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ORIGINAL ARTICLE

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Development of a pharmacy 'patient prioritization tool' for use in a Tertiary Paediatric Hospital

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Abstract

What is known and objective: Pharmacists play an integral role in paediatric patient care by ensuring the safe and optimal use of medications. There are increasing demands on pharmacists' time and challenges to meet them within allocated resources, and therefore, it is important to ensure that resources are used efficiently. Patient prioritization tools for clinical pharmacists have been proposed via many studies, but are generally adult-based and/or have not been validated to confirm their effectiveness. The aim of this study was to create, pilot and validate a patient prioritization tool to be used by pharmacists providing clinical pharmacy services to paediatric patients.

Methods: A two-phase (retrospective and prospective) observational audit of pharmacists' interventions collected via notes made on their ward handover information sheets and patient case notes was conducted over a 2-year period in a tertiary paediatric hospital. A patient prioritization tool was created based on pharmacists' interventions in real time. This tool could be used at the start of the working day (without the need to review the patient or their case notes) to identify patients who would benefit most from a clinical pharmacist review. The tool was validated for effectiveness and selectivity.

Results and discussion: The tool was easy to use and effective in identifying that 43% of paediatric inpatients did not require a routine clinical pharmacist review. It had 98% specificity in identifying patients who require a pharmacist intervention. It could be easily used at the start of the day to select patients for pharmacist review.

What is new and conclusion: A new patient prioritization tool has been developed and validated for identifying paediatric inpatients requiring clinical pharmacist review.

KEYWORDS

paediatric, pharmacist, prioritization

1 | WHAT IS KNOWN AND OBJECTIVE

Pharmacists play an integral role in paediatric patient care by ensuring the safe and optimal use of medications. However, increasing demands on pharmacists' time make it challenging to meet requests within allocated resources, and therefore, it is important to ensure that resources are used in the most efficient way.

In Australian paediatric pharmacy practice, there is an expectation that clinical pharmacists will 'review every patient every working day'. However, this is not always the most efficient use of pharmacists'

