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Impact of the COVID-19 Pandemic on the Use of Public Access Defibrillation Systems: A Systematic Review and Meta-analysis

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Abstract

Aim: This meta-analysis presented the impact of pandemic Coronavirus disease-2019 on the use of the public access defibrillation (PAD) system for adult patients with out-of-hospital cardiac arrest.

Materials and Methods: This study was designed as a systematic review and meta-analysis and is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines. We systematically searched PubMed, Medline, Embase, and the Cochrane Central Register of Controlled Trials databases until January 2024.

Results: This meta-analysis included 30 analyzed studies. Pooled analysis showed that activation of PAD among those two periods varied and amounted to 3.8% vs. 3.9%, respectively [odds ratio (OR)=0.77; 95% confidence interval (CI): 0.66 to 0.89; p<0.001]. There were no statistically significant differences in defibrillation using automated external defibrillators (AEDs) when comparing the pandemic period with the pre-pandemic period (5.0% vs. 6.2%; OR=0.78; 95% CI: 0.57 to 1.07; p=0.12).

Conclusion: The data indicate a substantial decrease in the activation of PAD during the pandemic. Furthermore, there were no statistically significant variations in the usage of shock using AEDs, suggesting that the use of AEDs remained similar to that in the pre-pandemic periods when they were available. It is essential to promote the usage of AEDs among bystanders and perform societal initiatives to achieve this objective.

Keywords: Automated external defibrillator, AED, public access defibrillation, SARS-CoV-2, COVID-19, pandemic

Introduction

The global outbreak of Coronavirus disease-2019 (COVID-19) has precipitated profound changes in healthcare systems, with far-reaching effects on emergency medical practices (1-3). Among the most critical impacts has been the management of out-of-hospital cardiac arrest (OHCA), a medical emergency that depends on prompt and effective intervention to improve survival rates (4,5). OHCA's unique nature demands immediate recognition and swift action, often in the form of cardiopulmonary resuscitation (CPR) and the use of public access defibrillation (PAD) systems by bystanders, before professional healthcare services can arrive. These PAD systems are strategically placed in public areas to allow rapid defibrillation, a key intervention that can significantly increase the chances of survival after cardiac arrest (6).

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However, the pandemic has introduced new challenges to the management of OHCA. First, the pervasive fear of contagion has made the public hesitant to perform CPR on strangers, primarily due to the close physical contact required during the resuscitation process (7). The requirement for mouth-to-mouth ventilation, a step that is necessary for effective CPR but also presents a risk for the spread of coronavirus, has made this reluctance worse. Additionally, the extensive public health restrictions and lockdowns implemented at the pandemic's peak further limited the public's ability to respond to emergencies (8). Training opportunities for CPR and PAD use were curtailed, and potential responders may have been less likely to access PAD devices because of movement restrictions or closures of the facilities where such devices are housed.

Research has highlighted these trends, suggesting a troubling decline in the engagement of laypeople in life-saving efforts during cardiac emergencies. With PAD systems' efficacy heavily reliant on public intervention, the pandemic's social distancing measures and the associated decline in public training and willingness to engage in rescue efforts have led to concerns about the system's underutilization during critical moments. These factors have created a ripple effect, potentially diminishing the overall effectiveness of emergency response systems for OHCA and thereby affecting survival outcomes. Such developments underscore the need for innovative solutions to ensure that the public remains equipped and willing to act despite cardiac emergencies, even during periods of widespread health crises (9).

The pandemic's effect on OHCA outcomes was observed not only in areas with high COVID-19 mortality rates but also in regions with lower rates of infection. For instance, the United States experienced lower rates of sustained return of spontaneous circulation (ROSC) during the pandemic across various communities, regardless of the local COVID-19 mortality rate. This suggests a broader systemic impact rather than isolated incidents confined to high-burden areas (10).

