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In-Hospital Cardiac Arrest

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Keywords

In-Hospital Cardiac Arrest

Introduction

Cardiac arrest (CA) is the absence of a palpable pulse and has heterogenous causes and outcomes. Discussion of CA is commonly divided by the location of the event (in-hospital cardiac arrest [IHCA] versus out-of-hospital cardiac arrest [OHCA]) and presentation (shockable versus non-shockable).

Management of IHCA and OHCA has some common elements, but important differences lay in the causes, typically available resources, and management. This article aims to review the epidemiology of IHCA, how the management of IHCA differs from OHCA, and future research areas in IHCA management.

Background and Epidemiology

Nearly all of the high-quality data about the epidemiology of IHCA comes from national quality improvement registries, including the American Heart Association's Get With the Guidelines – Resuscitation (GWTG-R)[1], the Swedish Cardiopulmonary Resuscitation Registry (SCRR)[2], the Danish in-hospital cardiac arrest registry[3], and the United Kingdom National Cardiac Arrest Audit (UK-NCCA)[4].

In the United States, an estimated 292,000 cases of adult IHCA and 15,200 cases of pediatric IHCA occur each year[1], with an average adult incidence rate of 10.16 per 1000 hospital admissions. Over a similar period, there were approximately 347,000 OHCA events[5], and IHCA makes up about half of all cardiac arrests. There is substantial variation in incidence across US hospitals with case-mix adjusted rates of IHCA among Medicare beneficiaries ranging from 2.4 to 25.5 per 1000 admissions[6]. Internationally, observed incidence rates vary with a median of 1.5 per 1000 admission [IQR, 1.2–2.2) in the UK-NCAA[4] and 1.7 per 1000 admission in the SCCR[7]. IHCA is a heterogeneous group of

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causes and comorbid conditions – a meta-analysis of published observational data identified hypoxia as the most frequent cause (26.5%, 95% confidence interval 14.2 – 38.7%) followed by acute coronary syndromes, arrhythmias, hypovolemia and infection[8]. The presenting rhythm was unshockable in 69.8% of cases[8].

Just as the causes of IHCA are varied, the outcomes vary as well. In an analysis of 2018 data from GWTG-R, 25.8% of patients suffering IHCA survived to hospital discharge, and 54.2% of events occurred in the ICU, operating room, or emergency department[5]. Outcomes vary by arrest location: IHCA in the cardiac catheterization laboratory or operating room was associated with 38.1% and 40.5% survival to hospital discharge respectively[9]. The duration of resuscitation efforts required is also associated with survival – one retrospective cohort revealed 62.0% 30-day survival for less than 5 minutes of resuscitative efforts compared with 8.1% survival for greater than 20 minutes[3]. Functional outcomes after IHCA are poorly assessed[10], although newer data suggest the majority of those who survive to hospital discharge likely have a favorable (modified Rankin Scale < 4) outcome[11,12].

Prevention

The majority of IHCA is preceded by clinical deterioration[13,14], and efforts to prevent IHCA have been focused on improving early identification and response to patient deterioration. Early warning systems such as NEWS[15], MEWS, and eCART[16] have been shown to identify patients at risk for IHCA. Rapid response teams are groups of clinicians who respond to patient deterioration events based on the theory that “failure to rescue” from continued deterioration leads to IHCA[17]. In meta-analysis, rapid response systems have been shown to reduce rates of IHCA[18]; however, the largest randomized clinical trial did not show a reduction in rates of IHCA[19]. In the pediatric intensive care unit, a bundle of interventions focused on situational awareness and communication decreased IHCA rates compared to hospitals that did not implement the bundle[20].

Medications

Current ACLS guidelines make no specific medication modifications for IHCA versus OHCA[21]. However, the evidence committee could not reach a consensus about intra-arrest administration of steroids for IHCA while recommending against them for OHCA[22]. At the time the guidelines were written, a single RCT examining a dosing protocol of vasopressin, methylprednisone, and epinephrine during IHCA suggested increased rates of ROSC and neurologically intact survival[23] but three additional studies were in progress. Of the three studies, one showed an increased rate of ROSC[24], one showed no benefit[25], and the third continues to recruit (NCT03317197).

