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Systematic review

Acute Triage Accuracy, Interprofessional Pharmaceutical Care, Mental Health Nursing Protocols, and Clinical Safety in Tertiary Hospital Settings: A Systematic Review of Primary Clinical Trials Involving Emergency Medicine Consultants, Emergency Physicians, Pharmacy Technicians, Anesthesia Technicians, Staff Nurses, Nursing Technicians, Social Workers, and Healthcare Security Personnel

Hadi Hamad Alyami[1], Nasser Sauod Nasser Alhwaymel[2], Norah Mohammed Kassab Alsubaie[3], Hatoon Mehaisen Almalki[4], Bader Abdulrahman Alhamad[5], Owaidh Mana Alqirad[6], Abdulmohsen Ali Al Ghamdi[7], Awatef Khulaif H. Alanazi[8], Abdullah Fahad Faisal Alghamdi[9], Reem Fahad Faisal Al-Ghamdi[10]

1. Emergency Medicine Consultant, Emergency Department, Riyadh First Health Cluster, King Saud Medical City, Riyadh, Saudi Arabia.
2. Emergency Medicine, Emergency Department, Riyadh First Health Cluster, Imam Abdulrahman Alfisal Hospital, Riyadh, Saudi Arabia.
3. Pharmacy Technician, Pharmacy Department, Riyadh First Health Cluster, King Saud Medical City, Riyadh, Saudi Arabia.
4. Social Service, Social Services Department, King Khalid Eye Specialist Hospital and Research Centre.
5. Anesthesia Technician, Anesthesia Department, First Riyadh Health Cluster, Al-Kharj Maternity and Child Hospital, Al-Kharj, Saudi Arabia.
6. Staff Nurse, Emergency Department, Riyadh First Health Cluster, Imam Abdulrahman Alfaisal Hospital, Riyadh, Saudi Arabia.
7. Pharmacy Technician, Pharmacy Department, Ministry of Health, Prince Mishari bin Saud Hospital, Baljurashi, Al Baha, Saudi Arabia.
8. Social Worker, Social Services Department, Riyadh Second Health Cluster, Al-Yamamah Hospital, Riyadh, Saudi Arabia.
9. Nursing Technician, Al-Baha Health Cluster, Eradah Complex for Mental Health, Al-Baha, Saudi Arabia. Email: afal-ghamdi@moh.gov.sa
10. Health Care Security, Nursing Department, Al-Baha Health Cluster, Al-Baha, Saudi Arabia. Email: Refalghamdi@moh.gov.sa

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Abstract

Background: Tertiary hospitals depend on accurate triage, safe medication processes, structured mental health nursing, and protection from violence, functions shared by several professional groups. Objective: To synthesize primary clinical trials involving emergency medicine consultants, emergency physicians, pharmacy technicians, anesthesia technicians, staff nurses, nursing technicians, social workers, and healthcare security personnel in tertiary hospitals. Methods: Following PRISMA 2020, PubMed, Scopus, and Web of Science were searched to 30 November 2024. Two authors independently screened records, extracted data, and assessed risk of bias with RoB 2 and ROBINS-I. Findings were synthesized narratively. Results: Of 5,301 records, 15 trials (12 randomized) were included. Physician-supported triage shortened emergency department (ED) stay by 24 to 36 minutes, and nurse-initiated protocols reduced time to acetaminophen by 186 minutes. Admission histories taken by pharmacists or pharmacy technicians reduced medication errors by more than 80%. Safewards reduced conflict by 15% and containment by 23.2%, structured risk assessment reduced severe aggression by 41%, and ED-SAFE lowered suicide attempt risk from 23% to 18%. A data-driven program halved violent events at 6 months, and an allied health team including a medical social worker shortened ED stay from 12.1 to 6.4 hours. Three trials had low risk of bias. Conclusion: Interprofessional, protocol-based interventions improved timeliness, medication safety, and behavioural safety. Multicentre trials measuring triage accuracy and patient harm are needed.

