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Medication Reconciliation Improvement Utilizing Process Redesign and Clinical Decision Support

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Background: Despite years of attention, hospitals continue to struggle to implement successful medication reconciliation. This study aimed to increase the percentage of hospital admission medication reconciliation (AdmMedRec) completion to ≥ 95% in 12 months at a large academic children's hospital.

Methods: A quality improvement (QI) project was initiated in April 2017 by an interdisciplinary team of physicians, nurses, pharmacists, and analysts, co-led by a pediatric hospitalist and chief medical information officer. Interventions were implemented through sequential Plan-Do-Study-Act cycles. Process maps, fishbone diagrams, and failure mode and effects analysis were used to identify AdmMedRec failures. Baseline data from 12,481 admission encounters July 2016–April 2017 were analyzed. Interventions included electronic health record (EHR) workflow redesign, clarification of clinicians' responsibilities, targeted training, Best Practice Advisory alert, and weekly reporting of specialty- and physician-specific performance data. Data from 13,082 postintervention period admission encounters were examined. Reconciliation by therapeutic drug classes was calculated as a proxy for quality.

Results: AdmMedRec completion rate increased from a baseline of 73% to 95% within 7 months from the start of this project and was sustained at 94% during the postintervention period. Psychiatry and hospital medicine demonstrated the largest improvements, with rates increasing from 17% to 88% and 76% to 98%, respectively. Percentages of reconciled medications in all 13 therapeutic classes, including high-risk drugs, improved significantly ($p < 0.05$).

Conclusions: Using an interdisciplinary team and interventions focused on process and culture changes, this QI initiative was successful at increasing AdmMedRec rates and reducing omission errors across all therapeutic drug classes.

Medication errors are widespread in the pediatric population, particularly in the inpatient setting, with a reported error rate as high as 27%.[1] Children are particularly vulnerable to medication errors due to weight-based dosing, heavy reliance on manual compounding of liquid medications, and their inability to perform their own medication safety checks. The Joint Commission identified medication reconciliation as a key safety practice and deemed it a National Patient Safety Goal in 2005.[2] Although it seems to be a straightforward aim, reducing errors has been a struggle due to tremendous process variation, lack of agreement on each profession's role in the reconciliation process, and dependence on the patient's ability to provide medication information accurately.[2–4] Furthermore, medication reconciliation requires extensive time and personnel.[5–8] In this age of electronic technology, institutions face a new set of problems related to health information technology: inadequate designs, poor usability, and lack of evidence for user satisfaction.[9–13] Because of these barriers, medication reconciliation adherence continues to be poor, particularly in limited-resource settings.[14–16]

Active review of home medications is the first crucial step in performing high-quality medication reconciliation. Failure to obtain a complete and accurate preadmission medication history has led to adverse drug events during hospitalization and after discharge.[10,17,18] To promote this first step, Merandi et al. recommended focusing on leveraging the electronic health record (EHR). The suggested EHR changes included standardization of the medication reconciliation process, highlighting medications that have not been reviewed to increase visibility, and permitting providers to move on to the next step only when all medications have been evaluated. Merandi et al. encouraged using visual indicators to remind providers when medication reconciliation is incomplete and performing random audits.[19] With national adoption of the EHR, institutions must learn to use them to improve medication reconciliation adherence and accuracy.

At Rady Children's Hospital–San Diego (RCHSD), we identified high variability in medication reconciliation adherence among various subspecialties and risk of patient harm from medication reconciliation–related adverse event reports—admission medication reconciliation (AdmMedRec) adherence was 73% for all inpatient admission encounters, with adherence across different subspecialties ranging from 17% to 81%. Given this poor adherence rate, we initiated a project to improve completion

