Operationalizing into Practice Medication Safety Practices for Pediatric-focused Services in the Adult Hospital Setting

A Consensus of Practical Best Practices from the ASHP SICP SAG on Medication Safety

Background

There are over 220 pediatric hospitals in the United States which are focused on the unique needs of the pediatric population.[1] Examples of these needs are stocking medical equipment capable of treating the smallest of patients, offering medications for weight-based dosing, and providing a unique multidisciplinary team for underserved pediatric populations. However, there has been an observed decline in the number of pediatric services offered by adult hospitals. This means that fewer hospitals may be adequately prepared to care for these pediatric patients.[2] An analysis of pediatric services and pediatrics from a 2018 survey from the American Hospital's Association identified only 32.1 pediatric units from a total of 4,421 analyzed hospitals. A decrease in demand in the past decade, changes in payer mix distribution of Medicaid and private insurances, and the increased costs of pediatric-focused labor costs and equipment have been attributed to the increasing trend in closures of pediatric services.[3] Interestingly, the number of Pediatric Intensive Care Unit beds increased during this time in children's hospitals.

The pandemic brought a surge in demand for pediatric care. For hospitals looking to readdress how they can provide pediatric-focused care for their patients, Kennedy et al (AJHP) provided an excellent framework in discussing "pediatric medication safety considerations for pharmacists in an adult hospital setting."[4] The increased demand has restarted the strategic planning for expanded pediatric service offerings in adult hospitals. There is increased discussion with validating medication safety practices for expanding satellite/ decentralized pediatric services or starting pediatric services at hospitals who primarily serve the adult population. The members of the ASHP Section of Inpatient Practitioners (SICP) Medication Safety Section Advisory Group (SAG) recognize the variable infrastructure of hospitals providing pediatric services and that the application of recommendations for pediatric medication safety practices is not a one-size-fits-all approach. Through idea-sharing and discussions regarding the ongoing concerns and operational challenges in providing pediatric services in adult hospitals, the ASHP SICP SAG on Medication Safety identified an opportunity to further this discussion.

This guidance reviews different stages of the medication use process and provides examples of how to operationalize the recommended pediatric safety strategies for consideration by hospitals with varying levels of neonatal and pediatric services.

Procurement and Formulary Management

The hospital formulary system determines the scope of medical management at the facility. The ideal state is to have designated neonatal and pediatric medications within the hospital formulary, with the consult of pediatric-trained pharmacists and healthcare providers.[5] Institutions with higher levels of pharmacy resources may be able to incorporate pediatric expertise representation at Pharmacy and Therapeutics Committee meetings with representation of pediatric subspecialties. If there are no pediatric

experts available to serve in this role, employing baseline strategies can ensure critical medications are available.

Minimum standard of pediatric medications on formulary: Consider a formulary review for maintaining emergent medications that would help stabilize the pediatric patient until they are able to be transferred to an appropriate facility for a higher level of care. Ensure that this is a consideration on the formulary review checklist. This step is essential for the evaluation of formulary removal based on the data to provide a minimum requirement for formulary placement. Low utilization and other alternative therapies may be recommended for formulary removal at an adult hospital; however, specific medications may be an alternative option for emergent situations in pediatric patients. This may justify the need to maintain a low volume (e.g. sodium polystyrene sulfonate for hyperkalemic pediatric patients if alternatives are more cost effective in adults to support maintaining the alternative).

- Develop a policy for patient supplied medications, including liquids. Pediatric formulations not readily available in a commercial form are often compounded. The evaluation criteria for permitting pediatric formulations should consider how the concentration (if liquid formulation) is reconciled in the HER from admission to discharge. If a home medication is a different concentration than the inpatient medication available, it may be reasonable consider using the patient home medication to avoid errors in all process of care.

