Pediatric Pharmacy Services: Current Models and Justification for Expansion

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Despite recommendations from numerous health care bodies, some hospitals that care for children have struggled to establish or expand pediatric pharmacy services. The current state of dedicated pediatric operational and clinical pharmacy services was characterized by results from a survey of hospitals that provide care to pediatric patients. The discussion of quality of care, safety, and financial impact is meant to provide concepts for justification of pediatric pharmacy service expansion.

ABBREVIATIONS AAP, American Academy of Pediatrics; PGY, postgraduate year; SD, standard deviation

KEYWORDS benchmarking; inpatient; pediatric hospitals; pharmaceutical services; pharmacists

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Introduction

Allocation of pediatric pharmacy services is often extrapolated from analysis of both internal and external pharmacy services provided to an adult population, despite multiple studies, national organizations, and regulatory bodies that say providing safe pediatric pharmacy services poses unique challenges. More resources are required to prevent adverse drug events in the vulnerable pediatric population. Allotting pediatric pharmacy resources based on extrapolated adult census data per pharmacist or adult medication order per pharmacist grossly underestimates what is needed to provide safe, comprehensive pharmacy services to pediatric patients. Despite recommendations from numerous health care bodies, including The Joint Commission, the American Academy of Pediatrics (AAP), Pediatric Pharmacy Advocacy Group, and the American Society of Health-System Pharmacists, some hospitals that care for children have failed to establish robust pediatric pharmacy services.^{1–3}

A survey was distributed amongst Vizient University Health System Consortium hospitals that provide pediatric-focused services to gain insight into their practice models, clinical services, and perception of interdisciplinary support for expansion of dedicated pediatric pharmacy services. Vizient, the nation's largest health care improvement company, has a membership that represents just over half of the acute care health systems, including more than 90% of the academic medical centers in the country. The responses are integrated throughout as approaches are discussed to justify expansion of operational and clinical inpatient pediatric pharmacy services. While impossible to encompass all possibilities owing to the relative heterogeneity of health care facilities with varying individual needs and

resources, the discussion of quality of care, safety, and financial impact is meant to provide concepts for justification of pediatric pharmacy service expansion.

Operational Pharmacy Services

Justification to increase operational pediatric pharmacy services starts with the identification of an appropriate operational model and benchmarking with facilities with a similar pediatric licensure of beds. Hospitals use a number of operational models to provide pharmacy services to pediatric patients. Hospitals that infrequently provide services to children do not typically have any dedicated pediatric pharmacy services, while large freestanding children's hospitals have a multitude of dedicated pediatric pharmacy services available 24 hours a day and 7 days a week. The majority of pediatric pharmacy practice models lie between these 2 extremes. While survey responses include those from freestanding children's hospitals, the overwhelming majority of survey responders were at facilities where the pediatric hospital or units were within a larger acute care hospital. Table 1 summarizes some common pediatric pharmacy operational models.

The type of operational model used at a hospital is based on a variety of dynamics; often one of the main factors is average pediatric licensed beds. Table 2 is a summary of survey results comparing operational models to number of pediatric beds.

Survey results were unable to characterize hours of operation based on service model. However, expansion of hours is a way to advance pediatric pharmacy services in non-24 hour sites if a suitable operational model is already in place. The ideal scenario includes having pediatric-trained resources allocated 24 hours a day, 7 days a week. Depending on the needs and

Table 1. Pediatric Pharmacy Operational Models

Model	Verification/Ordering	Preparation/Dispensing
No pediatric-dedicated services	No pediatric-dedicated pharmacist(s). Pharmacists verify/order both adult and pediatric orders	All pediatric medications prepared/dispensed in the same location as adult medications
Fully operational dispensing pharmacy with sterile compounding	Pediatric-dedicated pharmacists provide order verification/entry in a separate location from where adult medication is verified/ordered	Pediatric-dedicated preparation/dispensing of all pediatric medication orders
Dispensing pharmacy without sterile compounding	Pediatric-dedicated pharmacists provide order verification/entry in a separate location from where adult medication is verified/ordered	Pediatric-dedicated dispensing of some products, but not all (e.g., all sterile compound products are dispensed from a central location, but all oral medications are dispensed from the pediatric pharmacy)
Order verification satellite	Pediatric-dedicated pharmacist(s) provide order verification/entry in a separate location from where adult medication is verified/ordered	All pediatric medications prepared/dispensed in the same location as adult medications

resources of the facility, the expansion of hours covered by pediatric-dedicated pharmacy personnel may be more feasible than a major model overhaul, which could require new space allotment or construction.