Sodium bicarbonate is administered in approximately 50% of adult[26] and 60% of pediatric IHCA[27] events despite the recommendation against routine administration in current ACLS guidelines. Metanalysis of OHCA data suggests that administration of sodium bicarbonate is associated with decreased rates of sustained ROSC and favorable neurologic outcomes[28]. If is not known if this effect is directly due to sodium bicarbonate or if sodium bicarbonate administration is given as salvage therapy during a prolonged cardiac arrest event. A prospective randomized trial of sodium bicarbonate versus placebo is expected to begin enrollment in early 2023 (NCT05564130).

Echocardiography

Non-shockable rhythms make up the majority of initial IHCA presentations[8], and 85% of IHCA events contained PEA[29]. Point-of-care ultrasound (POCUS) has been proposed as a tool for rapidly identifying potentially reversible causes of CA. The REASON trial was a non-randomized, prospective study of POCUS that enrolled 793 patients with OHCA or IHCA and performed POCUS exam at the beginning and end of ACLS care[30]. Only 15% of the patients had IHCA; of those, 34 had an identified pericardial effusion – a reversible cause of cardiac arrest. POCUS transthoracic echocardiography during CA has been associated with increased duration of CPR interruptions[31], and some authors have suggested a role for transesophageal echocardiography (TEE) during cardiac arrest[32]. A prospective, randomized trial of TEE during IHCA has been announced but is not yet enrolling (NCT04220619).

Mechanical CPR

Mechanical chest compression devices have been studied in three large trials of OHCA without a clear outcome benefit[33–35]. Metanalysis of low-quality data suggests that mechanical compression devices in IHCA might improve survival[36]. Proposed benefits of mechanical CPR include fewer staff demands and improved CPR quality. One report of rapid implementation during the COVID-19 pandemic noted that more than half of users strongly agreed that it reduced the number of personnel in the room, improved CPR quality, and led to a more controlled resuscitation experience but transferring the patient into the device was a source of difficulty and delay[37].

Early Intervention

Original research on coronary care units in the 1970s showed a 20% absolute reduction in myocardial infarction mortality primarily due to rapid response to ventricular fibrillation[38]. Wearable automatic defibrillators are approved for sale in the United States but have not been shown to reduce out-of-hospital all-cause mortality in patients who are not candidates for an implantable defibrillator[39]. Zoll Medical performed a small multicenter feasibility study of a hospital wearable defibrillator in patients thought to be at high risk for IHCA (NCT02122549), but no further studies have been performed.

Cardiac Arrest and Highly Contagious Diseases

In the last decade, questions about the safety of healthcare workers performing cardiac resuscitation in patients with highly contagious diseases. The 2013–2016 Ebola epidemic in West Africa was associated with the repatriation of patients and secondary infections in healthcare workers in the United States and Spain (REF). At the time, there was limited to no data on the care of patients with Ebola outside of resource-limited settings; however, there was recognition of the challenges posed in providing critical care, including cardiopulmonary resuscitation, to these patients[40,41].

More recently, the spread of SARS-CoV-2 (COVID-19) around the globe was associated with high mortality rates. The practical implication of providing CPR to these patients, given the necessity of donning and doffing PPE, was highly debated. A 2021 systematic review of outcomes associated with cardiac resuscitation in hospitalized patients with SARS-CoV2 demonstrated that while ROSC was achieved in around one-third of the patients, survival to hospital discharge was less than 10%[42].

There is limited data on healthcare worker safety during CPR on patients with contagious diseases. Observational studies of cardiac resuscitation suggest that it is aerosol generating[43], and case reports from SARS-CoV-1 suggested nosocomial transmission linked with CPR[44]. Two small studies using simulated CPR have demonstrated the limited benefit of disposable N95 respirators in potential transmission[45]. There is some evidence that an electrostatic half-mask may provide superior protection from aerosols during cardiac resuscitation[46], but these masks limit verbal communication.