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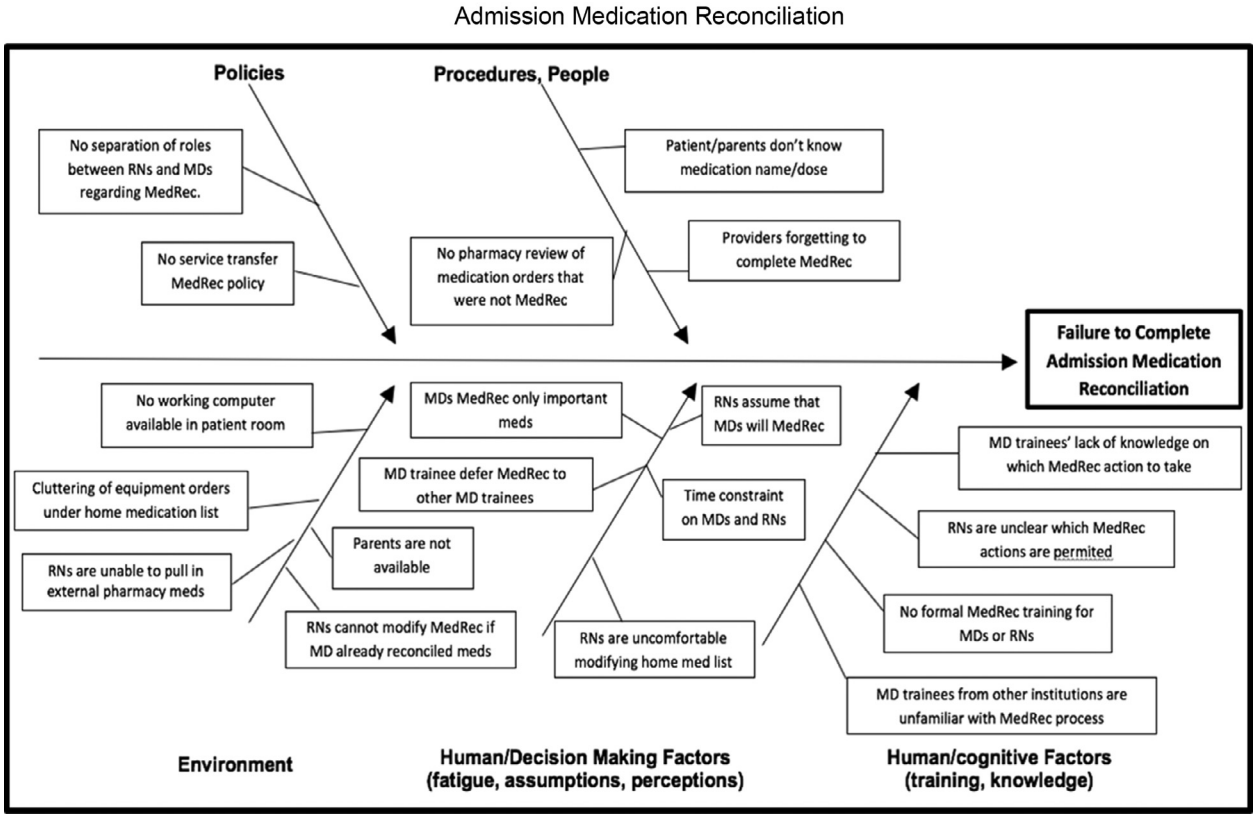


Figure 1: This fishbone diagram displays identified factors that can lead to admission medication reconciliation failures. MedRec, medication reconciliation.

of AdmMedRec. A medication reconciliation (MedRec) task force was formed to better understand the problem, formulate solutions, and implement processes to improve AdmMedRec completion. Our aim was to increase the percentage of completed AdmMedRec to $\geq$ 95% in 12 months. This article describes this quality improvement (QI) intervention at a large, single-center, pediatric health care system located in San Diego that uses an advanced, fully integrated EHR.

METHODS

Context

RCHSD is a large, tertiary, 551-bed, pediatric health care system located in Southern California serving over 260,000 children with about 20,000 annual admissions. RCHSD is affiliated with the University of California, San Diego (UCSD) School of Medicine and is the primary inpatient pediatric training site for residents and fellows from UCSD and five other local training programs. In 2009 RCHSD began transitioning from a paper-based health record to an EHR system (Epic, Epic Systems Corporation, Verona, Wisconsin) that includes computerized provider order entry (CPOE) with clinical decision support (CDS), clinical documentation, and an electronic medication administration record. Inpatient units transitioned in 2011.

Planning the Intervention

The QI project was initiated in April 2017 by a pediatric hospitalist and the chief medical information officer, who co-led an interdisciplinary team of physicians, nursing leaders, pharmacists, quality management leadership, and information technology specialists. This MedRec task force met biweekly to define the MedRec process, review data, assess barriers, and determine interventions. Process maps, fishbone diagrams (Figure 1), and failure mode and effects analysis (FMEA) were used to identify AdmMedRec failures and perceived risks. A key drivers diagram was used to guide selection of interventions (Figure 2). The MedRec workflow was categorized into (1) the review process in the "Review Home Meds" section and (2) the reconciliation process in the "Reconcile Home Meds" section. *Home Meds* were defined as all home medications used prior to admission, both prescribed and over-the-counter (OTC).

We defined AdmMedRec as complete when (1) the "Marked as Reviewed" button was selected by a provider in the "Review Home Meds" admission tab, and (2) a reconciliation action was taken on each and every home medication (*Order*, *Do Not Order*, *Replace*, or *Discontinue*). Failure to perform any of these steps would constitute a failed AdmMedRec. If a patient did not have any home medications, AdmMedRec was considered complete if the "Marked as Reviewed" button was selected by a provider.

