Impact of Nephrotoxic Medication Exposure on Acute Kidney Injury Rates in Pediatric and Neonatal Patients

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Background

- According to the American Academy of Pediatrics, nephrotoxic medications are the leading cause of acute kidney injuries in noncritically ill hospitalized children, with an incidence of 16–23%.[1]
- Pediatric patients, particularly neonates and infants, are at a greater risk of drug-induced kidney injury due to immature renal function, differing pharmacokinetics, and challenges in monitoring early signs of renal decline.[2]
- Studies have shown that nephrotoxic acute kidney injuries (NAKIs) are associated with increased mortality, prolonged mechanical ventilation, longer hospital stays, higher healthcare costs, and potential long-term sequelae such as chronic kidney disease. [3-5]
- The Children's Hospitals' Solutions for Patient Safety (SPS) has identified NAKI as a serious but preventable hospital-acquired condition. [6]
- The SPS has provided a list of nephrotoxic medications in their NAKI Improvement Initiative that has been used in this study's investigation.
- Despite the association between nephrotoxic medication exposure (NTMx) and NAKI, real-time monitoring and early detection remain a challenge, especially in the absence of standardized institutional tracking or clinical decision support.
- At Lee Health – Golisano Children's Hospital (GCHSWF), understanding the prevalence, causes, and associated outcomes of NAKI is critical for developing evidence-based strategies to reduce harm.

Objective

- Assess the incidence of NAKIs in hospitalized pediatric and neonatal patients at GCHSWF and identify patterns of nephrotoxic medication exposure associated with these events.

Methods

- **Study Design**: Retrospective data review of patients admitted to GCHSWF between January 1st, 2025 through June 1st 2025
- **Inclusion Criteria:** Patients ≥4 days old admitted to GCHSWF who met at least one NTMx criterion
  - **NTMx Criteria**: ≥3 days of IV aminoglycosides or IV vancomycin, or concurrent use of ≥3 nephrotoxic medications outlined by SPS
- **Exclusion Criteria:**
  - End-stage kidney disease (ESKD) receiving dialysis
  - Admission for purpose of establishing dialysis of ESKD
  - Continuous renal replacement therapy (CRRT) in place before exposure
  - Ambulatory patients and observation patients admitted to the emergency department observation units
  - Patients who receive nephrotoxic medications via the ophthalmic, otic, topical, inhaled, intra-vesicular, and intrathecal routes
  - In-hospital mortality during the admission in which NTMx occurred
- **Primary Outcome:** Percentage of NAKI events in those with NTMx
- **Secondary Outcomes:**
  - NTMx agent(s) most frequently associated with NAKI event
  - Average time to NAKI event (hours)
  - ICU vs Non-ICU NAKI Rate in those with NTMx
  - Hospital length of stay (days)

Results

Table 1. Patient Demographics (n = 102)

Age (years), median [IQR]	0.32 [0.05-8.9]
Weight (kg), median [IQR]	4.0 [1.1-18.8]
Female	48 (47.1)
Hospital Unit	
Medical/Surgical	12 (11.8)
Pediatric Intensive Care Unit	15 (14.7)
Neonatal Intensive Care Unit	52 (51)
Hematology/Oncology	23 (22.5)

Data represented as n (%) unless otherwise specified.

Figure 1. Proportion of NAKI vs Non-NAKI Events in Patients Exposed to Nephrotoxic Medications

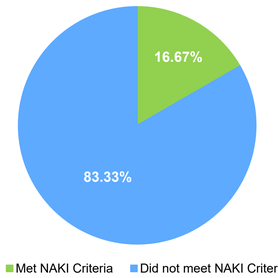

Figure 2. Proportion of Patients Meeting Each Nephrotoxic Medication Exposure Criterion