Standardize concentrations: Compare medications selected for formulary and for non-formulary stocking to the Standardize 4 Safety Initiative to match intravenous and oral concentrations where possible.[6] Include this analysis if there are outpatient or discharge services available to patients. During this analysis, consider what syringe and/or intravenous bag size will be standardized for neonatal, pediatric and adult populations to ensure differentiation of dosing expectations.

Select ready-to-administer dosage forms: Collaborate with the pharmacy procurement team to prioritize ready-to-administer dosage forms for neonatal and pediatric patients. Often, this will be ensuring that commercially available oral liquids or suspensions are purchased instead of compounding an alternate concentration in-house. Another consideration is purchasing products that do not require additional dilution to make a measurable volume for injectable products, such as controlled substances. This recommendation recognizes that carrying pediatric medications and formulations can increase the cost of inventory[7]. However, having products in the most ready-to-use form can mitigate errors. A medication safety analysis should be considered to identify if risks in preparation and administration would outweigh concerns with the increased cost of procuring the ready-to-use dosage form. Providing the most ready-to-use dosage form limits the need for additional manipulation by nursing personnel and decreases risks for errors.

Drug shortage strategies: Provide required concentrations when compounding products due to drug shortages. Often, pharmacy will switch to compounding medications to supply the needed dose. If this is not feasible due to limitations in labor or supply resources, providing the concentration needed for the nurse to withdraw the exact dose at the point of administration may be a practical balance. After the drug shortage resolves, it is important to develop a process to ensure that drug shortage mitigation IT changes are changed back to the original configurations, to allow for pediatric-specific products to be ordered again when available. Documenting the history of the changes provides guidance for reverting back to commercial products once shortages resolve and for future shortages.

Medication Storage

The strategies employed for medication storage greatly contribute to the operational efficiency of medication distribution flow as well as preventing upstream causes of medication errors derived from the dispensing pharmacy. Strategies discussed within this guidance focus on the recognized need to distinguish specific pediatric formulations within the adult population. Thus, some of the strategies described will not be appropriate for pediatric hospitals as they would lose the advantages in defined visual and process-based cues.

Pediatric inventory: Segregate medications used for neonatal and pediatric patients. Segregation can occur within the pharmacy or ideally, in a pediatric satellite pharmacy physically separated. If storing in the same space, different storage areas such as separate refrigerators may be used to store the same medication of different concentrations, those with similar packaging, or look-alike sound-alike names to designate separate dispensing workflows and avoid confusion. If technology, such as a medication carousel, is available for medication storage, leverage the ability to randomize storage locations to completely separate look-alike sound-alike medications from neonatal and pediatric products. Use barcode scanning for restocking and returning medications to inventory to ensure the right products are stocked together.

Color-coding and storage: Consider that some hospitals utilize color-coding storage designations when the pediatric volume is less frequent. The colors allow for intentional flags when seeking pediatric products amongst the adult formulations. Such standardization with color-coding has been demonstrated to prevent clinically significant errors especially in pediatric emergencies.[8] It is important to recognize that color-coding should be one of many strategies incorporated for differentiated medication storage practices, as too much color-coding can offer diminishing returns in differentiation utility.[9]
Color-coding strategies include but are not limited to:

- Color-coding storage bins such as pink for neonatal and purple for pediatrics
- Color-coded labels such as printing IV room pediatric orders on purple labels
- Color-coding storage of specific concentrations for neonatal and pediatric patients such as unique heparin concentrations

Differentiation between neonates and pediatric patients is not required, the examples listed above were submitted by current SAG Medication Safety members. Consider the need to further differentiate based on population mix.

Storage guidance in automated dispensing cabinets (ADC) or areas suppling pediatric medications: Implement processes or policies that do not allow select adult concentrations and high-risk medications to be stored in these devices/areas to prevent potential for overdose. Utilize ADC features to block the ability to load these medications to prevent urgent requests for medications to be added in the ADC without reviewing the safety considerations of the workflow.

Evaluate when it is appropriate to store both adult and pediatric concentrations. This should be a limited list and utilize multiple strategies addressing human factors to prevent confusion of these products, especially with low volume high risk situations such as anaphylaxis.

