An Internal Quality Improvement Collaborative Significantly Reduces Hospital-Wide Medication Error Related Adverse Drug Events

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Objective To reduce the rate of harmful adverse drug events (ADEs) of severity level D-I from a baseline peak of 0.24 ADE/1000 doses to 0.08 ADE/1000 doses.

Study design A hospital-wide, quasi-experimental time series quality improvement (QI) initiative to reduce ADEs was implemented. High-reliability concepts, microsystem-based multidisciplinary teams, and QI science methods were used. ADEs were detected through a combination of voluntary reporting, trigger tool analysis, reversal agent review, and pharmacy interventions. A multidisciplinary ADE Quality Collaborative focused on medication use processes, not on specific classes of medications. Effective interventions included huddles and an ADE prevention bundle.

Results The rate of harmful ADEs initially increased by >65% because of increased error reporting, temporally associated with the implementation of a program focused on high reliability and an improved safety culture. The quarterly rate was 0.17 ADE/1000 dispensed doses in Q1 2010. By the end of Q2 2013, the rate had decreased by 76.5%, to 0.04 ADE/1000 dispensed doses ($P < .001$).

Conclusion Using an internal collaborative model and QI methodologies focused on medication use processes, harmful ADEs were reduced hospital-wide by 76.5%. The concurrent implementation of a high-reliability, safety-focused program was important as well. *(J Pediatr 2014;165:1222-29)*.

Medication errors are common and significant causes of preventable harm, particularly for hospitalized children, in whom medication errors are 3 times more common than in adults.[1] Children are more prone to medication errors and resulting harm for several reasons. First, pediatric weight-based dosing requires use of nonstandard medication preparations that are subject to miscalculations in prescribing, dispensing, and administration processes. Second, immature metabolic systems are less tolerant of medication errors. Finally, children may be unable to communicate regarding the symptoms of an adverse drug event (ADE).[2] Estimates of the frequency of harmful medication errors or ADEs range from 13.4 to 49.8 per 1000 patient-days.[3,4]

In the fall of 2008, Nationwide Children's Hospital (NCH) set a goal of eliminating preventable patient harm. A key metric in monitoring the success of the safety program was the Preventable Harm Index.[5] At that time, medication errors accounted for nearly two-thirds of preventable patient harm, with more than 50% of those errors related to medication administration and smaller percentages related to prescribing and dispensing processes. The most common administration errors involved failure to perform the "5 rights of medication administration."[6] One-half of the preventable medication errors occurred in the critical care units; thus, the initial ADE reduction effort focused on medication administration errors in the critical care units. Eventually the other medication management processes were addressed, and the improvement effort spread throughout the hospital system.

Methods

Medications errors are mistakes in the prescribing, dispensing, administration, or monitoring of medications. ADEs, as defined here, are preventable medication errors that reach the patient and cause some de-

ADE	Adverse drug event
ADEQC	Adverse Drug Event Quality Collaborative
BCMA	Bar-coded medication administration
CPOE	Computerized practitioner order entry
EMR	Electronic medical record
IV	Intravenous
NCCMERP	National Coordinating Council for Medication Error Reporting and Prevention
NCH	Nationwide Children's Hospital
QI	Quality improvement

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gree of harm. Potential ADEs are medication errors in which prevention strategies (eg, pharmacist interventions with prescribers) prevent the error from reaching the patient.

This quality improvement (QI) effort involved implementation of evidence-based interventions or best practices designed to meet an established goal of zero patient harm from ADEs. No interventions involved a comparison of devices or therapies, and patients were not subjected to randomization. Medical records were accessed by QI team members as part of their normal responsibilities. No personal health information was shared. Therefore, the need for Institutional Review Board approval was waived (personal communication, Alex Rawkowsky, MD, Chairman, NCH Institutional Review Board).

NCH is an academic, nonprofit, 450-bed freestanding children's hospital located in Columbus, Ohio. Annually, the hospital provides care to more than 1 million outpatients, performs 26 000 surgeries, and has 25 000 inpatient discharges. The NCH pharmacy dispenses more than 1.5 million medication doses per year. The current electronic medical record (EMR) and computerized practitioner order entry (CPOE) systems (Epic Systems, Verona, Wisconsin) are fully integrated with clinical decision making support.