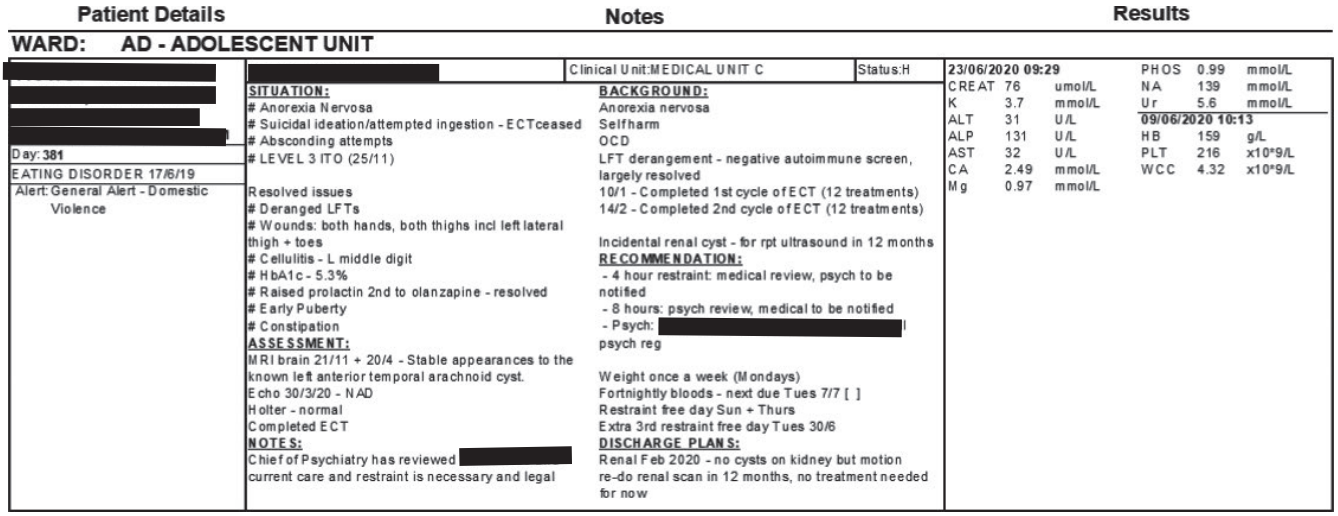


FIGURE 1 Example of an 'OACIS' handover sheet

time as a number of patients require minimal pharmacist input during their admission due to there being few, if any pre-admission medications, a limited use of inpatient medications and no medicines required on discharge. Additionally, many Australian hospitals currently only provide a five-day-per-week clinical pharmacy service. As staffing resources are limited, it is important that pharmacy departments review the way they currently provide services to ensure they are getting the best outcomes from the available resources.

One way forward would be to provide clinical pharmacy services to the more complex patients who would benefit the most from a clinical pharmacist input. A number of patient prioritization tools have been developed for general patient groups, utilising both paper and electronic medication management systems.[1-5] Most of these tools rely on events occurring during admission to determine a patient's potential risk by using surrogate markers such as use of high-risk or high-cost medications, pre-existing chronic medical conditions, abnormal laboratory values, extra monitoring requirements (eg therapeutic drug monitoring), frequent re-admissions to a healthcare facility and admission or transfer to higher acuity wards.[2,6-13] Published patient prioritization tools are generally adult-based and/or have not been validated to confirm their effectiveness at identifying priority patients. One systematic review of available patient prioritization tools for general patients highlighted that only 59% of tools were validated.[2] However, a key conclusion of these studies was the positive impact of assessment tools on both patient care and provision of pharmacy services.[2]

- Red—highest priority requiring daily pharmacy review
- Yellow—requiring less intensive patient monitoring (reviewing every second day)
- Green—requiring minimal pharmacy input (not reviewed again until discharge)

The patient prioritization tools can also aid less experienced pharmacists or clinical pharmacy assistants in identification and prioritization of patients for their input based on pharmaceutical care requirement within a paediatric population.[15,16] Similar to the tools created in adult settings, the paediatric prioritization tools focus on pharmaceutical care issues to identify high-risk patients who require a pharmacist review. Criteria highlighting the need for daily review include patients prescribed high-risk medicines, those prescribed psychotropic medication, receiving continuous infusions and those with severe, acute kidney injury.[15,17-19] However, despite the above, no validated patient prioritization tool is currently available for use in a paediatric setting.

The aim of this study was to create, pilot and validate a patient prioritization tool to be used by pharmacists providing clinical pharmacy services to paediatric patients in a healthcare system without an integrated electronic medication management system (EMM).

2 | METHOD

2.1 | Practice setting

The study was undertaken at the Women's and Children's Hospital (WCH) in Adelaide, Australia. This is a tertiary paediatric and obstetric facility with 160 paediatric, 50 neonatal and 90 obstetric funded bed spaces. Only patients admitted to the paediatric beds were included in the study. The hospital currently does not have an integrated electronic medication management system and uses a combination of paper-based and electronic systems. Prescribing and patient medical records are on paper. Telus Health's Open Architecture Clinical Information System (OACIS) is primarily used for viewing imaging and pathology information but is also used for medical, nursing and pharmacy handover notes and discharge summaries.

At the start of each working day, clinical pharmacists use OACIS to generate a hard copy ward list, which details all patients on the ward as in Figure 1. This aids in their workflow in terms of patient background, admission reason and admitting clinical teams, clinical status and need for prioritization.

2.2 | Ethics approval

This research was approved by the Women's and Children's Hospital Network (WCHN) Research Ethics Committee (reference number: 1001A/March/2021).

2.3 | Study design

This study consisted of two observational audits of pharmacists' OACIS handover sheets (including their documentation of interventions and daily work on these sheets) and patient case notes. A literature review was conducted for published paediatric prioritization tools. A paediatric patient prioritization tool (PPPT1) was developed using the guidance available from the literature and a 'brainstorming' session with the senior paediatric clinical pharmacy team at WCH to ascertain their views about which patients they would consider high priority. Patients in critical care areas including haematology/oncology, paediatric and neonatal intensive care units were all considered to be high priority, requiring a daily pharmacist review.

