The Clinical Impact Score: A Novel Framework for Guiding Artificial Intelligence Development in Radiology for Pediatric Populations

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Background

Artificial Intelligence (AI) has the potential to revolutionize radiology, but few algorithms have been developed for use in pediatric patients.

Purpose: We propose the **Clinical Impact Score (CIS)**, a novel framework that could help guide AI growth in pediatric radiology, an area where progress has lagged.

Methods

Imaging examinations performed on pediatric patients (age < 18 years) at our institution from 2019-2021 were analyzed.

To create the CIS framework, four separate variables were determined for each of 18 locally defined critical findings:

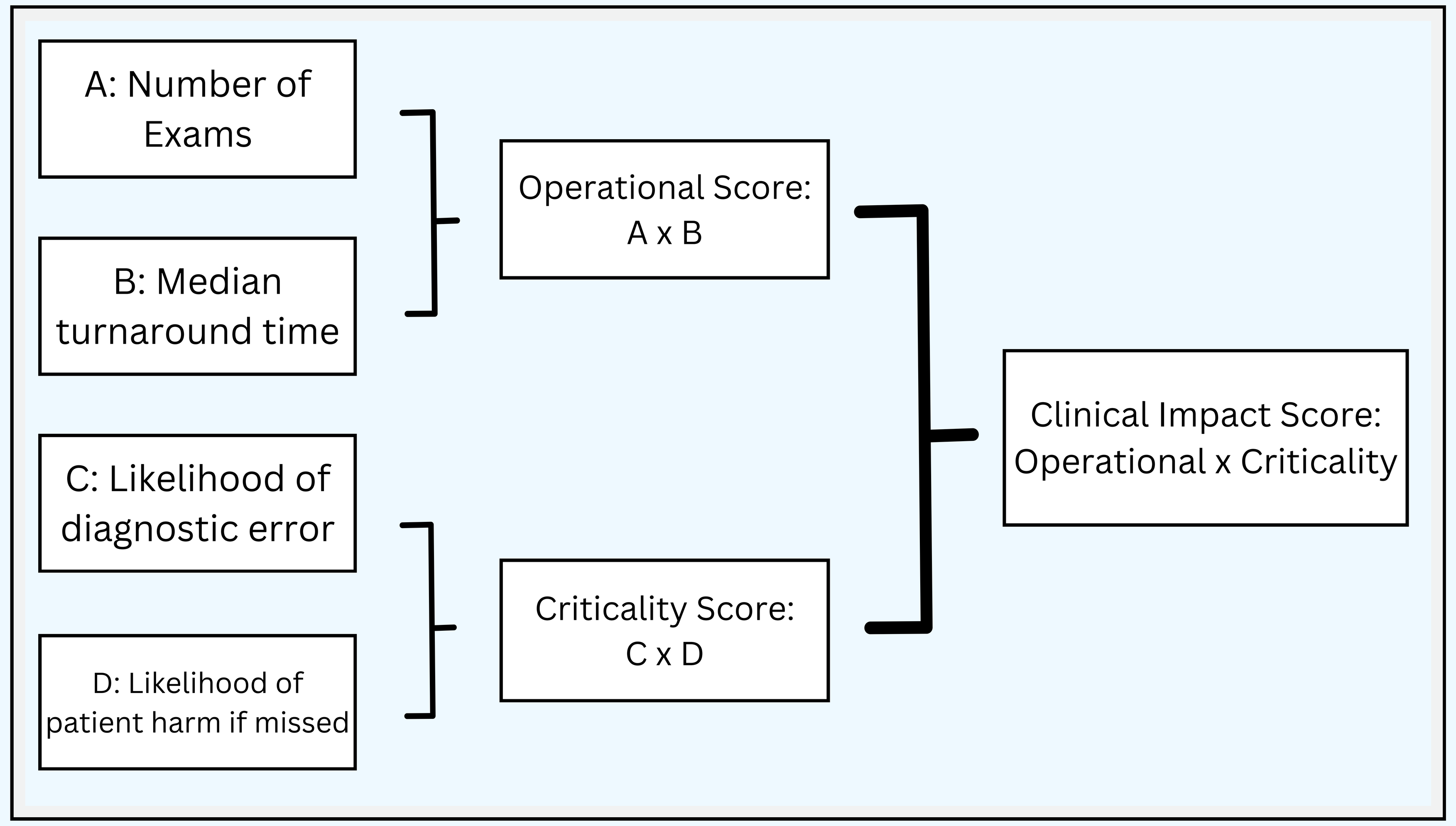
<u>Quantitative</u>: from database
- (A) number of exams performed during the study period with potential critical findings
- (B) median turnaround time

<u>Qualitative</u>: radiologist survey
- (C) likelihood of diagnostic error
- (D) likelihood of patient harm if finding is missed.

