Cost-Effectiveness Analysis of AI-Driven Pulmonary Embolism Response Team Activation in Mechanical Thrombectomy

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Background

Pulmonary embolism (PE) is a major source of morbidity and mortality in the United States, with mortality rates reported up to 30% in patients who do not receive timely therapy. Given the gravity of the disease and the importance of rapid identification and treatment, Pulmonary Embolism Response Teams (PERT) are essential in expediting and coordinating care of these patients. Conventional therapy has traditionally consisted of systemic anticoagulation and/or systemic thrombolysis, however advances in technology have resulted in the development of new techniques for treatment. In the past decade, the standard of care for high-risk pulmonary embolism with clinically significant right heart strain has moved towards mechanical thrombectomy.

Definitive diagnosis of acute PE often relies on a CTA of the chest specifically timed for contrast opacification of the pulmonary arteries. These studies should be prioritized for interpretation by the diagnostic radiologist based on urgency, however time of day, clinical acuity, and patient setting can negatively impact time to interpretation. This is often a rate limiting step between initial presentation and treatment with mechanical thrombectomy. As a result, several hospital systems are experimenting with artificial intelligence (AI) driven alert systems to activate PERT and expedite care of these patients.

The integration of AI for the management of intermediate and high-risk PEs has shown promise in improving patient outcomes, with significant reductions in right heart strain and adverse events. This study aims to evaluate the cost-effectiveness of this approach, with a focus on the reduction in ICU length of stay and overall cost savings.

Materials and Methods

Retrospective data was collected from an academic tertiary referral hospital in a large metropolitan area. Patients with acute PE who underwent mechanical thrombectomy from 2020-2024 were identified. Patients were divided into two cohorts based upon whether management was aided by an AI-based PERT alert system (Aidoc, Tel Aviv, Israel), which was implemented in early 2022. Data was collected on ICU length of stay, and cost was extrapolated using the established daily average of $3500. Cost-effectiveness analysis was performed based on ICU length of stay for both groups.

Results

A total of 13 patients met inclusion criteria.

Average length of ICU stay was 13 days in the pre-implementation group and 10 days in the post-implementation group

Average cost of ICU stay was $45,500 in the pre-implementation group and $35,000 in the post-implementation group.

	Pre-Intervention	Post-Intervention
N	6	7
Age (mean, range)	53, 36-71	60, 25-84
Sex		
Male	3	4
Female	3	3
Setting		
Emergency Department	5	5
Inpatient	1	2
ICU stay (days)	13 ± 13.5	10 ± 9.9
Hospital stay (days)	17 ± 11.5	14 ± 8.0
Cost of ICU stay	$45,500	$35,000

Discussion

AI implementation was associated with a 23% reduction in ICU length of stay (13 vs. 10 days) and 18% reduction in total hospital stay (17 vs. 14 days). The cost-effectiveness analysis revealed substantial cost savings due to reduced ICU stay. Based on the established average cost per ICU day of $3500, pre-implementation ICU costs were $45,500 per patient while post-implementation costs were $35,000 per patient, resulting in cost savings of $10,500 per patient. With an annual volume of 48 thrombectomies, estimated total yearly cost savings are $504,000. Assuming the total cost of a thrombectomy patient is $70,000, as has been established in prior literature, AI implementation led to a relative cost reduction of approximately 15% per patient.

Limitations of this study include the small sample size of 13 patients, relatively short data collection period, and single institution nature of the study. These factors may somewhat limit external validity. Similarly, the small sample size likely did not capture all mechanical thrombectomies performed at the institution in the specified time frame due to inconsistency in radiology reporting. The indication for mechanical thrombectomy in intermediate-risk acute PE patients is not yet well established, and management for these patients may vary on an individual clinician and hospital basis.

As the literature evolves and indications for mechanical thrombectomy become clear, it is likely that the annual volume of these procedures will continue to increase, thus creating the opportunity for further cost-savings with AI implementation. Future studies should focus on increased cohort size as well as expanded evaluation of patient outcomes. Moreover, AI alert systems may be applied to other emergent disease entities, which could contribute similar benefits as those shown in this study.

Conclusions

Implementation of an AI-based PERT alert system to expedite mechanical thrombectomy in patients with acute pulmonary embolism resulted in reduced duration of ICU and hospital stays by 3 days each, resulting in cost savings of $10,500 per patient, on average. These findings support adopting AI solutions in acute PE management protocols to enhance patient outcomes and reduce healthcare costs.

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