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Systematic review

## Comparison of respiratory and cardiac etiologies of adult cardiac arrest in emergency settings: A systematic review

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### Abstract

**Background:** Adult cardiac arrest (CA) in emergency department (ED) has different etiologies, mainly primary cardiac disease and respiratory failure. Etiology is important because rhythm profile, airway needs, post-resuscitation treatment, and survival differ between these groups. This systematic review compared respiratory and cardiac etiologies of adult CA in prehospital and ED settings. **Methods:** We searched PubMed, Scopus, Web of Science, and Cochrane for adult CA studies reporting cause, setting, rhythm, resuscitation variables, or outcomes. Original studies were included in the results. **Results:** We found wide variation in etiologic reporting. Regional Arab studies mainly classified arrest as medical, presumed cardiac, or non-traumatic, while respiratory causes were less separated. The Saudi SOHAR registry was the clearest regional source reporting presumed cardiac and respiratory categories. International etiologic cohorts showed that respiratory failure formed a large subgroup in resuscitated patients and that presumed respiratory arrest differed from presumed CA in rhythm pattern and neurologic outcome. **Conclusion:** Cardiac etiologies dominate registry coding in emergency CA, while respiratory etiologies are hidden inside medical or non-cardiac categories. Future registries need clearer cause definitions, stronger airway-event documentation, standardized reporting of respiratory, traumatic, and other causes.

### Keywords

Adult cardiac arrest; respiratory etiology; cardiac etiology; emergency department

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## Introduction

Adult cardiac arrest (CA) in emergency department (ED) is a critical condition, not a single diagnosis, and early care starts before the cause is fully confirmed. Advanced life support guidelines organize care around high-quality cardiopulmonary resuscitation (CPR), rhythm recognition, defibrillation for shockable rhythm, airway management, reversible-cause treatment, and post-resuscitation care. The early algorithm is used for respiratory and cardiac etiologies, and the underlying pathway and later treatment priorities differ.

Cardiac etiologies often involve acute coronary syndrome, malignant arrhythmia, structural heart disease, heart failure, or electrical instability. Respiratory etiologies include hypoxemia, airway obstruction, aspiration, pneumonia, asthma, chronic obstructive pulmonary disease, drowning, pulmonary embolism, or ventilatory failure (2).

In-hospital CA literature shows that etiology and ward context affect survival, neurological recovery, and escalation decisions (3). Out-of-hospital CA research found a variation in incidence and survival between systems, partly related to emergency medical service access, and bystander CPR (4). Survival predictors identified in studies include witnessed arrest, bystander CPR, shockable rhythm, shorter response time, and return of spontaneous circulation (ROSC) before hospital arrival (5).

Etiology reporting still a weakness in many CA studies because several registries use terms such as medical, presumed cardiac, non-traumatic, or unknown. A systematic review of in-hospital arrest etiologies found major heterogeneity in cause classification, and this limits direct comparison of cardiac and respiratory pathways (6). The GCC CA

scoping review reported limited regional data, low bystander CPR, low public access defibrillator use, and heterogeneous outcomes in Arab Gulf systems (7).

Post-CA syndrome gives another reason to classify etiology clearly because brain injury, myocardial dysfunction, systemic ischemia-reperfusion injury, and the precipitating disease all influence later death (8). Respiratory arrest is relevant in Eds because delayed oxygenation, aspiration, sepsis, obstructive lung disease, and pulmonary embolism affect post-arrest physiology after circulation returns (8). This systematic review compared adult CA caused by respiratory and cardiac etiologies in emergency settings (8).

## Methods

This systematic review followed the PRISMA 2020 reporting framework for identifying, screening, and selecting (Fig 1). We searched PubMed, Scopus, Web of Science, and Cochrane using combinations of “cardiac arrest,” “out-of-hospital cardiac arrest,” “emergency department,” “adult,” “etiology,” “cause,” “respiratory,” “cardiac,” “Arab,” “Saudi Arabia,” “Qatar,” “Kuwait,” “United Arab Emirates,” “Oman,” and “Lebanon”. Reference lists of relevant reviews and regional cardiac arrest papers were also screened to identify additional studies.