2.4 | Phase 1—March/April 2018

The clinical pharmacists were asked to undertake 'business as usual' with the expectation that all patients would be seen each working day (Monday to Friday). This part of the study was conducted over a 2-week period. Pharmacists were required to highlight any patient requiring a 'beneficial patient-specific activity/intervention' on their OACIS patient list, which were then collected and analysed. A beneficial patient-specific activity/intervention included a useful medication history (eg multiple medications), requirements to have regular medication charted, medication dosing errors corrected, order clarification, additional information added to medicine charts, medication approvals/consents, discharge counselling, creation of medication profiles, therapeutic drug monitoring (TDM), referrals from other hospital staff or the dispensary. It was important to note that this list was not exclusive, and it was up to the clinical judgement of the pharmacist to consider what activity/intervention they thought was worth recording.

The investigators applied the PPPT1 to each patient listed on the collected sheets to identify whether the tool would have identified them as a priority patient. Patient medical records were consulted to gain additional information regarding a patient's need for pharmacist input. The tool was also applied to patients who were not seen by the pharmacist or seen but did not need any pharmacist intervention, to determine the specificity of the tool in selecting the correct patients.

Based on these initial results and after discussion amongst the project team, the PPPT1 was adjusted and version 2 of the prioritization tool was created (PPPT2).

2.5 | Phase 2—January/February 2019

Over a six-week period, the clinical pharmacists undertook 'business as usual' and highlighted patients requiring *beneficial patient-specific activity/intervention* onto their OACIS sheets as in phase 1. These lists were then collected and analysed.

Two extra copies of the ward OACIS sheets were also printed out each morning. One junior pharmacist (first year post-graduation) and one senior pharmacist (ten plus years as a clinical pharmacist) applied the PPPT2 to all the OACIS sheets and categorized the patients as to their priority status.

The clinical pharmacists' (on the wards) annotated OACIS sheets were then compared to the junior and senior pharmacist annotated sheets to assess whether the same patients received any *beneficial patient-specific activity/intervention* by the clinical pharmacist. Differences in junior and senior pharmacists' categorization of patients, using the tool, were investigated to determine how pharmacists with different levels of experience would interpret the tool and apply it.

The data collected from the above were used to further modify the tool to the final version (PPPT3) (Figure 2).

3 | RESULTS AND DISCUSSION

3.1 | Phase 1 using PPPT 1—March/April 2018

A total of 300 patients were admitted to the study wards over the two weeks of data collection. The breakdown of patients seen by the pharmacists and identified by PPPT1 is detailed in Figure 3.

70% of patients were identified by the tool as requiring a pharmacist review. 28% of these patients were not identified by the clinical pharmacists as needing a pharmacist input, making them false positives. The reasons for the tool identifying these additional patients included chronic medical conditions, infections/sepsis, high-risk medicines, specialist medical teams and seizures. Further work was required to reduce these numbers.

The tool identified 93 of the same patients that the clinical pharmacists identified as having required pharmacist input (97), giving it a 96% specificity in identifying patients for pharmacist review.

Case notes were reviewed of the four patients that the clinical pharmacist intervened for but the tool failed to identify. These revealed the following reasons for non-identification for three of the patients:

- Patients with chronic medical conditions admitted for surgical procedures. Their chronic medical conditions had not been listed on the OACIS handover sheet at the time of review
- Patients on high-risk medications identified from medication chart review, but these were not listed on the OACIS handover sheet

