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Early Return, Serious Escalation: A Five-Year Nationwide Retrospective Study of Emergency Department Safety Among Older Adults in Jordan

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Abstract

Emergency department (ED) discharge is a high-risk transition. Because overall short-interval ED return rates often reflect routine healthcare utilization rather than true clinical quality deficits, we evaluated 72-hour ED returns with severe clinical outcomes as a novel patient-safety trigger to identify diagnostic and disposition errors among older adults in Jordan. This 2021–2025 retrospective cohort study used Jordan's national electronic health record (EHR) database, including adults aged ≥ 65 years discharged home from an ED. The primary outcome was a serious 72-hour ED return. In Phase 1, multivariable logistic regression with patient-level cluster-robust standard errors was used to identify independent predictors of these serious returns. In Phase 2, a structured physician chart review of 400 randomly sampled serious return cases was conducted using the Revised Safer Dx framework to assess preventability and identify safety vulnerabilities. Among 68,835 ED discharges (13,844 patients), 17,971 (26.1%) resulted in a 72-hour return; 3,872 (5.6% overall) met serious return criteria (median time: 8.52 hours). Serious returns were significantly associated with male sex (aOR 1.21, 95% CI 1.07–1.36; p = 0.002), > 10 prior ED visits (aOR 1.65, 95% CI 1.41–1.93; p < 0.001), primary health center index care (aOR 1.22, 95% CI 1.04–1.43; p = 0.017), and follow-up/administrative encounters (aOR 2.28, 95% CI 1.99–2.62; p < 0.001). Of 400 reviewed serious returns, 108 (27.0%) were probably or definitely preventable. Primary failures included inadequate safety-netting and discharge instructions (35.2%), premature discharge (28.7%), and probable missed or delayed diagnosis (20.4%). Over a quarter of 72-hour ED serious returns represented preventable failures. Health systems should transition to automated, outcome-filtered EHR triggers to accurately target quality improvement and prioritise high-risk older adults.

Introduction

Discharge from the emergency department (ED) is a safety-critical transition, particularly for older adults. Clinical decisions are often made under time pressure and diagnostic uncertainty, when disease trajectories may still be evolving. Subsequent deterioration may reflect unavoidable disease progression, but it may also indicate delayed or missed diagnosis, incomplete treatment, premature discharge, inadequate safety-netting or failure to arrange appropriate follow-up. Older adults may be especially vulnerable because of atypical presentations, multimorbidity, frailty, polypharmacy, cognitive or sensory impairment and dependence on caregivers for post-discharge care [1–4]. An unplanned return to the ED within 72 hours is commonly used as a trigger for possible problems in the initial episode of care. However, a return visit alone is neither evidence of preventable harm nor a sufficiently specific measure of ED quality. In a structured review of return visits, Calder *et al* identified an adverse event in approximately 12% of patients returning within 72 hours [5]. Other studies have demonstrated that early returns can identify diagnostic errors and opportunities for improvement, while also showing that many returns arise from disease progression, patient behaviour or limitations in access to community care [6, 7]. Consequently, using the overall return rate as a performance indicator risks conflating healthcare utilisation with unsafe care.

Linking an early return to objective evidence of clinical escalation—such as hospital admission, intensive care, emergency surgery or death—may provide a more informative surveillance trigger. Recent studies have examined overall and high-risk returns among older ED patients, but reported frequencies and predictors vary substantially because of differences in populations, time windows, outcome definitions and data-linkage methods [1, 8–11]. Single-centre analyses may also miss returns to other facilities. Although structured

trigger tools and return-visit audit programmes can identify adverse events and support organisational learning, few studies [7, 12] have combined large-scale cross-facility surveillance with clinical review to determine whether serious returns were preventable and which care processes contributed to them. Evidence from Middle Eastern health systems, including Jordan, remains particularly limited.

We therefore conducted a nationwide retrospective trigger-tool study aiming to estimate the frequency and timing of any and serious ED returns within 72 hours of discharge; identify patient, clinical and health-system factors associated with serious return; and describe the presenting complaints and subsequent escalation of care. In a second phase, multidisciplinary committee reviewed a sample of serious returns to assess preventability and identify diagnostic, disposition, treatment, follow-up and safety-netting concerns. By combining automated EHR data extraction to detect trigger events with structured clinical review, this study sought to determine whether serious short-interval ED returns can provide a feasible, learning-oriented trigger for diagnostic and discharge safety improvement.

Materials and Methods

Study design and data source

A retrospective, longitudinal EHR-based trigger-tool study was conducted to examine short-interval ED returns among older adults in Jordan. The analysis used de-identified, patient-level records from Hakeem®, Jordan's national centralised EHR system, which provides comprehensive data linkage across public ED encounters, hospital admissions, surgical encounters, death records, demographic data, facility characteristics and comorbidity indicators. The observation period was 1 January 2021 to 31 December 2025. Reporting was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [13].

Ethics

All methods were carried out in accordance with relevant guidelines and regulations (Declaration of Helsinki). The analysis used de-identified routinely collected EHR data. Ethical approval was obtained from the Ministry of Health in Jordan (MOH/REC/2025/604). The requirement for individual informed consent was waived by the ethics committee of the Ministry of Health in Jordan because of the retrospective design and use of de-identified records. Furthermore, informed consent was obtained from the medical experts who participated in the Phase 2 chart review process.

Study Population

The study population included adults aged 65 years or older with at least one recorded ED encounter during the study period. Eligible index ED visits were those ending in regular discharge home with valid ED arrival and exit timestamps. ED encounters ending in ward admission, ICU transfer, operating-room transfer, transfer to another facility, or death or had a missing or implausible timestamp sequence as well as duplicated

encounter records were excluded. The unit of analysis was the ED discharge event; therefore, individual patients could contribute multiple eligible index discharges over the study period.

Data extraction and quality assurance

Following ethical and data-access approval, an authorised team of trained health-data analysts from Electronic Health Solutions (EHS®) extracted the study data from the Hakeem® EHR system in January 2026. Before extraction, the research team prepared a prespecified data dictionary and extraction protocol defining the study population, eligibility criteria, observation period, required variables, and outcome definitions. The analysts used standardised Structured Query Language (SQL) queries to retrieve records from the ED encounter, hospital admission, surgical procedure, mortality, demographic, facility, and comorbidity tables.

