

Leveraging the Outpatient Pharmacy to Reduce Medication Waste in Pediatric Asthma Hospitalizations

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BACKGROUND AND OBJECTIVE: Previous local quality improvement focused on discharging patients with inhaled corticosteroids (ICS) “in-hand” decreased healthcare reutilization after hospitalization for an asthma exacerbation. However, as a result of these new processes, some patients admitted for an asthma exacerbation received more than one ICS inhaler during their admission, contributing to medication waste and potential patient confusion regarding their discharge medication regimen. We sought to decrease this waste.

METHODS: We conducted a quality improvement project to reduce the prescribing of multiple ICS inhalers to patients at a large academic children's hospital. Our primary outcome measure was the monthly percentage of patients admitted with an asthma exacerbation who were administered more than one ICS inhaler. A secondary outcome measure evaluated the reliability of the new process of using the hospital-based outpatient pharmacy

to supply ICS “in-hand” and verify insurance coverage. After the process map review, we hypothesized a delay in the initial ICS treatment decision would allow for both a finalized discharge medication plan and a standardized process to verify outpatient insurance coverage.

RESULTS: The mean percentage of patients receiving more than one ICS inhaler decreased from our baseline of 7.4% to 0.7%. Verification of outpatient prescription insurance coverage via the outpatient pharmacy increased from 0.7% to 50%. The average inpatient cost (average wholesale price) for ICS decreased by 62% to \$90.25.

CONCLUSIONS: Our process change to use the outpatient pharmacy to dispense and verify insurance coverage for ICS medication was associated with a reduction in medication waste during admission for an asthma exacerbation. *Journal of Hospital Medicine* 2020;15:28-34. © 2020 Society of Hospital Medicine

Asthma results in approximately 125,000 hospitalizations for children annually in the United States.^{1,2} The National Heart, Lung, and Blood Institute guidelines recommend that children with persistent asthma be treated with a daily controller medication, ie, an inhaled corticosteroid (ICS).³ Hospitalization for an asthma exacerbation provides an opportunity to optimize daily controller medications and improve disease self-management by providing access to medications and teaching appropriate use of complicated inhalation devices.

To reduce readmission⁴ by mitigating low rates of postdischarge filling of ICS prescriptions,^{5,6} a strategy of “meds-in-hand” was implemented at discharge. “Meds-in-hand” mitigates medication

access as a barrier to adherence by ensuring that patients are discharged from the hospital with all required medications in hand, removing any barriers to filling their initial prescriptions.⁷ The Asthma Improvement Collaborative at Cincinnati Children's Hospital Medical Center (CCHMC) previously applied quality improvement methodology to implement “meds-in-hand” as a key intervention in a broad strategy that successfully reduced asthma-specific utilization for the 30-day period following an asthma-related hospitalization of publicly insured children from 12% to 7%.^{8,9}

At the onset of the work described in this manuscript, children hospitalized with an acute exacerbation of persistent asthma were most often treated with an ICS while inpatients in addition to a standard short course of oral systemic corticosteroids. Conceptually, inpatient administration of ICS provided the opportunity to teach effective device usage with each inpatient administration and to reinforce daily use of the ICS as part of the patient's daily home medication regimen. However, a proportion of patients admitted for an asthma exacerbation were noted to receive more than one ICS inhaler during their admission, most commonly due to a change in dose or type of ICS. When this occurred, the initially dispensed inhaler was discarded de-