Outside of operational model, a variety of staffing models have evolved to optimize available resources to provide care to pediatric patients. As the role of clinical pediatric pharmacists has expanded over the last few decades, staffing models have adapted and changed to meet those demands. Table 3 summarizes various staffing models and the number of responding hospitals demonstrating those models.

Expansion of pharmacist roles can be justified by evolving the current staffing model to include increased clinical involvement, if not already present. Options include dedicating a staff pharmacist to pediatric medication verification if not already present, training and integrating staff pharmacists into dual responsibility roles, and/or increasing clinical specialist numbers. The result would be decompression of workload of individuals in particular roles, opening opportunities to increase clinical services like interdisciplinary rounding, antimicrobial stewardship, and collaborative drug therapy management. A case can be made for an

increase in the quality of care, and depending on the additional clinical services expanded, a financial case as a result of the optimization of drug resources used.⁴

Clinical Pharmacy Services

Pediatric Pharmacy Advocacy Group and the American Society of Health-System Pharmacists maintain that essential services include clinical pharmacy services in specialized, high-risk units (e.g., pediatric and neonatal intensive care units, hematology-oncology unit).² Clinical pharmacy services can be offered to pediatric patients with a variety of clinical practice models to deliver this care. Practice models may be described as clinical specialists with operational pharmacists, where clinical specialists have minimal operational responsibilities and operational pharmacists have minimal clinical responsibilities; clinical staff pharmacists that rotate clinical and operational responsibilities; or a hybrid model in which pharmacists specialize in pediatric care, but also have operational responsibilities. Pediatric hospitals use a variety of models that may include many, few, or no clinical specialists.

Regardless of the clinical practice model selected, the pharmacists' expertise and the clinical services

Table 2. Pediatric Pharmacy Operational Model by Number of Licensed Pediatric Beds*

Model Feature	No. of Licensed Pediatric Beds*		
	<99	100–199	200–299
No pediatric pharmacy services	3	1	1
Fully operational pharmacy with IV prep	3	13	3
Dispensing pharmacy without IV prep	3	0	1
Order verification satellite	1	0	1
Total responses	10	14	6

* Survey responders were asked to include neonatal intensive care unit beds, but exclude nursery beds in their number of licensed beds.

Table 3. Pediatric Pharmacy Staffing Models

Staffing Model	Description	No. of Responses
Staff only	Pharmacists provide solely operational responsibilities including product preparation and order verification on a daily basis	1
Clinical specialist only	Pharmacists with no operational responsibilities; only clinical responsibilities including drug utilization review, pharmacokinetic monitoring, and team rounding	1
Traditional	Pharmacists serve as either staff pharmacist or clinical specialist; both roles present throughout hospital structure	1
Dual responsibilities	All pharmacists assigned clinical and operational responsibilities	10
Clinical specialists and pharmacists with dual responsibilities	Portion of pharmacists serve in a role as clinical specialist solely; portion assigned to clinical and operational responsibilities	8
Staff pharmacists, dual responsibility pharmacists, and clinical specialists	All pharmacist roles exist	8
Total responses		29

offered determine the level of quality and excellence of a hospital's pediatric clinical pharmacy services. In essence, a hospital that has few or no pediatric clinical pharmacy specialists does not necessarily translate to a lack of robust clinical services. The clinical pharmacy services being provided should be those that have the greatest pharmacy impact by decreasing length of stay, reducing readmissions, preventing medication errors, increasing quality of care, and reducing drug costs. Figure 1 lists the most common pharmacy services provided by 32 responding institutions with a wide range of pediatric inpatient beds.

Participating in interdisciplinary rounds and order verification were the 2 services most frequently provided regardless of institution size. The same institutions were also asked to identify which inpatient services include pediatric pharmacists during interdisciplinary rounds. Responses are listed in Figure 2.

Aside from the clinical services provided to the hospital alone, resources allocated to education can be used to further justify positions. With the expansion of clinical services, training is necessary to develop the next generation of pharmacists with clinical expertise in pediatric medicine. This can be achieved through

Figure 1. Dedicated pharmacy services provided by number of pediatric beds.

* Survey responders were asked to include neonatal intensive care unit beds, but exclude nursery beds in their number of licensed beds.

Figure 2. Pediatric services covered during interdisciplinary rounds.

precepting pharmacy students from local colleges of pharmacy and establishing first- and/or second-year pharmacy residency programs. Table 4 highlights the presence of learners by pediatric bed number.