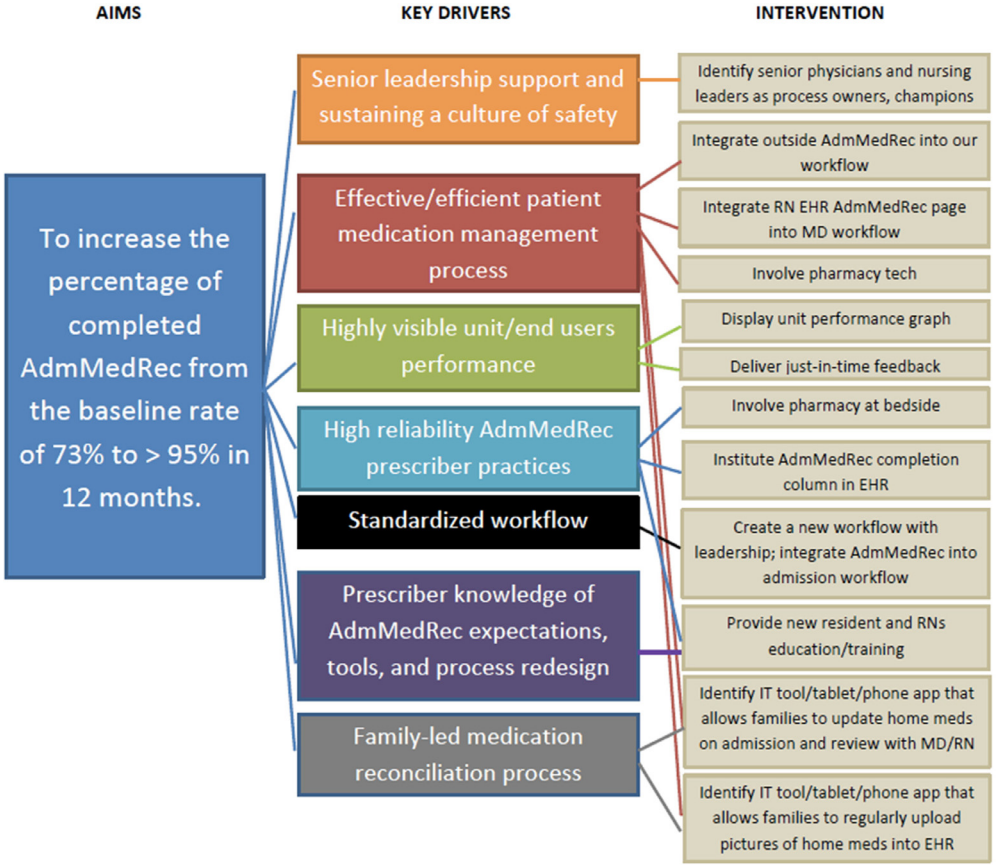


Figure 2: This diagram was used to guide the selection of interventions for our quality improvement iniative. AdmMedRec, admission medication reconciliation; EHR, electronic health record; IT, information technology.

In addition to evaluating whether the process was completed for each patient encounter, all medication orders were classified as high-alert or non-high-alert medications. The high-alert medication list was compiled from a combined list of medications defined by the Institute for Safe Medication Practices (ISMP) and the international modified Delphi process completed by Maaskant et al. in 2013.[20–22] The ISMP list of high-alert medications was based on error reports and expert opinions.[20] Maaskant et al. defined high-alert medications as medications that cause patient harm when misused due to a narrow therapeutic window or prior serious adverse events.[21] Non-high-alert medications were categorized into different therapeutic classes based on the Medi-Span Drug Indications Database (Wolters Kluwer Health, Indianapolis).

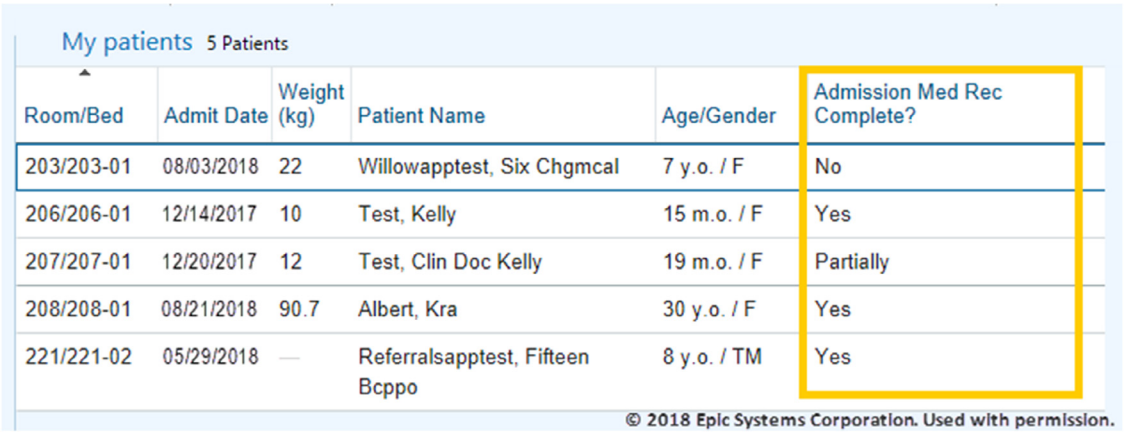
Measures

The primary outcome measure was the percentage of admission encounters with completed AdmMedRec. A secondary outcome measure was the change in completed medication reconciliation percentages between pre- and postintervention periods in each of the therapeutic classes (cardiovascular, respiratory, central nervous system, anti-infective, hematologic, urologic, biologics, gastrointestinal, neuromuscular, high-alert medications). In choosing the secondary outcome measure, the team discussed the options for a metric that would demonstrate the impact of our project, that was feasible in our setting, and for which data could be electronically collected without extensive record review. The team reviewed publications and found themes of moderate to high error rates (20%–56%), high percentage of errors due to omissions, and differing potential for severity of clinical impact due to drug classes.[23–25] These themes, along with ISMP and Joint Commission recommendations regarding medications with higher risk, suggested that the likelihood of error being committed for drugs with a higher risk of harm was substantial at our institution.[11,26,27] We therefore chose to examine the percentage of medications reconciled in different therapeutic classes pre- and postintervention as a proxy for the quality impact of AdmMedRec. An improvement in reconciliation percentages for these drugs would be interpreted as a positive impact of AdmMedRec on reducing potential risk of error in these drug classes.