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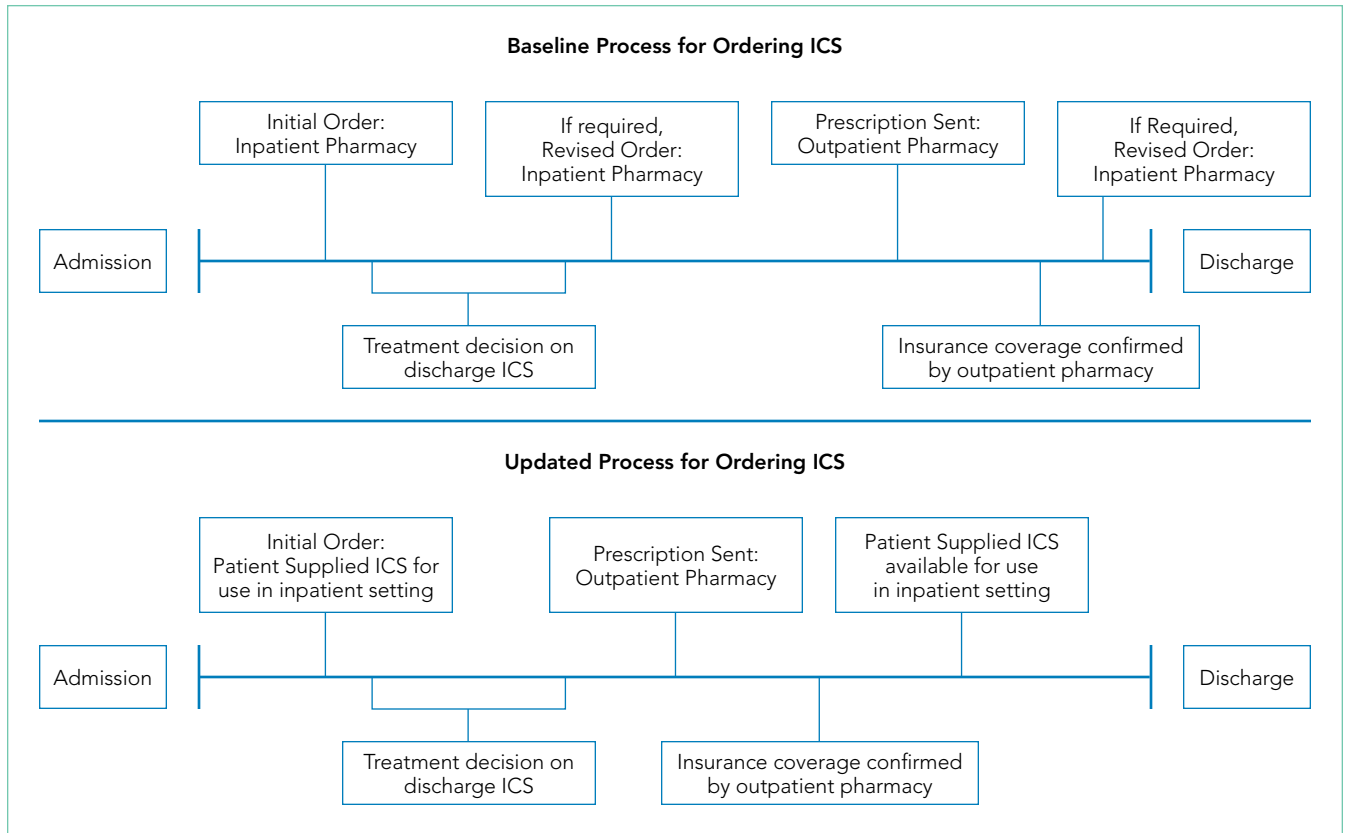


FIG 1. Baseline and updated ICS ordering process timelines.

Abbreviations: ICS, inhaled corticosteroids; PDSA, plan-do-study-act.

spite weeks of potential doses remaining. While some hospitals preferentially dispense ICS devices marketed to institutions with fewer doses per device, our pharmacy primarily dispensed ICS devices identical to retail locations containing at least a one-month supply of medication. In addition to the wasted medication, this practice resulted in additional work by healthcare staff, unnecessary patient charges, and potentially contributed to confusion about the discharge medication regimen.

Our specific aim for this quality improvement study was to reduce the monthly percentage of admissions for an acute asthma exacerbation treated with >1 ICS from 7% to 4% over a six-month period.

METHODS

Context

CCHMC is a quaternary care pediatric health system with more than 600 inpatient beds and 800-900 inpatient admissions per year for acute asthma exacerbation. The Hospital Medicine service cares for patients with asthma on five clinical teams across two different campuses. Care teams are supervised by an attending physician and may include residents, fellows, or nurse practitioners. Patients hospitalized for an acute asthma exacerbation may receive a consult from the Asthma Center consult team, staffed by faculty from either the Pediatric Pulmonology or Allergy/Immunology divisions. Respiratory therapists (RTs) administer inhaled medications and provide asthma education.

