Optimizing PEEP During Patient Transport to Imaging (MRI/CT): Evaluating Cost Savings and Clinical Impact

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Background: In the context of critically ill patients requiring mechanical ventilation, timely access to imaging (MRI/CT) is crucial for accurate diagnosis and treatment planning. However, the transportation of patients from the intensive care unit (ICU) to the imaging suites poses significant risks, particularly due to loss of positive end expiratory pressure (PEEP) that occurs when a ventilator circuit is disconnected during the patient's transition to a portable ventilation source and/or MRI approved ventilator. Loss of PEEP can lead to increased heart rate, decreased SpO2 and decreased blood pressure. Adverse events during intra-hospital transfers can occur in up to 60% of cases, with nearly 10% of these events being serious[1]. Imaging is often delayed due to patient's cardiopulmonary instability because of the loss of PEEP that occurs during circuit disconnection.

Methods

Our review focuses on cost savings of PEEP optimization and providing lung-safe ventilation of patients being transported to medical imaging (MRI/CT). We conducted an in-depth analysis of the associated costs when medical imaging scans are delayed due to unstable patient vital signs during transport caused by ventilator circuit disconnects. Common adverse effects observed during patient transfer include decreased oxygen saturation (SpO2), increased heart rate (HR), and decreased blood pressure (BP)[8]. Until these vital signs stabilize, the imaging cannot commence, resulting in wasted time for both the transport team and the imaging suite staff and increase adverse events risks for patients.

Results

Our analysis revealed significant implications to cost savings when imaging is delayed due to unstable patient vital signs. Here are the key findings:

Cost of a 15 min delay in MRI Suite with Mechanically Ventilated Patient

	Average Salary/ Per hr	Average Salary/ Per 15 min	Total
Respiratory Therapist[5]	$41.20	$10.30	$10.30
Nurse[4]	$55.08	$13.77	$13.77
ICU Physician[7]	$148.00	$37.00	$37.00
Porter (2x)[6]	$19.96	$4.99	$9.98
Imaging Technologist	$42.00	$10.50	$10.50
Radiologist[9]	$201.00	$50.25	$50.25
Imaging Suite[2]	$1,170.00	$292.50	$292.50
Imaging Suite Lost Revenue[3]	$1,170.00	$292.50	$292.50
15 min Delay Average Cost Per Event:$ 716.80			

1. Direct Cost Savings:

- Delayed scans due to unstable vital signs during transport result in wasted time for both the transport team and the imaging suite staff.
- By minimizing delays, hospitals can optimize resource utilization and reduce operational costs associated with idle staff and imaging suite time.
- Avoiding adverse events, would have additional costs savings.

2. Adverse Effects During Transport:

- Common adverse effects observed during patient transfer include decreased oxygen saturation (SpO2), increased heart rate (HR), and decreased blood pressure (BP). The adverse events can be avoided by maintaining positive pressure and avoiding ventilator circuit disconnects.
- These adverse effects contribute to delays in initiating scans, further emphasizing the need for efficient transport protocols.

3. Broader Impact on Patient Care:

- PEEP optimization and providing lung-safe ventilation and avoiding ventilator circuit disconnects (removal of positive pressure ventilation) not only saves costs but also enhances overall patient care.
- Streamlined protocols can improve workflow, reduce patient discomfort, and improve access to diagnostics.

Conclusion

In conclusion, our review highlights the critical importance of PEEP optimization and providing lung-safe ventilation to patients requiring intrahospital transport for medical imaging to obtain a timely diagnosis and treatment planning. The significant risks associated with intra-hospital transfers, particularly the loss of positive end-expiratory pressure (PEEP), underscore the need for streamlined protocols to minimize adverse events and optimize resource utilization. Our analysis demonstrates clear cost savings implications through PEEP optimization and providing lung-safe ventilation, with an average savings of $716.80 per 15-minute delay event. By minimizing delays and avoiding adverse effects such as decreased oxygen saturation, increased heart rate, and decreased blood pressure during transport, hospitals can not only reduce operational costs but also enhance overall patient care. Implementing of PEEP optimization and providing lung-safe ventilation protocols, including strategies to maintain positive pressure ventilation and prevent ventilator circuit disconnects, will not only optimize resource utilization but also improve workflow, reduce patient discomfort, and improve access to diagnostics. These findings underscore the importance of prioritizing patient safety and operational efficiency in the management of critically ill patients requiring mechanical ventilation.

[1]Portable Magnetic Resonance Imaging for ICU Patients - PMC (nih.gov), [2]Ontario, CA MRI Cost Average (newchoicehealth.com), [3]https://unf-montreal.ca/en/rate/, [4]https://www.incrediblehealth.com/salaries/s/icu-nurse/ca/Ontario, [5]https://www.jobbank.gc.ca/marketreport/wages-occupation/22786/ca, [6]https://ca.indeed.com/career/porter/salaries/Ontario, [7]https://ca.talent.com/salary?job=intensivist#:~:text=How%20much%20does%20a%20Intensivist,up%20to%20%24323%2C000%20per%20year, [8]https://ca.talent.com/salary?job=intensivist#:~:text=How%20much%20does%20a%20Intensivist,up%20to%20%24323%2C000%20per%20year, [9]https://www.salaryexpert.com/salary/job/radiologist/canada/ontario