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Differences in Pediatric Non-Interventional Radiology Procedural Sedation Practices and Adverse Events by Registered Nurses and Physicians^{1,2,3}

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Purpose: The purpose of this study was to determine differences in sedation-related adverse events according to the type of provider monitoring and delivering sedation.

Design and Methods: A retrospective, cross-sectional, correlational design using secondary data from the Pediatric Sedation Research Consortium database was used for this study.

Results: A sample of 36,352 cases (0–14 years of age) sedated and monitored for diagnostic radiology procedures by three types of providers (registered nurses [RNs] alone, physicians (MDs) alone, or registered nurse + physician [RN + MD sedation teams]) were compared. Patients sedated by RNs alone or MDs alone had lower odds of unanticipated adverse events (odds ratios 0.46 and 0.53, respectively; $p < 0.0001$) compared with RN + MD sedation provider teams.

Conclusions: Team skills may be an important competency for RN + MD sedation teams in the non-interventional radiology setting.

Practice Implications: This study can inform clinicians, administrators, and quality-improvement managers of the differences in adverse event outcomes of pediatric radiology procedures when RN + MD teams provide sedation compared with RNs or MDs alone.

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Background

Children require sedation more frequently and for different reasons than adults (Coté & Wilson, 2016). Children also require sedation for procedures more often than adults and at deeper levels; however, children also have the highest risk of and least tolerance for sedation complications, due to their anatomical and physiological

differences in areas such as the respiratory system (Cravero & Havidich, 2011).

Traditionally, anesthesia providers administered sedation in operating rooms (ORs), but procedures are increasingly being performed elsewhere, increasing demand for sedation in other settings and by non-anesthesiologist providers, including registered nurses (RNs) (Cohen et al., 2006; Couloures, Beach, Cravero, Monroe, & Hertzog, 2011; Cravero et al., 2006).

Current research on RN-provided sedation is limited, primarily consisting of single-site studies describing the implementation and outcomes of RN-led sedation services, or outcomes of RN-administered medication protocols in a single setting such as a radiology or endoscopy unit (Crego, 2014). Outcomes of RN-provided sedation have not been compared to physician non-anesthesiologist sedation providers (MD), or to RN-MD teams that monitor and deliver sedation.

The Joint Commission (TJC) – an organization that accredits health care organizations and programs in the United States – sedation standards describe two provider roles for sedation, but they do not specify the type of provider. One provider performs the intervention or procedure (a physician non-anesthesiologist sedation provider [MD]) and can simultaneously deliver or direct the delivery of sedative medications by another competent provider (usually an RN) (Coté & Wilson, 2016; Joint Commission International, 2011). TJC and American Academy of Pediatrics (AAP) provide specific guidelines for intended level of sedation (moderate or deep) due to the increased risk of complications with deeper levels of sedation (Joint Commission International, 2011; Coté & Wilson, 2016). Most children receiving sedation are likely to achieve deep sedation at some point during the procedure, regardless of the intended level of sedation, the medication used or the route of administration (Couloures et al., 2011; Coté & Wilson, 2016). Sedation level is a continuum, thus it is not always possible to predict how the patient will respond (ASA, 2002). The RN provider has the sole responsibility of continuously monitoring the patient throughout deep sedation procedures; if moderate sedation is performed, the second provider (usually the RN) can simultaneously assist with interruptible tasks during the sedation procedure and monitor the patient (Coté & Wilson, 2016; Joint Commission International, 2011). The influence of team factors, such as the use of an organization-wide sedation team with consistent membership, or individuals, who hold credentials in providing sedation and work in teams, may be important in comparing outcomes of sedation delivery systems. Preliminary studies by Blike, Cravero, and Nelson (2001) identified team-training skills used by airline crews as essential components in developing quality sedation care systems. However, current TJC standards continue to highlight psychomotor skills, such as airway management, knowledge of sedative medications, and monitoring procedures, as essential to ensure safe sedation care, but there is little to no description of training or assessment of team (RN + MD) approaches (Blike et al., 2001; Joint Commission International, 2011).

Several studies have documented that RNs provide sedation for procedures such as magnetic resonance imaging (MRI), computerized tomography (CT), and endoscopy as members of teams (Beebe et al., 2000; Lavoie, Vezina, Paul-Savoie, Cyr, & Lafrenaye, 2012; Woodthorpe, Trigg, Gurney, & Sury, 2007). In fact, one survey of gastroenterologists at United States endoscopy centers found that 89.5% of respondents included RNs as part of their endoscopy and sedation teams (Cohen et al., 2006). In addition, descriptive practice data from the Pediatric Sedation Research Consortium (PSRC, which contains multisite data on pediatric sedation, including adverse event rates and physiologic monitoring practices for non-anesthesiologist sedation providers Langhan, Mallory, Hertzog, Lowrie, & Cravero, 2012) and others have described cases with RNs solely delivering and monitoring sedation, using sedation protocols (Crego, 2014; Woodthorpe et al., 2007). However, the AAP sedation guidelines describe the role of personnel like RNs to be purely assistive, providing monitoring and support if resuscitation is required, rather than as primary sedation providers (*physicians or advanced practice providers*) that *order medication and maintain responsibility for the overall management of the patient throughout the sedation process* (Coté & Wilson, 2016). Several studies using PSRC data have examined outcomes according to sedation provider. In one study of 41,392 pediatric diagnostic radiology sedation cases, 31% received sedation and were monitored by only an RN during non-interventional diagnostic radiology procedures (Crego, 2014). An adverse event rate of 5.78% was reported for these patients; adverse events included minor complications (e.g., intravenous access) or major complications (e.g., unexpected need for bag-valve-mask ventilation) (Crego, 2014). In comparison, a prior study by Cravero et al. (2006) found a 5.3% incidence of minor and major complications in 30,037 sedation cases with MD and advanced practice sedation providers (physician assistants and nurse practitioners) for a variety of procedures. Cravero et al. (2006) did not examine RN-administered sedation. A third study investigated the impact of provider type on major complications during interventional and non-interventional procedural sedation (Couloures et al., 2011). The study found no significant differences in the rates of major complications between the categories of providers studied (anesthesiologists, non-anesthesiologists [emergency physician, intensivists, and pediatricians]), and others; RN-specific results were not reported.

Research on the frequency of adverse events in children according to sedation provider type, including RNs alone, MDs alone, and RN + MD teams, has not been reported. Our study is the first to use the PSRC database to investigate this.

Methods

A retrospective, cross-sectional, correlational design was used to determine differences in adverse events by provider type depending on sedation risk factors (age, weight, American Society of Anesthesiologists [ASA] score > 2, number of comorbid conditions), MRI procedures, number

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