# **RESEARCH NOTE**

https://doi.org/10.1186/s13104-025-07242-y

Meher et al. BMC Research Notes

# The medical radiation technologist model: a streamlined process for procedural sedations

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# Abstract

**Objective** Procedural sedations are a growing and routine form of sedation. Some of them may not require the presence of a nurse. The purpose of this study is to assess the impact of the Medical Radiation Technologists (MRT) model, which forgo the presence of a Registered Nurse (RN), for procedural sedations in Computed Tomography biopsies. The setting was a teaching hospital that moved from an RN to an MRT model. We compared staff utilization, turnaround times and incident reports between pre and post implementation, over 19 months overall.

**Results** No adverse events were observed under either model. Wait times were reduced by 25% from 131 to 98 min. Turnaround times were reduced by 2 min from 52 to 50 min. The joint cost of RN/MRIT was reduced by 37% per procedure, from \$141 to \$88.

**Conclusion** These results suggest that the MRT model is more cost-effective without compromising quality of care. The MRT model is promising and should be extended to more facilities and other routine procedural sedations to save time and resources.

**Keywords** Conscious sedation, Computed tomography, Image-guided biopsy, Biopsy, Medical radiation technologist, Registered nurse, Staffing utilization, Wait times

## Background

Nurses (RNs) have been in chronic shortage in many countries for decades [1]. Shortage and cost of highly skilled healthcare professionals put pressure on management to find ways to free these professionals from performing tasks that other qualified but more readily available personnel could perform [2]. In 2020 the additional challenge of the global pandemic coupled with the risk of staffing challenges impacted on routine

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procedural sedation procedures within the medical imaging program.

The technique of safely administering short-acting sedative or dissociative agents, with or without analgesics, is called procedural sedation. For patients during medical imaging examinations, the technique reduces pain, discomfort, and potentially unpleasant memories of the sedated patients [3]. It is less invasive than traditional sedations occurring in the operating room with an anesthesiologist administering a general anesthetic, and there was less disability with routine procedural sedations (RPS) when compared with general anesthesia [4]. As a consequence, the demand for procedural sedation is growing in interventional radiology (IR), and RPS increased from 7.7% of all sedation procedures to 27.7%



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between the 2009–2012 and the 2016–2019 periods, with a total of 25,600 patients receiving procedural sedation during the latter period [5].

RPS requires appropriately trained personnel to perform it. Medical Radiation Technologists (MRTs) are a regulated profession whose members provide patient care and deliver prescribed energy, such as radiation. They work with RNs who provide patient care such as sedation, monitoring, and recovery. These RNs require special training in radiation safety, contrast media medicine administration, sedation administration and monitoring [4]. RPS practices have been streamlined to save time and resources while remaining safe. First, by performing RPS at the bedside rather than in the operating room [6], and second, by moving from two to one physician present [7]. While the supervision of a physician remains required, the next step in streamlining the process would be to forgo the presence of an RN (RN model) and instead rely on an MRT to perform RPS (MRT model). In Canada, Ontario legislation states under the 1991 Regulated Health Professionals Act, an MRT can administer a substance by injection or inhalation and provide suctioning. Nevertheless, as staffing is often lacking in studies on RPS, there is little evidence of the efficiency gains and of the impacts on quality of care from adopting the MRT model [7].

This study aimed to determine the impact on safety incidents, costs, exam duration and wait times of moving RPS from an RN to an MRT model for CT biopsies. We analyzed pre-post data from a hospital that went from an RN to an MRT model.

### Methods

The study design was a retrospective pre-post comparison and after the implementation of a project to move from an RN model to an MRT model for performing RPS.

