma within 180 days of initial discharge.

Statistical Analysis:

Descriptive statistics were computed for all measures, including medians and interquartile range (IQR) for age and length of stay (LOS) and frequencies and percentages for categorical variables. A series of chi-square and Wilcoxon signed rank tests assessed relationships between all candidate measures and the inpatient readmission and ED utilization outcomes. Variables that were associated with at least one outcome at $p < 0.10$ were retained for investigation in a multiple logistic regression model. Non-significant bivariate predictors were tested for confounding, and were also included in multivariable analysis if found to be a confounder. Those variables that maintained a significance value of $p < 0.05$ after multivariable

analysis were retained in the final model and included in table representation. All analyses were performed using IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA).

Results:

A total of 1,176 patients between 2 and 17 years of age admitted with a primary diagnosis of asthma were included in our study. Patient demographics and clinical characteristics by primary outcome are presented in Table 1. 756 (64%) were discharged with an HMPC; 420 (36%) were not. 638 (84%) of all HMPCs were fully compliant, and an additional 118 (16%) were partially compliant. A total of 103 (8.8%) patients were readmitted within 180 days, while 356 (30.3%) returned to the ED for asthma related issues. There were no differences in HMPC compliance based on age, gender, insurance, or primary language, and no other differences were seen in HMPC type based on demographics and clinical characteristics.

Figure 1 demonstrates the overall change in both readmission within 180 days and repeat ED utilization over time for our study patients. We found that time (i.e. visit date) was associated with a slight decrease in ED utilization ($\beta = -.02$, $p = .01$), but no association was found with readmissions ($\beta = -.01$, $p = .29$).

Bivariate Analysis

HMPC compliance and type

Patients discharged with an HMPC were significantly less likely than those who had no HMPC to have an inpatient readmission within 180 days of initial discharge (OR= 0.56, 95% CI 0.37-0.84) (Table 1).

Patient demographics

Compared to the 13-17 year age group, patients between the ages of 2-5 years (OR=0.39, 95% CI 0.22-0.70) and 6-12 years (OR=0.37, 95% CI 0.20-0.67) were less likely to have a repeat inpatient readmission. However, patients between the ages of 2-5 years were more likely to return to the ED (OR=2.42, 95% CI 1.45-4.06). No differences in ED utilization were seen with the 6-12 year age group. Additionally, Hispanic patients were less likely to have an inpatient readmission (OR=0.54, 95% CI 0.36-0.81), but more likely to return to the ED (OR=1.66, 95% CI 1.26-2.19), while patients whose primary language was English were less likely to experience an ED revisit (OR=0.70, 95% CI 0.55-0.91).

Clinical covariates

Patients discharged with an inhaled corticosteroid trended toward being less likely to have a repeat inpatient admission (OR=0.67, 95% CI 0.44-1.02), without any effect on ED utilization (OR=0.92, 95% CI 0.70-1.20). Patients with longer initial LOS were more likely to be readmitted (OR=1.07, 95% CI 1.01-1.14), with no effect on repeat ED utilization (OR=0.99, 95% CI 0.93-1.04). All predictors found to be significant in bivariate analyses were maintained for multiple regression analysis. All non-significant predictors for readmission (gender, primary language, and ICU stay) and ED utilization (gender, inhaled corticosteroids, length of stay, and ICU stay) were tested for confounding and found to not be confounders. Therefore, they were excluded from our multivariable model.

Multiple Regression Analysis

Inpatient Readmission

Controlling for age and ethnicity (Table 2), patients discharged with an HMPC had significantly lower asthma related readmission rates than those without an HMPC (7% vs. 11.9%; aOR=0.63, 95% CI 0.41-0.95). Compared to 13-17 year old patients, patients age 2-5 years (aOR=0.45, 95% CI 0.25-0.80) and 6-12 years (aOR=0.41, 95% CI 0.22-0.75) were less likely to be readmitted. Hispanic patients were less likely to be readmitted than non-Hispanic patients (aOR=0.61, 95% CI 0.40-0.93). In the follow-up multiple regression analysis (Table 3), looking at the TJC standards for compliance, there was no association between a fully compliant HMPC and readmission (aOR=0.81, 95% CI 0.53-1.22).