Using an objective method for evaluating resource needs and determining the greatest benefit of pharmacy services, as well as using terminology and metrics that are relatable across disciplines, can help hospital leadership understand the value and importance of creating or expanding dedicated pediatric pharmacy services. Acuity scores such as a pharmacy intensity score, service census, high-risk medication use, and high-cost medication use are some metrics that have been used to identify areas with the greatest potential for pharmacy impact.⁵

Interprofessional Services

Garnering physician and nursing leadership support for expanding pharmacy services is another key component to consider when building a case for expansion of pediatric pharmacy services. It is important to have a continuous dialogue with physician and nursing leadership on their staff's expectations and perception of

pediatric pharmacy services. These relationships will be crucial when prioritizing and justifying an expansion of pediatric pharmacy services. All sites reported physician support for expansion of pediatric pharmacy services. All except for a few sites also had the full support of nursing leadership to expand pediatric pharmacy services. Table 5 outlines the most frequent requests for additional pediatric pharmacy services from physician and nurse leaders, as reported by pharmacists completing the survey. As one would expect there are many common goals from both groups, including expansion of operational hours, more pharmacist participation on clinical rounds, pharmacy-driven medication reconciliation, and pharmacist presence in the ambulatory clinic setting. Nurse leadership is also looking for dedicated unit-based pharmacists for pediatric units and pharmacist-led education for nursing staff.

Impact on Safety and Quality

In 2003, the AAP released a policy statement on Prevention of Medication Errors in the Pediatric Inpatient Setting.³ Within the policy statement, the AAP recommended that hospitals "provide an adequate

Table 4. Integration of Learners in Pediatric Clinical Pharmacy

No. of Pediatric Beds*	PGY1 Residents Annually		PGY2 Resident Annually		Student Pharmacists Annually	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
<99 beds (n = 10)	1.3 ± 2.5	0–6	0.1 ± 0.3	0–1	5.9 ± 4.4	0–12
100–199 beds (n = 15)	0.7 ± 2.1	0–8	0.5 ± 0.7	0–2	19.3 ± 16.3	0–60
200–299 beds (n = 7)	0.1 ± 0.4	0–1	1 ± 0.8	0–2	22 ± 24.9	0–75

PGY1, postgraduate year 1; PGY2, postgraduate year 2; SD, standard deviation

* Survey responders were asked to include neonatal intensive care unit beds, but exclude nursery beds in their number of licensed beds.

Table 5. Physician and Nurse Requests for Additional Pediatric Pharmacy Services

No. of Hospital Responses	Responses*
Top Physician Responses	
25	Increased pharmacist participation on clinical rounds/dedicated-service coverage (15) Operational expansion (e.g., expanded hours pediatric pharmacy coverage) (9) Medication reconciliation (5) Medication counseling (4) Antimicrobial stewardship (4) Ambulatory clinic presence (4) Pharmacy-driven committees/projects (4)
Top Nurse Responses	
21	Operational expansion (e.g., expanded hours pediatric pharmacy coverage) (9) Dedicated unit-based pharmacist (6) Increased pharmacist participation on clinical rounds (5) Medication reconciliation (5) Provide education for nursing staff (3) Ambulatory clinic presence (3) Medication counseling (2)

* Multiple responses were allowed.

number of nursing and pharmacy staff trained to prepare, dispense, and administer medications to children.” No opinion was provided on what the group felt was adequate, nor did the statement provide direction on how a facility might ascertain how many pediatric trained nurses and pharmacist staff were appropriate for a particular pediatric census size or acuity.

The pediatric population poses unique challenges to the pharmacy care provider, including medication and dose selection, routes and methods of administration, medication therapy monitoring, and counseling, owing to a lack of published drug information and commercially available pediatric dosage forms and concentrations.² Individualized weight-based dosing calculations and frequently changing pharmacokinetic parameters further complicate the pediatric patient profile.⁶ Pharmacists caring for the pediatric population must have knowledge about the pharmacokinetic and pharmacodynamics changes that occur with age (e.g., volume of distribution, protein binding, renal elimination, metabolism, muscle mass, and fluid requirements) and with disease-specific conditions that might affect drug choice or administration (e.g., short-gut syndrome, lactose intolerance). Owing to the lack of published pediatric-specific drug information, pharmacists must rely on experience and training to ensure appropriate care is provided.