ECMO – CPR

Venoarterial extracorporeal membrane oxygenation (VA-ECMO) applied to assist resuscitation during CPR is referred to as ECPR. The first report of successful ECPR was in 1966, demonstrating seven (7) successful resuscitations in eight (8) patients, with one (1) surviving neurologically intact to hospital discharge[47]. Over the past decade, reports of performed ECPR to the Extracorporeal Life Support Organization database have expanded to 1643 from 83 centers in 2009 to 20,317 from 577 centers in 2019[48]. This increase occurred in the absence of randomized trial data showing ECPR benefit[49]. The best evidence of the benefit of this technique in IHCA reported a 34.1% survival to hospital discharge in 135 patients receiving ECPR after >10 min of unsuccessful CPR[50]. The same investigators used propensity matching to compare ECPR to CPR. Overall survival to discharge with a CPC score of 1 or 2 in ECPR patients was 23.7% compared to 10.6% for conventional CPR[51]. A meta-analysis including 195 propensity-matched pairs showed a 13% absolute risk difference in functionally intact 30-day survival favoring ECPR[52].

Post-Arrest Care: Therapeutic Hypothermia

Current guidelines recommend targeted temperature management (TTM) for all patients who are comatose after cardiac arrest regardless of initial rhythm or location arrest[21]. Recommendations for using TTM in IHCA were primarily based on trials of TTM on OHCA as, until recently, only one trial of TTM included IHCA patients[22]. A recent large randomized trial of TTM, specifically in survivors of IHCA, showed no benefit[53], adding to the controversy about the optimal patient, duration, and degree of hypothermia. Guidelines recommend delaying prognostication after cardiac arrest for 72 hours until after normothermia[21]; delayed awakening has been reported after cardiac arrest treated with TTM[54].

Current Research

We identified ten recruiting or upcoming interventional trials, including patients with IHCA (Table 1). There remain ample opportunities to improve In-Hospital Cardiac Arrest outcomes, necessitating more research.

Discussion

IHCA remains a common event with poor clinical outcomes. Despite ongoing efforts in adult patients, the best available evidence does not show that early warning improves survival to hospital discharge. This does not demission the importance of rapid response teams, which respond to various clinical conditions to support the local clinical staff. The evidence is more positive in the Pediatric ICU population, suggesting that more can be learned in the adult population. Given that most of these events in the adult population develop from hypoxia leading to PEA arrests, hospitals should focus on delivering high-quality CPR. Responders should consider common reversible causes of PEA arrest early in resuscitation and post-resuscitation care. Identifying patients at higher risk from aspiration or other causes of acute hypoxemia might lead to improved patient outcomes; however, as noted above, this has not been shown true in randomized controlled trials.

Looking toward the future, there are several areas worth exploring. Our understanding of patients with cardiac events will be improved with large datasets involving multiple hospitals. The growth of electronic medical records and efforts to standardize datasets from these systems will facilitate growth in our understanding of epidemiology and the risk of IHCA. Future studies should also consider longer-term outcomes beyond survival to hospital discharge and focus on functional status at discharge. This understanding may help the bedside clinician discuss the risks and benefits of CPR at the time of admission.

Summary

1. In-Hospitals Cardiac Arrest remains common, with an incidence of 10.6 patients per 100 admissions.
2. Survival to hospital discharge for these patients is poor (25.8%), with little known about the functional status at discharge or long-term outcomes.
3. The majority of IHCAs are hypoxia-induced and present as non-shockable rhythms. Given this, responders should focus on high-quality CPR and identifying reversible causes of hypoxia.
4. Despite efforts in the adult population, early warning scores have yet to show benefit in reducing IHCA. In pediatric Intensive Care Units, there is evidence that a bundle of interprofessional communication can mitigate these events.
5. The roll of POCUS during resuscitation for IHCA is an area of ongoing research.
6. Sodium Bicarbonate is frequently administered in IHCA but has unclear benefits and may be harmful.
7. There remains clinical equipoise regarding the use of Steroids in IHCA.
8. Careful application of E-CPR has been associated with positive outcomes; however, it should be noted that its application is not universally available.