Keywords: Triage; Emergency Service, Hospital; Medication Reconciliation; Pharmacy Technicians; Psychiatric Nursing; Workplace Violence; Patient Safety; Tertiary Care Centers

Introduction

Triage determines the order and speed of emergency care, and a systematic review of emergency department (ED) triage found that only 11 of 42 reliability evaluations reported kappa values above 0.8 (1). A meta-analysis of 66 studies covering 33 triage systems reported moderate to good validity for identifying high- and low-urgency patients, with wide variation in performance between settings (2). Crowding adds to this problem, since it is associated with poorer patient outcomes and lower staff adherence to guideline-recommended treatment (3). Interventions at the front door, such as physician presence at triage and nurse-initiated protocols, therefore concern emergency medicine consultants, emergency physicians, and staff nurses directly, because these groups set the first care priorities for every arriving patient (1,3).

Medication discrepancies at emergency admission are frequent, and a meta-analysis of ED studies found that pharmacy-led reconciliation reduced the proportion of patients with discrepancies by 68% compared with usual care by nurses or physicians (4). Crowding compounds this risk, as staff in crowded departments adhere less consistently to guideline-recommended treatment (3). Only one study in that meta-analysis measured potential adverse drug events, which leaves the clinical value of pharmacist and pharmacy technician roles in the ED incompletely defined (4).

Aggressive behaviour on acute psychiatric wards and in EDs threatens patients and staff, and seclusion and restraint carry physical and psychological risks (5). A meta-analysis of ED studies quantified patient- and visitor-perpetrated violence and explored its association with drug and alcohol exposure (6). In acute psychiatric care, structured risk assessment and multimodal programs reduced aggression or coercion, although the strength of evidence was low (5). ED staff often under-report violent incidents, so the true incidence remains unclear and evaluation of prevention programs involving nurses, nursing technicians, and security personnel is difficult (6).

A Cochrane review of nine trials with 5,540 participants found that practice-based interventions improving collaboration between health and social care professionals slightly improved patient functional status, adherence to recommended practice, and use of healthcare resources (7). Existing reviews have examined triage

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systems, pharmacy services, and aggression management separately, which leaves the evidence on interprofessional interventions in tertiary hospitals fragmented (2,4,5). This systematic review therefore synthesized primary clinical trials on triage accuracy and timeliness, interprofessional pharmaceutical care, mental health nursing protocols, and clinical safety involving emergency medicine consultants, emergency physicians, pharmacy technicians, anesthesia technicians, staff nurses, nursing technicians, social workers, and healthcare security personnel (3,7).

Methods

Protocol and reporting

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement.

Eligibility criteria

Eligible studies were randomized (individual or cluster) or non-randomized controlled trials published in English in peer-reviewed journals before December 2024. Participants or intervention providers included emergency medicine consultants, emergency physicians, pharmacy technicians, anesthesia technicians, staff nurses, nursing technicians, social workers, or healthcare security personnel. Settings were EDs, acute psychiatric wards, or inpatient units of tertiary, teaching, or regional referral hospitals, including multicentre trials with at least one such site. Outcomes covered triage accuracy or timeliness, medication errors, aggression, coercion, violence, suicide attempts, ED length of stay, or clinician safety performance. Observational studies, simulation-only studies, student samples, protocols, reviews, and conference abstracts were excluded.

Information sources and search strategy

PubMed, Scopus, and Web of Science were searched from inception to 30 November 2024 using Medical Subject Headings and free-text terms: ("triage" OR "emergency service, hospital" OR "medication reconciliation" OR "pharmacy technicians" OR "psychiatric nursing" OR "aggression" OR "workplace violence" OR "security personnel" OR "social work" OR "anesthesia technician*") AND ("randomized controlled trial" OR "controlled clinical trial" OR "quasi-experimental") AND ("tertiary care centers" OR "hospitals, teaching" OR "emergency department"). The strategy was adapted to each database, and reference lists of included trials were hand-searched.

Study selection

Two authors independently screened titles and abstracts and then full texts, resolving disagreements by consensus. The searches retrieved 5,301 records (PubMed n = 1,486; Scopus n = 2,173; Web of Science n = 1,642). After removal of 1,947 duplicates, 3,354 records were screened and 3,198 were excluded. Of 156 reports sought, 7 were unavailable and 149 were assessed in full text. Exclusions (n = 134) were observational or uncontrolled designs (n = 52), non-tertiary settings (n = 23), no eligible outcome (n = 21), professional groups outside scope (n = 19), simulation-only or student samples (n = 11), and protocols or abstracts (n = 8). Hand searching added no trials, and 15 trials were included (Figure 1).