- Epinephrine kit differentiation example:
    - Adult epinephrine kit: Green label with adult dosing on outside of kit, epinephrine vial, and epinephrine-specific dosing syringe (0.15mg, 0.3mg, and 1mg)

- Pediatric epinephrine kit: Purple label with pediatric dosing on outside of kit, prefilled epinephrine syringe, three-way stopcock to withdraw correct volume from prefilled syringe, pediatric syringe that includes dose markings that are measurable based on the dosing label

Medication Histories and Medication Reconciliation

Ideally, every pediatric patient would have their medication history taken as a proper medication reconciliation. Unfortunately, with limited resources, this is not always possible. Each institution should assess where the pharmacist intervention may have the best yield for safety and clinical outcomes. Many hospitals utilize pediatric nursing or provider teams to provide the medication histories. Previous literature has shown the benefit in pharmacists, pharmacy students, and pharmacy technicians in providing the best possible medication history.[10,11,12] This information can then be used to ensure the proper medications have been continued or paused based on patient-specific factors. Adult hospitals serving pediatric patients should create a process to identify when a pharmacist and/or pharmacy technicians must perform the medication histories and reconciliations. Institutions could opt to cover designated patients.

Standardize processes for identifying complex pediatric patients: Identify complex neonatal and pediatric patients requiring pharmacy-driven medication histories. This can provide the most benefit with a limited number of resources since many pediatric patients are on a limited number of medications or none at all, The definition of a complex patient varies and would need to be clarified by each institution.

- One example of a complex patient scale is the Medication Regimen Complexity Index (MRCI) score. This score is validated in adults to help assess the complexity of a medication regimen.[13-14] Previous studies have assessed application with medication therapy management in pediatrics.[15] This is an example of a tool that could be electronically built and used in pediatric pharmacy workflow to identify patients who have more complex regimens. The MRCI scores based off dosage form, dosing frequency, and individualized instructions.[14] One pediatric study utilized the MRCI score and defined low scores as those 24-35, medium scores as 42-50, and high scores as 61-78, though there is no maximum score.[13] The specific score that would flag for a pharmacist or pharmacy technician medication history review needs to be individualized for each hospital depending on which types of pediatric patients and acuity of patients they serve.
- If the institution is unable to embed the MRCI scoring within the EHR, consider developing an institution selective list of criteria to manually identify patients that would benefit the most from a pharmacy-led medication history interview.
    - Priority factors may include compounded medications. As previously discussed, these can cause the potential for dosage errors due to different compounding strengths between the hospital and external pharmacies.
    - Other considerations may include: the need to use patient home medications, unique diets, unique allergies (e.g., red-dye allergy), number of prescriptions, number of medication administrations times, dosage forms utilized (i.e. suspensions), and specialized instructions.

Guidance for specific pediatric-focused medication history: Consider specific information to be included in a pediatric medication history such as strength (including suspension concentration), formulation (e.g. extended-release tablet, cream, etc), route (oral, gastric tube, etc), and any outside pharmacies utilized by family (including compounding and specialty pharmacies). Specifically outlining the instructions for calling outside pharmacies will ensure medication errors with dosage concentrations can be avoided. The patient's parent or caregiver may only recall the dose as a volume (mL) instead of an actual dose (mg).

The medication history collected by the pharmacy staff should be documented in the patient chart within a note in the electronic health record. Training for pharmacy staff should include information regarding common pediatric medications used and dosage formulations available.

- **Leverage EHR functionality: R**equire doses in micrograms, milligram or grams instead of or in addition to volume. Efforts to identify the correct dosage must correctly transition through the EHR environment. As previously reported, dosing errors can occur when medications are made in different concentrations and outside orders are continued inpatient without attention to the concentration of the product. **R**equiring a medication to have a dose in numerical dose instead of or in addition to volume helps to ensure consistency across transitions of care.

