SIIM CAIMI26 Conference on Artificial Intelligence in Medical Imaging
OCT 26-27 | University of Pennsylvania, Philadelphia, PA

Impact of AI-Based Triage on Downstream Clinical Communication and Emergency Department Disposition

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Purpose
Intracranial hemorrhage (ICH) has been shown to be a time-sensitive emergency in which treatment delays can worsen outcomes. AI-based triage systems can reduce radiology report turnaround times, but whether this translates into downstream clinical action remains unclear. Using NLP-derived labels and ED disposition data stratified by AI detection status, we evaluated whether AI triage produces measurable downstream clinical impact.

Methods
We evaluated ED head CTs before and after implementation of an AI-based ICH triage system. We developed and validated two NLP pipelines to extract structured clinical labels from free-text radiology reports: (1) ICH(+) exams and (2) documented clinician communication events. NLP-derived outputs were linked to radiology timestamps and EHR disposition data to construct an analysis pipeline. Primary outcomes included report turnaround time (TAT; scan completion to final report), communication latency (scan completion to documented clinician notification), and ED time-to-disposition (from arrival to admission or discharge). We further stratified ICH(+) cases in the post-implementation cohort by AI detection status [AI(+) vs AI(−)] to isolate the effect of AI prioritization on downstream outcomes.

Results
The AI triage system achieved 79.3% sensitivity, 94.2% specificity (F1 score 0.781) against NLP-derived ICH labels. Among ICH(+) exams, AI implementation was associated with reduced report TAT (median [IQR] minutes: 214.0 [132.0-361.5] vs 201.0 [120.0-330.0]; p=.028). Communication rates were comparable pre- and post-implementation (33.5% vs 32.0%; p=.093), with a non-significant trend toward reduced communication latency among AI(+) cases (p=.063). Among 10,898 pre-AI and 9,317 post-AI ED encounters, AI(+) cases demonstrated shorter time to admission than AI(−) cases (median 423.5 vs 523.0 minutes; p=.004), and AI(−) cases demonstrated shorter time to discharge than AI(+) cases (median 520.0 vs 611.0 minutes; p=.048).

Conclusion
AI-based ICH triage was associated with a significant reduction in report TAT and a trend toward reduced communication latency among AI-flagged cases. AI positive detection was associated with expedited admission and negative detection was associated with expedited discharge, suggesting AI may reshape clinical workflow rather than uniformly accelerate it.

Statement of Impact

These findings suggest that the clinical impact of AI triage extends beyond radiology efficiency and into acuity-dependent modulation of downstream care pathways, an effect not captured by traditional workflow metrics.