Data extraction and risk of bias

Two authors independently extracted study characteristics, interventions, outcomes, and results using a piloted form, and assessed randomized trials with the Cochrane Risk of Bias 2 (RoB 2) tool, using the cluster variant where relevant, and non-randomized trials with the Risk Of

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Bias In Non-randomized Studies of Interventions (ROBINS-I) tool (Table 1).

Data synthesis

Because interventions and outcome measures differed substantially, findings were synthesized narratively in four domains: triage and front-door care, pharmaceutical care and agitation management, mental health nursing protocols, and clinical safety and interprofessional support.

Results

Characteristics of included trials

The 15 trials, published between 2007 and 2022, comprised 12 randomized trials, four of them cluster randomized, and three non-randomized controlled trials (8–22). Patient samples ranged from 91 to 6,336 participants or visits, and four trials allocated wards, units, or EDs (16,17,19,20). Tables 2 and 3 summarize trial characteristics and outcomes (8–22).

Triage and front-door care

A triage liaison physician reduced ED length of stay by 36 minutes (4:21 vs 4:57 hours; p = 0.001) (8). A physician–nurse triage team lowered length of stay for discharged high-acuity patients from 4:29 to 4:05 hours and time to physician assessment from 1:21 to 0:55 hours (9). Nurse-initiated protocols shortened time to acetaminophen by 186 minutes, time to troponin by 79 minutes, and hip fracture length of stay by 224 minutes (10). A mobile education application raised nurses' triage accuracy scores from 3.90 to 4.77 and reduced undertriage relative to book-based learning (11).

Pharmaceutical care and agitation management

ED admission histories taken by pharmacists or pharmacy technicians reduced history and order errors by more than 80% in patients taking at least 10 medications (12). In three Colombian teaching hospitals, the pharmacist-acquired history arm accounted for 283 of 811 potential adverse drug events, against 528 with standard care (13). Intramuscular droperidol and midazolam gave similar durations of violent disturbance, measured as the time security staff were required, while midazolam needed additional sedation more often (hazard ratio 2.31) and caused more oversedation (14). Intravenous midazolam–droperidol achieved adequate sedation at 10 minutes in 25 percentage points more patients than droperidol or olanzapine alone, with similar adverse event rates (15).

Mental health nursing protocols

Across 31 acute psychiatric wards in 15 hospitals, Safewards reduced conflict by 15% (95% CI 5.7–23.7%) and containment by 23.2% (95% CI 9.9–35.5%) (16). Nurse-administered Brøset Violence Checklist assessment in the first three days of admission reduced severe aggressive incidents by 41% and coercive measures by 27% (17). In eight EDs, physician secondary screening, nurse-delivered prevention information, safety planning, and telephone follow-up lowered suicide attempt risk from 23% to 18%, a relative reduction of 20% (18).

Clinical safety and interprofessional support

Across 41 hospital units, including emergency, psychiatric, and security units, a data-driven intervention lowered violent events at 6 months (incident rate ratio 0.48, 95% CI 0.29–0.80) and injuries at 24 months (0.37, 95% CI 0.17–0.83) (19). A multicomponent ED violence prevention program did not outperform comparison sites, since assaults and threats fell in both arms (20). Early assessment by a senior medical social worker, occupational therapist, and physiotherapist cut median ED stay in older adults from 12.1 to 6.4 hours and admission from 55.9% to 19.3% (21). Simulation training raised median Anaesthetists' Non-Technical Skills scores of

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Rwandan anesthesia residents and technicians to 13.5, against 8 in controls (p = 0.002) (22).

Risk of bias

Three blinded randomized trials had low overall risk of bias (13–15). The other nine randomized trials raised some concerns, mainly from unblinded organizational interventions and staff-reported outcomes (8–10,12,16,17,19,21,22). Among non-randomized trials, ED-SAFE carried moderate risk, while the triage education and ED violence trials carried serious risk from confounding (11,18,20).