Processes for managing ketogenic diets and color dye allergies: Consider unique diets, such as the ketogenic diet. If a patient on the ketogenic diet receives medications with added dextrose, they could revert from ketosis and begin to seize. Resources should be available to pharmacy staff such as the Keto Diet Calculator, or another institution specific reference with specific NDCs.[16] Keto Diet Calculator does require a subscription, but it is free and can be edited to include information obtained by pharmacists at your institution.[16] Institutions should also consider having information readily available regarding red dye allergies. For example, your institution can keep track of specific NDCs that do not contain specific color-dye and make the list available to pharmacy staff. Upon reconciliation and further order verification, the pharmacist can put the NDC in the medication order or product comments so that nursing is aware it has been evaluated by pharmacy and communication is clear.

High Risk Medications at Discharge: Involve pharmacists in the discharge medication process to mitigate errors occurring in the transition from inpatient to outpatient care.[18] Liquid medication formulations account for 81.9% of medication errors outside of the hospital in children.[18] If available, a pharmacist could review liquid medications with patients prior to discharge or at discharge. Other medications that can be considered for discharge counseling by pharmacy could include abortive seizure agents, anticoagulants, and insulin. To identify agents, consider unique medication administration instructions, need for monitoring and dose complexity. Creating a focused list for institution specific needs would help to standardize the process and improve outcomes.[19]

Medication Ordering

Differentiate Medication Orders with CPOE: Prevent confusion between patient populations and pursue strategies to differentiate neonatal, pediatric, and adult medication orders. Strategies for differentiating orders include ordering pathways and EHR visual indicators of population-specific information.

- Providers, pharmacists and nurses, should have input in the design of order sets and orderables to ensure usability of all clinical team members. Evaluate the pediatric-focused “name” of medication orders to ensure that everyone is utilizing the same contextual vocabulary.
- Thoughtful application of weight-based doses versus standard doses into population-specific orders is important to ensure correct dose selection.
- When EHR capabilities permit, leverage filtering based on age and location to differentiate orders. Configure drug order panels to first require selection based on patient age prior to opening the drug order composer. Limit order visibility based on patient location so only pediatric orders are searchable.
- Finally, consider chart banners, bolding of patient age and weight, and selecting a chart color that is specific for pediatric patients as visual indicators to distinguish the patient population.

Clinical Decision Support (CDS) Alerts: Utilize dose checking/dose range checking alerts configured for neonatal and pediatric patients. These alerts serve as the baseline safety net for ensuring that doses ordered are not sub- or supratherapeutic. Ideally, CDS alerts would be configured at the order set level and facility/location level to specifically cover neonatal and pediatric dose ranges.

- Pediatric Clinical Pharmacists Specialist can offer expertise into clinical decision support, dosing ranges, and can facilitate clinical treatment decisions for adult-sized and obese pediatric patients. Although time intensive, the review of these alerts can further strengthen an effective error prevention strategy as these alerts can be configured to appear for providers, pharmacists and nursing.

- For organizations that do not have clinical pharmacists focused in pediatrics, the Institute for Safe Medication Practices and other patient safety organizations can offer support. The ASHP SAG on Medication Safety endorses the application of Key Potentially Inappropriate drugs in Pediatrics: The KIDs List.[20]

Enhance Patient Weight Strategies: Consider the multiple strategies that exist for safe incorporation of weight-based dosing into drug orders:

- The designated dosing weight must be viewable in the patient's profile or in the order composer when ordering medications.
- Automated dose calculators should be utilized for weight-based dosing when available in the EHR. Automated dose calculators should indicate when a dose exceeds minimum or maximum limits.
- Units must be uniform between all electronic interfaces including CPOE, ADCs, smart infusion pumps etc. Weight-based flow rates and doses should be aligned between CPOE and smart infusion pumps.