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References

1. Holmberg MJ, Ross CE, Fitzmaurice GM, et al. Annual Incidence of Adult and Pediatric In-Hospital Cardiac Arrest in the United States. Circ: Cardiovascular Quality and Outcomes. 2019;12(7):e005580. doi:10.1161/CIRCOUTCOMES.119.005580 [PubMed: 31545574]
2. Jerkeman M, Sultanian P, Lundgren P, et al. Trends in survival after cardiac arrest: a Swedish nationwide study over 30 years. Eur Heart J. Published online August 4, 2022:ehac414. doi:10.1093/eurheartj/ehac414
3. Yonis H, Andersen MP, Mills EHA, et al. Duration of resuscitation and long-term outcome after in-hospital cardiac arrest: A nationwide observational study. Resuscitation. 2022;179:267–273. doi:10.1016/j.resuscitation.2022.08.011 [PubMed: 36007858]
4. Nolan JP, Soar J, Smith GB, et al. Incidence and outcome of in-hospital cardiac arrest in the United Kingdom National Cardiac Arrest Audit. Resuscitation. 2014;85(8):987–992. doi:10.1016/j.resuscitation.2014.04.002 [PubMed: 24746785]
5. Virani SS, Alonso A, Benjamin EJ, et al. Heart Disease and Stroke Statistics—2020 Update: A Report From the American Heart Association. Circulation. 2020;141(9). doi:10.1161/CIR.0000000000000757
6. Rasmussen TP, Riley DJ, Sarazin MV, Chan PS, Girotra S. Variation Across Hospitals in In-Hospital Cardiac Arrest Incidence Among Medicare Beneficiaries. JAMA Netw Open. 2022;5(2):e2148485. doi:10.1001/jamanetworkopen.2021.48485 [PubMed: 35226085]
7. Hessulf F, Karlsson T, Lundgren P, et al. Factors of importance to 30-day survival after in-hospital cardiac arrest in Sweden – A population-based register study of more than 18,000 cases. International Journal of Cardiology. 2018;255:237–242. doi:10.1016/j.ijcard.2017.12.068 [PubMed: 29289346]
8. Allencherril J, Lee PYK, Khan K, Loya A, Pally A. Etiologies of In-hospital cardiac arrest: A systematic review and meta-analysis. Resuscitation. 2022;175:88–95. doi:10.1016/j.resuscitation.2022.03.005 [PubMed: 35278525]
9. Elkaryoni A, Tran AT, Saad M, et al. Patient characteristics and survival outcomes of cardiac arrest in the cardiac catheterization laboratory: Insights from get with the Guidelines®-Resuscitation registry. Resuscitation. Published online August 6, 2022:S0300–9572(22)00636–0. doi:10.1016/j.resuscitation.2022.08.002
10. Kobewka D, Young T, Adewole T, et al. Quality of life and functional outcomes after in-hospital cardiopulmonary resuscitation. A systematic review. Resuscitation. 2022;178:45–54. doi:10.1016/j.resuscitation.2022.07.011 [PubMed: 35840012]
11. Hannen LEM, Toprak B, Weimann J, et al. Clinical characteristics, causes and predictors of outcomes in patients with in-hospital cardiac arrest: results from the SURVIVE-ARREST study. Clin Res Cardiol. Published online August 17, 2022. doi:10.1007/s00392-022-02084-1
12. Doherty ZB, Fletcher JA, Fuzzard KL, et al. Functional outcomes following an in-hospital cardiac arrest: A retrospective cohort study. Aust Crit Care. 2022;35(4):424–429. doi:10.1016/j.aucc.2021.07.002 [PubMed: 34454801]
13. Kause J, Smith G, Prytherch D, Parr M, Flabouris A, Hillman K. A comparison of Antecedents to Cardiac Arrests, Deaths and EMergency Intensive care Admissions in Australia and New Zealand, and the United Kingdom—the ACADEMIA study. Resuscitation. 2004;62(3):275–282. doi:10.1016/j.resuscitation.2004.05.016 [PubMed: 15325446]
14. Franklin C, Mathew J. Developing strategies to prevent inhospital cardiac arrest: analyzing responses of physicians and nurses in the hours before the event. Crit Care Med. 1994;22(2):244–247. [PubMed: 8306682]