#### Site

The data for this study came from a 462-bed academic teaching hospital in Ontario, Canada. Its Medical Imaging Program (MIP) performs over 230,000 imaging examinations annually. It consists of 57 full-time and 69 part-time Medical Radiation Technologists (MRTs), 3 full-time and 2 part-time RNs and 2 full-time and 3 part-time Registered Practical Nurses (RPNs). Within the MIP, the Computed Tomography (CT) department staff consists of 9 full-time and 14 part-time MRTs. The RNs and registered practical nurses (RPNs) are utilized for all departments in the MIP. In early 2020 during the global pandemic of COVID-19, HSN's historical RN staffing challenges created an opportunity for the MIP leadership to review staff utilization within the MIP. That is when HSN began its quest in utilizing MRTs for routine procedural sedations.

Routine procedural sedations utilize MRT, RN and Radiologists. In 2020, the hospital moved from a nursing RPS model for biopsy procedures to an MRT RPS model. Certain patients were excluded from the MRT model though: patients with allergies, incapable of cooperating with the procedure, hemodynamic instability, pediatrics, and patients with comorbidities. For such patients, procedural sedation was considered complex, and the care model remained the same, RN model, with 1 RN, 2 MRTs, and 1 Radiologist. For the other routine procedural sedations, the care model changed to the MRT model, with 2 MRTs and 1 Radiologist. All MRTs and RNs performing RPT had completed all required training. This study focuses on RPS performed for CT biopsies only. The process for CT procedural sedations is outlined in the process graphic below (Fig. 1).

#### Data collection and analysis

Registration, start, and end times of procedures were extracted from the radiology information system (RIS), exam volumes from both the picture archiving communication system (PACS) and the RIS (for verification), staffing from the staff scheduling system and compensation rates were obtained from the accounting department. Safety incidents were extracted from the incident reporting system. In total, 16 months of data were extracted, 8 months pre (from July 1st, 2018, to February 28th, 2019) and 11 months post program implementation (from August 6th, 2020, to June 29th, 2021).

A pre-post comparison of routine procedural sedation for CT biopsies was completed using 4 outcome measures:

- 1. Turnaround time (exam time) was computed using start and end times of the procedure and compared pre versus post implementation.
- 2. Wait time was calculated from when patient registration for their CT routine biopsy to procedure start time and compared pre versus post implementation. Two procedures were excluded from the analysis for abnormal wait times. The need to confirm that an RN is available, in a context of shortages, is posited to contribute to delays in the start time of the procedure.
- 3. Incident reports were reviewed for safety incidents that may have occurred in relation to routine procedural sedations during both the RN model and the MRT model.
- 4. Staffing costs for both RN and MRT, pre versus post implementation were examined.

The total number of routine procedure sedation CT biopsies performed pre-implementation of the MRT program was used as a control variable, as large changes to biopsy



Fig. 1 CT procedural sedation process

demand may have impacted operations. The frequency of CT biopsies with no sedation was also analyzed as a control variable.

For the turnaround time and the wait time, the significance in the difference between the pre and post period was computed using an unpaired t test.

The research ethical boards at the academic institution provided ethical approval.

#### Results

In the "pre" period under the RN model, 41 patients received routine procedural sedations (23% of the 177 routine CT biopsies performed, with 77% receiving no sedation), or the equivalent of 61 procedures on a yearly basis. During the "post" period, as planned, no RN staff were used for these CT routine procedural sedation procedures, and 100% used an MRT instead. 79 patients received routine procedural sedations that way (34% of the 234 routine biopsies performed), or the equivalent of 86 procedures on a yearly basis.

Between the pre and the "post" period,

1. Turnaround time decreased from 52 to 50 min, or a reduction by 4% (p-value: 0.11). (See Table 1).

- 2. Wait time for RPS CT biopsies decreased by 25% from 131 min to 98 min (p-value: 0.013) (See Table 1).
- 3. No safety incidents for RPS for either the RN model or the MRT model were reported in the safety and reporting system.
- 4. Based on the hourly compensation (including benefits) of \$57 per hour for an RN versus \$53 per hour for an MRT, the staffing cost of a routine procedural sedation CT biopsy with the RN model was estimated at \$163 per hour versus \$106 in the MRT model or 37% less (not accounting for the radiologist, material, and facilities). Compounded with the shorter turnaround times, the cost of RN and MRT per procedure thus decreased from \$141 to \$88, a 38% decrease (See Table 2).