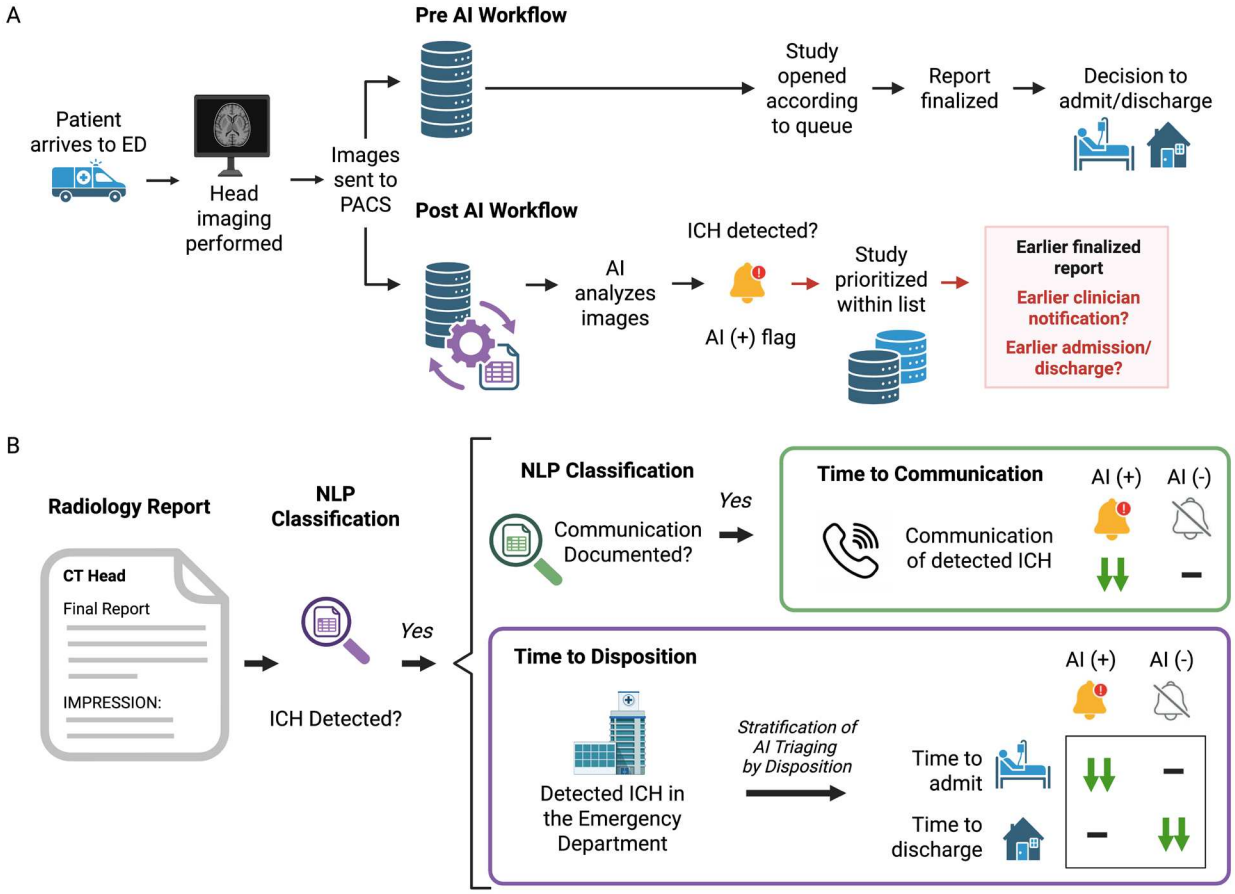

Figure 1. AI-Based Triaging Workflow and Downstream Clinical Outcome Assessment for Intracranial Hemorrhage (ICH). (A) Conceptual workflow illustrating emergency department (ED) evaluation before and after implementation of AI-based radiology triage. Before AI implementation, head CT exams entered the standard radiologist worklist and were interpreted according to queue order. After implementation, exams were analyzed by an AI algorithm for ICH detection. Studies flagged as AI positive [AI(+)] were prioritized within the radiologist worklist, potentially enabling earlier report finalization, clinician notification, and downstream clinical decision-making, including ED admission or discharge. **(B)** Downstream outcome assessment pipeline. Final radiology reports were analyzed using natural language processing (NLP) to identify ICH(+) exams and documented communication events. Communication latency was evaluated among exams with documented clinician communication. For ED encounters with ICH, patients were further stratified by disposition (hospital admission versus ED discharge) and AI triage status [AI(+) versus AI(-)] to evaluate the association between AI implementation and time to ED disposition. This framework extends evaluation of AI triage beyond radiology workflow metrics to patient-centered clinical outcomes.