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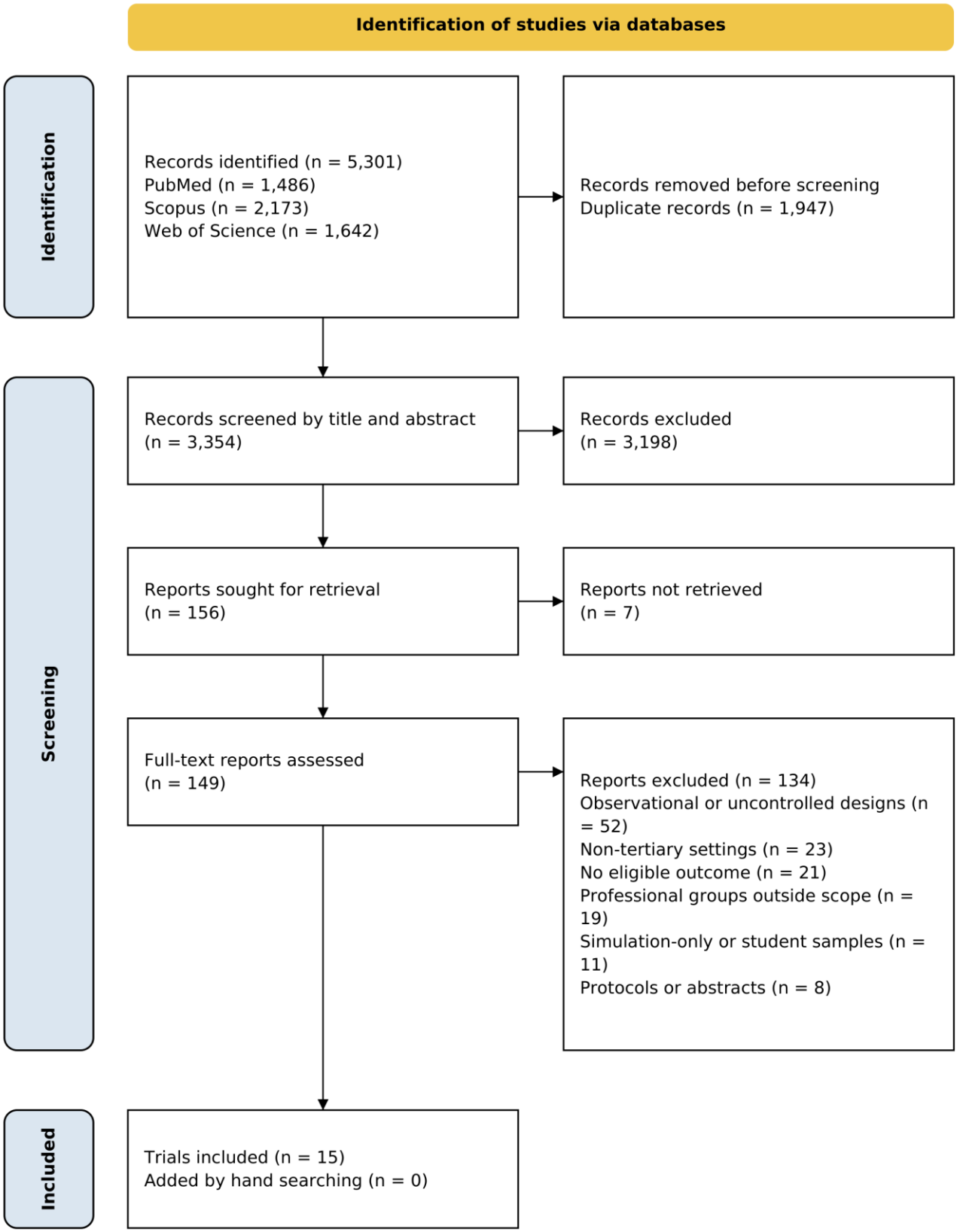


Figure 1. PRISMA 2020 flow diagram of study selection

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Table 1. Risk of bias of included trials

A. Randomized trials (RoB 2)

Study	D1	D2	D3	D4	D5	Overall
Holroyd et al., 2007	L	SC	L	L	L	SC
Cheng et al., 2013 (cluster)	L	SC	L	L	L	SC
Douma et al., 2016	L	SC	L	L	SC	SC
Pevnick et al., 2018	L	SC	L	L	L	SC
Becerra-Camargo et al., 2015	L	L	L	L	L	L
Isbister et al., 2010	L	L	L	L	L	L
Taylor et al., 2017	L	L	L	L	L	L
Bowers et al., 2015 (cluster)	L	SC	L	SC	L	SC
Abderhalden et al., 2008 (cluster)	SC	SC	L	SC	SC	SC
Arnetz et al., 2017 (cluster)	L	SC	SC	SC	SC	SC
Cassarino et al., 2021	L	SC	L	L	L	SC
Skelton et al., 2016	SC	SC	L	SC	L	SC

D1, randomization process; D2, deviations from intended interventions; D3, missing outcome data; D4, measurement of the outcome; D5, selection of the reported result; L, low risk; SC, some concerns.