Evaluate Laboratory Value Calculations: Add pediatric lab value calculations to the preset lab value listing if the hospital treats pediatric patients. When possible, configure automatic dose calculators to utilize the pediatric lab values specifically for pediatric patients. Often, lab values are reported based on adult formulas.

Evaluate Pediatric-Focused Resources for Code events: Leverage the EHR to develop a pediatric code ordering and documentation pathway that incorporates dose calculator functionality. Pediatric code response is vulnerable to drug ordering. A paper-based pediatric code protocol with standard weight-based dosing recommendations is an appropriate alternative reference tool.

Medication Order Verification

At institutions where neonatal and pediatric medication orders are at a lower medication order volume than adult orders, various methods of order validation can be employed to increase confidence. Dual pharmacist verification involves two pharmacists independently double-checking medication orders and/or final product preparation. Some institutions require this for all medication orders, and others prioritize based on designated high-risk classifications such as TPNs, hazardous medications and opioids. The ASHP SICP Medication Safety SAG considered different strategies, and implementation should consider patient volume, level of acuity and clinical specialist support in the design of order sets and protocols.

Standardize Drug Information References: Designate preferred neonatal and pediatric references for standard care and preferred references for unique considerations. These should be available to providers, pharmacists and nursing. If possible, educate providers to prioritize and utilize the same references as pediatric references can differ slightly in dosing and dose range recommendations.

Operational Strategies to Employ Validation of Neonatal and Pediatric Doses at Order Verification:

- Documentation of weight-based calculation and reference at pediatric order verification
    - Require the verifying pharmacist to document the dose calculated. For example: "Ordered: 2.5 mg/kg/dose, Ref: 2-4mg/kg/dose." This documentation's purpose is the mental double check of the dose and evaluation that the ordered dose is within an appropriate range. This is often used when the CPOE does not have an integrated dose calculator. This documentation does not need to be visible to providers and nursing. This can also serve as a reference for other verifying pharmacists to evaluate the pattern of changes of a medication order if needing to evaluate the order to provide a recommendation. Implement periodic audits of this documentation for quality assurance and validation that the verifying pharmacists are making consistent decisions on preferred references, especially if the hospital provides services to neonatal and pediatric patients.
- Utilizing dual pharmacist verification. After the first pharmacist verifies the medication order, the order will reroute to another pharmacist for verification of the order. There is no best practice on this strategy, and the ASHP SICP Medication Safety SAG recommends assessing risk points in the medication order verification process to identify utility of dual pharmacist verification.
    - One approach is requiring a select list of medications that are either considered high-risk medications or are involved in high-risk preparation and dispensing processes. Example: TPNs – If the CPOE order and compounder order are utilized on separate platforms, require an independent double check by pharmacists to validate for clinical appropriateness of the TPN order and also transcription accuracy in the transcription from CPOE order to compounder order.
- Separate Neonatal and Pediatric Orders for Verification: Segregate neonatal and pediatric orders by age and/or location to allow pediatric-focused evaluation of medication orders. Ideally, dedicated pediatric-trained pharmacists would cover the verification of these orders. If a separate order verification queue cannot be designated, utilize color-coding functionality to highlight neonatal and pediatric patients in the profile information during verification.
- Implementation of Autoverification: ASHP has developed an Autoverification toolkit.[21] Autoverification can offer efficiency and timely verification of medication orders that have less restrictions in application to the general population. Perform a risk assessment for neonatal and pediatric populations to assess whether autoverification of pediatric orders would be appropriate, to allow for more time-intensive review of high-risk medication orders. If autoverification is implemented, exclude higher risk medications and certain weight-based dosed medications. Ensure that the automated dispensing cabinets are profiled if autoverification is utilized for that location. Regularly audit autoverified orders to ensure that rules are working as intended. Consider activating a review autoverify feature (if possible, in the EHR) that allows for pharmacist review of autoverified orders.