ED Utilization

Controlling for age, ethnicity, and insurance, patients discharged with any type of HMPC had significantly lower asthma-related ED utilization rates than those without an HMPC (aOR=0.73, 95% CI 0.56-0.96). Patients between the ages of 2-5 years were more likely to return to the ED when compared to the 13-17 year age group (aOR=2.23, 95% CI 1.3-3.8), with no differences seen within the 6-12 year age group. Hispanic patients (aOR=1.50, 95% CI 1.1-2.0) and those with public insurance (OR=3.09, 95% CI 1.9-4.9) were significantly more likely to have repeat ED utilization. Full compliance on the HMPC was associated with lower likelihood of a return ED visit (aOR=0.71, 95% CI 0.55-0.92).

Discussion:

Our study shows a significant association between providing an HMPC upon discharge with decreased readmission rates and ED utilization within 180 days, with no association seen

between readmission and compliance based on TJC standards. Previous studies have shown either positive or no correlations between HMPC compliance and readmission rates.¹³⁻¹⁵ Prior to its retirement on January 1, 2016, CAC-3 had focused on an “all-or-none” approach to compliance, requiring that all five of the HMPC components be completed in full to meet compliance criteria. Those standards required the presence of PCP follow-up information. Based on our findings that degree of compliance was not associated with differences in readmission rates, the presence of specific PCP follow-up information may not be necessary to include on the HMPC. However, continuing to provide an HMPC upon discharge with or without this information could still provide clear benefit.

By providing an HMPC upon discharge, our patients and families received specific education related to medication use, trigger avoidance and identification of disease severity based on symptoms and/or peak flow numbers. This education was provided with every form, regardless of whether the form included PCP follow-up information. Patients who did not receive this form did not benefit from this additional education, which could have led to the significant results seen in our study. Therefore, it is possible that institutions who utilize these forms should continue to do so, despite the recent CAC-3 retirement.

In order to more effectively state that outcome differences were associated with HMPC use rather than unexpected changes over time, we examined whether there were any differences over time in readmission or ED utilization rates. We found no significant difference in readmissions, and a slight decrease in ED utilization, over the course of our study period. Based on our original hypothesis that an HMPC upon discharge would have an impact, it would be expected that decreases in one or both outcomes would be seen over time, perhaps due to

improved longitudinal quality improvement efforts and related patient/family education. This allows us to more confidently say that decreases in readmission rates within 180 days after discharge were more likely associated with HMPC use.

By implementing HMPC use into a system that was already providing specific asthma education for patients and families, we were able to address one of the limitations in the study by Fassl et al.¹⁵ By utilizing individual level data, we were also able to address the potential limitation by Morse et al., which used aggregate data to show no association between compliance and readmissions at the 7-, 30-, and 90-day post discharge timeframes.¹³

Younger patients were less likely to be readmitted when compared to those older than 13, however, they were more likely to return to the ED for asthma related issues. Given the potential ambiguity in diagnosing a young patient with asthma, it is possible that the younger patient cohort of our study had a higher proportion of those without a true asthma diagnosis. However, despite this possibility, they may still seek out resources when showing signs or symptoms that are concerning to the parent based on a previous asthma diagnosis. A prospective study design would be helpful to better understand the reasoning for return ED visits.

There are some limitations with our retrospective study design. We only focused on a single center and were unable to ascertain whether patients were re-admitted to or accessed resources at an outside institution. It is possible that our results would have been different had this information been obtained. However, since all of our included patients were directly admitted from our ED, it is possible that many would return to our facility for any future care post discharge. By excluding patients transferred from outside our institution, we attempted to limit the number of patients who may return to a different facility.

We were also unable to measure medication utilization after discharge or assess the impact of continued outpatient care that our patients may have received after discharge (e.g., continued use of inhaled corticosteroids). This may have led to an overestimation of the true association between HMPC compliance and readmission or ED utilization rates, since outpatient use of inhaled corticosteroids may have led to improvements in the outcomes we were studying. In addition, we were unaware of any asthma related quality improvement projects that may have been organized in parallel during our study period. Outpatient efforts to improve asthma management may have had an impact on our final outcome results.