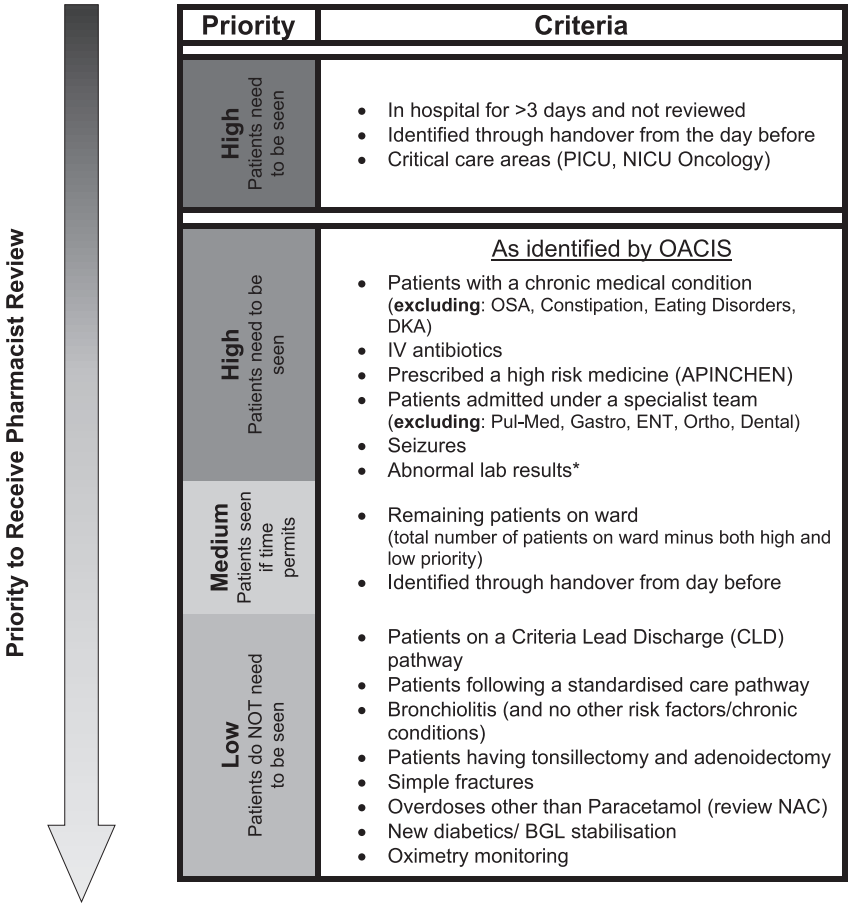


FIGURE 2 WCH paediatric patient prioritization tool (v3)

For this study, high-risk medicines were defined using the following acronym:

A	Anti-infectives (specifically those requiring therapeutic drug monitoring)
P	Potassium (IV)
I	Insulin
N	Narcotics and sedatives
C	Cytotoxics
H	Heparin and other anti-coagulants
E	Epidural/intrathecal agents
N	Neuromuscular blockers