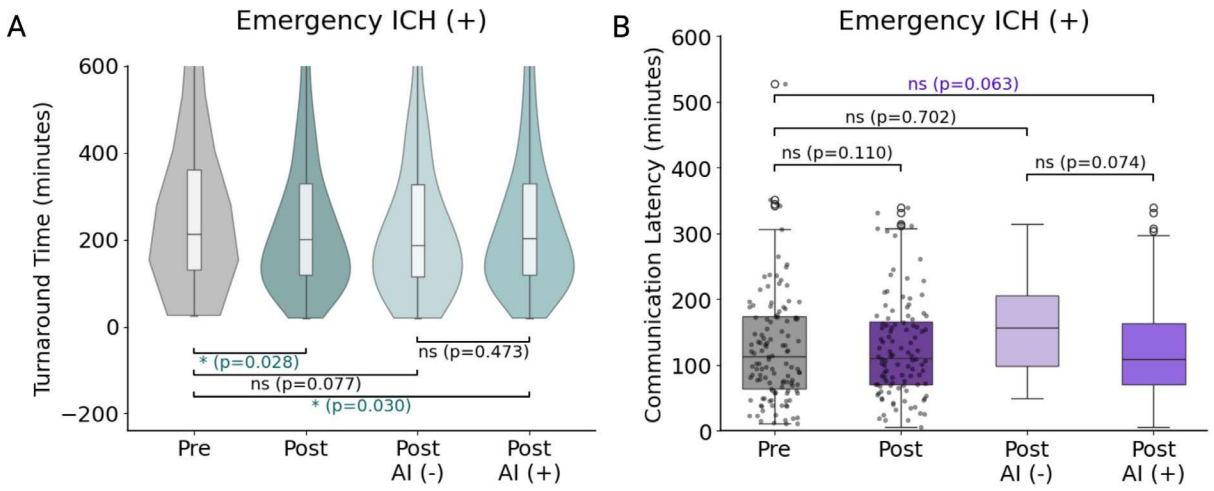

Figure 2. Impact of AI-Based Triaging on Radiology Turnaround Time and Clinical Communication in ICH(+) Cases. (**A**) Report turnaround time among emergency department (ED) ICH(+) exams identified by natural language processing (NLP) of radiology reports, comparing pre- and post-implementation periods and post-implementation AI detection status (median [IQR] minutes; pre AI: 214.0 [132.0-361.5]; post AI: 201.0 [120.0-330.0]; post AI(-): 188.0 [116.0-326.8]; post AI(+): 203.0 [120.0-329.5]). Box plots demonstrate time from imaging completion to final radiology report sign-off. Statistical comparisons were performed using Welch's two-sample t-tests. Pre-implementation turnaround time was significantly longer than post-implementation turnaround time (p=.028) and post AI(+) cases (p=.030), but not post AI(-) cases (p=.077). Turnaround time did not differ between post-implementation AI(-) and AI(+) cases (p=.474). (**B**) Communication latency among ED ICH(+) exams with documented clinician communication, comparing pre- and post-implementation cohorts and post-implementation AI detection status (median [IQR] minutes; pre AI: 113.0 [64.0-174.0], n=125; post AI: 111.0 [70.8-166.2], n=108; post AI(+): 109.0 [70.2-163.5], n=94; post AI(-): 157.5 [98.5-206.2], n=14). Box plots demonstrate time from radiology report availability to documented clinician communication. Statistical comparisons were performed using Mann-Whitney U tests.

