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The impact of AI tools on the detection of chest injuries from clinical imaging: a systematic review and meta-analysis

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IMPERIAL

Background & Methods

- Trauma and injuries are a major cause of death and disability in the working-aged population
- Common chest injuries include pneumothoraces, haemothoraces, rib fractures and lung contusions
- Chest injuries have been steadily increasing in prevalence
- There are increasing applications of AI in medical diagnostics

Population: adult patients with traumatic chest injuries with clinical imaging

Intervention: AI models or AI-assisted readers

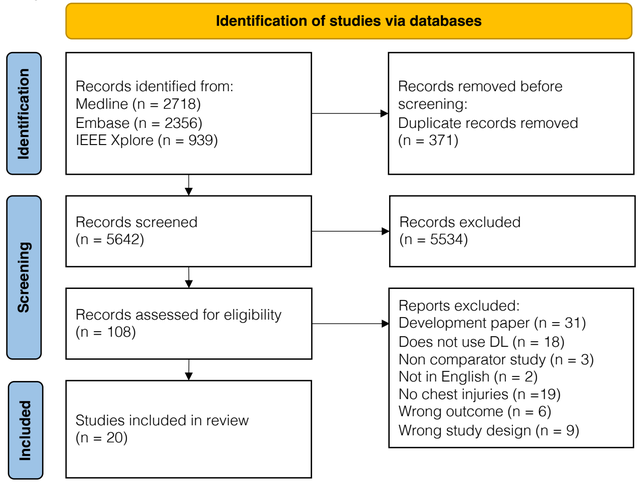
Comparator: unassisted readers

Outcome: diagnostic performance

Meta-analysis of impact on diagnostic performance of AI-assisted vs unassisted clinician readers to detect chest injuries

- $\text{Recall} = \text{Sensitivity} = \frac{\text{True Positive}}{\text{True Positive+False Negative}} = \frac{\text{TP}}{\text{TP+FN}}$
- $\text{Diagnostic time} = \text{time (s) for reader to detect injury}$

A systematic review of studies was conducted on Medline, Embase, and IEEE Xplore Digital Library from inception to April 2024[a]



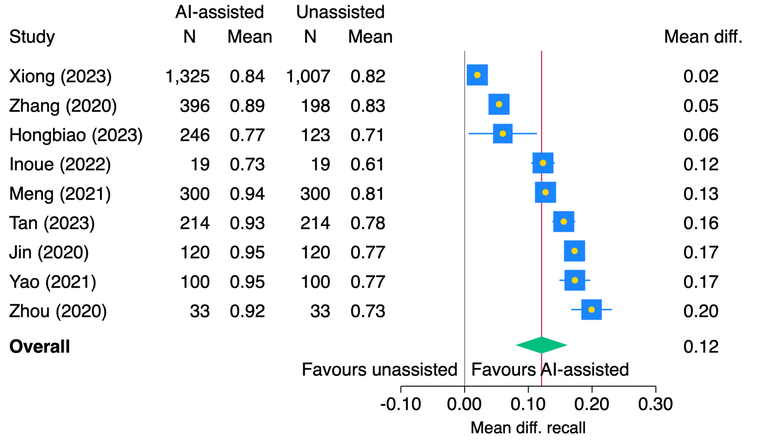
[a]prospectively registered on PROSPERO CRD42024568478

20 studies were included in the systematic review and all studies evaluated the detection of rib fractures