A retrospective observational cohort study in Italy looked at the time after the pandemic and found that the chances of getting bystander CPR and PAD were back to where they were before the pandemic, but the chances of ROSC decreased significantly. This pointed toward a partial recovery of the OHCA management system but also highlighted the need for a deeper understanding of the pandemic's long-term impact on emergency medical services and the public's willingness to engage in resuscitation efforts (9).

To the best of our knowledge, no meta-analysis has been conducted so far to address the activation of PAD and the use of automated external defibrillator (AED) to perform defibrillation during COVID-19 pandemic vs. pre-pandemic periods. Therefore, this meta-analysis presented the impact of pandemic COVID-19 on the use of the PAD system for adult patients with OHCA.

Materials and Methods

The present systematic review and meta-analysis were conducted in accordance with recommendations from the Cochrane Collaboration and are reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (11). Registration was completed on the International Prospective Register of Systematic Reviews platform with the number CRD42024500146.

Systematic reviews and meta-analyses do not require approval by institutional review committees, nor do study subjects should reconsent, and this was therefore not sought.

Data Sources and Searches

Two authors (AK and KK) independently conducted the literature search. According to the recommendations from the Cochrane Handbook for Systematic Reviews for meta-analysis, we implemented a systematic literature search in PubMed, Medline, Embase, and the Cochrane Central Register of Controlled Trials databases for articles comparing OHCA in pandemic and pre-pandemic periods which were published between the inception dates (January 2020) and January 2024. We used Boolean logic to create the search phrase: "heart arrest" OR "cardiac arrest" OR "cardiac arrest" OR "out-of-hospital cardiac arrest" OR "OHCA" OR "OOHCA" OR "OH-CA" OR "sudden cardiac death" AND "automatic external defibrillator" OR "automated external defibrillator" OR "defibrillator" OR "defibrillation" OR "AED" OR "public access defibrillation" OR "PAD" AND "coronavirus" OR "COVID" OR "COVID 19" OR "COVID-19" OR "Coronavirus disease 2019" OR "nCOV" OR "SARS-CoV2" OR "severe-acute-respiratory-syndrome-related coronavirus 2". We also manually searched the reference lists of the included studies to identify additional eligible studies.

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (1) study population: adult patients with OHCA; (2) studies reporting PAD activation or shock with AED during pandemic and pre-pandemic periods; and (5) study type: randomized and non-randomized trials. The exclusion criteria encompassed the following: (1) narrative reviews, commentaries, editorials, case series, conference abstracts, and correspondence letters; (2) duplicated publications; (3) literature in languages other than English; (4) pediatric patients or patients with in-hospital cardiac arrest (IHCA); and (5) texts where the full manuscript was not available.

Literature Screening and Data Extraction

Following the literature search, two reviewers independently examined the titles, abstracts, and keywords of the articles to determine their eligibility based on the predefined inclusion criteria. Subsequently, these reviewers conducted a thorough review of the full texts of the initially selected studies, excluding those that did not fulfill the stipulated exclusion criteria (AK and DK). Instances of disagreement were reconciled through collaborative discussion with a third investigator (KK). Extracts included: study title, first author, year of publication, country, patient characteristics (age, sex, home location of cardiac arrest), resuscitation characteristics (witnessed arrest, bystander CPR, PAD activation, shock with AED, shockable rhythm, EMS activation time, time to first defibrillation, survival to hospital admission (SHA), survival to hospital discharge (SHD) and SHD with good neurological outcome-defined as a score 1 or 2 in Cerebral Performance Categories Scale).

Risk of Bias Assessment

The assessment of the risk of bias in the included studies was independently conducted by two authors (AK and MT). During the quality assessment of the included studies, any disagreements were resolved by consensus with the third reviewer (LS). The Newcastle-Ottawa scale was used for this purpose (12). This scale is segmented into three categories: selection, comparability, and outcome, and is further subdivided into eight items, yielding a total possible score ranging from 0 to 9. Studies that attained a score of 7 or higher were categorized as high quality. Detailed information regarding the risk of bias assessment is presented in Table 1.

