Quality Improvement

Operationalizing a Medication Safety Gap Assessment for a Large Health System

Carley Warren, PharmD, BCPS, CPPS[1]; Joan Kramer, PharmD, BCPS, DPLA[1,2]; L Hayley Burgess, PharmD, MBA, BCPP, CPPS, GLBSS[1,2]

Author affiliations are listed at the end of this article.

Correspondence to:
Carley Warren, PharmD
Pharmacy Services
Clinical Services Group
HCA Healthcare
One Park Plaza, Bldg 2-4W
Nashville, TN 37203
(carley.castelein@hcahealthcare.com)

Abstract

Background
Medication errors continue to be a leading cause of medical errors. In the United States alone, 7000 to 9000 people die annually due to a medication error, and many more are harmed. Since 2014, the Institute for Safe Medication Practices (ISMP) has advocated for several best practices in acute care facilities derived from reports of patient harm.

Methods
The medication safety best practices chosen for this assessment were based on the 2020 ISMP Targeted Medication Safety Best Practices (TMSBP) and health system-identified opportunities. Each month, for 9 months, select best practices were covered with associated tools to assess the current state, document the gap, and close identified gaps.

Results
Overall, 121 acute care facilities participated in most safety best practice assessments. Of the best practices assessed, there were 8 practices that more than 20 hospitals documented as not implemented and 9 practices where more than 80 hospitals had fully implemented them.

Conclusion
Full implementation of medication safety best practices is a resource-intensive process that requires strong change management leadership at a local level. As noted by the redundancy in published ISMP TMSBP, there is an opportunity to continue improving safety in acute care facilities across the United States.

Keywords
medication safety; patient safety; medication management; safe medication use; medication errors; drug use errors; patient care management; medication therapy management

Introduction
The Institute for Safe Medication Practices (ISMP) is a nonprofit organization dedicated to preventing medication errors. They publish newsletters and alerts about current medication safety issues. Despite continued warnings being published on specific medication safety issues, harmful and fatal events persist. Medication errors continue to be a leading cause of medical errors. In the United States (US) alone, 7000 to 9000 people die annually due to a medication error and many more are harmed.[1] The 2000 report "To Err is Human" stated that patients are harmed, hospitals absorb the financial cost of the error, and medical workers face significant psychological tolls.[2] In 2014, ISMP published its first Targeted Medication Safety Best Practices for Hospitals (TMSBP), guidelines to identify and nationally mobilize the adoption of best practices.[3] The recommendations are developed from reports received through the ISMP National Medication Errors Reporting Program (ISMP MERP),

reviewed by an external expert panel, and approved by the ISMP Board of Trustees.[4] TMSBP has been updated biennially, including in 2016, 2018, 2020, and 2022 (**Appendix 1**).[3-7]

The first edition of TMSBP in 2014 included 6 best practices, of which 3 have been archived.[3] Remaining in the 2022 publication are recommendations on vinCRIStine dispensing, methotrexate ordering, and accurate patient weight documentation.[4] Given the continued reports of harm caused by previous recommended best practices, ISMP has included redundancy in their TMSBP. The 2022 edition included the addition of 3 new best practices: safeguard against oxytocin errors, increase barcode scanning in non-inpatient areas, and layer multiple medication safety strategies for high-alert medications.[4]

In 2020, the *BMJ Quality and Safety* published an editorial discussing how education alone is not sufficient to improve our systems since it is rarely reliable.[8] ISMP has also described a hierarchy of effectiveness of risk-reduction strategies in which high leverage, system reliability, risk-reduction strategies are most effective. A few examples include forcing functions and automation/computerization since they are the most effective but often the hardest or most resource-intensive to implement.[9] This project aimed to assess safety gaps from the outlined best practices across an extensive healthcare system of over 180 acute care facilities in more than 20 states.