Data Collection

Baseline data from 10 months (July 2016 to April 2017) and postintervention data (July 2018 to May 2019) were collected retrospectively via SAP BusinessObjects BI Platform Web Intelligence (2010–2017 SAP SE or an SAP

Admission Medication Reconciliation (AdmMedRec) Status Column



My patients 5 Patients

Room/Bed	Admit Date	Weight (kg)	Patient Name	Age/Gender	Admission Med Rec Complete?
203/203-01	08/03/2018	22	Willowapptest, Six Chgmcal	7 y.o. / F	No
206/206-01	12/14/2017	10	Test, Kelly	15 m.o. / F	Yes
207/207-01	12/20/2017	12	Test, Clin Doc Kelly	19 m.o. / F	Partially
208/208-01	08/21/2018	90.7	Albert, Kra	30 y.o. / F	Yes
221/221-02	05/29/2018	—	Referralsapptest, Fifteen Bcppo	8 y.o. / TM	Yes

Figure 3: Shown is the status column in the EHR for a sample patient list (all patients listed are fictitious). The column allows providers to track in real time the completion status of AdmMedRec as "Yes," "No" or "Partially."

affiliate company), a reporting and analysis tool that uses the Epic-released Medication Reconciliation Universe to pull and display data. Biweekly unit and service-specific data were collected prospectively and reviewed by the MedRec task force. AdmMedRec status was categorized dichotomously as either reconciled or not reconciled. Percentages of medications reconciled in each of the therapeutic classes were collected via SAP BusinessObjects Web Intelligence for the pre- and postintervention period. Medi-Span therapeutic drug class data were provided by RCHSD Pharmacy and Therapeutics committee.

Analysis

We used both qualitative and quantitative tools and analysis methods, including fishbone diagrams, FMEA, and a key drivers diagram, as previously noted. Statistical process control (SPC) charts were used to examine the impact of QI interventions over time. Control limits were set at $\pm 3\sigma$ per conventional standard and adjusted during the postintervention period based on special cause variation.[22,28,29]

We retrospectively analyzed de-identified encounter-level data for all inpatient admissions July 2016 to April 2017. These data, and the postintervention period data July 2018 to May 2019, were sorted by admitting service. We excluded the subspecialties with very low volume (fewer than 50 admissions per year) because the low volumes made it difficult to interpret performance data trends. For ease of review and identification of themes across similar provider types, four subspecialties groups were created: pediatric hospital medicine, psychiatry, surgical services (plastic surgery, neurosurgery, urology, cardiothoracic surgery, pediatric general surgery, orthopedic surgery, and otolaryngology), and other medical services (cardiology, gastroenterology, endocrinology, neurology, nephrology, pulmonology, intensive care, neonatology, and physical medicine and rehab). All interventions were rolled out at the same time across all groups. Provider medication reconciliation didactic training was part of Plan-Do-Study-Act (PDSA) cycle 2. In addition to this training, divisions with poor medication reconciliation performance received targeted training during this cycle. The percentages of medications reconciled in distinct therapeutic classes were compared pre- and postintervention using chi-square tests.

Interventions

We used the Model for Improvement, developed by Associates in Process Improvement, coupled with PDSA cycles, as our framework for developing and implementing a series of changes.[30]

PDSA Cycle 1 (April 2017). Our first hospitalwide intervention was aimed at providing performance feedback to providers via two EHR feature additions: the AdmMedRec status column and the AdmMedRec task reminder. When added to a physician's patient list, the AdmMedRec status column allows providers to track in real time the completion status of AdmMedRec as *Yes*, *Partially*, or *No* for each patient (Figure 3). This feature was automatically added to all physicians' inpatient patient lists. The AdmMedRec task reminder was added to the Admission Checklist (Figure 4) and is visible to all providers under the Admission Navigator, which is used on all patient admissions. All Admission Checklist items are one-click activity links that take the user directly to a specific tab in the Admission Navigator in which the task can be completed. Both newly added EHR features were customized changes specific to our institution. A nurse educator and a pediatric hospitalist fellow created and provided training to psychiatry, medical and surgical physicians, and pediatric residents. Training included didactic lectures and small-group interactive discussions to address both culture and process. Participants reviewed the selection of medication reconciliation as a National Patient Safety Goal in 2005 and examined the value of and

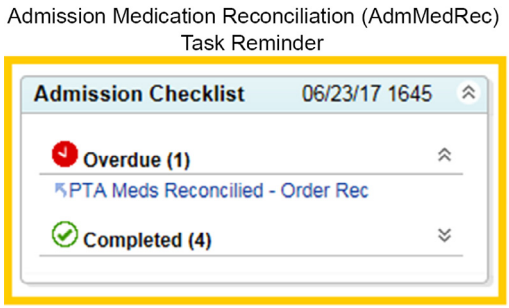


Figure 4: The AdmMedRec task reminder, which is visible to all providers under the Admission Navigator in the EHR, was added to the Admission Checklist. In the example shown here, admission medication reconciliation appears as an incomplete task. PTA, prior to admission.

responsibility to perform AdmMedRec.[31] Training on steps in the process was completed with interactive question and answer periods.