Statistical Analysis

The statistical analysis adhered to the guidelines set forth by the Cochrane Collaboration and the standards for reporting meta-analyses' quality (13). The Review Manager software (version 5.4, Nordic Cochrane Centre, Cochrane Collaboration, Denmark) and Stata (version 14, StataCorp, College Station, TX, USA) were used for statistical computations. Analyses were two-tailed with statistical significance set at $p<0.05$. The outcomes were articulated as pooled odds ratios (OR), mean differences, and their respective 95% confidence intervals (95% CI). For instances where continuous outcomes were presented as medians, ranges, and interquartile ranges, means and standard deviations were estimated using the methodology proposed by Hozo et al. (14). Heterogeneity among studies was quantitatively evaluated using the I2 statistic, with I2 values of 50%, 50-75%, and >75% indicating low, moderate, and high heterogeneity, respectively (15). If the results of each study showed that $I^2 \leq 50\%$ and $p>0.1$, indicating that the heterogeneity between studies was not statistically significant, the Mantel-Haenszel fixed-effects model was selected for meta-analysis; otherwise, the DerSimonian-Laird random-effects model was selected for meta-analysis. Assessment for potential bias was conducted using Egger's test and funnel plots (16), with funnel plot tests for asymmetry being applied to evaluate possible publication bias in cases where a meta-analysis included more than 10 trials (17). In addition, sensitivity analyses were conducted using the leave-one-out approach.

Results

Selected Studies

The PRISMA flow diagram of the literature search and study selection of our meta-analysis is depicted in Figure 1. Of the 733 identified records, 381 studies were screened after duplicate removal. This led to the eligibility assessment of 48 studies, of which 30 studies comprising were included in further analyses (9,10,18-45). The aforementioned papers were then incorporated into the meta-analysis. Among those articles, three provided data on both PAD activation and shock with AED, while the other 21 and six articles only mentioned information on PAD activation and shock with AED, respectively (Figure 2).

Baseline Characteristics

This meta-analysis included 30 analyzed studies with a combined cohort of 127,045 patients, of which 27 were retrospective studies and 3 were prospective studies. The global distribution