Records were linked across tables using the unique, pseudonymised patient identifier and encounter identifiers available in Hakeem®. Direct patient identifiers, including names and national identification numbers, were removed before the dataset was made available to the research team. The investigators received a de-identified, event-level analytic dataset through a secure, password-protected institutional data-sharing platform.

The extraction process included checks for duplicate encounters, missing timestamps, chronological inconsistencies, out-of-range values, and conflicting disposition records. One analyst developed the extraction queries, and a second analyst independently reviewed the code and resulting variable definitions. Aggregate encounter counts were compared with administrative source-system reports, and a random sample of 100 patient timelines was manually checked against the source records to confirm correct encounter sequencing and linkage. Any discrepancies were reviewed jointly by the analysts and investigators and corrected before the analytic dataset was finalised.

Ascertainment of return visits

Within each patient record, eligible ED encounters were sequenced chronologically according to their recorded arrival and exit date-times. The SQL algorithm identified the first ED arrival occurring after each eligible index discharge. Time to return was calculated in hours as the difference between the subsequent ED arrival time and the index ED exit time. Encounters with duplicated records, missing timestamps, or non-positive return intervals were completely excluded before outcome classification. The research team reviewed the derived variables and aggregate outputs, while the authorised data analysts performed the database extraction and programming. A 72-hour return was defined as a subsequent ED presentation occurring within 72 hours of index discharge. The same procedure was used to identify returns within 7 days, and 30 days.

The study used a 72-hour return window as a surveillance trigger for possible diagnostic or disposition-related safety concerns, as this timeframe is widely used in ED quality surveillance and has demonstrated value as an electronic trigger for identifying adverse events and diagnostic errors, particularly when the return results in admission or another escalation of care [5–7]. However, because crude 72-hour return rates may be

influenced by disease progression, planned reassessment, patient behaviour and access to outpatient care, they should not be interpreted as direct indicators of unsafe care [14]. Accordingly, the present study used the 72-hour interval as a sensitive case-finding trigger, enriched it with objective markers of clinical escalation and applied structured physician review to assess preventability. A 48-hour window was additionally examined in sensitivity analysis to assess the robustness and operational efficiency of the selected threshold.

A return visit in isolation was not interpreted as definitive evidence of preventable harm or error, as many returns result from natural disease progression, planned follow-ups, or lack of community care access. Instead, returns accompanied by severe clinical escalation were treated as higher-priority trigger events, indicating potential safety failures and consequently in need for further clinical and system-level safety assessment.

Outcomes

The primary outcome was a serious 72-hour ED return. This was defined as a return ED visit within 72 hours of an eligible index discharge that met one or more of the following clinical escalation criteria: (1) direct transfer from the ED to a hospital ward, ICU, or operating room; (2) death recorded during the return ED encounter; or (3) subsequent linked EHR records indicating a hospital admission, surgical procedure, or death within 24 hours of the return ED arrival.

Secondary outcomes included any 72-hour ED return, 7-day ED return, 30-day ED return, time from discharge to return, and the individual components of serious escalation. Because a single return episode could involve multiple escalation outcomes (e.g., a patient admitted to the ward who is later transferred to the ICU), these specific escalation criteria were evaluated independently and were not mutually exclusive.

Covariates

Candidate predictors were selected *a priori* based on clinical plausibility and their availability in the EHR. These included age, sex, governorate, and facility type (primary health centres - typically provide basic outpatient and general practitioner services with limited acute care capabilities, comprehensive health centres - typically provide basic broader outpatient and general practitioner services with limited acute care capabilities, and general and specialised hospitals - serve as larger regional hubs offering 24-hour emergency care, basic laboratory, and radiological services). General and specialised hospitals provide full-scale, high-acuity ED care and inpatient admission capabilities, comorbidity burden using the non-age-adjusted Charlson Comorbidity Index (CCI), previous ED utilisation and the index-visit chief complaint (chief complaint text was cleaned and grouped into clinically meaningful categories as in see **Supplementary Table S1**). Previous ED utilisation was defined as the number of ED encounters recorded for the same patient before the relevant index discharge.

The CCI, a validated weighted measure of chronic disease burden [15], was identified from International Classification of Diseases, 10th Revision (ICD-10) diagnosis codes recorded in the available Hakeem® diagnostic history before each index ED discharge and mapped using the coding algorithm developed by

Quan *et al*. [16]. The corresponding condition weights were summed to produce the CCI score. Age was not incorporated into the CCI because it was included separately in the multivariable model. Patients with no qualifying CCI code in their available diagnostic history were assigned a CCI score of zero, indicating that no CCI condition was identified in the coded records [15, 16]. Scores were categorised into three risk tiers (scores of 0, 1–2, and ≥ 3) with score ≥ 3 indicates high comorbidity burden. Because the absence of a recorded diagnosis may reflect incomplete coding, comorbidity-related estimates were interpreted cautiously.

Encounters with missing or implausible arrival and exit timestamps were completely excluded during the initial cohort definition phase. Because missingness for key demographic and visit covariates (e.g., age, sex, facility type) was negligible (< 1%), we utilised complete case analysis for all multivariable regression modeling without relying on multiple imputation.

Chief complaints were available as free text. Entries were manually reviewed and standardised by two independent clinical researchers through case conversion, harmonisation of obvious spelling variations and grouping of clinically similar terms. A random sample of 5% of entries was cross-checked by a senior emergency physician to validate the clinical accuracy of the groupings. The resulting preliminary categories included pain/musculoskeletal or non-specific symptoms; neurological symptoms, weakness or dizziness; respiratory or influenza-like symptoms; abdominal, gastrointestinal or urinary symptoms; and other or unclear complaints. Missing, ambiguous and non-interpretable complaints were retained as a distinct category to avoid excluding records in which documentation quality may itself have been informative.

Manual chart review and safety-event classification

To estimate the positive predictive value of the serious 72-hour return trigger and characterise associated patient-safety vulnerabilities, we conducted a Phase 2 manual review of 400 cases selected from the 3,872 serious return events. The sample size was calculated conservatively using an expected safety-event proportion of 50%, a 95% confidence level, a 5% absolute precision margin, and a finite-population correction. This calculation yielded a minimum requirement of 350 reviews. Reviewing 400 cases (10.3% of all serious returns) provided a worst-case 95% margin of error of approximately ± 4.9 percentage points under simple random sampling. Serious return visits were explicitly selected because combining a short return interval with admission or clinical escalation increases the yield of clinically important safety events, whereas an unselected 72-hour return alone has relatively low specificity [5, 6].