The prevention of medication errors in pediatric patients is imperative. Medication errors have the potential to cause harm in the pediatric population at a higher rate than in the adult population, and the potential for adverse drug events within the pediatric inpatient population is about 3 times as high as for hospitalized adults.¹⁷ Pediatric trained pharmacists are in the best position to prevent these errors. It is particularly important for teaching hospitals that treat pediatric patients

to have dedicated pediatric pharmacists. A study at a moderately sized pediatric teaching hospital evaluated the impact that pediatric pharmacists can have on the prevention of adverse drug events. During a 2-month study period, 1315 interventions were recorded for an average of 21 interventions a day. Approximately 25% of the interventions were prescribing errors. The majority of interventions were made during order review, and it was noted that the least experienced physicians made the majority of errors. The study found that approximately 6% of orders reviewed contained an error, yet only 0.2% of all errors during the study period reached the patient.⁸

Providing care to pediatric patients often takes an increased time requirement. Holden et al⁹ discussed the effects of mental demands during dispensing on perceived medication safety and employee well-being at 2 pediatric hospital pharmacies. Their research is novel because they assessed pharmacy workload in terms of the subjective mental workload of the dispensing task rather than the historical volume-based approach. When subjective mental workload is assessed for pediatric medication orders, a multitude of factors are considered. Calculation of individualized doses, limited published literature or US Food and Drug Administration approval to support pediatric medication use, dosing, pharmacokinetics, safety, efficacy, stability, bioavailability, and compatibility lead to increased verification time. Dispensing time and effort is increased owing to the lack of commercially available pediatric oral formulations, the need for medication dilutions, more frequent dosing regimens, and weight-based dosing.

Financial Impact

When attempting to justify an increase in pediatric pharmacy operational and/or clinical resources, it is important to include benchmarking data, as well as

the impact on patient safety and quality of care; it is equally important to address the financial implications. Currently, inpatient pharmacy is not considered a revenue-generating department; as such, strictly bottom-line financial justification for expansion of inpatient services is often impossible. Internal time and motion studies can establish a baseline to help justify future resource needs related to expansion of clinical services or operational workload, while also providing a way to measure the impact of added technology or responsibilities on the workflow of pharmacy staff.^{10,11} Citing literature that has evaluated error rate reduction, therapy optimization, reduced mortality and length of stay, reduced drug costs, and overall cost-benefit ratios from similar populations, services, or locations will help support your case and provide hospital leadership with an estimation of benefits.¹²

A published retrospective cohort study¹³ reported on the impact of a clinical pharmacist on patient care, length of stay, and cost in 40 pediatric patients with cystic fibrosis. The authors found that clinical pharmacist-managed therapeutic drug monitoring compared to usual care resulted in patients with cystic fibrosis achieving target antibiotic serum levels an average of 3 days sooner, average length of stays 3 days shorter, fewer dosage adjustments, and fewer laboratory tests, for a total cost reduction of \$287,832 or approximately 15% for the clinical pharmacist-managed group.

The current financial pharmaceutical environment lends itself to making a strong business case for an increase in pharmacy services to help reduce costs. Clinically experienced pharmacists can help blunt the impact of new high-priced drugs as well as the unexpected exponential price increases on older drugs.

We discussed the potentially devastating effects adverse drug events have on patients, but they also have a significant financial impact on hospitals. It is estimated that the total cost of preventable medication errors across US hospitals is approximately \$16.4 billion annually.¹⁴ One study, which reviewed the cost implications of having a critical care pharmacist present in an adult intensive care unit, found that the cost avoidance for adverse drug events totaled between \$205,919 and \$280,421 in a 4.5-month period.¹⁵

The ability to meet Centers for Medicare & Medicaid Services meaningful use recommended core measures for pediatric patients will have increasing financial implications on hospitals. Use of appropriate medications for asthma, childhood immunization status, and appropriate treatment for children with upper respiratory infection are 3 measures that a pharmacist can directly impact.¹⁶

Summary

Pediatric patients require specialized pharmaceutical care that includes both operational and clinical components. Comparing the resources required to

care for an adult patient is an ineffective method to determine the resources needed to provide safe care to the pediatric population.

When attempting to justify new or expanded pediatric pharmacy services, initial steps must include a reevaluation of the current operational and clinical practice models. A combination of benchmarking data, a validated objective scoring tool, and survey data from pharmacy and non-pharmacy hospital leadership should be used to prioritize the areas of greatest need and ones that will provide the most significant impact. Justification for the identified areas of expansion of pediatric pharmacy services should then include benchmarking data, expected impact on quality of care and patient safety, interdisciplinary support, guidelines from national organizations, and a detailed financial case.

ARTICLE INFORMATION

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