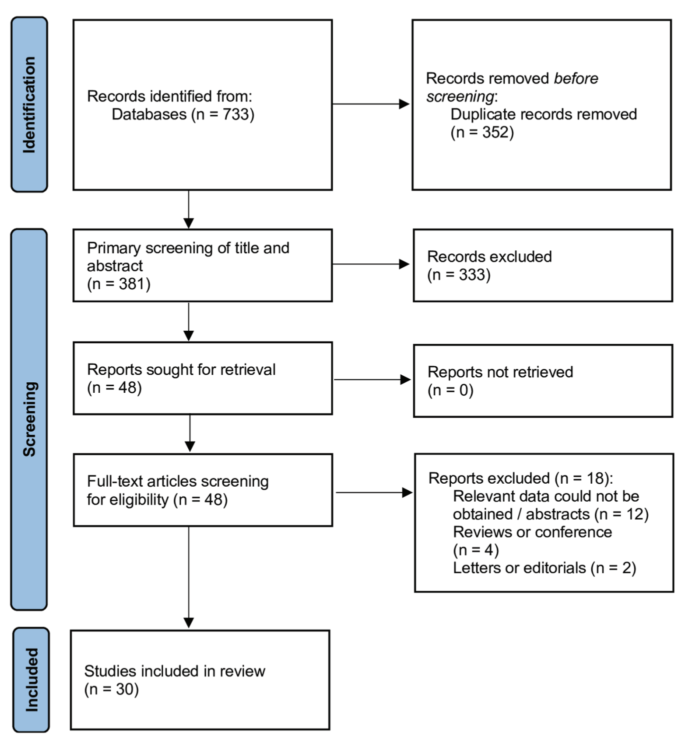

Figure 1. PRISMA flowchart

Table 1. Baseline characteristics of the included trials

Study	Country	Study design	Pandemic period			Pre-pandemic period			NOS score
			No.	Age, years	Sex, male	No.	Age, years	Sex, male	
Ahn et al., 2021 (18)	Korea	PS	152	74.9±2.6	102 (67.1%)	145	72.9±3.4	91 (62.8%)	8
Baert et al., 2020 (19)	France	RS	1005	68±17	676 (67.3%)	1620	69±17	1071 (66.1%)	8
Baldi et al., 2021 (20)	Switzerland	RS	911	69±4	623 (68.4%)	933	70.5±4	636 (68.2%)	8
Chan et al., 2021 (10)	USA	PS	9863	62.6 (19.3)	6040 (61.3%)	9440	62.2±19.2	5922 (62.7%)	8
Chavez et al., 2022 (21)	USA	RS	4418	63 (51-74)	2781 (62.9%)	3619	63 (51-74)	2307 (63.8%)	8
Cho et al., 2020 (22)	Korea	RS	171	74 (62-80)	108 (63.2%)	158	74.3 (61.8-82.2)	103 (65.2%)	8
Chugh et al., 2023 (23)	USA	PS	907	69.5±17.0	586 (64.6%)	1315	71.3±15.8	857 (65.2%)	8
Fothergill et al., 2021 (24)	UK	RS	3122	71±19	1839 (59.0%)	1724	68±20	1069 (62.0%)	8
Gregers et al., 2022 (25)	Denmark	RS	74	74±16	5067.6%)	182	74±18	117 (62.3%)	7
Huabbangyang et al., 2023 (26)	Thailand	RS	482	65.18±18.16	304 (63.1%)	513	64.18±19.94	320 (62.4%)	8
Leung et al., 2023 (27)	China	RS	2185	77.69±4.18	1880 (86.0%)	1502	78 (63-88)	844 (56.2%)	8
Lim et al., 2021 (28)	Singapore	RS	1400	73 (60-84)	882 (63.0%)	2493	71.01±3.84	1597 (64.1%)	8
Lim et al., 2021 (B) (29)	Singapore	RS	1063	71.05±14.98	647 (60.87%)	891	70.07±15.06	577 (64.76%)	8
Lim et al., 2022 (30)	International	PS	2084	69.02±5.21	1235 (59.3%)	1900	68.79±4.86	1161 (61.1%)	8
Liu et al., 2023 (31)	Taiwan	RS	497	78 (65-85)	292 (59.0%)	567	76 (64-85)	313 (55.4%)	8
Liu et al., 2023 (B) (32)	USA	RS	3142	63 (51-75)	2005 (63.8%)	2837	64 (52-75)	1859 (65.5%)	8
Nishiyama et al., 2022 (33)	Japan	RS	2371	80 (70-87)	1384 (58.4%)	2420	78 (68-86)	1403 (58.0%)	8
Oh and Ahn, 2023 (34)	Korea	RS	9240	60.0±17.3	1868 (20.2%)	22,897	59.1±17.5	5024 (21.9%)	8
Riyapan et al., 2022 (35)	Thailand	RS	350	63.4±19.4	208 (59.4%)	341	62.7±18.5	210 (61.6%)	8
Rosell Ortiz et al., 2020 (36)	Sapin	RS	1446	64.36±16.5	1028 (71.1%)	1723	65.61 (16.9)	1210 (70.2%)	9
Shibahashi et al., 2022 (37)	Japan	RS	3109	NS	1778 (57.2%)	3234	NS	1868 (67.8%)	8
Stirparo et al., 2023 (9)	Italy	RS	1767	NS	NS	1097	NS	NS	7
Sugiyama et al., 2023 (38)	Japan	RS	1730	66±17.33	108 (58.8%)	1637	66.3±17.5	918 (56.1%)	9
Sultanian et al., 2021 (39)	Sweden	RS	1016	69.6±17.8	697 (68.6%)	930	70.8 (16.6)	604 (64.9%)	9
Sun et al., 2021 (40)	USA	RS	298	NS	NS	220	NS	NS	7
Talikowska et al., 2021 (41)	Australia	RS	145	61 (46-74)	101 (69.7%)	501	60 (46-74)	345 (68.9%)	8
Tanaka et al., 2024 (42)	Japan	PS	5023	76 (62-84)	3095 (61.6%)	2015	72 (62-84)	1236 (61.4)	8
Uy-Evanado et al., 2021 (43)	USA	RS	278	64.9±18.3	174 (62.6%)	231	69.1±17.4	137 (78.7%)	8
Watanabe et al., 2023 (44)	Japan	RS	257	76.46±15.32	161 (62.6%)	262	75.47±16.31	160 (61.1%)	8
Yu et al., 2021 (45)	Taiwan	RS	622	70.41±16.21	394 (63.3%)	570	70.93 (16.45)	353 (61.9%)	8

