

CHARACTERIZING DELIRIUM IN PEDIATRIC CRITICALLY ILL PATIENTS

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Background

Delirium is a syndrome of acute brain failure characterized by rapidly evolving acute disturbances in cognition and attention. Delirium in critically ill children is linked to higher ICU mortality, longer stays, and post-ICU morbidity. The international prevalence of delirium in PICUs is 25%, and this figure increases to 38% for patients who stay longer than five days. Despite its prevalence, delirium is often underdiagnosed due to lack of universal screening. No evidence-based intervention exists to either prevent or treat delirium. Some factors, including poorly managed pain, have been linked to delirium. Early and progressive mobility is associated with improved outcomes in critically ill adults. Similar effects could be observed in children. Evidence for improved outcomes with this practice does not exist. This intervention can be resource-intensive and optimal methods for staff training haven't yet been identified.

Study 1 - The effects of intraoperative methadone on postoperative pain control in pediatric patients: a scoping review

The literature search was conducted in PubMed, Scopus, Embase, and CINAHL databases. Criteria for inclusion were studies that evaluated postoperative opioid consumption, pain scores, and adverse events in pediatric patients who received intraoperative methadone.

Overall, postoperative opioid consumption was lower in children who received methadone compared to those who received other opioids. Most studies suggested that methadone was superior to other opioids in reducing postoperative pain scores. The frequency of adverse events was similar between the groups that received methadone and other opioids. Methodological concerns were identified in 4 out of the 5 studies included.

Preliminary evidence suggests potential benefit of intraoperative methadone in pediatric patients. We cannot make strong recommendations due to methodological concerns in most studies.

Originality

- First formal evaluation of intraoperative use of methadone in pediatric surgery.
- Finds tentative association with reduced opioid consumption post-surgery.
- Identifies research gap; calls for more rigorous studies to validate findings.

Study 2 - Impact of a Multifaceted Early Mobility Intervention for Critically Ill Children – the PICU Up! trial: study protocol for a multicenter stepped-wedge cluster randomized controlled trial.

The study aims to evaluate the efficacy of the PICU Up! intervention in decreasing the duration of mechanical ventilation (primary outcome) in critically ill children, to assess improvement in delirium and functional status compared to usual care. A secondary goal is to identify factors that contribute to the reliable delivery of the PICU Up! program. The study will produce new evidence regarding the optimization of short-term and long-term outcomes in pediatric critical care settings, particularly focusing on mechanical ventilation duration, delirium incidence, and functional outcomes.

Originality

- Largest pediatric study evaluating early mobility intervention for ICU outcomes.
- Uses integrated, multidisciplinary approach including sedation, sleep hygiene, and delirium prevention.
- Challenges and redefines existing PICU care paradigms.

Study 3 - Factors Associated with Delirium Screening in Critically Ill Children: A multicenter study of >9,000 PICU days

The study aims to identify patient-level factors that influence the frequency of daily delirium screening in Pediatric Intensive Care Units (PICUs) with existing delirium screening protocols. Out of 1056

patients, 74% were screened for delirium at least once during their PICU stay. Factors like longer PICU stay, invasive mechanical ventilation, and dexmedetomidine infusions were associated with increased delirium screening. Female gender and continuous infusions of opioids, benzodiazepines, or ketamine were linked to decreased screening.

Despite established screening protocols, only 56% of eligible patient days included delirium screening. Girls, patients in early stages of their PICU stay, and those without an endotracheal tube had lower odds of daily delirium screening. The study calls for structured quality improvement processes to standardize and increase the frequency of delirium screening.

Originality

- Examines delirium screening across various age groups and diagnoses in six U.S. PICUs.
- Identifies patient subgroups more susceptible to under-identification of delirium.
- Insights are critical for refining delirium detection best practices.

Study 4 - Simulating mobility: Developing novel nurse education to improve physical rehabilitation of critically ill children

The study aims to develop an early-mobility simulation curriculum for PICU nurses based on adult learning theory. It also seeks to evaluate whether this curriculum improves nurses' self-efficacy, knowledge, and skills in mobilizing critically ill children.

Before the curriculum, 73% felt confident, and none felt confident in mobilizing a PICU patient. Post-curriculum, 100% felt at least confident in mobilizing a PICU patient ($P=0.031$). Knowledge scores improved significantly ($P=0.001$), as did completion of required clinical tasks during the Observed Structured Clinical Examination ($P=0.0037$).

Developing a simulation-based early mobility curriculum for PICU nurses is feasible. Completion of the curriculum led to improved self-efficacy, knowledge, and clinical skills in mobilizing critically ill children.

Originality

- Educational initiative tailored for PICU nurses.
- Focuses on specialized skills for physical rehabilitation.
- Addresses the role of physical immobility in exacerbating delirium.

Study 5 - Development of a Stata toolkit for pediatric risk score calculation

The study aims to develop a publicly available Stata command for calculating Pediatric Logistic Organ Dysfunction-2 (PELOD-2), the Paediatric Index of Mortality 3 (PIM-3) scores, the Pediatric Risk of Mortality (PRISM III and PRISM IV scores) in Pediatric Intensive Care Units (PICUs). This addresses the issue of complexity and the absence of a robust open-source calculator for these scores. Developed Stata toolkit implementing PRISM, PELOD and PIM scoring, offering robust error-proofing, data validation, supporting both SI and U.S. lab value units, and providing a graphical user interface. Validation was done using unit tests and deidentified data. Spot checks were performed for accuracy. Performance was tested using 10,000,000 simulated patient records and five distinct datasets.

The command calculated PRISM and its extension, the PRISM IV, PELOD-2, PIM-3 scores with 100% accuracy in spot checks and on simulated data.

The toolkit accurately and efficiently calculates pediatric scores over datasets of all sizes. It improves reproducibility of research and offers time and resource savings for the research community.

Originality

- Validated Stata command for computing pediatric risk score calculations.
- Enhances data analysis accuracy and research reproducibility.

This thesis serves as a comprehensive guide that addresses the complex challenges surrounding pediatric delirium. Through its innovative and synergistic contributions, it lays a robust foundation for the advancement of future research and quality improvement initiatives in this critical area of healthcare.