To evaluate these cases, a multidisciplinary committee of three medical experts (comprising a consultant pharmacotherapist, a consultant internist, and an emergency medicine specialist) reviewed the complete clinical documentation from the index and return encounters. Reviewers utilized a standardised review form adapted from established ED adverse-event classifications and the Revised Safer Dx/DEER frameworks [5, 17, 18]. To minimise hindsight bias, reviewers assessed index-visit decisions using only the clinical information documented at that time. Each case was independently assigned a four-level preventability rating: 1 = not preventable, 2 = possibly preventable, 3 = probably preventable, and 4 = definitely preventable, consistent with ordinal preventability approaches used in previous physician-review studies.[19]

Cases rated probably or definitely preventable (scores ≥ 3) were assigned one primary safety-issue category: probable missed or delayed diagnosis; premature or unsafe discharge; inadequate safety-netting or discharge communication; treatment or management failure; or follow-up/access failure. Cases rated not preventable were classified as expected disease progression, while cases rated possibly preventable were retained as an uncertain category. These classifications reflect recognised diagnostic, management, disposition, communication, and follow-up failures in ED adverse-event research [5, 17].

If disagreements in ratings arose between the three experts; cases were subsequently adjudicated by a fourth senior consultant internist. The use of multiple independent reviewers and structured adjudication reduces uncertainty in implicit chart-review judgements [5, 20]. Inter-rater reliability was calculated from the original pre-consensus ratings using unweighted Cohen's κ for the nominal safety-issue classification and linearly weighted κ for the ordinal preventability scale, reported with 95% confidence intervals [21].

Statistical analysis

We described the cohort, index ED discharges, return visits and serious return events using frequencies and percentages for categorical variables and means with standard deviations or medians with interquartile ranges for continuous variables, according to their distribution.

We used multivariable logistic regression to examine associations between patient-, encounter- and facility-level characteristics and serious 72-hour ED return. The dependent variable was serious 72-hour return (yes/no). Models included age, sex, governorate, facility type, CCI, previous ED utilisation and chief-complaint category. As patients could contribute multiple eligible index discharges, we used patient-level cluster-robust standard errors to account for within-patient correlation. Associations were reported as adjusted odds ratios with 95% confidence intervals. All tests were two-sided, and p values below 0.05 were considered statistically significant.

We assessed robustness by repeating the analysis using only the first eligible index ED discharge per patient. Additional sensitivity analyses examined alternative return windows and more restrictive definitions of serious return based solely on documented ED disposition.

Regression model assumptions were systematically evaluated prior to finalising the results. We tested for multicollinearity among independent variables using Variance Inflation Factors (VIF), with a VIF threshold of < 5 considered acceptable. Furthermore, overall model discrimination was assessed using the area under the receiver operating characteristic curve (AUC / C-statistic), and model calibration was evaluated using the Hosmer-Lemeshow goodness-of-fit test. For the manual chart review, inter-rater reliability between the two primary reviewers was calculated using Cohen's kappa.

Results

Study Cohort and Eligible Emergency Department Discharges

The source cohort included 47,942 older adults, of whom 25,352 had at least one recorded ED encounter. After restricting the analysis to ED encounters ending in regular/home discharge with valid ED timestamps,

the final analytic dataset included 68,835 eligible index ED discharge events among 13,844 patients (Fig. 1).

Patients contributed a median of 2 eligible ED discharge events each, with an interquartile range of 1–5 events. Overall, 5,030 patients contributed one eligible ED discharge, 4,804 contributed 2 to 4 discharges, 2,249 contributed 5 to 9 discharges, and 1,761 contributed 10 or more eligible discharges.

Figure 1. illustrates the study cohort and two-phase trigger-tool review pathway. Phase 1 used linked EHRs to identify serious returns after eligible ED discharges. Phase 2 comprised structured independent review of a stratified random sample of serious-return cases. Serious-return criteria were not mutually exclusive.

Patient and Event Characteristics

Across eligible ED discharge events, the mean patient age was 73.5 years with a standard deviation of 6.3 years. Females accounted for 52.4% of eligible ED discharges. Patients with any 72-hour ED return were slightly older than those without return, with a mean age of 73.9 years compared with 73.3 years. They also had higher previous ED utilisation. Serious 72-hour return events were more common among males than females. Males accounted for 53.8% of serious 72-hour returns, although they represented 47.6% of eligible ED discharges overall (**Table 1**).

Chief complaint text was grouped into preliminary clinical categories. The most common index complaint category was pain/musculoskeletal/non-specific symptoms, representing 25,494 ED discharges or 37.0% of eligible discharges. This was followed by neurological/weakness/dizziness complaints, respiratory or flu-like complaints, and missing or unclear complaint entries. The highest rate of serious 72-hour return was observed among records with pain-related at 27.6%, followed by the missing or unclear chief complaints at 21.7%, followed by neurological/weakness/dizziness at 15.6%, and respiratory or flu-like complaint at 15.6%.

Table 1. Characteristics of eligible ED discharge events

Characteristic	Overall ED discharges (n=68,835)	No 72-hour return (n=50,864)	Any 72-hour return (n=17,971)	Serious 72-hour return* (n=3,872)	Unadjusted p-value‡
Patient demographics					
Age, years; mean (SD)	73.5 (6.3)	73.3 (6.2)	73.9 (6.3)	73.8 (6.4)	<0.001
Sex, n (%)					<0.001
Female	36,070 (52.4)	27,592 (54.2)	8,478 (47.2)	1,788 (46.2)	
Male	32,765 (47.6)	23,272 (45.8)	9,493 (52.8)	2,084 (53.8)	
Governorate, n (%)					<0.001
Amman	33,740 (49.0)	25,443 (50.0)	8,297 (46.2)	2,078 (53.6)	
Irbid	11,680 (17.0)	5,763 (11.3)	5,917 (32.9)	962 (24.8)	
Zarqa	9,765 (14.2)	8,166 (16.1)	1,599 (8.9)	321 (8.3)	
Ma'an	3,558 (5.2)	3,007 (5.9)	551 (3.1)	167 (4.3)	
Karak	2,770 (4.0)	2,190 (4.3)	580 (3.2)	31 (0.8)	
Balqa	2,327 (3.4)	2,053 (4.0)	274 (1.5)	78 (2.0)	
Madaba	1,909 (2.8)	1,642 (3.2)	267 (1.5)	72 (1.9)	
Mafraq	1,110 (1.6)	793 (1.6)	317 (1.8)	106 (2.7)	
Ajloun	1,011 (1.5)	923 (1.8)	88 (0.5)	30 (0.8)	
Tafila	711 (1.0)	658 (1.3)	53 (0.3)	21 (0.5)	
Jerash	181 (0.3)	163 (0.3)	18 (0.1)	6 (0.2)	
Aqaba	73 (0.1)	63 (0.1)	10 (0.1)	0 (0.0)	
Facility type, n (%)					<0.001
General hospital	48,742 (70.8)	35,025 (68.9)	13,717 (76.3)	2,740 (70.8)	
Comprehensive health centre	14,516 (21.1)	11,875 (23.3)	2,641 (14.7)	750 (19.4)	
Primary health centre	5,574 (8.1)	3,961 (7.8)	1,613 (9.0)	382 (9.9)	
Specialised hospital	3 (<0.1)	3 (<0.1)	0 (0.0)	0 (0.0)	
Comorbidity and healthcare utilization					