PDSA Cycle 2 (June 2017). Our second intervention addressed the lack of clear delineation of roles and responsibilities between physicians and nurses. AdmMedRec workflows for nurses and physicians were observed, and then best practice workflows were developed to clarify each clinician's responsibilities. From this process, our multidisciplinary team tasked nurses with updating the "Review Home Meds" section and clicking the "Mark as Reviewed" button when medication history review was complete; physicians were tasked with selecting a reconciliation action for each home medication in the "Reconcile Home Meds" section. Training was created and provided to all physicians and pediatric residents. Separate training sessions were done with psychiatry and surgery, given their low performances after PDSA cycle 1 and to address the unique unit workflow of the psychiatry unit. Training included didactic content and interactive cases with step-by-step AdmMedRec instructions. Nursing training was completed via e-mail instructions and disseminated via nursing leadership meetings.

PDSA Cycle 3 (September 2017). The third intervention addressed newly identified problems: (1) lack of clarity on terminology used, (2) limited use of outside pharmacy data, and (3) confusion over the correct reconciliation action for "completed" prescription and OTC medications.

We simplified and standardized the nursing "Review Home Meds" section by changing the terms used on button selection for each home medication from "*Last Taking: Yesterday, Today, Past Week, Past Month, > Month,* [and] *Unknown*" to "*Taking, Completed, Not taking as ordered, PRN-Taking as directed,* [and] *Unknown.*" Button changes were customized modifications chosen by the MedRec task force and are specific to our institution. These selections allowed nurses to more clearly communicate pertinent information to physicians about each home medication.

Nurses initially did not have access to outside pharmacy prescriptions, preventing them from effectively updating the home medications list. We made these available via a third-party vendor solution integrated into the nursing AdmMedRec navigator. In addition, nurses were encouraged to use the underutilized *Flag Meds for Removal* and *Medication Comment* functions to flag expired or completed prescribed medications for physician review and to actively discontinue OTC medications not used within the past two weeks. This empowered nurses to play an active role in AdmMedRec and reduce redundancy in the MedRec process.

PDSA Cycle 4 (November 2017). Our fourth cycle targeted low adherence by surgical services. An AdmMedRec Best Practice Advisory (BPA) alert was created by our EHR analyst to fire for all ordering providers (physicians, nurse practitioners, physician assistants, fellows, and residents) when any attempt to enter inpatient orders occurred when AdmMedRec was still incomplete. The AdmMedRec BPA alert (Figure 5), when fired, contained a hyperlink to the Admission Navigator with easy two-step instructions on AdmMedRec completion. Providers had the option to defer AdmMedRec by selecting one of the following reasons: *No Caretaker Available, Emergent orders, Admit hold orders* (partial admission orders placed prior to a full admission during transition of care team), or *Updating Order Reconciliation* (used when only partial AdmMedRec is possible and requires the provider to return later to complete the process). When one of these four reasons was selected on the AdmMedRec BPA alert, it would not fire again for that specific provider for four hours to minimize workflow interruption.

PDSA Cycle 5 (June 2018). This intervention addressed continued variability in physician- and specialty-specific performance. A report of specialty-specific unblinded performance data for all specialties was e-mailed weekly to all division chiefs and key senior hospital leadership. An additional report with provider-specific performance data was e-mailed to any subspecialty division chief with AdmMedRec performance below 90%. This promoted accountability at the division level and encouraged subspecialty leaders to address individual performance, barriers to workflow, and opportunities for discipline-specific training. Senior leaders were aware and supportive of all cycles of this project and promoted this cycle as an opportunity to assist lower performers.

Ethical Consideration

The project was reviewed by the Institutional Review Board at the University of California, San Diego/Rady Children's Hospital and was determined not to be human subjects research. QI Institutional Review was obtained.