# Discussion

# Healthcare process and utilization

The MRT model significantly reduced delays in procedures and created flexibility in addressing scheduling challenges. Not having to delay the exam due to RN availability had a positive impact on the procedure start time. Procedures with negligible risks that involve delays in routine procedural sedation should be avoided, and these findings align with that important goal [8].



Table 1 Comparison of the average turnaround and wait time between the RN and the MRT models

Table 2 Comparison of the cost of RN and MRT per procedure between the RN and the MRT models



On the other hand, the average total exam procedure time was reduced by only 2 min, which was not statistically significant. More research and a bigger sample size is needed to determine whether there is a real impact on procedure time.

Together, these efficiencies translate to improved diagnostic performance and more effective utilization of human health resources. Using this approach allows the RN to shift the focus to the recovery process for all procedural sedations. RNs then assessed the level of consciousness, using a discharge scoring system post sedation [9], and were able to provide continuous uninterrupted monitoring after sedation. Therefore, RNs were utilized more effectively, thereby reducing any negative impact on RN availability.

#### Implications for research and practice

Findings in this study suggest that organizations should feel confident in implementing an MRT routine procedural sedation program, provided effective training and criteria are applied [4]. In the context of a rising need for sedation [5, 9], a persistent shortage of healthcare professionals [2], and growing pressures for efficiency in healthcare, healthcare organizations should consider all opportunities to optimize staff utilization from a multidisciplinary team perspective.

Proper conditions should be provided to mitigate the risks of forgoing the presence of an RN. Effective training, and processes such as criteria, checklists, visuals, and effective use of medical professionals' scope of practice should be used.

At the time of the evaluation, the hospital was the only site in Ontario supporting MRT RPS, limiting comparisons. More studies need to be done on MRT and the associated benefits of this model to allow for effective meta-analysis on this approach.

## Limitations

The study was conducted during the global pandemic of COVID-19, which added extra stress and requirements to staff. A decision was made to not proceed with qualitative analysis at the time of the evaluation given the resource constraints that nurses and MRTs faced in providing care to patients. Nevertheless, CT biopsies are considered urgent procedures and were not impacted by the canceling of non-urgent/elective procedures due to the impact of the global pandemic of COVID-19.

Secondly, the data availability did not allow us to have the pre and post periods cover the same period of the year. Therefore, seasonal effects may have biased the data.

The sample size of 41 pre and 79 post implementation procedures was relatively small. While procedural sedations remain relatively safe [7], tracking the impact on quality of care by reducing nurses' involvement should be monitored in future implementations of the MRT models.

## Conclusion

This study suggests that RPS can be safely and effectively performed without the presence of an RN. Beyond RPS, this opens new opportunities to consider. As healthcare organizations face increasing shortages of clinical staff, it suggests one solution might lie in more effectively utilizing highly qualified staff. While the quality of care should be of paramount importance, using the right people at the right time in the right role performing the right procedure should guide staffing decisions.

Acknowledgements Not applicable.

#### Author contributions

Jennifer Meher, Julien Meyer, Annette Tracey, Housne Begum and Pria Nippak contributed to the conception or design of the work, the acquisition, analysis, or interpretation of the data. Jennifer Meher, Julien Meyer, Annette Tracey, Housne Begum and Pria Nippak were involved in drafting and commenting on the paper and have approved the final version.

#### Funding

No funding.

#### Data availability

The datasets generated and/or analysed during the current study are not publicly available due to ongoing analysis of data but are available from the corresponding author on reasonable request.

#### Declarations

#### Ethics approval and consent to participate

Informed written consent was obtained from all participants. The Toronto Metropolitan University's REB approved the study 2023 – 397.

#### Consent for publication

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

#### Received: 18 February 2025 / Accepted: 4 April 2025 Published online: 16 April 2025

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