Product Preparation and Dispensing

Leverage Automation and Technology: Utilize barcode scanning while preparing medications where possible, such as within dispensing workflows, packaging workflows and sterile and non-sterile compounding workflows. If possible, allow for gravimetric functionality for different concentrations and dilutions for the highest risk neonatal and pediatric patients, such as caffeine citrate for neonates. Since oral liquids are leveraged more in the pediatric population, utilize pharmacy software, whether integrated within the EHR or external programs, to standardize the process for compounding and reconstituting medications. This critical step of product preparation for pediatric doses ensures that technology plays an essential role in validating the correct information throughout this dispensing process. If possible, allow for gravimetric functionality for different concentrations and dilutions for the highest risk neonatal and pediatric patients, such as caffeine citrate for neonates. Since oral liquids are leveraged more in the pediatric population, utilize pharmacy software, whether integrated within the EHR or external programs, to standardize the process for compounding and reconstituting medications.

Preparation and Dispensing Workflow: Segregate tasks pertaining to pediatric preparations.

- Assign a designated technician to focus on preparing medications for neonatal and pediatric patients for sterile compounding, non-sterile compounding, repackaging, and preparation of patient-specific oral syringe doses. If this is not feasible, separate the tasks for neonatal and pediatric patients within the shift such as implementing dedicated pediatric batches that can be printed from a separate printer.
- Pediatric doses can change frequently throughout the day. Based on the facility's volume and rounding times, grouping some of the preparation and dispensing workflow can support efficiency and conserve labor and medication resources. The operations team should evaluate the appropriate balance of increasing the number of batches per day to reflect frequent dose changes and labor resources needed being readily available to quickly prepare/ compound medications.

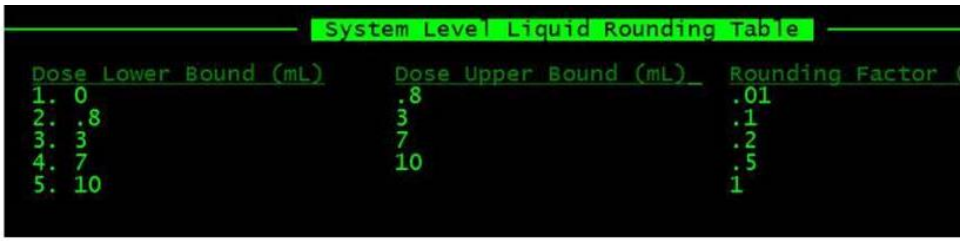
Standardize Dose Rounding Rules to Support Dose Measurability: Standardize dose rounding to ensure dose volumes needed in medication preparation are measurable. This removes manual interpretation of rounding the dose volume when the dose volume ordered does not neatly measure to a calibrated marking. The rounding logic can be incorporated within the EHR or standardized doses can be determined if the former is not a possibility. Standardize syringe selection based on a dose volume range to ensure measurability during the preparation process.

Standardize dispensable dosage forms with the EHR. Develop a strategy to guide dispensing of doses in a syringe versus infusion bag by considering cut-offs for weight-based dosing (such as <10 kg defaults to a syringe), and concentration/max-volume factors (such as >50 mL defaults to IV piggyback). Administer infusions via syringe pumps to allow for a more precise degree of administration. For example, a 3mL syringe may be utilized for continuous infusions running 0.01 mL/hr to 0.1mL/hr, depending on the capabilities of the syringe infusion pump; whereas a large volume infusion pump can infuse at a minimum of 0.5mL/hour. Syringe pumps also impose additional considerations such as: concentration and rate limitations for medication administration in 1 mL and 3 mL volumes, and type of tubing needed to reduce drug lost in the tubing during administration.