It was also difficult to know if other unmeasured variables were associated with our primary outcomes. For instance, patients with a first time wheezing episode may have received less education about asthma, or physicians may have been reluctant to label a patient as having asthma, and opted to not provide an HMPC upon discharge. We were also unable to assign specific asthma severity classifications upon admission and, therefore, could not account for this in our final analyses. It is possible that patients with less severe disease would be less likely to receive an HMPC and less likely to receive an inhaled corticosteroid; however we would also expect less severe patients to have decreased odds of revisit, therefore underestimating the true effect.

Since the children's asthma care measures were implemented in 2007, there has been a lot of debate regarding their effectiveness in preventing readmissions and improving overall patient outcomes. Nkoy et al. was able to identify nine feasible and reliable evidence-based clinical process measures to assess the quality of inpatient asthma.¹⁷ Although provider compliance was found to be low with most of these measures, it highlights the importance of

identifying strategies that will have the most impact on patients once they are discharged from the hospital. Further studies are needed to evaluate the effectiveness of measures such as scheduled follow-up appointments, improved communication between inpatient and outpatient providers, and interventions by a social worker prior to discharge.¹⁸

Conclusion:

Through retrospective review of outcomes within a quaternary care children's hospital including a large percentage of Hispanic and publicly insured patients, we found an association between providing an HMPC, and related education, upon discharge with reductions in both readmission and ED utilization rates 180 days after initial hospitalization. This finding for readmissions (but not ED utilization) was masked when utilizing previous standards by TJC regarding strict HMPC compliance. Therefore, continued use of an HMPC upon discharge for patients with asthma may have ongoing benefit.

Declaration of Interest and Acknowledgements

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The authors have no financial relationships relevant to this article to disclose.

Conflicts of Interest

The authors have no conflicts of interest to disclose.

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Table 1. Patient demographics based on primary outcomes

Inpatient Readmission					ED return	
Characteristic	Yes	No	p-	Yes	No	p-value
Age Categories (years), N (%)			.03			<.001
2-5	47(45.6%)	535(49.9%)		213(59.8%)	369(45%)	
6-12	37(35.9%)	453(42.2%)		123(34.6%)	367(44.8%)	
13-17	19(18.5%)	85(7.9%)		20(5.6%)	84(10.2%)	
LOS (days), median (IQR)	2.05(1.41-	1.66(1.08-	.03	1.64(1.11-	1.70(1.14-	.65
Gender, N (%)			.48			.35
Male	69(67%)	681(63.5%)		220(61.8%)	530(64.6%)	
Female	34(33%)	392(36.5%)		136(38.2%)	290(35.4%)	
Ethnicity, N (%)			.003			<.001
Hispanic	55(53.4%)	720(67.1%)		264(74.2%)	511(62.3%)	
Non-Hispanic	48(46.6%)	340(32.9%)		92(25.8%)	296(37.7%)	
Primary Language, N (%)			.53			.01
English	63(61.2%)	603(56.2%)		184(51.7%)	482(58.8%)	
Other	40(38.8%)	437(43.8%)		168(48.3%)	309(41.2%)	
Insurance, N (%)			.07			<.001
Public Insurance	81(78.6%)	917(85.5%)		333(93.5%)	665(81.1%)	
Other	22(21.4%)	156(14.5%)		23(6.5%)	155(18.9%)	
Inhaled Corticosteroids, N (%)	63(61.2%)	752(70.1%)	.06	242(68%)	573(69.9%)	.52
ICU During Index admission, N (%)	10(9.7%)	117(10.9%)	.71	31(8.7%)	96(11.7%)	.13
HMPC Compliance, N (%)			.01			.12
None	50 (48.5%)	370 (34.5%)		139 (39.0%)	281 (34.3%)	
Partial/Full	53 (51.5%)	703 (65.5%)		217 (61.0%)	539 (65.7%)	
HMPC Compliance, N (%)			.10			.04
None/Partial	55 (53.4%)	483 (45.0%)		179 (50.3%)	359 (43.8%)	
Full	48 (46.6%)	590 (55.0%)		177 (49.7%)	461 (56.2%)	

Table 2. Multivariable Logistic Regression Model of Inpatient Readmission and Repeat ED Utilization by Any HMPC (Partial or Full Compliance vs. No Compliance).