Planning the Intervention

Our improvement team included physicians from Hospital Medicine and Pulmonary Medicine, an Asthma Education Coordinator, a Clinical Pharmacist, a Pediatric Chief Resident, and a clinical research coordinator. Initial interventions targeted a single resident team at the main campus before spreading improvement activities to all resident teams at the main campus and then the satellite campus by February 2017.

Development of our process map (Figure 1) revealed that the decision for ordering inpatient ICS treatment frequently occurred at admission. Subsequently, the care team or consulting team might make a change in the ICS to fine-tune the outpatient medication regimen given that admission for asthma often results from suboptimal chronic symptom control. Baseline analysis of changes in ICS orders revealed that 81% of ICS changes were associated with a step-up in therapy, defined as an increase in the daily dose of the ICS or the addition of a long-acting beta-agonist. The other common ICS adjustment, accounting for 17%, was a change in corticosteroid without a step-up in therapy, (ie, beclomethasone to fluticasone) that typically occurred near the end of the hospitalization to accommodate outpatient insurance formularies, independent of patient factors related to illness severity.

We utilized the model for improvement and sought to decrease the number of patients administered more than one ICS during an admission through a step-wise quality improve-

ment approach, utilizing plan-do-study-act (PDSA) cycles.¹⁰ This study was reviewed and designated as not human subjects research by the CCHMC institutional review board.

Improvement Activities

We conceived key drivers or domains that would be necessary to address to effect change. Key drivers included a standardized process for delayed initiation of ICS and confirmation of outpatient insurance prescription drug coverage, prescriber education, and real-time failure notification.

PDSA Interventions

PDSA 1 & 2: Standardized Process for Initiation of ICS

Our initial tests of change targeted the timing of when an ICS was ordered during hospitalization for an asthma exacerbation. Providers were instructed to delay ordering an ICS until the patient's albuterol treatments were spaced to every three hours and to include a standardized communication prompt within the albuterol order. The prompt instructed the RT to contact the provider once the patient's albuterol treatments were spaced to every three hours and ask for an ICS order, if appropriate. This intervention was abandoned because it did not reliably occur.

The subsequent intervention delayed the start of ICS treatment by using a PRN indication advising that the ICS was to be administered once the patient's albuterol treatments were spaced to every three hours. However, after an error resulted in the PRN indication being included on a discharge prescription for an ICS, the PRN indication was abandoned. Subsequent work to develop a standardized process for delayed initiation of ICS occurred as part of the workflow to address the confirmation of outpatient formulary coverage as described next.

PDSA 3: Prioritize the Use of the Institution's Outpatient Pharmacy

Medication changes that occurred because of outpatient insurance formulary denials were a unique challenge; they required a medication change after the discharge treatment plan had been finalized, and a prescription was already submitted to the outpatient pharmacy. In addition, neither our inpatient electronic medical record nor our inpatient hospital pharmacy has access to decision support tools that incorporate outpatient prescription formulary coverage. Alternatively, outpatient pharmacies have a standard workflow that routinely confirms insurance coverage before dispensing medication. The institutional policy was modified to allow for the inpatient administration of patient-supplied medications, pursuant to an inpatient order. Patient-supplied medications include those brought from home or those supplied by the outpatient pharmacy.

Subsequently, we developed a standardized process to confirm outpatient prescription drug coverage by using our hospital-based outpatient pharmacy to dispense ICS for inpatient treatment and asthma education. This new workflow included placing an order for an ICS at admission as a patient-supplied medication with an administration comment to "please administer once available from the outpatient pharmacy" (Figure 1).

Then, once the discharge medication plan is finalized, the prescription is submitted to the outpatient pharmacy. Following verification of insurance coverage, the outpatient pharmacy dispenses the ICS, allowing it to be used for patient education and inpatient administration. If the patient is ineligible to have their prescription filled by the outpatient pharmacy for reasons other than formulary coverage, the ICS is dispensed from the hospital inpatient pharmacy as per the previous standard workflow. Inpatient ICS inhalers are then relabeled for home use per the existing practice to support medications-in-hand.

Further workflow improvements occurred following the development of an algorithm to help the outpatient pharmacy contact the correct inpatient team, and augmentation of the medication delivery process included notification of the RT when the ICS was delivered to the inpatient unit.