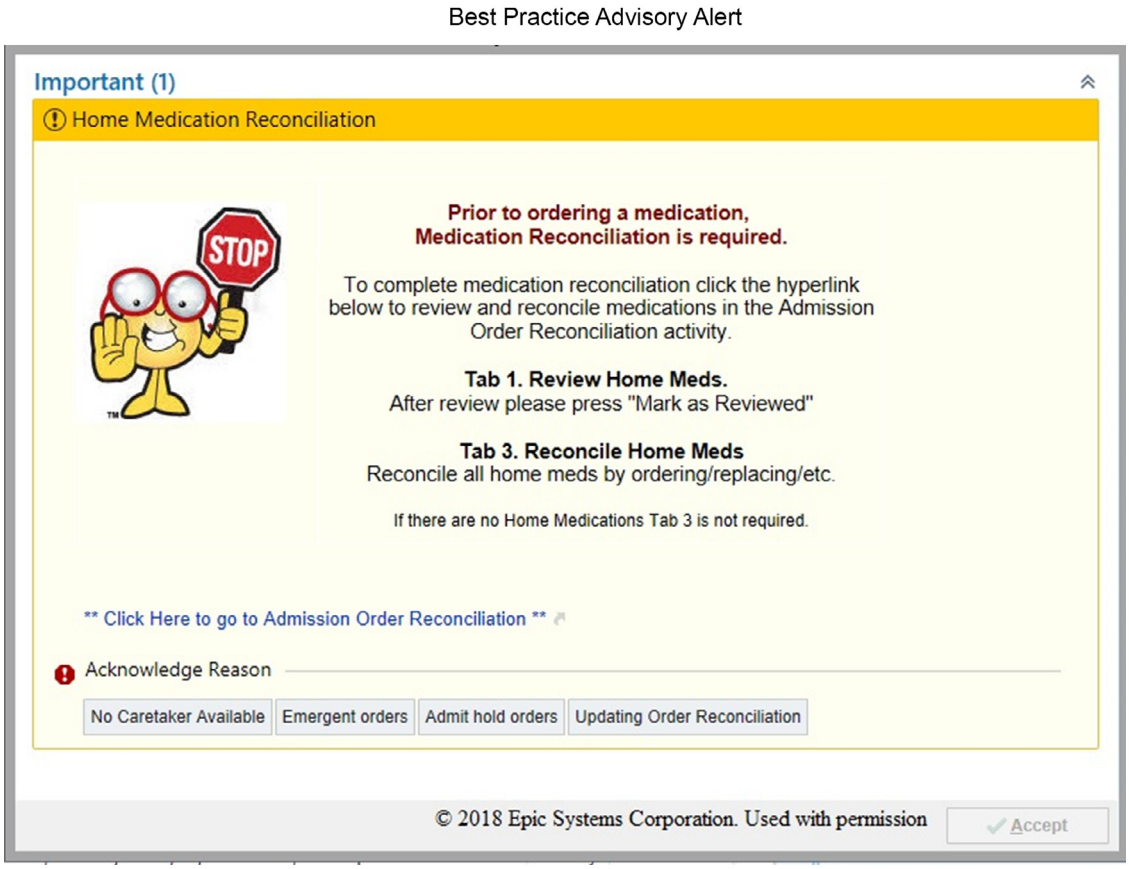


Figure 5: When fired, the admission medical reconciliation (AdmMedRec) Best Practice Advisory (BPA) alert, contained a link to the Admission Navigator with two-step instructions on AdmMedRec completion. Providers had the option to defer AdmMedRec by selecting one of the four reasons shown at the bottom of the BPA alert.

RESULTS

Baseline AdmMedRec completion was 73% for the 12,481 eligible admission encounters. The average number of home medications per encounter was 3.8, with a range of 0 to 68 and a median of 2. The control chart (Figure 6) shows percentages of completed AdmMedRec monthly. Within seven months of the start of this QI initiative, average AdmMedRec completion for the entire institution reached 95%, and this rate was sustained for three months. Average completion rate during the postintervention period has been sustained at an average of 94%. Pediatric hospital medicine and psychiatry demonstrated the most significant improvement, with increases of 22 percentage points (76% to 98%) and 81 percentage points (17% to 98%), respectively. The process demonstrated a > 3 standard deviation improvement, consistent with special cause variation in May 2017 for the entire hospital.

Percentages of medications reconciled in each of the therapeutic classes are shown in Table 1. There was a total of 52,547 medication orders over 8,649 admission encounters during the preintervention period, for an average of 5,255 orders and 865 admissions per month. There was a total of 64,478 medication orders across 10,077 admission encounters during the post-intervention period, for an average of 5,862 orders and 916 admissions per month. Percentages of medications reconciled in all 13 therapeutic classes were statistically higher after interventions ($p < 0.05$), including the high-alert drug class.

DISCUSSION

In this QI initiative, our interdisciplinary team used the Model for Improvement to identify and resolve process failures to reach our aim, dramatically improving AdmMedRec completion across our institution with sustained gains. Our goal was to focus on improving the AdmMedRec adherence rate and address operational failures that were occurring despite having a robust up-to-date EHR in place for many years and having used available standard AdmMedRec processes in our EHR. Although we did not directly assess the quality of reconciliation performed, we did improve the percentage of medications reconciled in all 13 therapeutic classes, which addresses the most commonly reported error type—those due to omissions.[32,33] This suggests that providers may have been more attentive to the process of obtaining a medication history. We also enabled providers to improve quality of care by clarifying our medication reconciliation policies and clearly defining provider roles. This