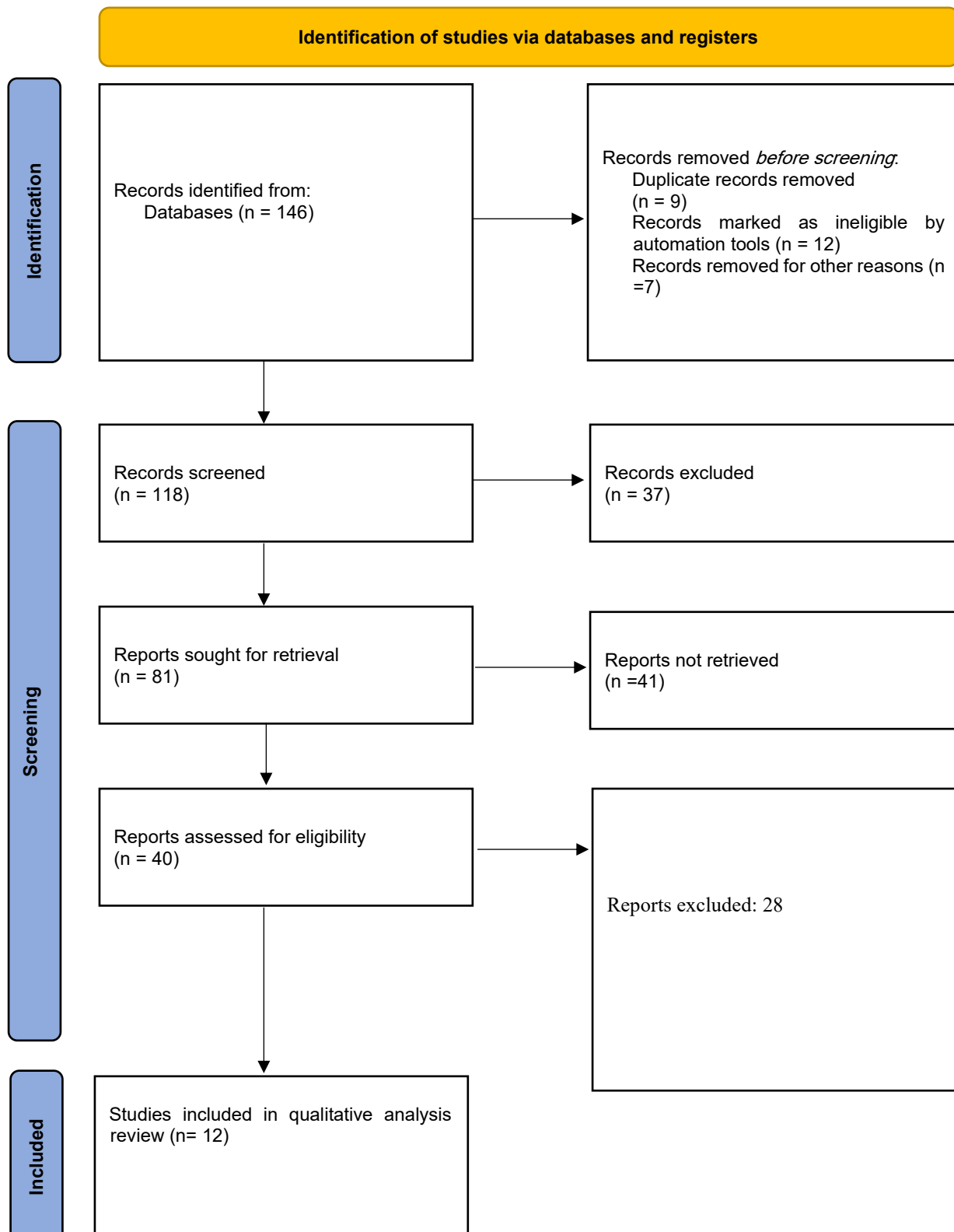
The inclusion criteria were original studies of adult CA patients in prehospital, emergency medical service, or ED settings, with extractable information about cause, presumed cardiac etiology, respiratory etiology, non-cardiac etiology, rhythm, ROSC, survival, or neurological outcome. Eligible studies were registry-based, cohort, cross-sectional,

prospective descriptive, or retrospective observational. We exclude studies limited to pediatrics, trauma-only arrest, animal models, simulation, opinion papers, editorials, or non-emergency inpatient populations.

Data extracted from the included studies included country, design, setting, sample size, adult age focus, etiologic classification, initial rhythm, bystander CPR, ROSC, survival to discharge, and

neurological outcome when reported. Because included studies used different etiologic categories, a narrative synthesis was selected instead of meta-analysis. Cardiac etiology was defined as a study category of presumed cardiac, cardiac cause, ischemic cause, arrhythmic cause, or coronary-related arrest. Respiratory etiology was defined as respiratory failure, hypoxemic event, airway or lung cause, drowning, aspiration, or pulmonary disease.