PDSA 4: Prescriber Education

Prescribers received education regarding PDSA interventions before testing and throughout the improvement cycle. Education sessions included informal coaching by the Asthma Education Coordinator, e-mail reminders containing screenshots of the ordering process, and formal didactic sessions for ordering providers. The Asthma Education Coordinator also provided education to the nursing and respiratory therapy staff regarding the implemented process and workflow changes.

PDSA 5: Real-Time Failure Notification

To supplement education for the complicated process change, the improvement team utilized a decision support tool (Vigilanz Corp., Chicago, IL) linked to EMR data to provide notification of real-time process failures. When a patient with an admission diagnosis of asthma had a prescription for an ICS verified and dispensed by the inpatient pharmacy, an automated message with relevant patient information would be sent to a member of the improvement team. Following a brief chart review, directed feedback could be offered to the ordering provider, allowing the prescription to be redirected to the outpatient pharmacy.

Study of the Improvement

Patients of all ages, with the *International Classification of Diseases, Ninth Revision, and Tenth Revision* codes for asthma (493.xx or J45.xx) were included in data collection and analysis if they were treated by the Hospital Medicine service, as the first inpatient service or after transfer from the ICU, and prescribed an ICS with or without a long-acting beta-agonist. Data were collected retrospectively and aggregated monthly. The baseline period was from January 2015 through October 2016. The intervention period was from November 2016 through March 2018. The prolonged baseline and study periods were utilized to understand the seasonal nature of asthma exacerbations.

Measures

Our primary outcome measure was defined as the monthly number of patients admitted to Hospital Medicine for an acute