These variables were selected based on their potential to impact diagnostic accuracy and patient outcomes.

Operational and Criticality Scores were obtained (shown in Clinical Impact Score Design); the normalized values were compared in Figure 1.

Clinical Impact Score Design



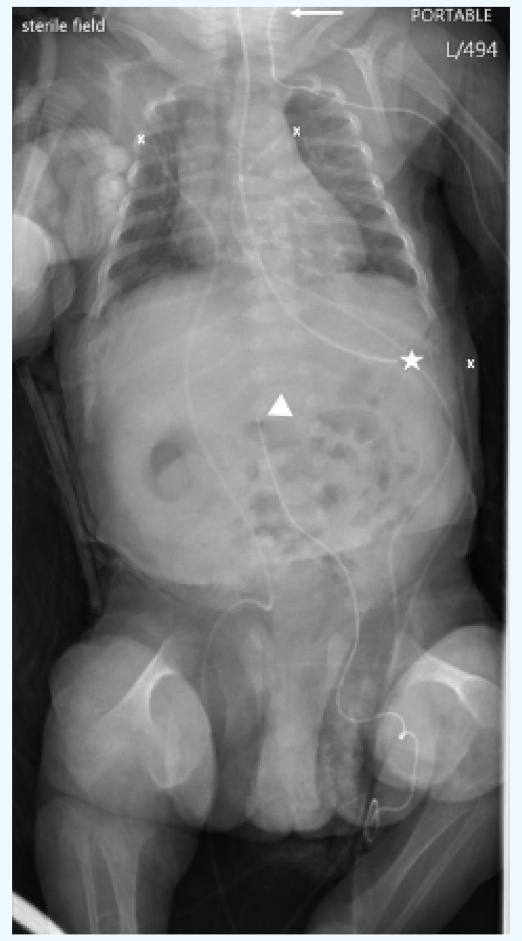


Image 1. 3-month-old male imaged for new central line placement – Left upper extremity PICC extends cephalad outside the field of view into the expected location of the internal jugular vein, which is a critical malposition. Enteric tube (star), left lower extremity PICC (arrowhead), and external leads (x) are annotated for clarity

Results

Finding	Median TAT	Number of Exams	Criticality	Error
Line malposition (life-threatening)	25	140798	5	2
Significant FB	23	176597	5	1
Tension PTX	25	128019	5	1
Bowel obstruction	21	48578	4	3
Pneumoperitoneum	21	48578	4	2
Increased ICP	33	11661	5	3
Stroke	35	12555	5	2
Hydrocephalus	33	11661	5	2
ICH	33	11661	5	2
PE	62	5774	5	2
Midgut volvulus	30	9336	5	2
Ovarian torsion	26	10077	5	2
Spinal cord compression	95	2917	5	1
New tumor	33	5088	4	2
Suspected NAT	29	1364	5	3
DVT	37	4468	3.5	1
Testicular torsion	23	4664	5	1
Unreduced intussusception	14	3538	4	1

Table 1. Abbreviations: FB, foreign body; PTX, pneumothorax; ICP, intracranial pressure; ICH, intracranial hemorrhage; PE, pulmonary embolism; NAT, non-accidental trauma; DVT, deep vein thrombosis. Data from studies between October 1st, 2019 and September 30th, 2021.