NS: Not specified, PS: Prospective study, RS: Retrospective study

of the original studies included in the meta-analysis is presented in Figure 3. The baseline patient characteristics of the included studies are summarized in Table 1. According to the Newcastle Ottawa Scale, all studies were of high quality. The risk of bias assessment for the included studies is described in Table 1. The full characteristics related to resuscitation are shown in Table 2.

Outcomes

Twenty-four studies reported PAD activation during pandemic and pre-pandemic periods. Pooled analysis showed that activation of PAD among those two periods varied and amounted to 3.8% vs. 3.9%, respectively (OR=0.77; 95% CI: 0.66 to 0.89; p<0.001; Figure 4).

In contrast, there were no statistically significant differences in defibrillation using AEDs when comparing the pandemic period with the pre-pandemic period (5.0% vs. 6.2%; OR=0.78; 95% CI: 0.57 to 1.07; p=0.12; Figure 5).

Discussion

This systematic review and meta-analysis presents intriguing findings regarding PAD activation and AED use during the

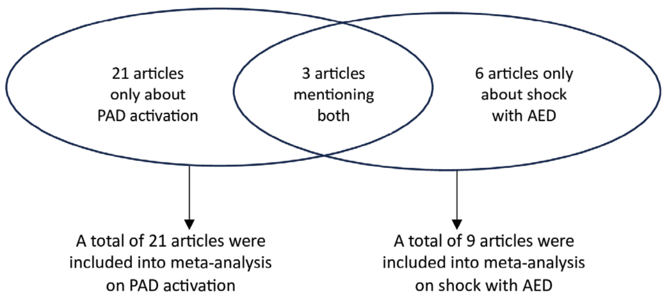

Figure 2. The number and distribution of articles used in the meta-analysis on PAD activation and defibrillation with AED

PAD: Public access defibrillation, AED: Automated external defibrillators

COVID-19 pandemic. The pooled analysis showing PAD activation rates of 3.8% during the pandemic versus 3.9% in the pre-pandemic period, with an OR of 0.77, suggests a slight but statistically significant decrease in PAD activation during the pandemic. This decrease can be attributed to various factors associated with the pandemic, such as reduced public mobility and access to areas where PADs are typically located, as indicated by most AEDs becoming inaccessible due to government-mandated closures during the pandemic (46).

On the other hand, the absence of statistically significant differences in shock with AED (5.0% during the pandemic vs. 6.2% pre-pandemic; OR=0.78) suggests that when AEDs were accessible, their use was not markedly different from pre-pandemic times. This observation might reflect the ongoing effectiveness of public education campaigns and the ingrained public response to cardiac emergencies, even under pandemic conditions (47). The pandemic also significantly shifted public attitudes toward CPR and publicly accessible defibrillator use. Hawkes et al. (47) noted that national initiatives led to an increase in the number of people trained in CPR, which correlated with improved bystander CPR rates and OHCA outcomes. Inaba et al.'s (48) study further examined the pandemic's impact on bystander reactions to OHCA, underscoring how public response to cardiac emergencies evolved during this period. Moreover, a study conducted in the United Kingdom focused on the early defibrillation aspect of OHCA management during the pandemic, emphasizing its essential role in the survival chain for such emergencies (47). This was complemented by many meta-analyses that compared the epidemiological characteristics and outcomes of OHCA during the COVID-19 pandemic with those during the pre-pandemic period (49-51). Overall, these studies collectively underscore the significant influence of the COVID-19 pandemic on various facets of OHCA management, from public response and PAD usage to the clinical outcomes of these critical events. There are conflicting studies on changes in the witnessed use of CPR and AEDs, indicating that this may have varied by region and specific pandemic conditions (52). Overall, despite pandemic-induced changes in the availability and use of AEDs, their effectiveness and frequency of use remained similar.