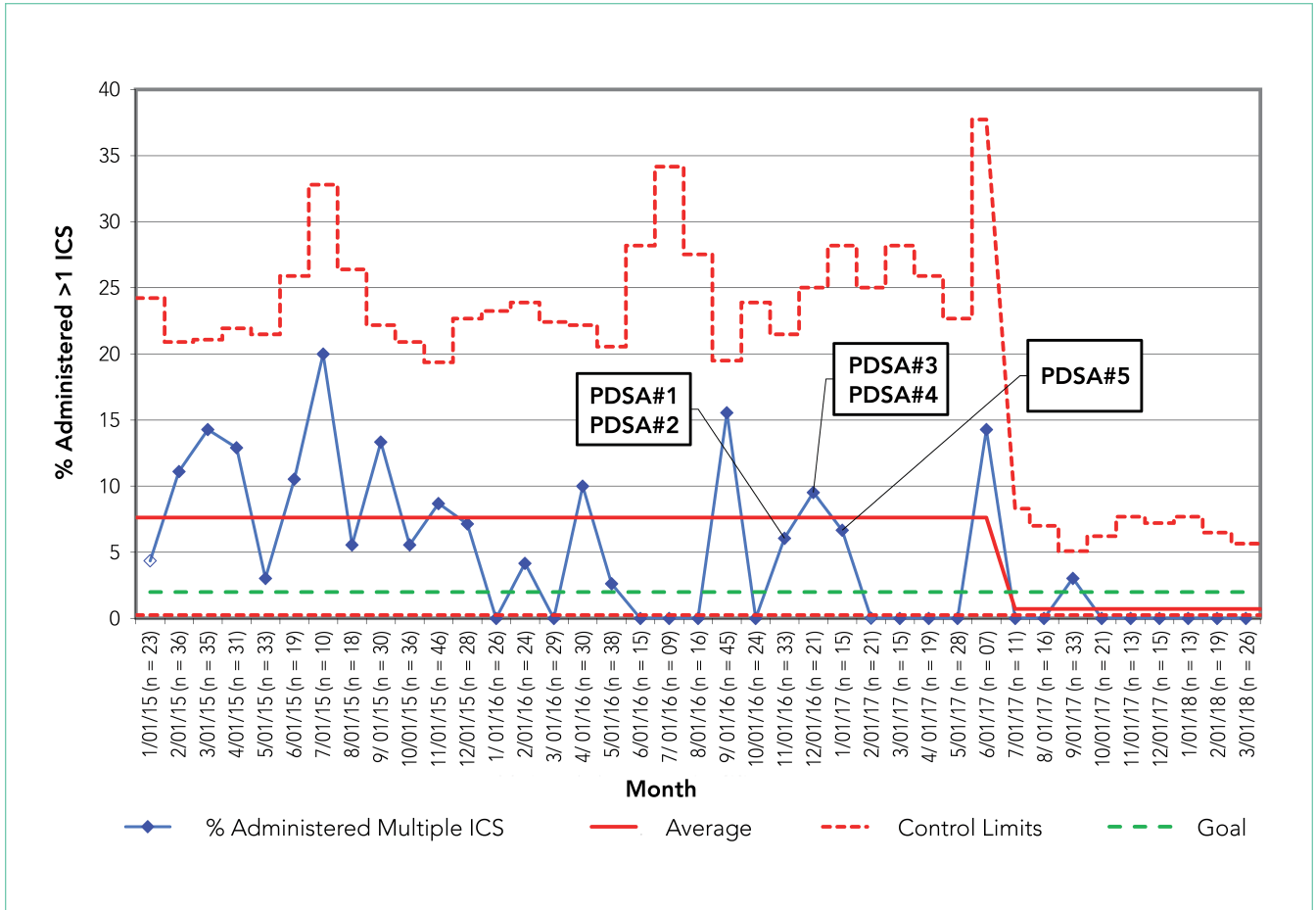


FIG 2. Monthly percentage of patients admitted to Hospital Medicine administered more than one ICS. January 01, 2015, through March 31, 2018.

Abbreviations: ICS, inhaled corticosteroids; PDSA, plan-do-study-act.

asthma exacerbation administered more than one ICS divided by the total number of asthma patients administered at least one dose of an ICS (patient-supplied or dispensed from the inpatient pharmacy). A full list of ICS is included in the appendix Table.

A secondary process measure approximated our adherence to obtaining ICS from the outpatient pharmacy for inpatient use. All medications administered during hospitalization are documented in the medication administration report. However, only medications dispensed from the inpatient pharmacy are associated with a patient charge. Patient-supplied medications, including those dispensed from the hospital outpatient pharmacy, are not associated with an inpatient charge. Therefore, the secondary process measure was defined as the monthly number of asthma patients administered an ICS not associated with an inpatient charge divided by the total number of asthma patients administered an ICS.

A cost outcome measure was developed to track changes in the average cost of an ICS included on inpatient bills during hospitalization for an asthma exacerbation. This outcome measure was defined as the total monthly cost, using the average wholesale price, of the ICS included on the inpatient bill for an

asthma exacerbation, divided by the total number of asthma patients administered at least one dose of an ICS (patient-supplied or dispensed from the inpatient pharmacy). The costs of patient-supplied medications (including those dispensed from the outpatient pharmacy) are not included on inpatient hospital bills or this secondary outcome measure.

Our *a priori* intent was to reduce ICS medication waste while maintaining a highly reliable system that included inpatient administration and education with ICS devices and maintain our medications-in-hand practice. A balancing measure was developed to monitor the reliability of inpatient administration of ICS. It was defined as the monthly number of patients who received a discharge prescription for an ICS and were administered an ICS while an inpatient divided by the total number of asthma patients with a discharge prescription for an ICS.

Analysis

Measures were evaluated using statistical process control charts and special cause variation was determined by previously established rules. Our primary, secondary, and balancing measures were all evaluated using a p-chart with variable subgroup size. The cost outcome measure was evaluated using an X-bar S control chart.¹¹⁻¹³