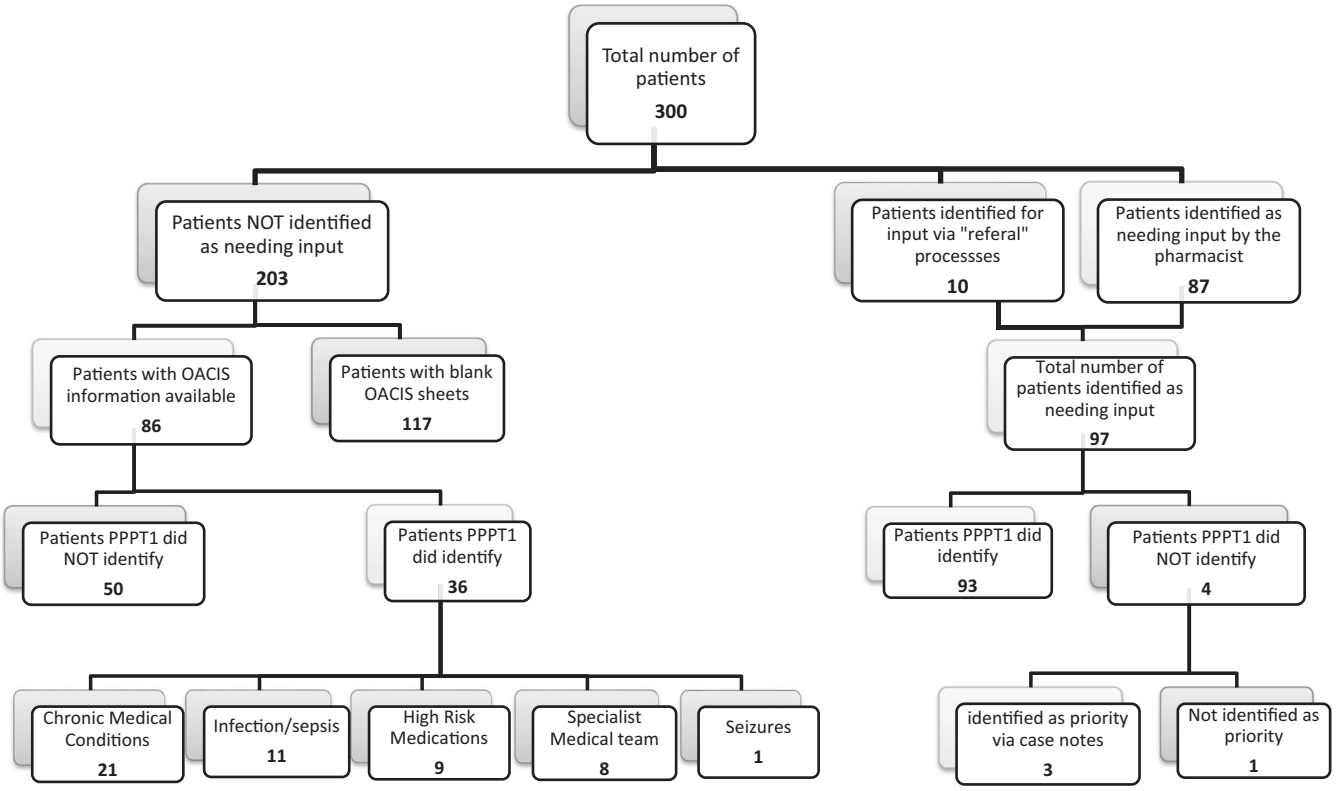
- No high-risk criteria could be identified for the fourth patient even from the case notes

PPPT1 relies on other healthcare professionals documenting information into OACIS in a timely manner. Patients with no medical/nursing OACIS information at the time of the review (117 of 300) could not be easily analysed by the tool. Ways to better use the default available information (patient demographics, location in the hospital, admission reason and admitting team) needed to be identified.

The results from PPPT1 trial were used to modify the tool to improve its specificity and to reduce the number of false positives—PPPT2.

3.2 | Phase 2 using PPPT2—January/February 2019

There were a total of 1148 patients in the wards during the period of data collection. The clinical pharmacists reviewed 864 of these



Breakdown phase one of data collection (using PPPT1)

FIGURE 3 Breakdown phase 1 of data collection

TABLE 1 Number of patients who had 'useful' pharmacist intervention in phase 2 of the project

Reason for identification	Percentage of patients reviewed (n = 864)
Admission medication reconciliation	18%
Charting intervention	18.8%
Discharge medication reconciliation/ counselling	32.6%
Therapeutic drug monitoring	9%
Regulatory approvals facilitated (ID approvals, SAS approvals and IPU approvals)	6.9%
Dispensary queries	7.4%
Medical/nursing queries	16.4%
Handover from previous day	6.2%

Note: NB: The total percentage exceeds 100% as patients could have more than one reason for identification.

patients and highlighted 420 of these having received a 'useful' pharmacist intervention as in Table 1. The tool identified 647 (56.4%) patients as high priority, of which 410 patients were the same as those identified by the clinical pharmacists as needing pharmacist input (420). The tool was thereby 97.6% specific in identifying patients for pharmacist review.

During this phase of the study, the usability of the tool was tested by having both a senior pharmacist and a junior pharmacist apply PPPT2 to all the patients. This resulted in the senior pharmacist identifying 647 (56.4%) of the total patients meeting selection criteria, whereas the junior pharmacist identified 592 (51.6%) who met selection criteria. The reasons for these differences were evaluated and used to clarify the language and intent within the PPPT2 to create the final version PPPT3.

At the end of phase 2 of the study:

- The tool only failed to identify 2.4% of patients who needed a clinical pharmacists intervention
- The tool identified 56.4% patients as high priority—needing pharmacist review

The PPPT2 was further modified based on the above results and post-discussions with the senior pharmacist team, as follows.