CCI, n (%)					<0.001
0	40,248 (58.5)	30,208 (59.4)	10,040 (55.9)	2,094 (54.1)	
1–2	7,919 (11.5)	5,845 (11.5)	2,074 (11.5)	452 (11.7)	
≥3	20,668 (30.0)	14,811 (29.1)	5,857 (32.6)	1,326 (34.2)	
Prior ED visits, n (%)					<0.001
0	10,010 (14.5)	8,471 (16.7)	1,539 (8.6)	428 (11.1)	
1–2	13,786 (20.0)	11,404 (22.4)	2,382 (13.3)	652 (16.8)	
3–5	12,554 (18.2)	9,980 (19.6)	2,574 (14.3)	677 (17.5)	
6–10	11,455 (16.6)	8,659 (17.0)	2,796 (15.6)	654 (16.9)	
>10	21,030 (30.6)	12,350 (24.3)	8,680 (48.3)	1,461 (37.7)	
Index ED Chief Complaint Category, n (%)†					<0.001
Pain/musculoskeletal/non-specific	25,494 (37.0)	20,617 (40.5)	4,877 (27.1)	1,067 (27.6)	
Neurological/weakness/dizziness	8,452 (12.3)	5,912 (11.6)	2,540 (14.1)	605 (15.6)	
Respiratory/influenza-like	8,050 (11.7)	5,375 (10.6)	2,675 (14.9)	326 (8.4)	
Abdominal/GI/urinary	3,436 (5.0)	2,518 (5.0)	918 (5.1)	215 (5.6)	
Fever/infection	2,757 (4.0)	1,734 (3.4)	1,023 (5.7)	110 (2.8)	
Chronic/metabolic	2,648 (3.8)	1,891 (3.7)	757 (4.2)	121 (3.1)	
Chest pain/cardiac/syncope	2,527 (3.7)	2,150 (4.2)	377 (2.1)	106 (2.7)	
Falls/trauma/wound	317 (0.5)	269 (0.5)	48 (0.3)	9 (0.2)	
Follow-up/administrative	2,154 (3.1)	1,855 (3.6)	299 (1.7)	77 (2.0)	
Other	5,703 (8.3)	4,241 (8.3)	1,462 (8.1)	394 (10.2)	
Missing/unclear	7,297 (10.6)	4,302 (8.5)	2,995 (16.7)	842 (21.7)	

Abbreviations: ED, emergency department; SD, standard deviation; IQR, interquartile range; GI, gastrointestinal.

† Percentages for categorical variables represent column percentages to describe the composition of each outcome group.

‡ p-values calculated using Pearson's Chi-square test for categorical variables, Student's t-test for continuous normally distributed variables (age), and Mann-Whitney U test for non-normally distributed variables (prior ED visits).

Among the **68,835 eligible index ED discharges**, **17,971** were followed by an ED return within 72 hours, corresponding to **26.1%** of eligible ED discharge events. At the patient level, **5,419 patients** experienced at least one 72-hour ED return.

Serious 72-hour ED returns occurred after **3,872 index ED discharges**, representing **5.6%** of all eligible ED discharges and **21.5%** of all 72-hour return events. At the patient level, **2,233 patients** had at least one serious 72-hour ED return (**Table 2**).

Returns within broader time windows were also common. ED return within **7 days** occurred after **22,768 discharges** (**33.1%**), while ED return within **30 days** occurred after **33,364 discharges** (**48.5%**).

The median time from ED discharge to any 72-hour return was **12.35 hours** with an interquartile range of **0.60–30.20 hours**. Serious 72-hour returns occurred earlier, with a median return time of **8.52 hours** and an interquartile range of **0.30–26.60 hours**. Very short return intervals suggest that sensitivity analyses should exclude possible duplicate, administrative, or same-episode records **(Supplementary Figure S1)**.

Among the 3,872 serious 72-hour return events, serious escalation was most commonly identified through a linked hospital admission within 24 hours, ICU transfer, or ward transfer. Because the serious-return definition allowed more than one escalation criterion, categories were not mutually exclusive.

A linked hospital admission within 24 hours was present in 2,206 serious return events. ED disposition at the return visit showed transfer to ICU in 1,096 events, transfer to ward in 756 events, transfer to the operating room in 131 events, and death in the ED in 54 events. Linked surgery within 24 hours occurred in 38 events, and linked death within 24 hours occurred in 33 events.

Table 2. Frequency of ED returns and clinical criteria for serious escalation

Outcome / Escalation Criterion	Event Count	Percentage
Frequency of ED Returns	*(N = 68,835)*	
Eligible index ED discharges	68,835	100.0%
Any 72-hour ED return	17,971	26.1%
Serious 72-hour ED return	3,872	5.6%
7-day ED return	22,768	33.1%
30-day ED return	33,364	48.5%
Serious Escalation Criteria†	*(N = 3,872)*	
Linked hospital admission within 24 hours	2,206	57.0%
ED disposition: Transferred to ICU	1,096	28.3%
ED disposition: Transferred to ward	756	19.5%
ED disposition: Transferred to OR	131	3.4%
Death in ED	54	1.4%
Linked surgery within 24 hours	38	1.0%
Linked death within 24 hours	33	0.9%

Abbreviations: ED, emergency department; ICU, intensive care unit; OR, operating room.