15. Smith GB, Prytherch DR, Meredith P, Schmidt PE, Featherstone PI. The ability of the National Early Warning Score (NEWS) to discriminate patients at risk of early cardiac arrest, unanticipated intensive care unit admission, and death. Resuscitation. 2013;84(4):465–470. doi:10.1016/j.resuscitation.2012.12.016 [PubMed: 23295778]
16. Green M, Lander H, Snyder A, Hudson P, Churpek M, Edelson D. Comparison of the Between the Flags calling criteria to the MEWS, NEWS and the electronic Cardiac Arrest Risk Triage (eCART) score for the identification of deteriorating ward patients. Resuscitation. 2018;123:86–91. doi:10.1016/j.resuscitation.2017.10.028 [PubMed: 29169912]
17. Jones DA, DeVita MA, Bellomo R. Rapid-Response Teams. N Engl J Med. 2011;365(2):139–146. doi:10.1056/NEJMra0910926 [PubMed: 21751906]
18. Maharaj R, Raffaele I, Wendon J. Rapid response systems: a systematic review and meta-analysis. Crit Care. 2015;19:254. doi:10.1186/s13054-015-0973-y [PubMed: 26070457]
19. Hillman K, Chen J, Cretikos M, et al. Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. Lancet. 2005;365(9477):2091–2097. doi:10.1016/S0140-6736(05)66733-5 [PubMed: 15964445]
20. Alten J, Cooper DS, Klugman D, et al. Preventing Cardiac Arrest in the Pediatric Cardiac Intensive Care Unit Through Multicenter Collaboration. JAMA Pediatr. 2022;176(10):1027–1036. doi:10.1001/jamapediatrics.2022.2238 [PubMed: 35788631]
21. Panchal AR, Bartos JA, Cabañas JG, et al. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020;142(16_suppl_2). doi:10.1161/CIR.0000000000000916
22. Berg KM, Soar J, Andersen LW, et al. Adult Advanced Life Support: 2020 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Circulation. 2020;142(16_suppl_1). doi:10.1161/CIR.0000000000000893
23. Mentzelopoulos SD, Malachias S, Chamos C, et al. Vasopressin, Steroids, and Epinephrine and Neurologically Favorable Survival After In-Hospital Cardiac Arrest: A Randomized Clinical Trial. JAMA. 2013;310(3):270. doi:10.1001/jama.2013.7832 [PubMed: 23860985]
24. Andersen LW, Isbye D, Kjærgaard J, et al. Effect of Vasopressin and Methylprednisolone vs Placebo on Return of Spontaneous Circulation in Patients With In-Hospital Cardiac Arrest: A Randomized Clinical Trial. JAMA. 2021;326(16):1586–1594. doi:10.1001/jama.2021.16628 [PubMed: 34587236]
25. Mentzelopoulos SD, Pappa E, Malachias S, et al. Physiologic effects of stress dose corticosteroids in in-hospital cardiac arrest (CORTICA): A randomized clinical trial. Resusc Plus. 2022;10:100252. doi:10.1016/j.resplu.2022.100252 [PubMed: 35652112]
26. Moskowitz A, Ross CE, Andersen LW, Grossestreuer AV, Berg KM, Donnino MW. Trends Over Time in Drug Administration During Adult In-Hospital Cardiac Arrest*: Critical Care Medicine. 2019;47(2):194–200. doi:10.1097/CCM.0000000000003506 [PubMed: 30407950]
27. Raymond TT, Stromberg D, Stigall W, Burton G, Zaritsky A, American Heart Association's Get With The Guidelines-Resuscitation Investigators. Sodium bicarbonate use during in-hospital pediatric pulseless cardiac arrest - a report from the American Heart Association Get With The Guidelines(®)-Resuscitation. Resuscitation. 2015;89:106–113. doi:10.1016/j.resuscitation.2015.01.007 [PubMed: 25613362]
28. Alshahrani MS, Aldandan HW. Use of sodium bicarbonate in out-of-hospital cardiac arrest: a systematic review and meta-analysis. Int J Emerg Med. 2021;14(1):21. doi:10.1186/s12245-021-00344-x [PubMed: 33849429]
29. Norvik A, Unneland E, Bergum D, et al. Pulseless electrical activity in in-hospital cardiac arrest - A crossroad for decisions. Resuscitation. 2022;176:117–124. doi:10.1016/j.resuscitation.2022.04.024 [PubMed: 35490937]
30. Gaspari R, Weekes A, Adhikari S, et al. Emergency department point-of-care ultrasound in out-of-hospital and in-ED cardiac arrest. Resuscitation. 2016;109:33–39. doi:10.1016/j.resuscitation.2016.09.018 [PubMed: 27693280]
31. Huis In 't Veld MA, Allison MG, Bostick DS, et al. Ultrasound use during cardiopulmonary resuscitation is associated with delays in chest compressions. Resuscitation. 2017;119:95–98. doi:10.1016/j.resuscitation.2017.07.021 [PubMed: 28754527]