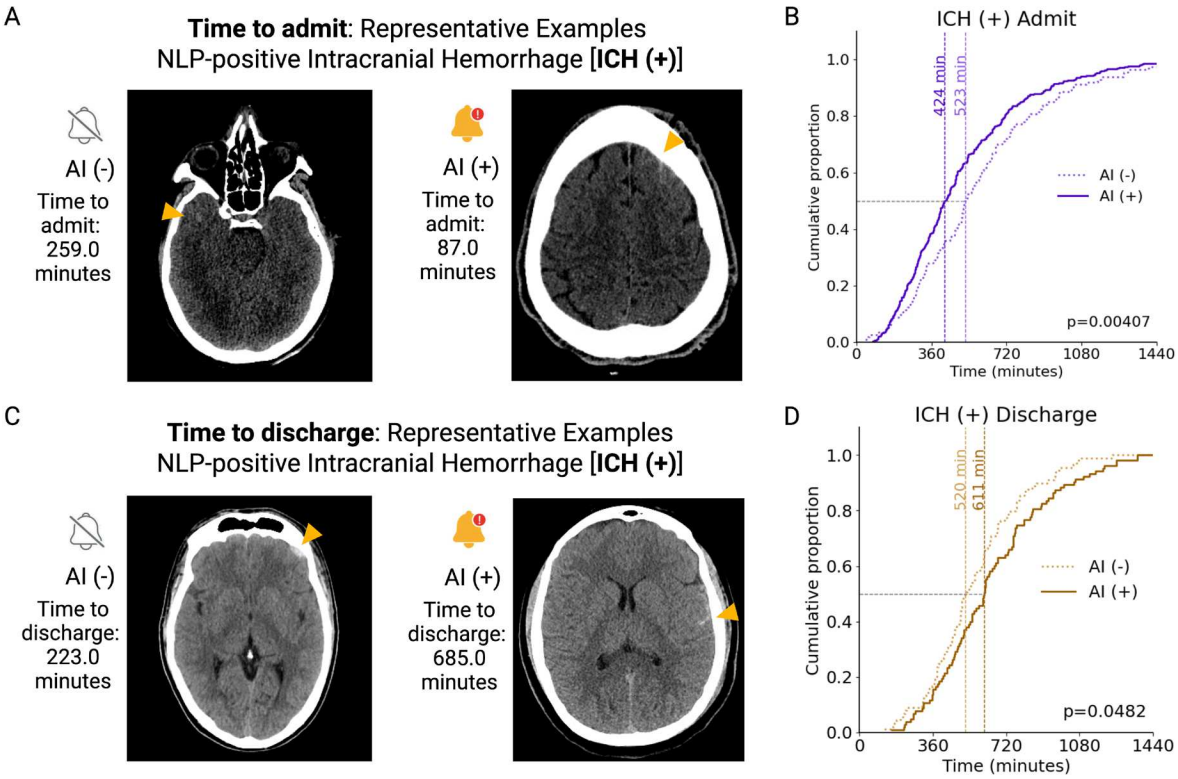

Figure 3. Impact of AI-Based Triaging and Downstream Emergency Department Time-to-Disposition in ICH(+) Cases. Four different representative patient examples of positive intracranial hemorrhages detected by NLP [ICH(+)] on radiology reports are shown, along with the cumulative distribution functions of times to disposition from the emergency department (ED) of ICH(+) cases stratified by AI detection. Statistical comparisons were performed using two-sided Mann-Whitney U tests. (**A**) Two examples of patients who were subsequently admitted from the ED with clinically proven ICH. Left axial CT head non-contrast shows a right anterior temporal lobe intraparenchymal hemorrhage that was not flagged as positive by AI [AI(-)] and associated with a time to admission of 259 minutes. Right axial CT head non-contrast shows a left frontal subarachnoid hemorrhage that was flagged as positive [AI(+)] and had a time to admission of 87 minutes. (**B**) AI(+) cases demonstrated reduced time to admission compared with AI(-) cases (median [IQR] minutes: 423.5 [281.0-651.0] (n=444) vs 523.0 [334.0-740.5] (n=114); *p=.004*). (**C**) Two examples of patients who were subsequently discharged from the ED with clinically proven ICH. Left axial CT head non-contrast shows a left frontal epidural hemorrhage that was AI(-) and associated with a time to discharge of 233 minutes. Right axial CT head non-contrast shows a left temporal subarachnoid hemorrhage that was AI(+) and had a time to discharge of 685 minutes. (**D**) AI(-) cases demonstrated reduced time to discharge compared with AI(+) cases (median [IQR] minutes: 520.0 [397.0-679.0] (n=89) vs 611.0 [455.0-789.0] (n=103); *p=.048*).