

## Cohort flow summary

The primary outcome was defined at the ED encounter level as inpatient admission to the index hospital (“Admit”) versus routine ED discharge (“Discharge”).

- Initial ED encounters: 1,081,472
- Excluded encounters based on disposition category: 83,363
  - Transfers, observation pathways, LWBS/AMA, expired, unspecified, and other non-comparable dispositions
- Final analytic cohort: 998,109 ED encounters
  - Discharge: 819,758 (82.13%)
  - Admit: 178,351 (17.87%)

Supplementary Table 1. Emergency department disposition categories and analytic mapping

| ED Disposition category        | Count (before filtering) | Percentage (%) | Included in analysis | Analytic outcome | Rationale                    |
|--------------------------------|--------------------------|----------------|----------------------|------------------|------------------------------|
| Discharge                      | 819,758                  | 75.80          | Yes                  | Discharge        | Routine ED discharge         |
| Admit                          | 178,351                  | 16.49          | Yes                  | Admit            | Inpatient admission          |
| Transfer to Another Facility   | 30,020                   | 2.78           | No                   | Excluded         | Care outside the hospital    |
| LWBS (Left Without Being Seen) | 23,011                   | 2.13           | No                   | Excluded         | No completed evaluation      |
| AMA (Against Medical Advice)   | 20,833                   | 1.93           | No                   | Excluded         | Non-standard termination     |
| ED Dismiss – Never Arrived     | 5,336                    | 0.49           | No                   | Excluded         | No clinical encounter        |
| *Unspecified                   | 2,755                    | 0.25           | No                   | Excluded         | Outcome unclear              |
| Expired                        | 1,326                    | 0.12           | No                   | Excluded         | Outcome unclear              |
| ED Observation                 | 36                       | <0.01          | No                   | Excluded         | Observation pathway          |
| Discharge Pending              | 32                       | <0.01          | No                   | Excluded         | Final disposition unresolved |
| Admit to Home Recovery Care    | 7                        | <0.01          | No                   | Excluded         | Non-facility-based care      |
| Behavioral Health Hold         | 5                        | <0.01          | No                   | Excluded         | Psychiatric pathway          |
| Psych Observation              | 2                        | <0.01          | No                   | Excluded         | Observation pathway          |

Evaluation metrics summary

| Supplementary Table 2: Machine learning performance metrics |                                                                                         |                                                             |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Metric                                                      | Formula                                                                                 | Interpretation                                              |
| Accuracy                                                    | $(TP + TN) / (TP + TN + FP + FN)$                                                       | Proportion of all encounters correctly classified           |
| Recall (Sensitivity)                                        | $TP / (TP + FN)$                                                                        | Proportion of admitted patients correctly identified        |
| Precision (PPV)                                             | $TP / (TP + FP)$                                                                        | Proportion of predicted admissions that were truly admitted |
| F1-score                                                    | $2 \times (\text{Precision} \times \text{Recall}) / (\text{Precision} + \text{Recall})$ | Balance between precision and recall                        |
| AUROC                                                       | Area under ROC curve (TPR vs. FPR)                                                      | Overall discriminative ability across thresholds            |
| AUPRC                                                       | Area under Precision–Recall curve                                                       | Discriminative ability for imbalanced data                  |

\*Abbreviations: TP = True Positive, TN = True Negative, FP = False Positive, FN = False Negative, PPV = Positive Predictive Value, TPR = True Positive Rate, FPR = False Positive Rate.