Methods

The scope of this project and report was to guide operationalizing an assessment, evaluating current systems, and closing identified medication safety gaps. The formal assessment of best practices began in March 2021 with a stepwise approach (**Table 1**). The best practice focus for the month was introduced on a leadership call with key medication safety leaders (eg, regional pharmacy leaders, directors of pharmacy, pharmacy clinical managers, and pharmacy operations managers). The framework, a recommended checklist of items for assessment, and tools (eg, sample guidance policy, business case templates, electronic medical record build guides, and ordering infor-

Table 1. 2021 Calendar for Best Practice Assessment in All Hospitals

Month	Best practices covered
February	• Introduce topic and calendar to come in coming months • Clinical pharmacy services model assessment
March	• Medication safety walkarounds • Using external safety risks and errors to prevent similar errors in your organization
April	• Vinca alkaloids safety • Eliminate glacial acetic acid from the hospital • Neuromuscular blocking agent safety
May	• Methotrexate safety • Oral liquid dosing devices display in metric scale only • Oral liquids dispensed by pharmacy in oral or ENFit syringes
June	• Limit and monitor automated dispensing cabinet (ADC) overrides • Accurate patient weight • FentaNYL patch safety
July	• Intramuscular or subcutaneous route of administration • Injectable promethazine safety
August	• Sterile compounding preparation safety • Antidote, reversal agent, and rescue agent safety
September	• Intravenous medication administration using programmable infusion pump dose error-reduction software • Dispensing medications in unit-of-use
October	• Eliminate 1000 mL bags of sterile water outside of pharmacy

mation for syringes) were provided to assess each item. In addition to the ISMP TMSBP, 4 additional healthcare system best practices were presented and assessed.

Health system-specific best practices were introduced to increase the interdisciplinary nature of providing safe medications for use. Best practice A, which was medication safety walkarounds, dove deeper into medication safety issues in individual care areas to increase medication safety knowledge, identify and address risks, and encourage event reporting. Best practice B, which was using unit-of-use medications, was included to prevent inadvertent overdoses and underdoses while reducing the preparation burden on nurses administrating the medications. Only appropriate routes of administration in order sets and use of intramuscular use only or subcutaneous use only visual cues were recommended in best practice C to safeguard against intravenous (IV) administration of an intramuscular (IM) or subcutaneous only medication. Lastly, best practice D assessed the optimization of unit-based clinical pharmacy services for consistent patient care by reaching goal thresholds to provide clinical care to patients 24 hours per day, 7 days per week. The ISMP TMSBP and health system best practices were used to improve overall medication safety and address system vulnerabilities. This project was a quality improvement project and, therefore, did not need IRB review.

Each month, the facility leaders were asked to assess the best practices presented on the monthly leadership call to determine if those practices were fully implemented, partially implemented, not implemented, or not applicable. From there, they were to address any partially or not implemented practices and document an action plan to close the identified gap. The regional pharmacy leader was responsible for coaching facility leaders by spreading best practices, escalating barriers for removal as appropriate, and facilitating answers to questions as they arose.

Results

The health system findings by each element of the best practice were reported in **Appendix 2**. Overall, 121 acute care facilities participated in most of each assessed element. There was an average response rate of 2 out of 3 hospitals for overall best practice assessment results. The 4 best practices with the highest reported implementation (>100 hospitals) were methotrexate safety practices, procurement of oral liquid dosing devices that display metric scale units, using smart infusion pumps with heparin, and ensuring appropriate reversal/rescue agents were readily available in pertinent care areas. The 3 best practices with the lowest reported implementation were the removal of injectable promethazine from the hospital, consistently conducting medication safety walkarounds, and ensuring that medications (tablets, injectables) are sent in a unit-of-use form.

The best practice assessment for items in which at least 4 out of every 6 hospitals (ie, >80 hospitals) reported full implementation of best practices included: preventing fentaNYL patch storage and administration for patients with acute pain only, using external safety risks to proactively assess internal systems, requiring a hard stop at pharmacist verification for methotrexate orders with non-oncologic indication, using provider facing rules for methotrexate weekly dose ordering, purchasing oral liquid dosing devices with only metric scale, administering standard IV heparin concentrations with smart infusion pump dose error reduction software, ensuring antidotes and rescue agents are readily available according to policy, maintaining infusion pump libraries, having a facility quality process to ensure the appropriate use of naloxone, and using electronic health record strategies to prevent IV ordering for medications that should not be administered IV.

The items in which at least 1 out of every 6 hospitals (ie, >20 hospitals) reported their practices were not implemented included: the elimination of injectable promethazine from the hospital, providing discharge patient education on all oral methotrexate orders, having scales that lock in metric units, ensuring oral liquids were dispensed by a pharmacy in an oral or ENfit syringe, using an interdisciplinary team to ensure overrides are according to policy, consistently completing and documenting medication safety walkarounds, sending unit-of-use dosage forms for tablets and injectable products (adults and pediatrics), and labeling medications that should not be administered intravenously.