† Categories for serious escalation are not mutually exclusive, as a single return encounter could meet more than one criterion (e.g., an admission followed by surgery).

Adjusted predictors of serious 72-hour ED return

In an event-level logistic regression model with patient-level cluster-robust standard errors, serious 72-hour ED return was independently associated with male sex, prior ED utilisation, primary health center source facility type, and selected chief complaint categories (**Table 3**).

Male sex was associated with higher odds of serious 72-hour return compared with female sex. Increasing age was also weakly associated with serious return, with an adjusted odds ratio of **1.04 per 5-year increase**.

Prior ED utilisation showed a dose-response pattern. Compared with patients with no prior ED visits, those with **3–5 prior ED visits** had higher adjusted odds of serious return, and the odds increased further among patients with **6–10** and **>10 prior ED visits**.

Compared with pain/musculoskeletal/non-specific complaints, serious return was more likely among patients with follow-up, administrative or procedure-related encounters, missing or unclear complaints, other complaints and abdominal/GI/urinary complaints.

Table 3. Adjusted associations with serious 72-hour emergency department return

Predictor	Adjusted OR	95% CI	p value
Age, per 5-year increase	1.04	0.99–1.09	0.144
Sex			
Female	Reference	—	—
Male	1.21	1.07–1.36	0.002
CCI			
0	Reference	—	—
1–2	1.02	0.86–1.22	0.792
≥3	1.05	0.91–1.21	0.490
Prior ED visits			
0	Reference	—	—
1–2	1.12	0.99–1.27	0.062
3–5	1.31	1.15–1.48	<0.001
6–10	1.38	1.21–1.57	<0.001
>10	1.65	1.41–1.93	<0.001
Governorate‡			
Amman	Reference	—	—
Irbid	1.42	1.28–1.57	<0.001
Zarqa	0.55	0.48–0.63	<0.001
Ma'an	0.85	0.71–1.02	0.081
Karak	0.21	0.14–0.31	<0.001
Balqa	0.57	0.45–0.72	<0.001
Madaba	0.65	0.51–0.83	0.001
Mafraq	1.48	1.19–1.84	<0.001
Ajloun	0.49	0.34–0.71	<0.001
Tafila	0.50	0.32–0.78	0.002
Jerash	0.56	0.25–1.25	0.156
Facility type			
General hospital†	Reference	—	—
Comprehensive health centre	0.90	0.80–1.02	0.090

Primary health centre	1.22	1.04–1.43	0.017
Index chief-complaint category			
Pain/musculoskeletal/trauma symptoms	Reference	—	—
Chest pain/cardiac/syncope	1.09	0.90–1.31	0.386
Respiratory/influenza-like symptoms	0.96	0.81–1.13	0.605
Neurological symptoms, weakness or dizziness	0.92	0.76–1.11	0.375
Abdominal, gastrointestinal or urinary symptoms	1.53	1.28–1.83	<0.001
Fever/infection-related symptoms	1.03	0.84–1.25	0.806
Metabolic or chronic-disease-related symptoms	1.01	0.66–1.57	0.951
Follow-up, administrative or procedure-related encounters	2.28	1.99–2.62	<0.001
Falls, trauma and wound	0.68	0.35–1.32	0.254
Other	1.65	1.44–1.89	<0.001
Missing and unclear symptoms	2.91	2.62–3.23	<0.001

The multivariable logistic regression model demonstrated adequate discrimination, with a C-statistic of 0.71 (95% CI 0.69 to 0.73). The Hosmer-Lemeshow test indicated good model calibration (p = 0.18), suggesting the model adequately fit the data.

†Specialized-hospital encounters (n=3) were combined with the general-hospital category because of sparse data.

‡ Aqaba and Missing/invalid governorate categories were excluded from the multivariable regression model due to quasi-complete separation (zero or near-zero outcome events).

Sensitivity Analysis

When the return window was shortened from 72 to 48 hours, 15,801 of 68,835 eligible ED discharges resulted in an ED return (23.0%). Of these, 3,452 were serious 48-hour returns, corresponding to 5.0% of all eligible discharge events and 89.2% of serious 72-hour returns. At the patient level, 5,044 patients experienced at least one 48-hour return and 2,073 experienced at least one serious 48-hour return.

When the serious-return outcome was restricted to escalation documented directly in the return ED disposition—transfer to a ward, ICU, operating room, or death—2,037 events met the definition. This represented 3.0% of all eligible ED discharges and 52.6% of serious 72-hour returns identified using the broader linked-record definition. These findings indicate that a substantial proportion of serious short-interval returns required escalation not fully captured by the return ED disposition alone, including linked admission, surgery or death within 24 hours.

When the analysis was restricted to the first eligible ED discharge per patient, the cohort included **13,844 patients** (**Supplementary Figure S2**). In this patient-level sensitivity analysis, **2,770 patients** returned to the ED within 72 hours, corresponding to **20.0%** of patients. Serious 72-hour ED return occurred in **801 patients**, corresponding to **5.8%** of patients and **28.9%** of 72-hour returns. This sensitivity analysis confirmed that serious 72-hour return remained a clinically important signal even when repeated ED discharges from the same patient were removed. Furthermore, when the multivariable regression model was re-run using the restricted 48-hour window and the first-discharge-only definitions, the direction and significance of the primary predictors—including male sex, prior ED utilisation, and missing/unclear chief complaints—remained consistent with the primary model, demonstrating the robustness of our findings.

Chart Review and Patient Safety Classification

Among the random sample of 400 serious 72-hour return cases reviewed, inter-rater reliability based on pre-consensus ratings was substantial (weighted Cohen's κ = 0.76 [95% CI, 0.68 to 0.84]). Based on the 4-point preventability scale, 196 cases (49.0%) were rated as not preventable, reflecting expected disease progression despite appropriate care. An additional 96 cases (24.0%) were rated as possibly preventable (**Table 4**).

Overall, 108 cases (27.0%; 95% CI, 22.9% to 31.1%) were rated as probably preventable (n=74, 18.5%) or definitely preventable (n=34, 8.5%). Among these 108 preventable safety events, the most frequent primary system or diagnostic failures identified were inadequate safety-netting or discharge instructions (35.2%, n=38), premature or unsafe discharge (28.7%, n=31), and probable missed or delayed diagnosis (20.4%, n=22). Less frequent issues included follow-up or access failures (10.2%, n=11) and treatment/management failures (5.6%, n=6).