B. Non-randomized trials (ROBINS-I)

Domain	Moon and Cho, 2022	Miller et al., 2017	Gillespie et al., 2014
Confounding	S	M	S
Selection	M	L	M
Classification	L	L	L
Deviations	M	M	M
Missing data	L	M	L
Measurement	M	L	S
Reporting	M	L	M
Overall	S	M	S

L, low; M, moderate; S, serious.

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Table 2. Characteristics of included trials

Study (ref)	Design	Setting	Sample	Staff groups
Holroyd et al., 2007 (8)	RCT	Teaching ED, Canada	5,718 patients	EM physicians, nurses
Cheng et al., 2013 (9)	Cluster RCT	Tertiary ED, Canada	6,336 visits	EM physicians, nurses
Douma et al., 2016 (10)	RCT	Urban ED, Canada	143 patients	Staff nurses
Moon and Cho, 2022 (11)	NRCT	Six EDs, Korea	66 nurses	Emergency nurses
Pevnick et al., 2018 (12)	RCT	Tertiary ED, USA	306 patients	Pharmacists, pharmacy technicians
Becerra-Camargo et al., 2015 (13)	RCT	Teaching hospitals, Colombia	270 patients	Pharmacists, physicians
Isbister et al., 2010 (14)	RCT	Teaching ED, Australia	91 patients	EM physicians, nurses, security
Taylor et al., 2017 (15)	RCT	Tertiary EDs, Australia	349 patients	EM physicians, nurses
Bowers et al., 2015 (16)	Cluster RCT	Psychiatric wards, UK	31 wards	Nurses, nursing assistants
Abderhalden et al., 2008 (17)	Cluster RCT	Admission wards, Switzerland	14 wards	Psychiatric nurses
Miller et al., 2017 (18)	NRCT	Eight EDs, USA	1,376 patients	ED nurses, physicians
Arnetz et al., 2017 (19)	Cluster RCT	Seven hospitals, USA	41 units	Nurses, security staff
Gillespie et al., 2014 (20)	NRCT	Six EDs, USA	209 staff	Nurses, care assistants, physicians
Cassarino et al., 2021 (21)	RCT	University ED, Ireland	353 patients	Social worker, therapists
Skelton et al., 2016 (22)	RCT	Tertiary hospital, Rwanda	20 providers	Anesthesia residents, technicians

Table 3. Interventions and main outcomes

First author (ref)	Intervention vs comparator	Main result
Holroyd (8)	Triage liaison physician vs usual triage	Stay 4:21 vs 4:57 h
Cheng (9)	Physician–nurse triage vs nurse triage	Stay 4:05 vs 4:29 h
Douma (10)	Nurse protocols vs usual care	Analgesia 186 min earlier
Moon (11)	Mobile vs book training	Accuracy 3.90 to 4.77
Pevnick (12)	Pharmacy history vs usual care	Errors >80% lower
Becerra-Camargo (13)	Pharmacist history vs usual care	Potential ADEs 283 vs 528
Isbister (14)	Droperidol vs midazolam	Similar duration

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First author (ref)	Intervention vs comparator	Main result
Taylor (15)	Midazolam–droperidol vs monotherapy	Sedation +25 percentage points
Bowers (16)	Safewards vs control	Conflict −15%
Abderhalden (17)	Risk checklist vs usual care	Aggression −41%
Miller (18)	Suicide prevention bundle vs usual care	Attempts 18% vs 23%
Arnetz (19)	Action plans vs none	Violence IRR 0.48
Gillespie (20)	Prevention program vs comparison	No difference
Cassarino (21)	Allied health team vs usual care	Stay 6.4 vs 12.1 h
Skelton (22)	Simulation vs none	ANTS 13.5 vs 8
ADE, adverse drug event; ANTS, Anaesthetists' Non-Technical Skills; ED, emergency department; EM, emergency medicine; h, hours; IRR, incident rate ratio; min, minutes; NRCT, non-randomized controlled trial; RCT, randomized controlled trial.		