Fig 1: PRISMA flow chart



## Results

The included studies consisted of 13 original studies, 10 from Arab countries or Arab regional settings and 3 international etiologic comparator studies. Arab

studies were from Saudi Arabia, Qatar, Kuwait, United Arab Emirates, Oman, and Lebanon. Characteristics of the included studies presented in (Table 1).

**Table 1. Characteristics of the included studies**

Study	Country	Design and setting	Sample	Etiology	Outcome
Chen et al. (10)	United States	Retrospective cohort; resuscitated arrest reaching hospital care	986	Respiratory failure 15%; cardiac causes 26%	Etiology linked with wide outcome differences
Alabdali et al. (12)	Saudi Arabia	National Out-of-hospital cardiac arrest (OHCA) registry, SOHAR	3671	Presumed cardiac 17.4%; respiratory 3.9%; medical 93.6%	Survival to discharge 2.9%
Almiro et al. (13)	Saudi Arabia	Cross-sectional Emergency medical services (EMS) registry, Riyadh province	1023	Incident labels included shortness of breath and chest pain	Bystander CPR 12.7%; shockable rhythm 17.7%
Bin Salleh et al. (14)	Saudi Arabia	Prospective descriptive adult OHCA, university hospital	96	Non-traumatic 87.5%; traumatic 12.5%	Mortality 95.8%
Irfan et al. (15)	Qatar	Nationwide observational OHCA	577 EMS-treated; 447 final	Cardiac 471; non-cardiac 106; respiratory 7 in non-cardiac group	Survival 8.1% in final cohort
Al Hasan et al. (16)	Kuwait	Adult EMS-treated OHCA, ED-linked records	332 EMS-treated; 286 cardiac etiologies	Cardiac etiology main inclusion group	ROSC 3.5%; survival 0.3%
Alqahtani et al. (17)	UAE	National ambulance OHCA characterization	414	Etiology not separated into cardiac vs respiratory	Low bystander CPR and low survival
Batt et al. (18)	UAE	Prospective descriptive OHCA, Northern Emirates	384	Etiology not separated in detail	ROSC 3.1%; bystander CPR 30%
Nadar et al. (19)	Oman	Single-center OHCA admission cohort	216	Coronary angiography and post-OHCA outcomes	Discharge survival 13%
El Sayed et al. (20)	Lebanon	Adult OHCA presumed cardiac, Beirut	214	Presumed cardiac etiology	Discharge survival 5.5%

Study	Country	Design and setting	Sample	Etiology	Outcome
Refaat et al. (21)	Lebanon	Young OHCA patients in ED over 10 years	54	Etiology studied in patients <35 years	Discharge survival 16.7%
Conroy and Jolin (22)	Saudi Arabia	OHCA and ED CA, Riyadh	39 Cardiac etiology 29 non-cardiac 10	Early Saudi ED and OHCA experience	Low EMS use and low prehospital CPR

Alabdali et al. registry provided the largest Arab dataset, with 3671 OHCA cases and a medical cause in 93.6% of cases, they reported presumed cardiac cause in 17.4% and respiratory cause in 3.9%, the same registry reported home as the dominant arrest location, prehospital ROSC in 7.4%, survival to discharge in 2.9%, and good neurological outcome in fewer than 0.5% (12).

Almiro et al. found similar system-level problems with cause classification and outcomes (13), they reported 1023 OHCA cases in Riyadh province, with 65.2% male patients, 77.5% home location, 17.7% shockable rhythm, and 12.7% bystander CPR (13). Bin Salleh et al. reported 96 adult OHCA cases at a university hospital, with 87.5% non-traumatic arrests, 94.8% asystole, and 95.8% mortality (14).

Qatar reported a nationwide Utstein-style OHCA cohort with 577 EMS-treated cases, including 471 cardiac-etiology cases and 106 non-cardiac cases. The non-cardiac group included trauma, respiratory, submersion, and other causes, with respiratory cause forming a small explicitly coded category in the available report. Survival to discharge in the final analysis was 8.1%, and shockable rhythm was a strong favorable predictor (15).