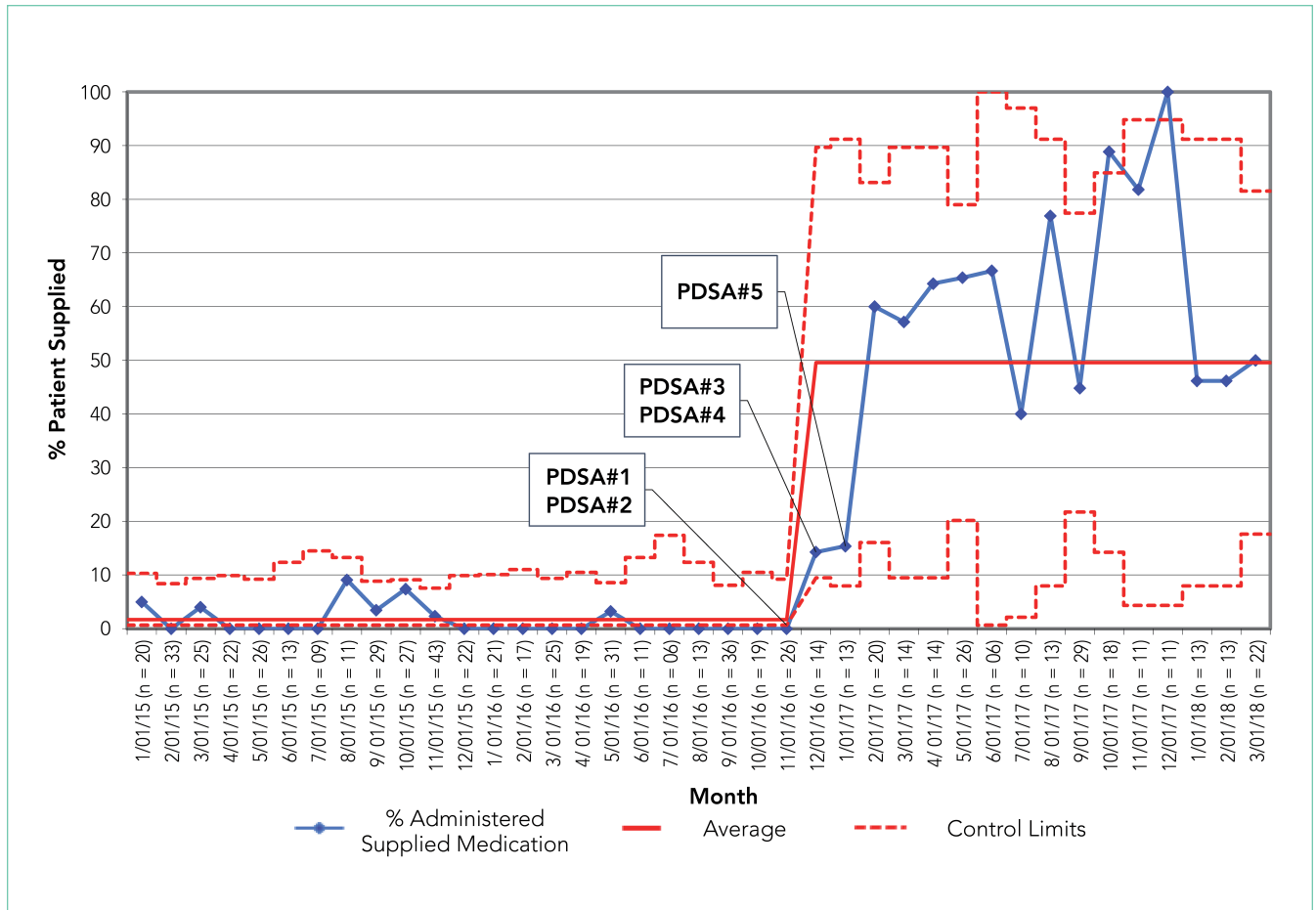


FIG 3. Monthly percentage of inpatient administered ICS using patient-supplied medications. January 01, 2015, through March 31, 2018.

Abbreviations: ICS, inhaled corticosteroids; PDSA, plan-do-study-act.

RESULTS

Primary Outcome Measure

During the baseline period, 7.4% of patients admitted to Hospital Medicine for an acute asthma exacerbation were administered more than one ICS, ranging from 0%-20% of patients per month (Figure 2). Following the start of our interventions, we met criteria for special cause allowing adjustment of the centerline.¹³ The mean percentage of patients receiving more than one ICS decreased from 7.4% to 0.7%. Figure 2 includes the n-value displayed each month and represents all patients admitted to the Hospital Medicine service with an asthma exacerbation who were administered at least one ICS.

Secondary Process Measure

During the baseline period, there were only rare occurrences (less than 1%) of a patient-supplied ICS being administered during an asthma admission. Following the start of our intervention period, the frequency of inpatient administration of patient-supplied ICS showed a rapid increase and met rules for special cause with an increase in the mean percent from 0.7% to 50% (Figure 3). The n-value displayed each month represents all patients admitted to the Hospital Medicine service for an asthma exacerbation administered at least one ICS.

Cost Outcome Measure

The average cost of an ICS billed during hospitalization for an acute asthma exacerbation was \$236.57 per ICS during the baseline period. After the intervention period, the average inpatient cost for ICS decreased by 62% to \$90.25 per ICS (Figure 4).