Example table of standardization of volumes to round to the next measurable dose:

Total Vol. (ML)	**Smallest LINE increment (ML)**	**Calculated Lowest Measurable Dose (size of syringe / number of calibrations)**	***Smallest Accurate Dose (20% of volume)*[22]**
1 ML	0.01 ML	0.01	0.2
3 ML	0.1 ML	0.1	0.6
5 ML	0.2 ML	0.2	1
10 ML	0.2 ML	0.2	2
20 ML	1 ML	1	4

EHR Dose Lower Bound (ML)	**EHR Dose Upper Bound (ML)**	**EHR Rounding Factor (ML)**
0	1	0.01
1	3	0.1
3	10	0.2
10		1



Splitting Doses: Determine if resources for preparation allow pharmacy to prepare split doses. ISMP recommends using the commercially prepared exact unit dose when possible [ISMP Half to Do it article]. For pediatrics, this can be more challenging given weight-based dosing. The ideal goal for approaching this practice includes providing nursing the dose in the most ready-to-administer form to achieve exact dosing and timely availability of access to medications. Various strategies may be employed:

- Identify and procure the smaller needed dose to stock and dispense avoiding the need for tablet-splitting or dilutions of injectable products.
- Prepare all manipulated doses in pharmacy.
- Allow for 1 single tablet splitting on the floor by nursing for non-hazardous tablets.
- Pre-package ½ tablets for high use medications. Consider ¼ tablets, which should be prepared by pharmacy.
- Standardize doses to round to a whole unit-dose cup. Nurses can also draw up dose from the unit-dose cup. This may be appropriate for acetaminophen and ibuprofen doses that are often administered from PRN orders.

An example of the split dosing approach is included:

- If the medication is available in the automated dispensing cabinet (ADC), the ADC logic to prioritize what is available in the ADC will direct the nurse to vend the medication from the ACD and prepare the partial dose (i.e., split the tablet, prepare a partial dose from vial or liquid). If possible, include a “partial package” warning during the BCMA medication administration process.
- If the medication is not stocked in the ADC:
    - Scheduled and parental: pharmacy to draw up dose
    - PRN and parental: pharmacy to send whole vial for nurse to prepare dose
    - Short stability and parental: pharmacy to send whole vial for nurse to prepare dose

- Not parental: pharmacy to prepare partial dose or split tablets prior to dispensing

Ready-to-dispense dosage forms: Provide orderable concentrations within the EHR that provide the most measurable dose options based on the range of populations covered. Any manipulation of a medication prior to administration that is performed by the administering health care team member removes the second check process to ensure that the manipulated dose is the right dose. An example is controlled substances that require dilution by the nurse in order to achieve a measurable dose. The ideal state (provided resources) would be for pharmacy to prepare diluted vials so that nursing would only need to withdraw the needed dose instead of manipulations on the floor to achieve a measurable dose.

Administration

There is strong literature supporting practices involving medication safety and administration. Recommendations for pediatric-specific considerations heavily leverage automation and technology to improve the effectiveness of error mitigation strategies. Additional strategies should consider opportunities in workflow and human behaviors.

Leverage Smart Infusion Pumps: Utilize smart infusion pumps for all injectable large volume and small volume medications. This technology accounts for several potential pitfalls with the administration of infusion medications in weight-based dosing, narrow dose changes and guardrails to prevent therapeutic toxicities. Avoid use of basic infusion settings by ensuring all possible neonatal and pediatric medications are included in the library. The ideal state is to implement interoperability; however, an in-depth assessment is needed to understand the range supported by devices offering interoperability for small volume and large volume parentals in terms of the specificity of infusion rates. Consider infusion sets such as microbore tubing and strategies to account for potential loss of drug within the tubing.

Conversion to ENFit oral syringes: Implement ENFit devices for oral medication preparation and administration to prevent wrong route errors and misconnections. For smaller pediatric patients including neonates, many of the medications needed are administered by intravenous route and are prepared in a syringe. Ensure that all enteral feeding devices are compatible with ENFit syringes and appropriate adaptors are obtained if needed (e.g., feeding tubes, pumps, etc.). Collaborate with nursing and materials management to have adequate supplies on patient care units, and that frontline nursing are trained on the safe use for small doses compared to larger doses.