Discussion

The project was launched on the heels of the COVID-19 pandemic when many supply shortages existed, staff were transitioning, processes were in flux, and general internal workforce human factors (eg, fatigue, stress) were escalated. There are many challenges associated with the best practices that had the most opportunity, which aligned with the findings of this project. The underlying themes include obtaining capital for purchasing additional supplies and equipment, resistance to change, limited medication safety leader capacity, and hardwiring processes.

Several items that allude to practices not being implemented or partially implemented reflect the ability to manage system-level change. Research shows that creating a sense of urgency, instilling ownership, or establishing governance are the foundational aspects of change.[10] Given the instability in US healthcare (eg, staffing turnover, supply constraints, financial resiliency efforts) and the need to complete this study in 9 months, the ownership and governance proved challenging where there was no sense of urgency. For example, the capital required to purchase additional scales that have added safety features required budgeting and approvals that may extend beyond a dedicated month's timeframe for completion. Hospitals successful at implementing the best practices worked consistently to engage multidisciplinary teams and service line leaders in medication management process changes at the local and regional level long before this targeted gap assessment. Existing change control practices such as pharmacy and therapeutics committee agenda items, electronic medical record informatics requests, relationships with nursing directors, and routine meetings with C-suite leaders helped lay the foundation for closing several identified gaps. Additionally, hospitals that could demonstrate the impact on patient care through local data experienced less resistance to change. Regions that successfully implemented the best practices for their hospitals learned to share how an individual hospital resolved a barrier and spread procedures when feasible (eg, standard order sets, ordering information for EnFit syringes, nursing huddle cards).

The project occurred within a single large health system with greater consistency in overarching priorities and strategy operationalization, which may have impacted the replicability of results. Additionally, local facility leaders were leading the assessment, which could be interpreted with a subjective bias and reliance on their documentation. This factor was accounted for by outlining specific requirements to be met for the best practice to be considered fully implemented. Regional pharmacy leadership was leveraged to provide oversight to ensure best practice implementation status was documented appropriately. It is unknown if the work was completed for the 1 out of 3 hospitals that did not respond since there is no documentation.

Conclusion

The findings from this work can help guide how to conduct a gap assessment and inform leaders on best practices that may need further assessment at their institutions so they can prioritize resources and address vulnerabilities. The next steps for this team are to ensure procedures/processes successfully implemented are spread to hospitals that identified partial or no implementation, remove barriers for successful implementation, ensure the sustainability of the work that has been done, and assess the 3 new best practices for the newest ISMP TMSBP with the intent of strengthening the medication management system and improving patient safety.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Drs Warren and Burgess are employees of Clinical Service Group, HCA Healthcare, and Dr Kramer is a retired employee of Clinical Sevices Group, HCA Healthcare, an organization affiliated with the journal's publisher.

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Author Affiliations

1. Clinical Services Group, HCA Healthcare, Nashville, TN
2. VigiLanz Corporation, Minneapolis, MN

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Appendix 1. History of ISMP Targeted Medication Safety Best Practices[3-7]