ADE and medication error detection methodology includes a voluntary electronic event reporting system, monthly 20-chart trigger tool analysis,[7,8] 100% review of all dispensed reversal agents (eg, naloxone), and pharmacist interventions with prescribing practitioners. The severity of ADEs is measured using a variation of the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) Scale.[9] (A detailed description of the NCCMERP Scale is available at http://www.nccmerp.org/pdf/indexColor2001-06-12.pdf.) We classified ADEs with a NCCMERP severity level of D-I as harmful. Relatively minor level D medication errors were more frequent and involved the same failure modes as more serious ADEs, and thus were included to ensure a sufficient number of ADEs to allow identification of opportunities for improvement.

The primary outcome metric was the rate of ADEs per 1000 dispensed doses over time. The numerator was the number of ADEs identified by the detection strategies, and the denominator was total medications dispensed. Secondary metrics included total detected ADEs regardless of severity per 1000 dispensed doses and total nonharmful potential ADEs (severity level A-C) per 1000 dispensed doses. Statistical process control charts[10] were used to show outcome metric progress and assess the impact of interventions over time.

Collaborative Model and Improvement Methodology

In July 2009 (phase 1), an internal QI collaborative comprising multidisciplinary representatives from all critical care units and 2 additional units that were experiencing frequent ADEs was convened. This ADE Quality Collaborative (ADEQC) mirrored the Institute for Healthcare Improvement Breakthrough Series[11] and used the Model for Improvement.[12] **Figure 1** illustrates the initial specific aim and key driver diagram developed by the ADEQC. The

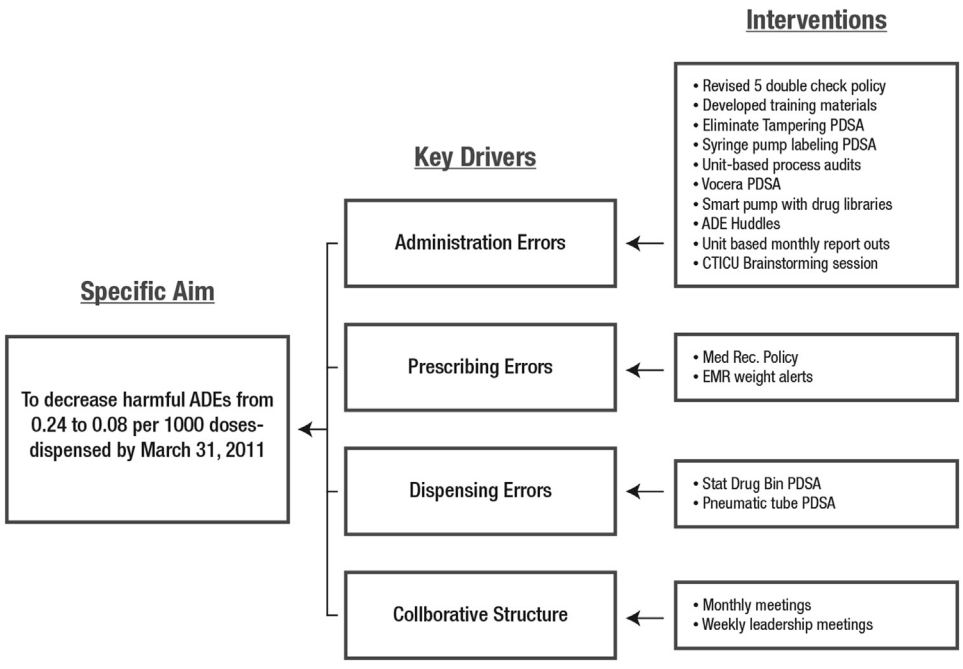

Figure 1. Specific aim and key driver diagram for the ADEQC. The baseline was not officially determined until February 2010, when reporting of ADEs peaked as the full impact of the safety program was felt. The key drivers are barriers that must be overcome to impact the specific aim. Typically, key drivers are expressed as elements that must be addressed to achieve the specific aim; however, the key driver diagram as presented here is what we used to drive change. *CTICU*, cardiothoracic intensive care unit; *PDSA*, plan-do-study-act.