- 'Referrals from Dispensary and wards' was removed from the tool and added as a generic prioritization comment, as the tool works with the information on the OACIS sheets
- A number of patients picked up by PPPT2 without any pharmacist intervention were those who had obstructive sleep apnoea (OSA), constipation, eating disorders and diabetic ketoacidosis (DKA) as 'chronic medical conditions'. These patients often do not require significant pharmacist interventions on presentation to the hospital. These medical conditions were excluded from PPPT3

- Keeping 'patients under a specialist medical team' as a criteria in PPPT2 identified general respiratory and simple gastroenterology patients who were in the hospital for very brief visits and needed symptom management and did not require significant pharmacist intervention. Complex patients under these teams were found to be identified by the tool via other selection criterion. This criterion was excluded from PPPT3.
- Some surgical patients, especially neurosurgical patients, had some significant drugs prescribed and interventions made. Thereby, the term 'specialist medical teams' was changed to 'specialist teams' and simple surgical patients including ENT, orthopaedic and dental teams excluded.
- The term infection/sepsis in PPPT2 was non-specific and identified patients who were on simple oral antibiotics and those who presented with infection but were no longer infectious. This criterion was changed to patients on 'IV antibiotics' in PPPT3
- 'Seizures' as a criterion generated a significant discussion and it was decided that all patients with seizures should be included, due to the complex medications patients might be on.
- The abnormal laboratory results list was amended to only include laboratory values that are often affected by medications, for example potassium, sodium and INR.
- Several criteria were added to the low priority list, including simple diabetes management and patients presenting for oximetry monitoring.

A patient prioritization tool for clinical pharmacists to prioritize patients is required to ensure best use of their time. This study describes the multiphase process that led to the development of an effective patient prioritization tool for paediatric population. The tool has some similarities to the other published paediatric studies.[15,17-19] The advantage of the tool created from this study is that it has been designed based on real-time pharmacists' interventions rather than theoretical high-risk criteria for hospitalized patients.

The development of the tool followed a practical approach interlaced with the daily provision of clinical pharmacy services, modifying and validating it at each stage. There was constant dialogue with the front-line ward pharmacy-based personnel, and the experience of senior pharmacists was invaluable. The usability of the tool was also tested by using the interpretation of a senior and a junior pharmacist and the learnings incorporated into the final tool.

The tool has been designed to use information printed in medical and/or nursing handover sheets. Some higher turnover wards were found to not write much information on their OACIS handover sheets, and this was found to be a limitation in phase 1 of the study. However, in phase 2, the basic information documented at admission, for example admitting team, ward location and reason for admission, was used to prioritize patients and found to be effective. The wards with minimal documented OACIS information were the short-stay surgical wards where patients present for day surgeries and usually do not require pharmacist intervention. Complex patients are moved to other surgical wards where the documentation on the OACIS handover occurs.

The final tool (PPPT3) identifies that only 57% of the paediatric inpatients are considered high priority for pharmacist review and is 98% specific in selecting the patients that need pharmacist intervention. This tool has now been accepted in practice within the pharmacy department. Discussions are underway as to how the clinical pharmacy service can be restructured utilising this tool, reducing the review of low priority patients on the weekdays and the potential to move resources to review high priority patients on the weekends, that is changing from a conventional 5-day to a 7-day clinical pharmacy service.

4 | WHAT IS NEW AND CONCLUSION

A new paediatric patient prioritization tool based on real-time pharmacists' interventions has been developed and validated. The tool is effective in identifying those higher-risk patients who will benefit most from a pharmacist review. The principles and selection criterion utilized should enable the tool to be used within any paediatric setting, electronic, paper-based or a mixed system.

Effective use of this tool should provide opportunities to review the provision of clinical pharmacy services and ensure that services are provided to those patients who will most benefit from a pharmacist input.

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CONFLICT OF INTEREST

All authors have nothing to declare.

ETHICAL APPROVAL

This research was approved by the Women's and Children's Hospital Network (WCHN) Research Ethics Committee (Reference Number: 1001A/March/2021).

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