<table>
<tr><th>2014</th><th>2016</th><th>2018</th><th>2020</th><th>2022</th></tr>
<tr><td colspan="5">Dispense vinCRIStine (and other vinca alkaloids) in a minibag of a compatible solution and not in a syringe.</td></tr>
<tr><td colspan="5">Use a weekly dosage regimen default for oral methotrexate. If overrode to daily, require a hard stop verification of an appropriate oncologic indication. Provide patient education by a pharmacist for all weekly oral methotrexate discharge orders.</td></tr>
<tr><td>Measure and express patient weights in metric units only. Ensure that scales used for weighing patients are set and measure only in metric units.</td><td colspan="4">Weigh each patient as soon as possible on admission and during each appropriate outpatient or emergency department encounter. Avoid the use of stated, estimated, or historical weight. Measure and document patient weights in metric units only.</td></tr>
<tr><td colspan="2">Ensure that all oral liquids that are not commercially available as unit dose product are dispensed by the pharmacy in an oral syringe.</td><td>Ensure that all oral liquid medications that are not commercially available in unit dose packaging are dispensed by the pharmacy in oral or ENFit syringe.</td><td>Ensure that all oral liquid medications that are not commercially available in unit dose packaging are dispensed by the pharmacy in an oral syringe or an enteral syringe that meets the International Organization for Standardization (ISO) 80369 standard, such as ENFit.</td><td>Moved to archive in 2022</td></tr>
<tr><td>Purchase oral liquid dosing devices (oral syringes/cups/droppers) that only display the metric scale.</td><td>Purchase oral liquid dosing devices (oral syringes/cups/droppers) that only display the metric scale. If patients are being discharged with oral liquids, ensure they receive oral syringes and are educated about measuring medications in milliliters.</td><td>Purchase oral liquid dosing devices (oral syringes/cups/droppers) that only display the metric scale.</td><td>Purchase oral liquid dosing devices (oral syringes/cups/droppers) that only display the metric scale.</td><td>Moved to archive in 2022</td></tr>
<tr><td colspan="3">Eliminate glacial acetic acid from all areas of the hospital.</td><td>Moved to archive in 2020</td><td></td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Segregate, sequester, and differentiate all neuromuscular blocking agents (NMBs) from other medications, wherever they are stored in the organization.</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">Administer medication infusions via a programmable infusion pump utilizing dose error-reduction systems. Maintain a 95% or greater compliance rate for the use of dose error-reduction systems. Monitor compliance with use of smart pump dose error-reduction systems on a monthly basis. If your organization allows for the administration of an IV bolus or a loading dose from a continuous medication infusion, use a smart pump that allows programming of the bolus (or loading dose) and continuous infusion rate with separate limits for each.</td></tr>
</table>

Appendix 1. Continued

2014	2016	2018	2020	2022
			Ensure all appropriate antidotes, reversal agents, and rescue agents are readily available. Have standardized protocols and/or coupled order sets in place that permit the emergency administration of all appropriate antidotes, reversal agents, and rescue agents used in the facility. Have directions for use/administration readily available in all clinical areas where the antidotes, reversal agents, and rescue agents are used.	
			Eliminate all 1000 mL bags of sterile water (labeled for "injection," "irrigation," or "inhalation") from all areas outside of the pharmacy.	Moved to archive in 2022
			When compounding sterile preparations, perform an independent verification to ensure that the proper ingredients (medications and diluents) are added, including confirmation of the proper amount (volume) of each ingredient prior to its addition to the final container.	
			Eliminate the prescribing of fentaNYL patches for opioid-naïve patients and/or patients with acute pain.	
			Seek out and use information about medication safety risks and errors that have occurred in other organizations outside of your facility and take action to prevent similar errors.	
			Verify and document a patient's opioid status (naïve versus tolerant) and type of pain (acute versus chronic) before prescribing and dispensing extended-release and long-acting opioids.	
			Limit the variety of medications that can be removed from an automated dispensing cabinet (ADC) using the override function. Require a medication order (eg, electronic, written, telephone, verbal) prior to removing any medication from an ADC, including those removed using the override function. Monitor ADC overrides to verify appropriateness, transcription of orders, and documentation of administration. Periodically review for appropriateness the list of medications available using the override function.	
				Require the use of standard order sets for prescribing oxytocin antepartum and/or postpartum that reflect a standardized clinical approach to labor induction/augmentation and control of postpartum bleeding. Standardize to a single concentration/bag size for both antepartum and postpartum oxytocin infusions (eg, 30 units in 500 mL Lactated Ringers). Standardize how oxytocin doses, concentration, and rates are expressed. Communicate orders for oxytocin infusions in terms of the dose rate (eg, milliunits/minute) and align with the smart infusion pump dose error-reduction system (DERS). Provide oxytocin in a ready-to-use form. Boldly label both sides of the infusion bag to differentiate oxytocin bags from plain hydrating solutions and magnesium infusions. Avoid bringing oxytocin infusion bags to the patient's bedside until it is prescribed and needed.