Repeat Inpatient Admission				Repeat ED Utilization		
Odds Ratio		95% CI	P	Odds Ratio	95% CI	P
HMPC Compliance	0.63	0.41-0.95	0.028	0.73	0.56-0.96	0.022
(Partial/Full vs. None)						
Age (years, categorical) ^a						
2-5	0.45	0.25-0.80	0.007	2.23	1.32-3.79	0.003
6-12	0.41	0.22-0.75	0.004	1.29	0.75-2.21	0.36
Hispanic Ethnicity	0.61	0.40-0.93	0.020	1.50	1.12-2.00	0.006
Public Insurance (Medi-Cal)	-	-	-	3.09	1.94-4.93	<0.001

^aThe reference group is: 13-17 years.

Table 3. Multivariable Logistic Regression Model of Inpatient Readmission and Repeat ED Utilization by Fully Compliant HMPC (Full Compliance vs. No HMPC or Partial Compliance).

Repeat Inpatient Admission				Repeat ED Utilization		
Odds Ratio				95% CI	P	
HMPC Compliance (Full vs. None/Partial)	0.81	0.53-1.22	0.31	0.71	0.55-0.92	0.010
Age (years, categorical) ^a						
2-5	0.44	0.24-0.79	0.006	2.28	1.34-3.87	0.002
6-12	0.40	0.22-0.74	0.003	1.31	0.76-2.25	0.34
Hispanic Ethnicity	0.58	0.39-0.88	0.011	1.48	1.11-1.98	0.007
Public Insurance (Medi-Cal)	-	-	-	3.09	1.94-4.93	<0.001

^aThe reference group is: 13-17 years.

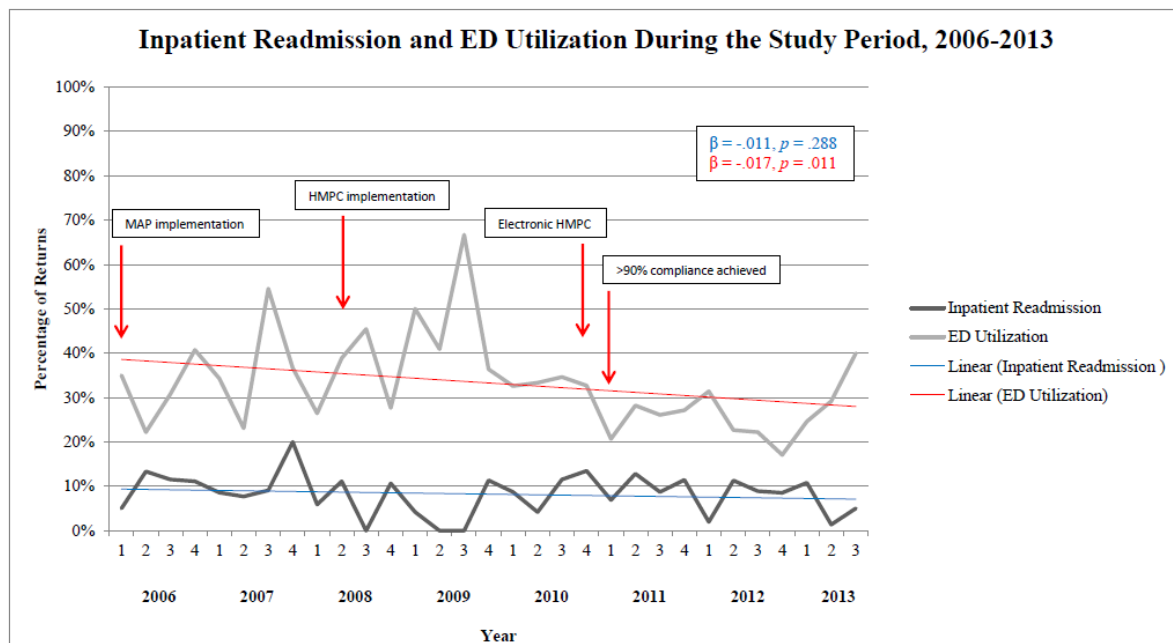


Figure 1.