32. Parker BK, Salerno A, Euerle BD. The Use of Transesophageal Echocardiography During Cardiac Arrest Resuscitation: A Literature Review. J Ultrasound Med. 2019;38(5):1141–1151. doi:10.1002/jum.14794 [PubMed: 30280396]

33. Perkins GD, Lall R, Quinn T, et al. Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial. Lancet. 2015;385(9972):947–955. doi:10.1016/S0140-6736(14)61886-9 [PubMed: 25467566]

34. Rubertsson S, Lindgren E, Smekal D, et al. Mechanical chest compressions and simultaneous defibrillation vs conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest: the LINC randomized trial. JAMA. 2014;311(1):53–61. doi:10.1001/jama.2013.282538 [PubMed: 24240611]

35. Wik L, Olsen JA, Persse D, et al. Manual vs. integrated automatic load-distributing band CPR with equal survival after out of hospital cardiac arrest. The randomized CIRC trial. Resuscitation. 2014;85(6):741–748. doi:10.1016/j.resuscitation.2014.03.005 [PubMed: 24642406]

36. Couper K, Yeung J, Nicholson T, Quinn T, Lall R, Perkins GD. Mechanical chest compression devices at in-hospital cardiac arrest: A systematic review and meta-analysis. Resuscitation. 2016;103:24–31. doi:10.1016/j.resuscitation.2016.03.004 [PubMed: 26976675]

37. Bhatnagar A, Khraishah H, Lee J, et al. Rapid implementation of a mechanical chest compression device for in-hospital cardiac arrest during the COVID-19 pandemic. Resuscitation. 2020;156:4–5. doi:10.1016/j.resuscitation.2020.08.122 [PubMed: 32866550]

38. Hedayati HA, Farivar S. The role of coronary care unit in reduction of mortality rate and sudden death in acute myocardial infarction. Pahlavi Med J. 1977;8(2):198–207. [PubMed: 887281]

39. Olgin JE, Pletcher MJ, Vittinghoff E, et al. Wearable Cardioverter–Defibrillator after Myocardial Infarction. N Engl J Med. 2018;379(13):1205–1215. doi:10.1056/NEJMoa1800781 [PubMed: 30280654]

40. Ebola Murthy S. and provision of critical care. The Lancet. 2015;385(9976):1392–1393. doi:10.1016/S0140-6736(15)60712-7

41. Ulrich CM, Grady C. Cardiopulmonary Resuscitation for Ebola patients: Ethical considerations. Nursing Outlook. 2015;63(1):16–18. doi:10.1016/j.outlook.2014.11.011 [PubMed: 25645475]