Table 4. Patient safety characteristics and preventability of a reviewed sample of serious 72-hour ED returns (n=400)

Characteristic	Cases (n=400)	Percentage
Preventability Rating		
1. Not preventable (Disease progression)	196	49.0
2. Possibly preventable	96	24.0
3. Probably preventable	74	18.5
4. Definitely preventable	34	8.5
Primary Safety Issue Classification*	*(n=108)*	
Inadequate safety-netting / discharge instructions	38	35.2
Premature discharge (e.g., abnormal vitals)	31	28.7
Probable missed diagnosis / diagnostic delay	22	20.4
Follow-up / access failure	11	10.2
Treatment failure	6	5.6

Discussion

In this nationwide, linked EHR study of older adults discharged from EDs in Jordan, 26.1% of eligible discharges were followed by a return within 72 hours and 5.6% met the definition of a serious return, defined as a 72-hour return resulting in ward/ICU admission, surgery, or death. Serious events occurred early: the median time to return was 8.5 hours, and a 48-hour trigger identified 89.2% of serious 72-hour returns. Among 400 serious returns undergoing structured review, 27.0% were judged probably or definitely preventable. Inadequate safety-netting, premature discharge and missed or delayed diagnosis accounted for most preventable cases. Previous ED utilisation demonstrated the clearest dose–response association, while male sex, abdominal/gastrointestinal/urinary presentations, non-specific complaints, facility type and governorate were also associated with serious return. The model showed moderate discrimination (area under the receiver operating characteristic curve 0.71), supporting its use for prioritising record review rather than directing individual disposition decisions.

The observed 26.1% all-return rate exceeds recent estimates from older populations. Wang *et al* reported a 72-hour return rate of 8.64% among older adults in Taiwan [1], while Müller *et al* reported 5.1% among patients aged ≥70 years discharged from a Swiss tertiary ED [8]. A 2025 cohort of 39 138 ED discharges found an overall return rate of 8.2% [9]. These estimates are not directly comparable. Our study captured returns across multiple facilities, included repeated eligible discharges and could not consistently distinguish planned from unplanned encounters. Single-centre studies may miss returns to other hospitals and commonly exclude scheduled follow-up visits.

Differences were greater for serious returns because published definitions are substantially narrower. Wang *et al* defined a high-risk return as one resulting in intensive care, emergency surgery or cardiac arrest and reported a rate of 0.2% [9]. Liu *et al* identified critical returns involving intensive or high-dependency care or

death after 0.12% of more than one million ED discharges [10]. By comparison, our composite included any linked admission within 24 hours, which accounted for 57.0% of serious events. Even the ED-disposition-only sensitivity definition, yielding a rate of 3.0%, included ward admissions. The higher rate should therefore not be interpreted as evidence of inferior ED quality without harmonised definitions, denominators and linkage methods.

Nevertheless, returns involving escalation of care are clinically important. A 2026 nationally representative US analysis found that 6.1% of admissions among older adults were preceded by an ED treat-and-release visit within 72 hours. Return-visit admission was independently associated with in-hospital mortality compared with direct ward admission (adjusted OR 2.72) [11]. Similarly, Liu *et al* found that critical returns were associated with older age, male sex, comorbidity, abnormal physiological and laboratory findings, and gastrointestinal or diagnostically unclassified presentations [10]. These findings support surveillance focused on clinical deterioration rather than unselected return visits.

Our chart review also confirms that a serious return is a screening signal, not evidence of error. Only 27.0% of reviewed cases were probably or definitely preventable, whereas 49.0% were considered not preventable. This estimate is of a similar order to the 23.4% prevalence of quality issues reported in a Canadian programme reviewing 12,852 return visits [7], but exceeds estimates from studies examining unselected returns [5,6]. The difference is expected because our sample was enriched for admission, intensive care, surgery or death. Natural disease progression, patient preference and barriers to follow-up remain important explanations for serious returns.

Several predictor findings were consistent with recent evidence. Abdominal/gastrointestinal/urinary presentations were associated with serious return in our study. Müller *et al* similarly found that gastrointestinal diagnoses and nausea were associated with approximately threefold higher odds of a 72-hour return [8]. Liu *et al* reported increased critical-return risk for gastrointestinal disorders, genitourinary symptoms, abdominal pain and unclassified diagnoses [10]. These presentations are frequently non-specific in older adults and may represent evolving disease or unresolved diagnostic uncertainty.

Previous ED use showed a stronger association than age or CCI. This is consistent with evidence linking early return among older adults to previous healthcare utilisation, polypharmacy, impaired mobility and post-discharge care needs [1]. Recurrent utilisation may therefore capture vulnerability not adequately represented by diagnostic comorbidity indices, including frailty, cognitive impairment, functional dependence, medication burden and limited social support.

The absence of an independent CCI association differs from recent studies. Liu *et al* reported progressively higher odds of critical return across increasing CCI categories [10], while Wang *et al* found chronic major disease and older age independently associated with high-risk returns [9]. A 2024 prospective multicentre study also showed that older adults with frailty experienced more revisits, admissions and deaths than those without frailty [2]. Our null findings may reflect restricted age variability, incomplete comorbidity coding or the inability of CCI to measure functional and cognitive vulnerability. Incorporating a validated frailty measure, cognition, mobility and caregiver support may improve future models.

Inadequate safety-netting was the most frequent problem among preventable cases. This finding is supported by a 2024 systematic review and meta-analysis in which older adults' pooled comprehension was 41% for medication instructions, 76% for follow-up and 81% for self-care; understanding of return precautions varied substantially between studies [3]. Cognitive impairment, sensory limitations, health literacy, polypharmacy and dependence on caregivers may further compromise discharge comprehension. Safety-netting should therefore be evaluated as a clinical process rather than solely by the presence of written instructions.

The findings support a two-stage surveillance model that uses automated triggers to identify early ED returns involving clinical escalation—such as admission, intensive care, surgery, or death—followed by structured multidisciplinary review to determine the underlying cause [5]. A recent multicenter validation screening over 450,000 records demonstrated the tool's effectiveness for automated safety surveillance, achieving an area under the curve of 0.78 [12]. Capturing nearly 90% of serious 72-hour returns, a 48-hour window offers a practical operational trigger that prioritises cases with unresolved abnormal observations, recurrent ED use, diagnostic uncertainty, or high-risk abdominal and urinary presentations [5]. However, automated triggers should not be used to mandate admission, as a 2025 study showed that admitting older adults with diagnostic uncertainty reduced revisits but increased overall readmissions and mortality, proving that admission is not a risk-free solution [22].