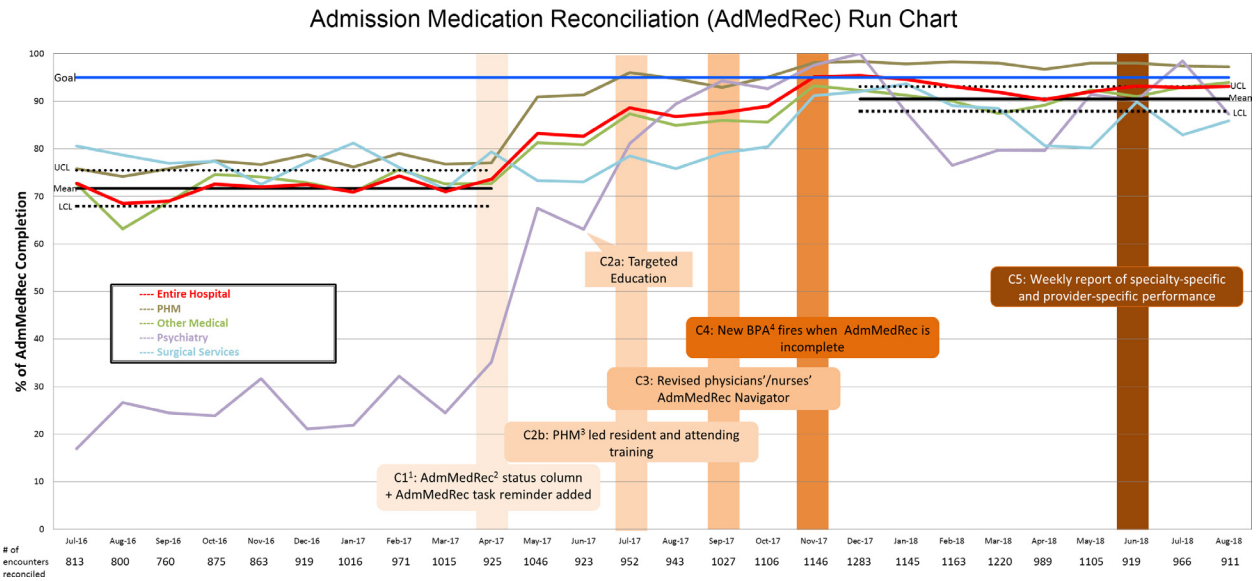


Figure 6: Shown here is a run chart for the entire hospital as well as for pediatric hospital medicine (PHM) service, other medical services, surgical services, and psychiatry. C, Plan-Do-Study-Act cycle; BPA, Best Practice Advisory.

Table 1. Pre- and Postintervention Admission Medication Reconciliation by Pharmaceutical Class*

	Preintervention # of Patients/Total Patient Encounters 6,547/8,649		Postintervention # of Patients/Total Patient Encounters 7,482/10,077		
Pharmaceutical Class	# of orders reconciled/Total	%	# of orders reconciled/Total	%	Chi-Squared P Value
Analgesics	3,729/5,382	**69.3**	5,970/6,414	**93.1**	**< 0.0001**
Anti-infective	3,237/4,095	**79.0**	4,374/4,822	**90.7**	**< 0.0001**
Biologics	58/76	**76.3**	102/110	**92.7**	**0.0016**
Cardiovascular Agents	1,753/2,152	**81.5**	2,586/2,715	**95.2**	**< 0.0001**
Central Nervous System Drugs	1,528/3,119	**49.0**	3,110/3,540	**87.9**	**< 0.0001**
Endocrine & Metabolic	1,099/1,433	**76.7**	1,599/1,728	**92.5**	**< 0.0001**
Gastrointestinal Agents	7,037/8,575	**82.1**	10,626/11,247	**94.5**	**< 0.0001**
Genitourinary Products	151/181	**83.4**	141/148	**95.3**	**0.0007**
Hematologic Agents	1,345/1,631	**82.5**	1,911/2,025	**94.4**	**< 0.0001**
High-Alert Drugs	2,058/2,707	**76.0**	2,237/2,454	**91.2**	**< 0.0001**
Miscellaneous	10,199/13,071	**78.0**	15,723/16,750	**93.9**	**< 0.0001**
Neuromuscular Drugs	5,613/7,494	**74.9**	8,619/9,247	**93.2**	**< 0.0001**
Respiratory Agent	1,917/2,631	**72.9**	3,079/3,278	**93.9**	**< 0.0001**

* Percentage of medication orders reconciled in each pharmaceutical class pre- and postintervention. The numerator represents the number of medication orders reconciled in that medication class. The denominator represents the total number of medication orders in that medication class. Statistical significance was set at $p < 0.05$.

QI study provides an important perspective for pediatric health care organizations that aim to improve medication reconciliation without the use of intensive EHR modifications or pharmacist-led interventions. It confirms findings from a systematic review by Mueller et al. that identified improved reconciliation through information technology automation, reports, and/or standardized nursing approaches to medication history taking.[7] Finally, our study adds to the literature by highlighting the importance of medication reconciliation for preventing potential medication errors and harms.[34]

Our successful AdmMedRec performance was achieved with four main drivers: (1) senior leadership's investment in a culture of safety, (2) effective integration of the EHR into the workflow, (3) clinician training, and (4) transparent data sharing as used by high reliability systems. In cycle 1 we achieved moderate gains by instituting a simple checklist and making the AdmMedRec status visible to providers. The outcome suggests that our AdmMedRec failures were in part due to the process being hidden from view. It was therefore crucial to create an EHR visual cue that would effect change without being intrusive. In cy-

cle 2 we leveraged this new state of awareness to promote end users' engagement in learning their roles and responsibilities. We achieved more gains when we found that variability of terms resulted in a lack of clarity that then made nurses hesitant to act. We believe our gains in cycle 3 were not solely due to clarifying words, but to the confidence this then gave our nurses. Our final two cycles focused on specific target groups, further refining processes for ordering providers, and on making the outcomes even more transparent across our system. These final steps were successful because we had already obtained buy-in from and had actively engaged providers throughout our system, and because senior leaders supported this cycle in a nonpunitive manner. These elements are generalizable and transferrable to all systems that use an EHR, though our changes were customized to our local environment.