Balancing Measure

Our balancing measure tracking inpatient ICS administration showed a baseline percent of 83% (Appendix Figure). Following the change to the outpatient pharmacy supplying inpatient ICS, our data exhibited special cause as it fell outside the lower control limits. Later in our intervention period, our data reflected a change in the system, with a decrease in the mean percent of patients with a discharge prescription for an ICS who were administered a dose of an ICS from 83% to 67%. Appendix Figure includes a monthly n-value displayed on the x-axis that includes all patients admitted to the Hospital Medicine service for an asthma exacerbation.

DISCUSSION

Our team reduced the monthly percent of children hospitalized with an acute asthma exacerbation administered more than one

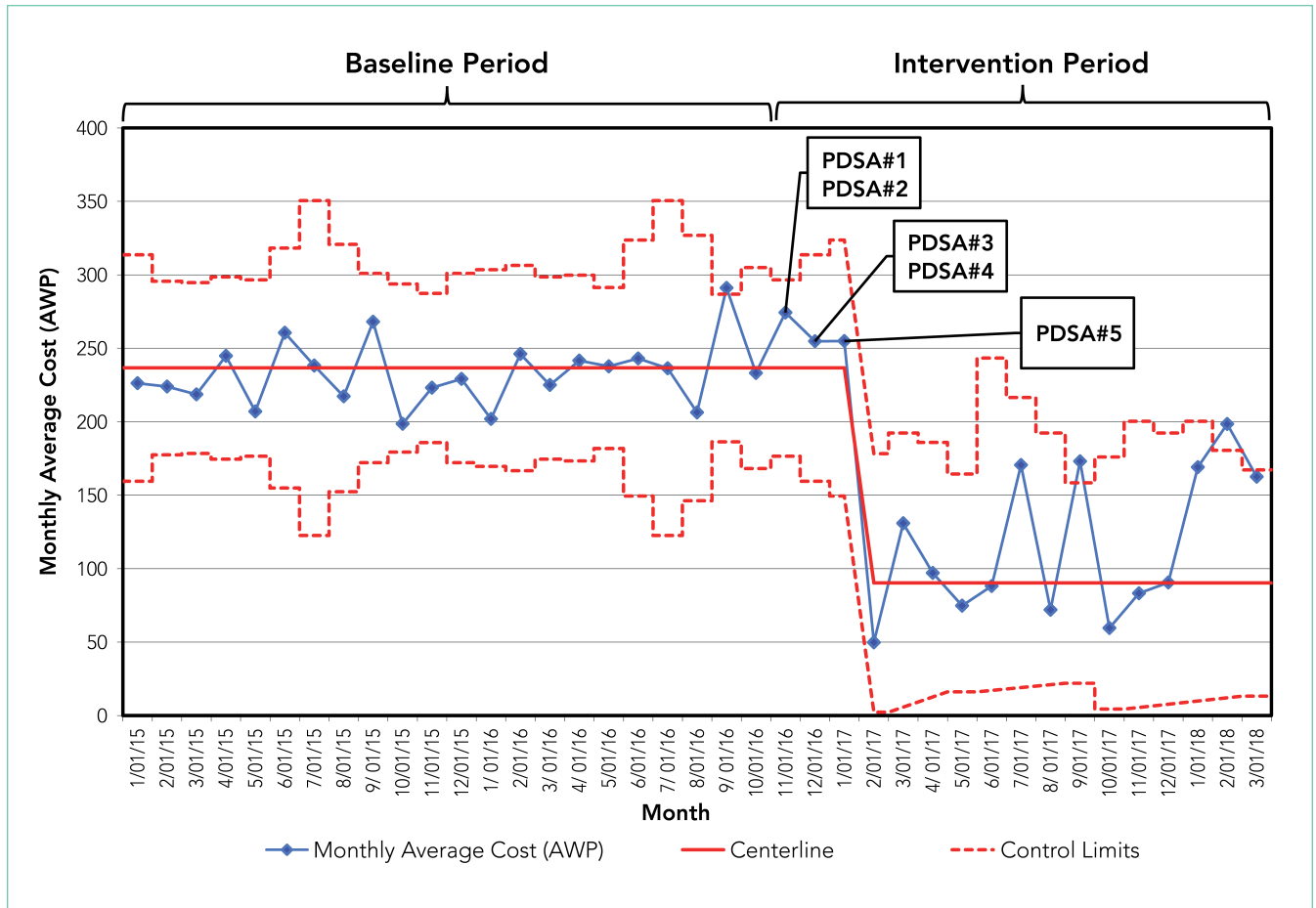


FIG 4. Monthly inpatient ICS cost (AWP) per Hospital Medicine asthma admission administered at least one dose of ICS. January 01, 2015, through March 31, 2018.