Study	Injury type	Test scans	Male	Age	Ground truth	Reader experience
Azuma (2022)	RF	28 / 30	22 (78.6%)	31.3 (29-35)	2x SR ± discussion	4x JR + 4x SR
Gipson (2022)	PTx RF	P: 172/1400 R: 349/1400	949 (68%)	52 (33-69)	CT report	1x SR
Hongbiao (2023)	RF	123	82 (67%)	54 (46-64)	3x SR	3x JR + 3x SR
Inoue (2022)	RF	19	13 (68.4%)	51.2 ± 19.2	2x SO ± CT report	3x O
Jin (2020)	RF	120	(63.8%)	55.1 (21-94)	3x JR+ 2x SR	1x JR + 1x SR
Kaiume (2021)	RF	39	28 (71.8%)	58 (20-91)	2x SR	2x JR
Li (2023)	RF	2145 / 2319	1459 (62.9%)	58.15 ± 14.12	3x SR	SR
Lin (2023)	RF	350	189 (63%)	(18-90)	2x SR	2x JR
Liu (2022)	RF	197 / 393	245 (62.3%)	45.6 (18-89)	3x SR	6x JR
Meng (2021)	RF	300	183 (61%)	54	4x SR	2x JR
Tan (2023)	RF	214	123 (57.5%)	54.2 (21-89)	2x SR ± discussion	2x JR + 2x SR
Wang (2023)	RF	976 / 1613	894 (55.4%)	49.1 (18-80)	2x SR	6x SR
Xiong (2023)	RF	2332	1405 (60.2%)	51.4 (18-83)	2x SR + follow up CT ± CTS	2x SR
Yang (2022)	RF	195	108 (55.4%)	58 (23-88)	2x R	3x R
Yao (2021)	RF	100	62 (62%)	56.7 (23-88)	4x SR	JR + SR
Zhang (2020)	RF	102 / 198	115 (58.1%)	52.7 (18-81)	2x SR	2x SR
Zhou (2020)	RF	33	19 (57.6%)	62 (26-80)	4x SR	5x SR
Zhou (2021)	RF	260	166 (63.8%)	56.2 ± 13.2	4x SR ± CTS	5x SR
Zhou (2022)	RF	45	23 (51.1%)	53.42 ± 12.71	4x SR) ± CTS	5x SR
Zhou (2023)	RF	88 / 113	85 (75.2%)	50.2 (4-88)	Follow up CT	2x SR

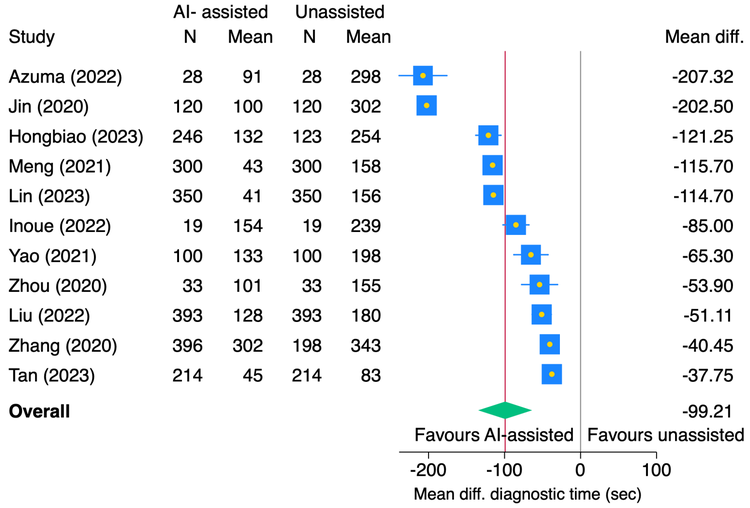
Results

There was a 30% increase[b] in recall associated with readers assisted with AI compared to unassisted readers



[b]Recall: AI-assisted readers 0.95; unassisted readers 0.73

A 46% reduction[c] in diagnostic time was associated with readers assisted with AI compared to unassisted readers



[c]Diagnostic time: assisted readers 1m 55s; unassisted readers 3m 34s

Conclusions:

Systematic review:
- Reader studies all evaluated rib fracture detection AI models
- The majority of readers are from a radiology background

Meta-analysis:
- AI-assisted reading was associated with improved detection of rib fractures
- An increase in the recall and a reduction in the diagnostic time of the reader

Future work:
- Development of models capable of detecting multiple injuries
- Evaluation of AI impact on the wider clinical workforce

References: *Zhao et al.* (2024) Diagnostic evaluation of blunt chest trauma by imaging-based application of artificial intelligence; *Lopez-Melia et al.* (2024) Deep learning for acute rib fracture detection in CT data: a systematic review and meta-analysis; *Whiting et al.* (2011) QUADAS-2: A Revised Tool for the Quality Assessment of Diagnostic Accuracy Studies