Our MedRec task force consisted of a multidisciplinary team, which encouraged not only the development of multifaceted interventions but also a hospitalwide collaborative effort during the implementation phase. The EHR modifications were identified by those active at the bedside and tested by them, following Lean principles of listening to the voice of the customer.[35] Physician, nursing, and institutional leaders were highly invested in AdmMedRec and patient safety, serving as strong role models for providers. Due to such leadership, the inpatient policies were revised to reflect the institution's new AdmMedRec workflow.

Effective integration of EHR tools into clinician workflows was crucial to the success of this QI initiative. CDS tools such as BPA alert, when not implemented well, are often disruptive to provider workflow. The AdmMedRec BPA alert was created to fire only when providers are placing inpatient orders and AdmMedRec is incomplete. The hyperlink in the AdmMedRec BPA alert is actionable in a way that requires little additional effort by the user. Thoughtful construction and implementation of CDS enhances not only clinical decision making but also the provider experience, both of which promote project success. All EHR changes, including the creation of AdmMedRec BPA alert, made during this QI project can be easily replicated at other institutions using existing functionalities in Epic software. The generalizability of these EHR custom modifications allows other institutions to replicate the success of this QI initiative.

Clinician training was also an integral part of the project. We engaged providers using local AdmMedRec cases that had led to adverse patient outcomes to highlight the importance of providers' roles in patient safety. The training was interactive, reviewed common AdmMedRec barriers, and encouraged group formulation of solutions. Through this training, we addressed the value of—and the responsibility to perform—medication reconciliation and empowered providers to take ownership of the process and to embrace team members' roles in it. While training was provided to all pediatric residents, subspecialty-specific attending training was completed based on performance, with priority given to low-performing subspecialties (psychiatry, surgical services). Subspecialty-specific training allowed for the opportunity to demonstrate differences in workflow, which helped the MedRec task force develop more effective interventions.

The transparent sharing of AdmMedRec performance data across subspecialties was an important attribute of our culture of safety. We instituted this practice systemwide and found that it promoted accountability and drove improvement similar to other published reports.[36,37]

Studies on the link between specific drug classes and discrepancies cite omission errors as most frequently found. Tamblyn et al. demonstrated that gastrointestinal and central nervous system drugs were more likely to be omitted on admission medication histories.[38] Other studies note that provider behavior or specialty may drive differing reconciliation rates across medication classes. Greater reconciliation rates have been reported for medications frequently involved in adverse drug events (for example, anticoagulants) or those related to the ordering provider's specialty.[32,33,38] This supports the need for a system approach to ensure reconciliation of all medications. In our QI initiative, we similarly chose to capture omission errors by therapeutic class as a proxy for quality impact. We found an increase in reconciliation percentages not in a select few, but in each of the 13 therapeutic classes. These data allow providers to see the effects of their attention to the reconciliation process in a more impactful manner than merely displaying the total adherence rate. This offers an important message for providers: AdmMedRec is more than a task-completion event.

Limitations and Future Steps

Despite the success of this QI initiative, there were some limitations. This study was solely focused on the inpatient setting, thus we cannot speak to the effects on the outpatient setting. Training of residents was incomplete due to multiple rotating resident groups that started and stopped rotations at different times. However, attending physicians were expected to engage and educate their trainees and division members on AdmMedRec.

This QI initiative was also limited by what our EHR captured. We could only infer that EHR documentation reflected the medication reconciliation process at the bedside. We also did not directly address the quality or clinical impact of medication reconciliation in this project. Our institution focused on improving adherence as the first step toward changing culture and physician practices. Due to our limited personnel and pharmacy resources, we were unable to directly assess reconciliation accuracy. Lack of dedicated pharmacists, however, reflects the reality found in most institutions. The percentage of medications reconciled in various therapeutic classes pre- and postintervention was used as a proxy for the value of and improve-

ment in the quality of the AdmMedRec process; however, it was not directly tied to patient outcomes. Another limitation includes our inability to assess the unique impact of this project on adverse drug events. Finally, although it is possible that other projects may have influenced our outcomes, this initiative was the only project addressing admission medication reconciliation during the study period.

Our next step is to assess the quality of medication reconciliation with clinical outcome and provider satisfaction measures, while sustaining this performance success over time. In addition, we are expanding our improvement project to inpatient discharge medication reconciliation and the ambulatory setting.

CONCLUSION

We successfully used QI methods and EHR optimization to improve and sustain admission medication reconciliation adherence at a large academic children's hospital. We also demonstrated a significant increase in percentages of medications reconciled in all 13 therapeutic classes. Essential interventions that led to the success of this project were clarification of clinicians' roles, EHR modifications, workflow improvement, and increased transparency of data. These methods are generalizable to other institutions. By increasing medication reconciliation adherence and decreasing medication omission error, institutions are taking a central step toward reducing preventable medication errors in the inpatient setting.

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