While potential interventions include senior physician reviews, repeat vital sign checks, teach-back communication, medication reconciliation, and rapid follow-up, evidence for their impact on clinical outcomes remains mixed [5]. A 2025 meta-analysis noted that decision-support, pharmacist, and geriatrician programmes improved inappropriate prescribing without consistently improving hospital outcomes [23], and an umbrella review similarly found high heterogeneity and limited certainty regarding interventions to reduce post-discharge adverse events [4]. Consequently, future quality initiatives must be evaluated using preventable harm, patient understanding, and continuity of care rather than return rates alone [5]. Finally, variations observed across facilities and governorates likely stem from differences in case mix, referral pathways, diagnostic resources, and inpatient capacity, and these data should be used to guide process improvements rather than to attribute poor performance to specific centers or clinicians [5].

Strengths include the large linked cohort, capture of cross-facility returns, assessment of multiple markers of clinical escalation, sensitivity analyses and structured review of serious cases. Manual review distinguished preventable safety events from expected disease progression, and reviewer agreement was substantial.

The findings support a two-stage surveillance model that uses automated EHR data extraction queries (as performed in Phase 1 of this study) as triggers to identify early ED returns involving clinical escalation. This is followed by structured multidisciplinary review to determine the underlying cause [5]. A recent multicenter validation screening over 450,000 records demonstrated the tool's effectiveness for automated safety surveillance, achieving an area under the curve of 0.78 [12]. Capturing nearly 90% of serious 72-hour returns, a 48-hour window offers a practical operational trigger that prioritises cases with unresolved abnormal observations, recurrent ED use, diagnostic uncertainty, or high-risk abdominal and urinary presentations [5]. However, these electronic triggers are designed for retrospective quality and safety review, not as real-time clinical decision support tools to mandate hospital admissions. As a 2025 study showed,

broadly admitting older adults with diagnostic uncertainty reduced short-term revisits but ultimately increased overall readmissions and mortality, proving that admission is not a risk-free solution [22].

The study remains subject to limitations inherent in retrospective EHR research. Outcome ascertainment depended on accurate encounter sequencing, linkage and coding. Planned visits could not always be distinguished from unplanned returns. The intentionally sensitive serious-return definition limits comparison with studies restricted to intensive care, surgery or death. Preventability was assessed only among serious returns and may have been influenced by hindsight. Important variables—including frailty, cognition, functional status, medication burden, caregiver support, repeated physiological measurements, test results and ED crowding—were unavailable or incomplete. The study period also included the COVID-19 pandemic, and findings might not generalise to healthcare systems with different referral and continuity arrangements.

Conclusion

Serious 72-hour ED returns among older adults should be interpreted as triggers for structured review rather than direct indicators of error. Although return rates were higher than recent international estimates, differences in outcome definitions, cross-facility capture, and encounter classification preclude direct performance comparisons. Approximately one-quarter of reviewed serious returns were probably or definitely preventable, most commonly involving safety-netting, disposition, or diagnostic processes. Health systems should transition to using automated EHR triggers based on severe clinical outcomes (such as admission or death) to target quality improvement, prioritise high-risk presenting complaints, and improve discharge safety-netting for older adults. Future studies should incorporate frailty and physiological trajectories and evaluate whether targeted interventions reduce preventable harm rather than merely reducing return visits.

Declarations

Contributors

Conceptualization: D.H.A.-Q., E.T., E.M., R.A. and E.A.R., Data curation: E.T., R.S.H., L.I.A., and T.S.H., Formal analysis: A.A., Funding acquisition: S.A.R., Investigation: A.A. and E.T., Methodology: N.A.M. and D.H.A.-Q., Project administration: D.H.A.-Q., N.O., S.A.R., and N.A.M., Resources: A.A., Software: A.A. and E.A.R., Supervision: D.H.A.-Q., Validation: N.A.M., Visualization: D.H.A.-Q., N.A.M., R.S.H., L.I.A., and T.S.H., Writing—original draft: D.H.A.-Q., E.A.R., N.A.M., R.S.H., L.I.A., T.S.H., E.M., R.A., N.O. and A.A., Writing—review and editing: D.H.A.-Q.

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Competing interests

None declared.

Patient consent for publication

The requirement for individual informed consent was waived because of the retrospective design and use of de-identified records.

Ethics approval and consent to participate

All methods were carried out in accordance with relevant guidelines and regulations. Ethical approval was obtained from the Ministry of Health in Jordan (MOH/REC/2025/604). The requirement for informed consent from patients was waived by the ethics committee of the Ministry of Health in Jordan due to the retrospective design of the study. Informed consent was obtained from all medical experts who participated in the rating/review process.

Data availability statement

Data are available as supplementary file.