Discussion

Interprofessional, protocol-based interventions in tertiary EDs and acute wards improved timeliness of care, admission medication history accuracy, and control of aggression and coercion (8,12,16). The strongest evidence came from blinded medication history and sedation trials with low risk of bias (13–15). Organizational interventions showed a consistent direction of benefit, although most were unblinded single-centre trials (8–10,21).

The 36-minute and 24-minute reductions in length of stay with physician-supported triage agree with an earlier review that pooled two randomized trials of triage liaison physicians (8,9,23). A meta-analysis of senior doctor triage reported a 26.26-minute reduction in length of stay for medium-acuity patients and a 21% lower risk of leaving without being seen (24). A review of triage nurse ordering found it effective in reducing length of stay, especially for injuries and suspected fractures, which matches the 224-minute gain with the hip fracture protocol (10,25). Only one included trial measured triage accuracy, and its non-randomized allocation limits causal inference (11). Direct trial evidence on accuracy matters, since the validity of established triage systems varies widely between settings (2,11).

The similar performance of pharmacists and pharmacy technicians supports task sharing within pharmacy teams in EDs with limited pharmacist coverage (12). Pooled evidence shows that pharmacist-led reconciliation reduces adverse drug event-related hospital revisits by 67% and ED visits by 28% (26). The Colombian trial adds data on potential adverse drug events, an outcome that an earlier ED meta-analysis found in only one study (4,13). The droperidol findings align with a Cochrane review of psychosis-induced agitation reporting effective tranquillisation without more adverse effects than comparators (14,27).

Reductions in conflict, containment, and coercion with Safewards and structured risk assessment reflect components of successful seclusion and restraint reduction programs, such as leadership and staff training (16,17,28). An earlier review graded the evidence for risk assessment as low strength, a gap the two included cluster trials partly address (5,17). The 20% relative reduction in suicide attempts with ED-SAFE agrees with a meta-analysis in which active contact and follow-up after ED care

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reduced repeat attempts at 6 months (relative risk 0.48) (18,29).

Workplace violence findings were mixed, since the unit-level data-driven approach reduced events and injuries while the ED program did not (19,20). A review of ED violence prevention similarly reported unclear effectiveness, which supports trials with standardized incident reporting that include security personnel (30). The fall in admissions with the social worker-led allied health team agrees with evidence that ED interventions combining two or more strategies appear associated with the greatest effects in older adults (21,31). The Rwandan trial was the only eligible study of anesthesia technicians, and an earlier review found simulation-based crisis resource management training superior to no or didactic training in three of four workplace studies (22,32).

Heterogeneity in interventions and outcomes precluded meta-analysis, a constraint shared with earlier reviews of crowding and aggression management (3,5). Most trials came from high-income countries, and only one involved anesthesia technicians, which restricts application to regional tertiary hospitals (22). Staff-reported outcomes in violence and aggression trials remain vulnerable to under-reporting, a recognized problem in ED violence research (6,20).

Conclusion

Interprofessional, protocol-based interventions in tertiary EDs and acute psychiatric units improved the timeliness of front-door care, the accuracy of admission medication histories, and the control of aggression, coercion, and suicidal behaviour. Pharmacy technicians reduced medication history errors to a similar extent as pharmacists, and an allied health team including a medical social worker shortened ED stay and reduced admissions in older adults. Evidence on triage accuracy, security personnel, and anesthesia technicians rests on few trials with moderate to serious risk of bias. Multicentre randomized trials with standardized safety outcomes are needed in tertiary hospitals, including those in the Gulf region.

List of Abbreviations

ADE, adverse drug event; ANTS, Anaesthetists' Non-Technical Skills; CI, confidence interval; ED, emergency department; ED-SAFE, Emergency Department Safety Assessment and Follow-up Evaluation; EM, emergency medicine; IRR, incident rate ratio; NRCT, non-randomized controlled trial; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomized controlled trial; RoB 2, Cochrane Risk of Bias 2; ROBINS-I, Risk Of Bias In Non-randomized Studies of Interventions.

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