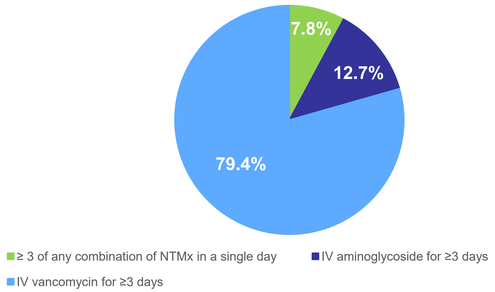

Figure 3. Nephrotoxic Medication Distribution in Patients Meeting the ≥3 Drugs/Day Exposure Criterion

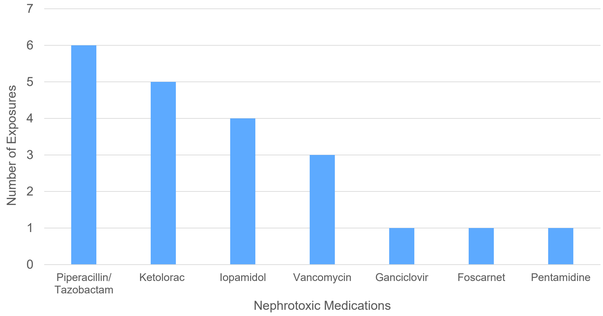

Table 2. Additional Secondary Outcomes and Data Collected

Average time to NAKI event (hours)*	27.3 [19.3-60.7]
Proportion of NAKI Events Occurring in ICU Patients	16/17 (94.1%)
NICU	15/16 (93.8%)
Median Hospital length of stay (days) [IQR]	54.1 [17.6-112.2]
With NAKI event	98.6 [40.9-115.1]
Without NAKI event	36.15 [14-112]

*Average time to NAKI event (hours) is defined as the time from meeting nephrotoxic medication exposure criteria—either ≥3 consecutive days of IV aminoglycosides or IV vancomycin or the concurrent use of ≥3 nephrotoxic medications—until the onset of AKI, measured from the start of the exposure window through up to 2 days after its completion.

Discussion

- Out of the 102 patients included in this study, only 17 (16.67%) met NAKI criteria. Although this represents a relatively low incidence at our institution, a pharmacist-led surveillance strategy may aid in early recognition and reduction of NAKI incidence in this vulnerable population.
- The average time for a NAKI event to occur is 27 hours. This supports intentional timing of lab draws from day 1 of admission up until 2 days after meeting NTMx criteria for future surveillance program implementation.
- Vancomycin was the most common NTMx criterion, and accounted for the most NAKI events, 81 of 102 patients (79.4%).
- With 16/17 (94.1%) of the NAKI events occurring in the ICU setting, these findings suggest critically ill patients are at a higher risk of experiencing a NAKI event
- The most common reason for exclusion was incomplete serum creatinine (SCr) data from the time patients met NTMx criteria through the end of the exposure window, likely reflecting minimized lab draws in pediatric care. This gap may have resulted in missed NAKI events. The second most common exclusion was age, as some patients met exposure criteria before day 4 of life and therefore did not meet eligibility requirements.
- SCr varies considerably in infants due to the transition away from maternal creatinine and the naturally lower muscle mass seen during early development. In our cohort, SCr values declined with age as anticipated, reflecting these physiologic changes rather than true improvements in kidney function. Given this variability and the limited availability of consistent SCr data in patients under 1 year old, renal function was estimated using the Schwartz equation. This method provides a practical alternative but may not fully represent true renal function in this population.

Conclusion

- Patients meeting NTMx criteria showed an increased susceptibility to NAKI events, with the highest risk observed among those < 1 year and those in critical care units.
- Implementation of a pharmacist-led surveillance strategy could reduce further incidence of NAKI events.
- Strategies for surveillance programs should focus on intentional timing of renal function tests beginning at the time of admission and throughout the NTMx window to promote early detection, prevention, and resolution of NAKI events.

References

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Disclosure

Authors of this presentation have nothing to disclose concerning possible financial/personal relationships with commercial entities that may have direct/indirect interest in the subject matter of this presentation.