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Figures

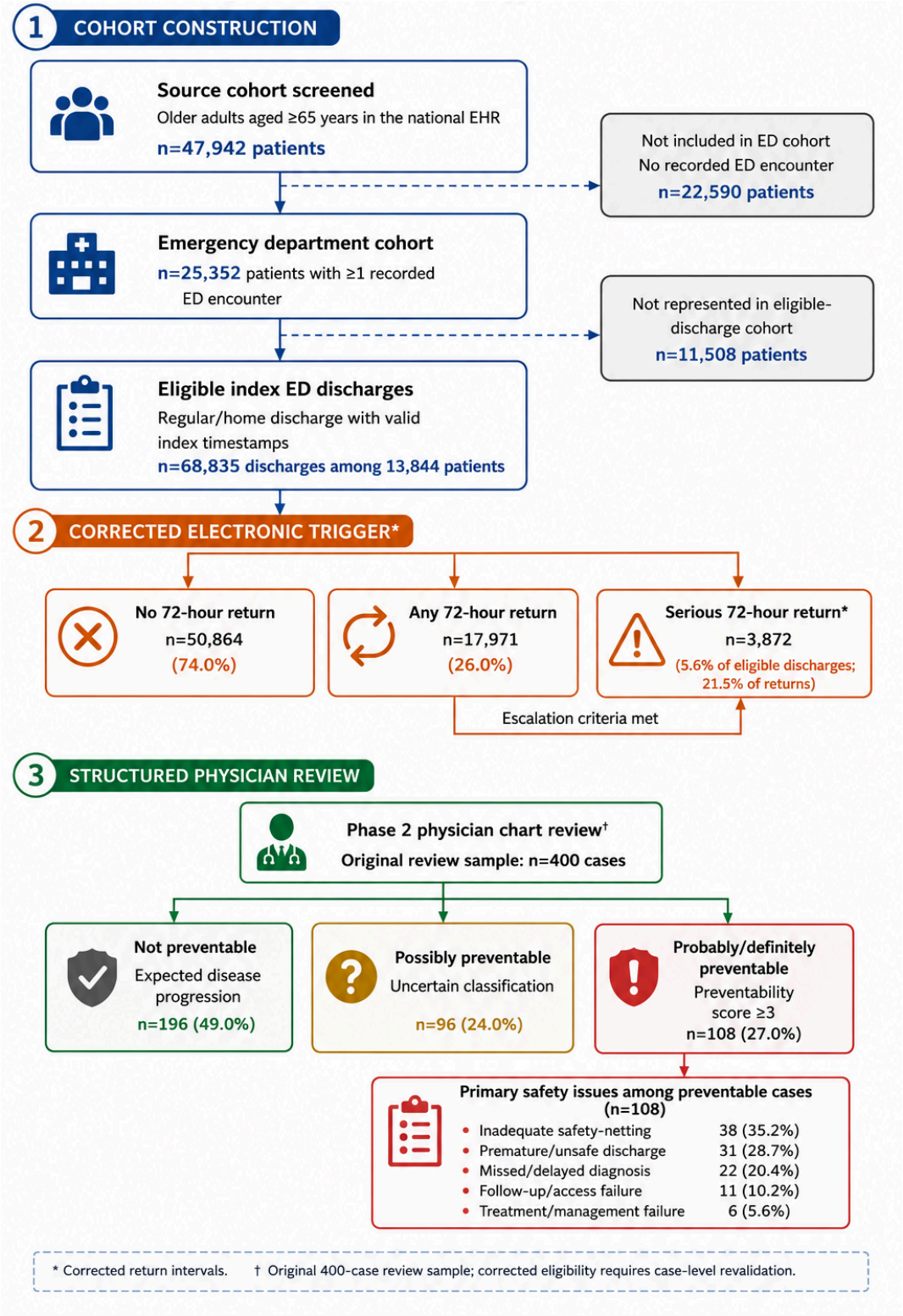


Figure 1

Study cohort and trigger-tool review flow

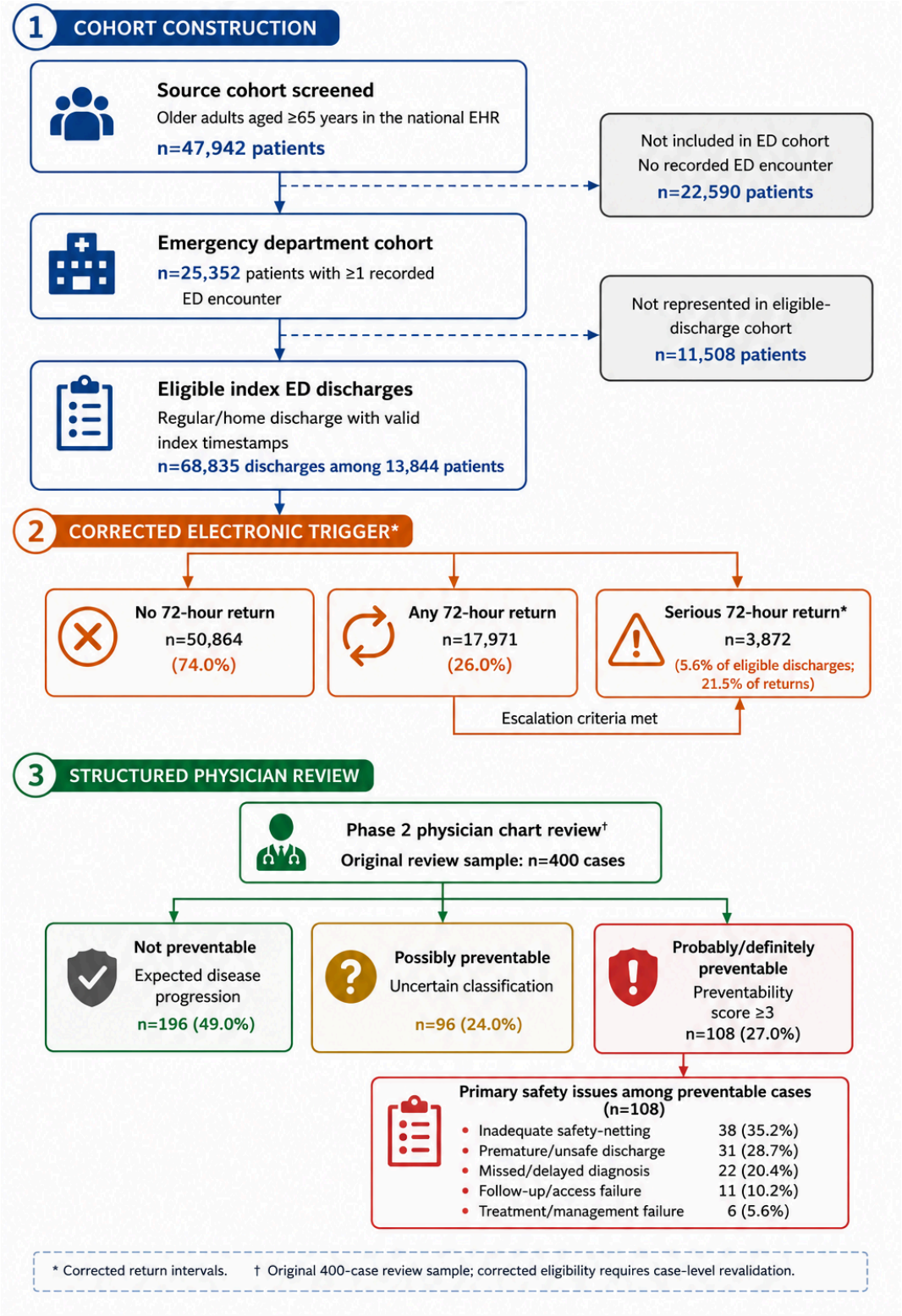


Figure 1

Study cohort and trigger-tool review flow

Supplementary Files

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- EDData.xlsx
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- AppendixA.docx
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