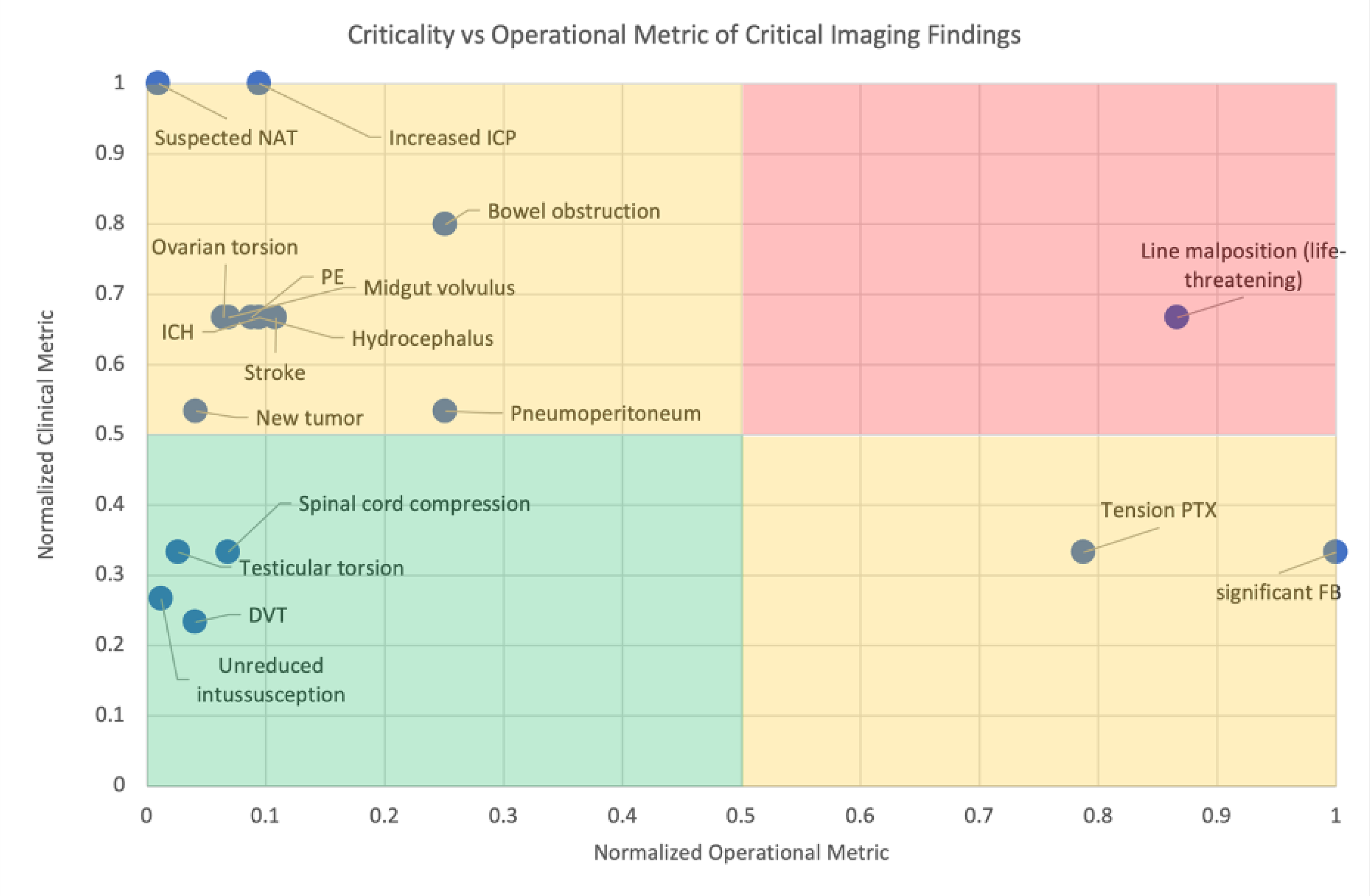


Figure 1. Normalized Clinical vs Operational Scores. Normalized values are calculated by dividing the findings value by the max value in the dataset. Findings within the green, yellow, and red boxes represent findings of increasing importance for AI development prioritization, respectively

Summary

Of the 18 critical findings, line malposition, significant foreign body, and tension pneumothorax had the highest CIS, while unreduced intussusception had the lowest.

The finding of a significant foreign body was ranked with the highest Operational Score, followed by line malposition and tension pneumothorax.

Suspected child abuse and increased intracranial pressure were equally ranked with the highest Criticality Scores.

Conclusion

The Clinical Impact Score ranks critical findings in pediatric radiology, indicating high-impact use cases for AI development and highlight areas needing urgent attention, like detecting line malposition

Development of AI algorithms using this framework optimizes the impact on patient outcomes in pediatric radiology.

The CIS is scored from quantitative and qualitative data, and therefore can vary between radiology groups, demographics and hospital capabilities across the country.

This framework can easily be replicated to meet the needs of other institutions, providing discrete targets for AI algorithm developers to focus on.