Kuwait, United Arab Emirates, Oman, and Lebanon added regional data of low survival and incomplete etiologic separation (16,17,19,20). Kuwait focused on adult EMS-treated OHCA of cardiac etiology, with 286 cardiac cases, ROSC in 3.5%, and survival to discharge in 0.3% (16). UAE and Oman studies provided important emergency system outcomes, although their reporting did not give a clean respiratory-versus-cardiac comparison suitable for pooling (17,19). El Sayed et al. reported 214 adult presumed-cardiac OHCA patients, with low bystander CPR, high asystole frequency, and 5.5% survival to discharge (20). Refaat et al. studied young OHCA patients under 35 years of age and reported higher discharge survival (21). Chen et al. developed criteria for arrest etiology in resuscitated patients and found respiratory failure as the most common single etiology at 15%, while cardiac causes accounted for 26% (10).

## Discussion

The present review found that cardiac causes dominate many emergency CA registries, while respiratory causes are under-identified unless the study uses detailed etiologic adjudication (10). This finding is in line with broader resuscitation literature showing that registry definitions, rhythm categories, and system factors affect reported CA outcomes (4). It also matches the GCC scoping

review, which found limited regional reporting and low bystander CPR across Gulf CA studies (7).

The most important practical point is that “presumed cardiac” is not the same as confirmed cardiac disease. Many emergency systems classify non-traumatic adult OHCA as presumed cardiac when there is no clear external cause (6). Chen et al. found that detailed post-resuscitation review identifies respiratory failure as a major cause (10).

Arab studies show a repeated pattern of low bystander CPR, low shockable rhythm frequency, delayed emergency medical service access, and low survival (7). In Saudi Arabia, SOHAR reported survival to discharge of only 2.9%, and the Riyadh university hospital cohort reported 95.8% mortality (12,14). Kuwait, UAE, and Lebanon found low ROSC or low survival in several datasets, which indicates that system-level interventions remain urgent (16,18,20).

Respiratory etiology is important because treatment after ROSC differs from treatment after primary ischemic or arrhythmic arrest (1). Respiratory arrest places early emphasis on airway patency, oxygenation, ventilation, aspiration control, pneumonia or sepsis treatment, and pulmonary embolism assessment (2). CA of presumed ischemic or arrhythmic origin places more emphasis on defibrillation, electrocardiography, coronary evaluation, hemodynamic support, and cardiology pathway activation (2).

The poor separation of cause categories affects research quality and patient care (6). If respiratory arrest is hidden under “medical” or “presumed cardiac,” studies overestimate the cardiac group and underestimate airway and pulmonary burden

(10). This weakens quality-improvement plans because the interventions needed for public defibrillation differ from those needed for early airway rescue, ambulance oxygenation, sepsis recognition, drowning response, and chronic respiratory disease management (1).

The Arab regional data describe emergency systems where arrests frequently occur at home, bystander CPR is often low, and ambulance use varies (7), these affect cardiac and respiratory arrests because late recognition reduces the chance of shockable rhythm and increases the proportion of asystole on arrival (5). Regional registries need standardized Utstein reporting with separate fields for presumed cardiac, respiratory, traumatic, drowning, poisoning, sepsis, pulmonary embolism, and unknown causes (7).

Meta-analysis was not suitable in this review because the included studies differed in design, setting, patient selection, cause definitions, and outcome reporting. Studies included all EMS-treated OHCA, only ED-arriving patients, presumed cardiac etiology, and other focused on young patients (13,16,20,21).

## Conclusion

The comparison between respiratory and cardiac etiologies is limited by weak cause reporting. Arab-country studies show important emergency data from Saudi Arabia, Qatar, Kuwait, United Arab Emirates, Oman, and Lebanon. Many studies use presumed cardiac, medical, non-traumatic, or mixed labels rather than detailed respiratory and cardiac categories. Cardiac etiologies dominate registry coding, while respiratory etiologies are

often under-separated despite their clinical importance. Future emergency CA registries need standardized cause definitions, separate respiratory fields, better airway and pulmonary documentation, and linked survival and neurological outcome data.

### List of abbreviations

CA: Cardiac arrest

ED: Emergency department

CPR: Cardiopulmonary resuscitation

EMS: Emergency medical services

GCC: Gulf Cooperation Council

OHCA: Out-of-hospital cardiac arrest

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

ROSC: Return of spontaneous circulation

SOHAR: Saudi Out-of-Hospital Cardiac Arrest Registry

UAE: United Arab Emirates

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