42. Ippolito M, Catalisano G, Marino C, et al. Mortality after in-hospital cardiac arrest in patients with COVID-19: A systematic review and meta-analysis. Resuscitation. 2021;164:122–129. doi:10.1016/j.resuscitation.2021.04.025. [PubMed: 33964332]

43. Wyckoff MH, Singletary EM, Soar J, et al. 2021 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. Resuscitation. 2021;169:229–311. doi:10.1016/j.resuscitation.2021.10.040 [PubMed: 34933747]

44. Christian MD, Loutfy M, McDonald LC, et al. Possible SARS coronavirus transmission during cardiopulmonary resuscitation. Emerging Infect Dis. 2004;10(2):287–293. doi:10.3201/eid1002.030700

45. Shin H, Oh J, Lim TH, Kang H, Song Y, Lee S. Comparing the protective performances of 3 types of N95 filtering facepiece respirators during chest compressions: A randomized simulation study. Medicine. 2017;96(42):e8308. doi:10.1097/MD.0000000000008308 [PubMed: 29049235]

46. Barros AJ, Sifri CD, Bell TD, Eby JC, Enfield KB. Effectiveness of Elastomeric Half-Mask Respirators vs N95 Filtering Facepiece Respirators During Simulated Resuscitation: A Nonrandomized Controlled Trial. JAMA Netw Open. 2021;4(3):e211564. doi:10.1001/jamanetworkopen.2021.1564 [PubMed: 33724389]

47. Kennedy JH. The role of assisted circulation in cardiac resuscitation. JAMA. 1966;197(8):615–618. [PubMed: 5953090]

48. Extracorporeal Life Support Organization. ECLS International Summary of Statistics. Accessed October 22, 2022. https://www.elso.org/Portals/0/Files/Reports/2020_January/International%20Summary%20January%202020_page1.pdf

49. Abrams D, MacLaren G, Lorusso R, et al. Extracorporeal cardiopulmonary resuscitation in adults: evidence and implications. Intensive Care Med. 2022;48(1):1–15. doi:10.1007/s00134-021-06514-y [PubMed: 34505911]

50. Chen YS, Yu HY, Huang SC, et al. Extracorporeal membrane oxygenation support can extend the duration of cardiopulmonary resuscitation. Crit Care Med. 2008;36(9):2529–2535. doi:10.1097/CCM.0b013e318183f491 [PubMed: 18679121]
51. Chen YS, Lin JW, Yu HY, et al. Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis. Lancet. 2008;372(9638):554–561. doi:10.1016/S0140-6736(08)60958-7 [PubMed: 18603291]
52. Ouweneel DM, Schotborgh JV, Limpens J, et al. Extracorporeal life support during cardiac arrest and cardiogenic shock: a systematic review and meta-analysis. Intensive Care Med. 2016;42(12):1922–1934. doi:10.1007/s00134-016-4536-8 [PubMed: 27647331]
53. Wolfrum S, Roedl K, Hanebutte A, et al. Temperature Control After In-Hospital Cardiac Arrest: A Randomized Clinical Trial. Circulation. Published online September 28, 2022:101161CIRCULATIONAHA122060106. doi:10.1161/CIRCULATIONAHA.122.060106
54. Lee DH, Cho YS, Lee BK, et al. Late Awakening Is Common in Settings Without Withdrawal of Life-Sustaining Therapy in Out-of-Hospital Cardiac Arrest Survivors Who Undergo Targeted Temperature Management*. Critical Care Medicine. 2022;50(2):235–244. doi:10.1097/CCM.0000000000005274 [PubMed: 34524155]

Clinics Care Points:

- Around half of cardiac arrest in the United States occurs in the hospital
- Most IHCA is due to deterioration rather than sudden arrythmias
- Most patients with IHCA do not survive to hospital discharge
- Favorable neurologic outcomes are common among those who do survive to hospital discharge

Synopsis:

This article reviews the epidemiology and management of in-hospital cardiac arrest.