Intentional Independent Double Checks: Designation of nursing independent double checks should be incorporated as part of the layered error mitigation strategy.[23] Examples include administration of targeted high alert medications such as highly concentrated opioids administration and total parental nutrition administration, in which the effect of the potential error is much more clinically significant. This intervention creates a “pause” within the administration process to allow for focused, intentional review of rights of administration. In adult hospitals with a smaller population of pediatric services, the frequency of administration may be limited causing anxiety if staff have not utilized a medication recently.

Automated Dispensing Cabinets (ADC) Overrides: Audit documentation of medications removed using the override function from an automated dispensing cabinet to evaluate the appropriate use of the medications within the neonatal and pediatric populations.[24] The override function bypasses the pharmacist verification and the opportunity for the additional dosing check. Identify opportunities to collaborate with providers and nursing to ensure that there are appropriate PRN orders and readily accessible medication orders for scheduled beside procedures. For instance, if there is a high quantity of

lidocaine removed utilizing the override function from the ADC on the newborn patient care unit, it may be indicative of the lack of utilization of medication orders for circumcision.

Other Considerations

The ASHP SICP Medication Safety SAG discussed additional topics that were deemed essential to developing pediatric-focused strategies within the adult hospital setting.

Pediatric competency: There has been previous work to centralize and develop resources for pediatric competencies.

- The ASHP Pharmacy Competency Assessment Center has neonatal- and pediatric-focused modules on medication management, pharmacokinetics, oncology patient management and nutrition support management.[25]
- Core Competency in Pediatric Hospital Pharmacy Practice: Boucher E. et al. updated the recommendations for requirements in pediatric core competencies. This may serve as a start to develop the checklist of core competencies needed for the care of neonatal and pediatric patients.[26]
- Kenney A. et al. developed a great table of commonly used pediatric resources[27]
- Ensure that there is adequate coverage by pharmacists and technicians for pediatric-focused workflows and clinical care of patients. Operationally, this includes sterile and non-sterile compounding skills, packaging, medication distribution. Consider what are minimum competencies that all staff should be comfortable with especially if pediatric patients are placed on in adult focused areas.
- Consider "live action" competency training to validate understanding of unique pediatric needs such as measurable doses, code blue event training, etc.
- Response to Neonatal and Pediatric Emergency Events[28]: Schedule regular pediatric code blue training and simulations. Consider covering PALS certification for pharmacists based on patient volume and resources.

Pediatric Medication Safety Representation: Discussed in previous sections, advocate for pediatric representation on all hospital committees such as Pharmacy & Therapeutics Committee, and Medication Safety Committee, Medical Emergency Team Committee, etc. If there are extensive pediatric services incorporated in a larger adult hospital, the ASHP SICP Medication SAG recommends a pediatric medication safety pharmacist.[29] This resource can also serve as the pediatric representative in several hospital groups and centralize quality improvement discussions to ensure that neonatal and pediatric patients are considered in major clinical and operational decisions.

Join Patient Safety Organizations: Broaden the discussion by joining pediatric-focused associations to learn about upcoming initiatives, practice updates and develop a network of other institutions for information sharing.

- Pediatric Pharmacy Association (https://www.ppag.org/)
- Children's Hospitals' Solutions for Patient Safety (https://www.solutionsforpatientsafety.org/)
- Children's Hospital Association (https://www.childrenshospitals.org/)

Conclusion

The strategies described in this document are a mixture of pediatric-focused best practices and operational safe practices discussed within the ASHP SICP Medication Safety SAG to address concerns for institutions primarily providing care to adult populations. Many of the discussion points came from questions raised in the SAG monthly meetings to understand how to make it safer to care for pediatric patients. Certainly, these strategies do not provide a one-size-fits-all approach. The ASHP SICP

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The SICP Medication Safety SAG hopes that this guidance document provides a starting point to provide baseline practices to ensure safety in caring for pediatric patients considering the variation of resources available.

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