Abbreviations: ICS, inhaled corticosteroids; PDSA, plan-do-study-act.

ICS from 7.4% to 0.7% after implementation of a new workflow process for ordering ICS utilizing the hospital-based outpatient pharmacy. The new workflow delayed ordering and administration of the initial inpatient ICS treatment, allowing time to consider a step-up in therapy. The brief delay in initiating ICS is not expected to have clinical consequence given the concomitant treatment with systemic corticosteroids. In addition, the outpatient pharmacy was utilized to verify insurance coverage reliably prior to dispensing ICS, reducing medication waste, and discharge delays due to outpatient medication formulary conflicts.

Our hospital's previous approach to inpatient asthma care resulted in a highly reliable process to ensure patients were discharged with medications-in-hand as part of a broader system that effectively decreased reutilization. However, the previous process inadvertently resulted in medication waste. This waste included nearly full inhalers being discarded, additional work by the healthcare team (ordering providers, pharmacists, and RTs), and unnecessary patient charges.

While the primary driver of our decision to use the outpatient pharmacy was to adjudicate insurance prescription coverage reliably to prevent waste, this change likely resulted in a financial benefit to patients. The average cost per asthma admission of an inpatient billed for ICS using the average whole-

sale price, decreased by 62% following our interventions. The decrease in cost was primarily driven by using patient-supplied medications, including prescriptions newly filled by the on-site outpatient pharmacy, whose costs were not captured in this measure. While our secondary measure may underestimate the total expense incurred by families for an ICS, families likely receive their medications at a lower cost from the outpatient pharmacy than if the ICS was provided by an inpatient pharmacy. The average wholesale price is not what families are charged or pay for medications, partly due to differences in overhead costs that result in inpatient pharmacies having significantly higher charges than outpatient pharmacies. In addition, the 6.7% absolute reduction of our primary measure resulted in direct savings by reducing inpatient medication waste. Our process results in 67 fewer wasted ICS devices (\$15,960) per 1,000 admissions for asthma exacerbation, extrapolated using the average cost (\$238.20, average wholesale price) of each ICS during the baseline period.

Our quality improvement study had several limitations. (1) The interventions occurred at a single center with an established culture that embraces quality improvement, which may limit the generalizability of the work. (2) Our process verified insurance coverage with a hospital-based outpatient pharma-

cy. Some ICS prescriptions continued to be dispensed from the inpatient pharmacy, limiting our ability to verify insurance coverage. Local factors, including regulatory restrictions and delivery requirements, may limit the generalizability of using an outpatient pharmacy in this manner. (3) We achieved our goal of decreasing medication waste, but our *a priori* goal was to maintain our commitment to our established practice of interactive patient education with an ICS device as well as medications-in-hand at time of discharge. Our balancing measure showed a decrease in the percent of patients with a discharge prescription for an ICS who also received an inpatient dose of that ICS. This implies a decreased fidelity in our previously established education protocols. We had postulated that this occurred when the patient-supplied medication arrived on the day of discharge, but not close to when the medication was scheduled on the medication administration report, preventing administration. However, this is not a direct measure of patients receiving medications-in-hand or interactive medication education. Both may have occurred without administration of the ICS. (4) Despite a hospital culture that embraces quality improvement, this project required a significant change in the workflow that required considerable education at the time of implementation to integrate the new process reliably. However, once the process was in place, we have been able to sustain our improvement with limited educational investment.

CONCLUSIONS

Implementation of a new process for ordering ICS that emphasized delaying treatment until all necessary information was available and using an outpatient pharmacy to confirm insurance formulary coverage reduced the waste associated with more than one ICS being prescribed during a single admission.

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designed the study, critically reviewed the manuscript for important intellectual content, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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