Table 1:

Selected Interventional IHCA Trials from clinicaltrials.gov

Enrolling and Upcoming Interventional IHCA Trials
NCT03902873: The Effect of a Real-time Audiovisual Feedback System on CPR Quality Target Enrollment: 300, *Recruiting* Begin: 2018–11-20 End: 2021–11-20 Evaluate the effect of a real-time audiovisual feedback system on CPR quality during in-hospital cardiac arrest.
NCT04009759: Influence of Morphine or Ketamine or Saline Applied During In-hospital Cardiopulmonary Resuscitation on Early Survival Target Enrollment: 240, *Not yet recruiting* Begin: 2021–10-01 (Anticipated) End: 2026–01-01 Evaluate the effect of morphine or/and ketamine on survival and neurological outcome in patients with cardiac arrest.
NCT05139849: VAsopressin and STeroids in Addition to Adrenaline in Cardiac Arrest - a Randomized Clinical Trial Target Enrollment: 1276, *Recruiting* Begin: 2021–11-17 End: 2027–04-30 This is an investigator initiated randomized, placebo controlled, double blind, superiority, multicenter clinical trial of patients with IHCA who are receiving epinephrine randomized to either treatment with vasopressin and steroids or placebo.
NCT04924985: Goal-directed CPR Using Cerebral Oximetry Target Enrollment: 150, *Recruiting* Begin: 2022–02-11 End: 2025–07-31 A single-center, randomized controlled pilot trial of adults with IHCA randomized to physiologic feedback CPR with cerebral oxygenation and end-tidal carbon dioxide physiological targets or standard CPR.
NCT04220619: RescueTEE for In-hospital Cardiac Arrest (ReTEECA Trial) Target Enrollment: 250, *Not yet recruiting* Begin: 2022–03-01 (Anticipated) End: 2024–12-01 Studying the utility and interventional outcomes of rescue transesophageal echocardiography (RescueTEE) to aid in diagnosis, change in management, and outcomes during CPR by using a point of care RescueTEE protocol in the evaluation of in-hospital cardiac arrest (IHCA).
NCT05444049: NEURESCUE Device as an Adjunct to In-Hospital Cardiac Arrest (ARISE) Target Enrollment: 10, *Not yet recruiting* Begin: 2022–07-31 (Anticipated) End: 2023–03-31 The objective of this study is to investigate the feasibility of an aortic balloon occlusion device designed to improve cerebral blood flow as an adjunct to Advanced Cardiac Life Support (ACLS) in adults with cardiac arrest.
NCT05480319: Prospective Deployment of a Cardiac Arrest Response System (EDICARS) in the Emergency Department Target Enrollment: 2010, *Not yet recruiting* Begin: 2022–08-01 (Anticipated) End: 2023–07-31 A cluster-randomized trial of using wearable sensors on high-risk patients to prevent ED-based IHCA.
NCT04464603: Impact of a mHealth Supportive Tool on Cardiopulmonary Resuscitation' Situational Awareness Target Enrollment: 36, *Not yet recruiting* Begin: 2022–12-01 (Anticipated) End: 2023–05-01 A prospective, single-center, randomized controlled trial in a tertiary pediatric emergency department evaluating the impact of a mHealth supportive tool compared to conventional communication methods on situational awareness, leadership, team communication effectiveness and performance during standardized, simulation-based, pediatric in-hospital cardiac arrest scenario using a high-fidelity manikin.
NCT05520762: Hospital Airway Resuscitation Trial Target Enrollment: 1060, *Not yet recruiting* Begin: 2022–12-31 (Anticipated) End: 2027–02-28 A cluster-randomized, pragmatic trial of advanced airway management with a strategy of first choice supraglottic airway vs. first choice endotracheal intubation during in-hospital cardiac arrest.
NCT05564130: Bicarbonate for In-Hospital Cardiac Arrest Target Enrollment: 778, *Not yet recruiting* Begin: 2023–02-01 (Anticipated) End: 2026–02-01 An investigator-initiated, multicenter, randomized, placebo-controlled, parallel group, double-blind, superiority trial of sodium bicarbonate during adult in-hospital cardiac arrest.