Despite an increase in the frequency of witnessed CPR during the COVID-19 pandemic (53) and a slight decrease in PAD activation while maintaining the frequency of defibrillation using AEDs, the analysis of the scientific literature allows us to conclude that COVID-19 had an adverse effect on the survival of patients with both OHCA and IHCA. One of the critical aspects of COVID-19's impact is the emergence of coagulopathy associated with the virus, known as COVID-19-associated coagulopathy. This condition is characterized by a state of hypercoagulability,

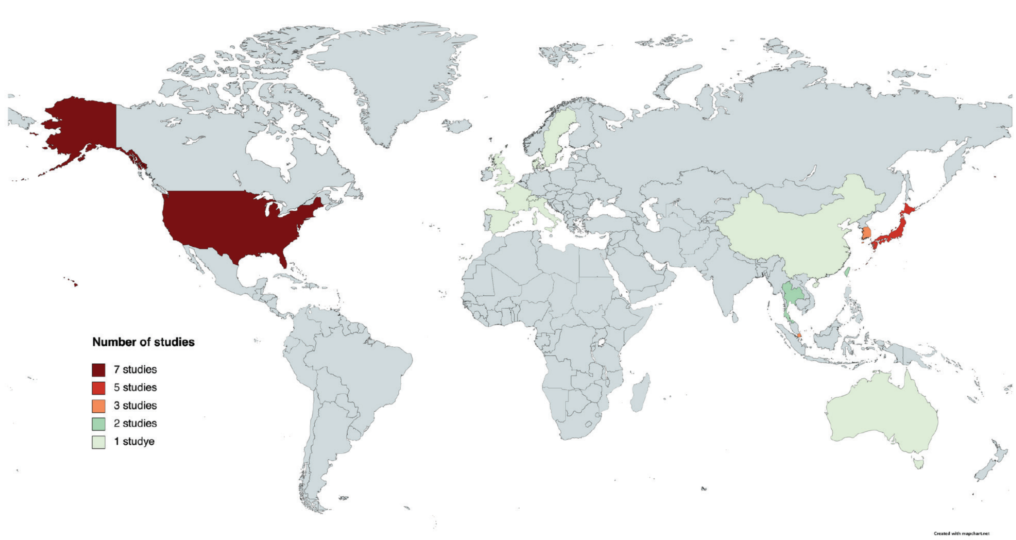

Figure 3. Global distribution of articles included in the meta-analysis

Table 2. Baseline patient characteristics and resuscitation characteristics among included trials

Parameter	Number of studies	Event/participants of mean±SD		Events		Heterogeneity between trials		P value for differences across groups
		Pandemic period	Control period	OR or MD	95% CI	p value	I2 statistics	
Age, years	27	66.8±15.2	64.4±16.1	0.30	-0.19 to 0.79	<0.001	97%	0.22
Sex, male	29	31,798/57,181	32,576/67,033	1.07	0.99 to 1.17	<0.001	89%	0.10
Home location of cardiac arrest	25	31,456/42,092	26,885/38,568	1.23	1.12 to 1.34	<0.001	85%	**<0.001**
Witnessed arrest	27	24,435/49,965 (48.9%)	29,618/61,742 (48.0%)	1.23	1.05 to 1.44	<0.001	97%	**0.01**
Bystander CPR	30	24,801/56,590 (43.8%)	25,737/66,934 (38.5%)	1.09	0.96 to 1.24	<0.001	96%	0.18
Shockable rhythm	26	7298/48,596	10,313/6,700	0.95	0.92 to 0.99	0.02	41%	**0.007**
EMS response time, min	21	9.9 (4.9)	9.5 (5.0)	1.03	0.75 to 1.31	<0.001	100%	**<0.001**
First defibrillation time, min	3	14.7 (4.9)	12.5 (4.3)	2.66	1.28 to 4.04	<0.001	99%	**<0.001**
SHA	26	9818/51,391	15,615/61,032	0.72	0.64 to 0.81	<0.001	91%	**<0.001**
SHD	25	3895/52,174	6848/61,711	0.64	0.57 to 0.71	<0.001	76%	**<0.001**
SHD with a good neurological outcome	17	1860/36.242	3288/45,530	0.68	0.59 to 0.77	<0.001	60%	**<0.001**