Appendix 1. Continued

2014	2016	2018	2020	2022
				Maximize the use of barcode verification prior to medication and vaccine administration by expanding use beyond inpatient care areas. Specifically target clinical areas with an increased likelihood of a short or limited patient stay (eg, emergency department, perioperative areas, infusion clinics, dialysis centers, radiology, labor and delivery areas, catheterization laboratory, outpatient areas). Regularly review compliance and other metric data to assess utilization and effectiveness of this safety technology (eg, scanning compliance rates; bypassed or acknowledged alerts).
				Layer numerous strategies throughout the medication-use process to improve safety with high-alert medications. For each medication on the facility's high-alert medication list, outline a robust set of processes for managing risk, impacting as many steps of the medication-use process as feasible. Ensure that the strategies address system vulnerabilities in each stage of the medication-use process (ie, prescribing, dispensing, administering, and monitoring) and apply to prescribers, pharmacists, nurses, and other practitioners involved in the medication-use process. Avoid reliance on low-leverage risk-reduction strategies (eg, applying high-alert medication labels on pharmacy storage bins, providing education) to prevent errors, and instead bundle these with mid- and high-leverage strategies. Limit the use of independent double checks to select high-alert medications with the greatest risk for error within the organization. (eg, chemotherapy, opioid infusions, intravenous [IV] insulin, heparin infusions). Regularly assess for risk in the systems and practices used to support the safe use of medications by using information from internal and external sources (eg, The Joint Commission, ISMP). Establish outcome and process measures to monitor safety and routinely collect data to determine the effectiveness of risk-reduction strategies.

Appendix 2. Health System Results for Assessment of Each Best Practice Criteria

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
A process is in place and followed for changing vinca alkaloid IV push orders, including contacting the provider and having a new order written/entered by the provider, with 2 pharmacists checking the new order.	121	47 (38.8)	6 (5.0)	8 (6.6)	60 (49.6)
Dispense vinCRIStine (and other vinca alkaloids in a minibag of a compatible solution and not in a syringe.	121	52 (43.0)	12 (9.9)	6 (5.0)	51 (42.1)
EHR warnings for vinca alkaloids are set up to prevent IV push or intrathecal administration.	121	56 (46.3)	5 (4.1)	3 (2.5)	57 (47.1)
Oncology order sets for IV administration of vinca alkaloids are built in CPOE to directly interface with EHR.	121	29 (24.0)	3 (2.5)	14 (11.6)	75 (62.0)
Paper order sets for vinca alkaloids are set up to prevent IV push or intrathecal administration.	121	38 (31.4)	3 (2.5)	8 (6.6)	72 (59.5)
Vinca alkaloids are dispensed with appropriate high-alert labeling.	121	53 (43.8)	4 (3.3)	1 (0.8)	63 (52.1)
Vinca alkaloids are stored with appropriate high-alert labeling.	121	43 (35.3)	11 (9.1)	1 (0.8)	66 (54.5)
VinCRIStine (and other vinca alkaloids) minibags are fully primed with the infusion set and a closed-system transfer device.	121	55 (45.5)	5 (4.1)	3 (2.5)	58 (47.9)
Eliminate all 1000 mL bags of sterile water (labeled for "injection," "irrigation," or "inhalation") from all areas outside of the pharmacy.	121	79 (65.3)	29 (24.0)	11 (9.1)	2 (1.7)
Put into place policies and procedures to ensure the elimination of all 1000 mL bags of sterile water (labeled for "injection," "irrigation," or "inhalation") from all areas outside of the pharmacy.	121	62 (51.2)	39 (32.3)	17 (14.0)	3 (2.5)
For sterile preparations compounded using IV workflow software, perform an independent verification to ensure that the proper ingredients (medications and diluents) are added, including confirmation of the proper amount (volume) of each ingredient prior to its addition to the final container.	121	60 (49.6)	9 (7.4)	12 (9.9)	40 (33.1)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement

Appendix 2. Continued

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
For sterile preparations compounded without the use of an IV workflow software, perform an independent verification to ensure that the proper ingredients (medications and diluents) are added, including confirmation of the proper amount (volume) of each ingredient prior to its addition to the final container.	121	47 (38.8)	58 (47.9)	10 (8.3)	6 (5.0)
Eliminate the prescribing of fentaNYL patches for opioid-naïve patients and/or patients with acute pain.	121	98 (81.0)	8 (6.6)	14 (11.6)	1 (0.8)
Processes are in place within the ADC to prevent the dispensing of fentaNYL patches to opioid-naïve patients and/or patients with acute pain.	121	96 (79.3)	19 (15.7)	5 (4.1)	1 (0.8)
Eliminate injectable promethazine from the hospital.	121	59 (48.8)	29 (24.0)	33 (27.3)	0 (0)
Seek out and use information about medication safety risks and errors that have occurred in other organizations outside of your facility, and take action to prevent similar errors.	121	85 (70.2)	26 (21.5)	10 (8.3)	0 (0)
• Limit the variety of medication that can be removed from an ADC using the override function. Override parameters should be aligned with pharmacy service hours. • Require a medication order (eg, electronic written, telephone, verbal) prior to removing any medication from an ADC, including those removed using the override function. • Monitor ADC overrides to verify appropriateness, transcription of orders, and documentation of administration. • Review the appropriateness of the list of medications available using the override function. • Restrict the medications available using override to those that would be needed emergently such as antidotes, rescue and reversal agents, life-sustaining drugs, and comfort measure medications such as those used to manage acute pain or intractable nausea and vomiting."	121	73 (60.3)	37 (30.6)	11 (9.1)	0 (0)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement

Appendix 2. Continued

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
Provider-facing rules are built and live, which use a weekly dosage schedule default for oral methotrexate in electronic systems when medication orders are entered.	121	105 (86.8)	5 (4.1)	8 (6.6)	3 (2.5)
Require a pharmacy-facing hard stop verification of an appropriate oncologic indication for all daily oral methotrexate orders.	121	106 (87.6)	3 (2.5)	8 (6.6)	4 (3.3)
Provide patient education for all oral methotrexate discharge orders; ensure clear written and verbal instructions; require the patient repeat back instructions to validate understanding; provide ISMP leaflet on oral methotrexate.	121	70 (57.9)	8 (6.6)	28 (23.1)	15 (12.4)
Scales are locked to metric units if able to be, or set to metric units if not able to be locked.	121	62 (51.2)	42 (34.7)	16 (13.2)	1 (0.8)
Scales to weigh patients are able to be locked to metric units.	121	39 (32.2)	48 (39.7)	24 (19.8)	10 (8.3)
Weigh each patient as soon as possible on admission and during each outpatient or emergency department encounter. Record weight in metric units only.	121	59 (48.8)	48 (39.7)	13 (10.7)	1 (0.8)
Ensure that all oral liquid medications that are not commercially available in unit dose packaging are dispensed by the pharmacy in an oral or ENFit syringe.	121	71 (58.7)	40 (33.1)	9 (7.4)	1 (0.8)
Supply controls are in place on nursing units to ensure oral liquid medications that are not commercially available in unit dose packaging are dispensed by pharmacy in an oral or ENFit syringe.	121	76 (62.8)	31 (25.6)	14 (11.6)	0 (0)
Purchase oral liquid dosing devices (oral syringes/Enfit syringes) that display the metric scale in easy-to-read print (not embossed).	121	105 (86.8)	11 (9.1)	2 (1.7)	3 (2.5)
Purchase oral liquid dosing devices (oral syringes/Enfit syringes) that only display the metric scale.	121	107 (88.4)	12 (9.9)	2 (1.7)	0 (0)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement

Appendix 2. Continued

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
Eliminate glacial acetic acid from all areas of the hospital (laboratory use excluded if the laboratory purchases the product directly from an external source).	121	96 (79.3)	22 (18.2)	1 (0.8)	2 (1.7)
Differentiate all NMBs from other medications.	121	98 (81.0)	19 (15.7)	2 (1.7)	2 (1.7)
In ADCs, segregate, sequester, and differentiate all NMBs from other medications, wherever they are stored in the organization.	121	84 (69.4)	27 (22.3)	9 (7.4)	1 (0.8)
In patient care areas, segregate, sequester, and differentiate all NMBs from other medications.	121	105 (86.8)	7 (5.8)	8 (6.6)	1 (0.8)
In the pharmacy, segregate, sequester, and differentiate all NMBs from other medications.	121	92 (76.0)	22 (18.2)	6 (5.0)	1 (0.8)
Administer IV heparin infusions in standard concentrations.	121	113 (93.4)	1 (0.8)	0 (0)	7 (5.8)
Administer IV heparin infusions via a programmable infusion pump utilizing dose error- reduction software.	121	93 (76.9)	13 (10.7)	1 (0.8)	14 (11.6)
Administer IV heparin infusions via a programmable infusion pump.	121	109 (90.1)	6 (5.0)	0 (0)	6 (5.0)
Administer IV insulin infusions in standard concentrations.	121	106 (87.6)	2 (1.7)	0 (0)	13 (10.7)
Administer IV insulin infusions via a programmable infusion pump utilizing dose error-reduction software.	121	103 (85.1)	8 (6.6)	1 (0.8)	9 (7.4)
Administer IV insulin infusions via a programmable infusion pump.	121	99 (81.8)	7 (5.8)	1 (0.8)	14 (11.6)
Employ an interdisciplinary team approach to maintain smart pump drug libraries.	121	101 (83.5)	11 (9.1)	5 (4.1)	4 (3.3)
Employ an interdisciplinary team that uses continuous QAPI processes to ensure compliance with facility policy and prevent overrides.	121	74 (61.2)	24 (19.8)	21 (17.4)	2 (1.7)
Programmable infusion pump libraries are maintained up-to-date.	121	107 (88.4)	5 (4.1)	0 (0)	9 (7.4)
Ensure all appropriate antidotes, reversal agents, and rescue agents are readily available in the clinical areas identified in facility policies and procedures.	121	106 (87.6)	10 (8.3)	5 (4.1)	0 (0)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement

Appendix 2. Continued

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
Ensure the facility has standardized protocols and/or coupled order sets in place that permit the emergency administration of all appropriate antidotes, reversal agents, and rescue agents used in the facility. Have directions for use/administration readily available in all clinical areas where the antidotes, reversal agents, and rescue agents are used.	121	75 (62.0)	39 (32.2)	7 (5.8)	0 (0)
The facility has QAPI processes in place to ensure appropriate use of anticoagulant reversal agents (vitamin K, prothrombin complex concentrate, protamine).	120	68 (56.2)	28 (23.1)	22 (18.2)	2 (1.7)
The facility has QAPI processes in place to ensure appropriate use of benzodiazepine reversal agents (ie, flumazenil)	121	74 (61.2)	26 (21.5)	18 (14.9)	3 (2.5)
The facility has QAPI processes in place to ensure appropriate use of opioid reversal agents (naloxone).	121	88 (72.7)	22 (18.2)	10 (8.3)	1 (0.8)
Medication Safety Walkaround findings have documented action plans, and the facility tracks the completion of action plans.	121	37 (30.6)	33 (27.3)	50 (41.3)	1 (0.8)
Medication Safety Walkarounds are completed quarterly for at least the following areas as applicable, and outcomes are formally documented and reported. • ICU • Medical/Surgical • ED • NICU/Pediatrics • Plus 2 additional nursing units	121	41 (33.9)	48 (39.7)	32 (26.4)	0 (0)
Adult medication injectables that are not to be administered to the patient in their entirety are sent from pharmacy as unit of use.	121	28 (23.1)	51 (42.1)	32 (26.4)	10 (8.3)
Adult medication tablets that require splitting are sent from pharmacy as unit of use.	121	24 (19.8)	63 (52.1)	34 (28.1)	0 (0)
Pediatric medication injectables that are not to be administered to the patient in their entirety are sent from pharmacy as unit of use.	121	29 (24.0)	53 (43.8)	21 (17.4)	18 (14.9)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement

Appendix 2. Continued

Best practice	Hospitals	Fully implemented n (%)	Partially implemented n (%)	Not implemented n (%)	Not applicable n (%)
Pediatric medication tablets that require splitting are sent from pharmacy as unit of use.	121	26 (21.5)	57 (47.1)	21 (17.4)	17 (14.0)
Medications that should not be administered intravenously have EHR systems strategies in place for patient safety.	121	94 (77.7)	24 (19.8)	2 (1.7)	1 (0.8)
Medications that should not be administered intrave-nously have labeling systems strategies in place for patient safety.	121	66 (54.5)	28 (23.1)	25 (20.7)	2 (1.7)
Appropriate utilization of clinical pharmacists is needed to provide clinical care to patients 24 hours day/7 days a week.	121	74 (61.2)	19 (15.7)	11 (9.1)	17 (14.0)

Abbreviations: CPOE = computer physician order entry; EHR = electronic health record; ADC = automated dispensing cabinet; NMBs = neuromuscular blocking agents; QAPI = quality assurance and performance improvement