CI: Confidence interval, CPR: Cardiopulmonary resuscitation, EMS: Emergency medical service, MD: Mean difference, OR: Odds ratio, SHA: Survival to hospital admission, SHD: Survival to hospital discharge

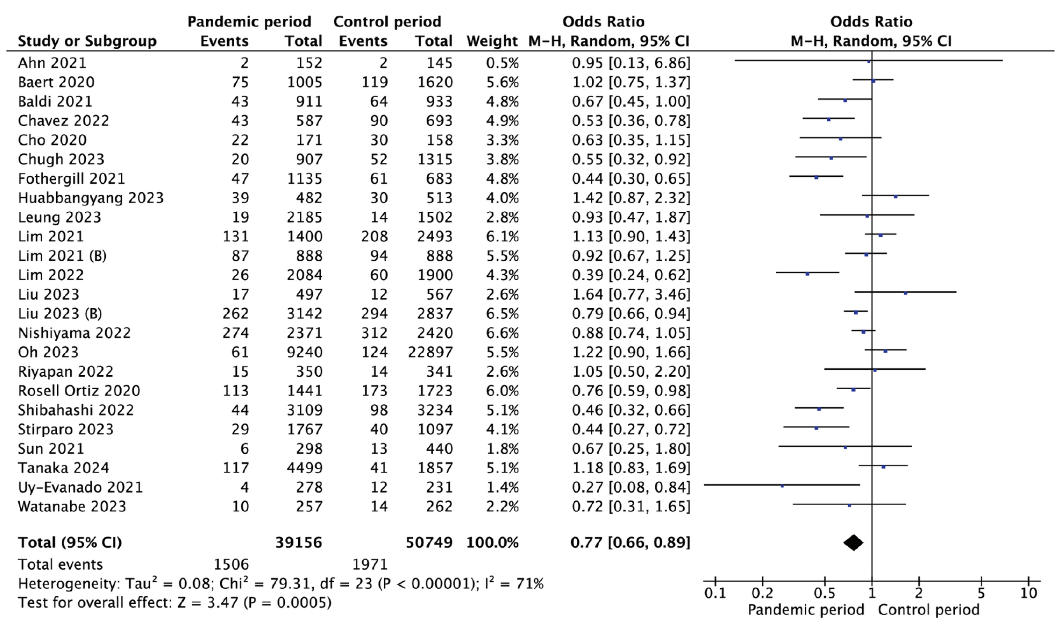

Figure 4. Forest plot of PAD ratio among COVID-19 pandemic vs. pre-pandemic periods. The center of each square represents the odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results

PAD: Public access defibrillation, COVID-19: Coronavirus disease-2019, CI: Confidence interval

Study or Subgroup	Pandemic period Events	Pandemic period Total	Control period Events	Control period Total	Weight	Odds Ratio M-H, Random, 95% CI
Baert 2020	21	1005	36	1620	11.8%	0.94 [0.55, 1.62]
Chan 2021	565	9862	766	9440	18.1%	0.69 [0.61, 0.77]
Gregers 2022	7	74	25	182	7.4%	0.66 [0.27, 1.59]
Nishiyama 2022	32	2371	48	2420	13.3%	0.68 [0.43, 1.06]
Sugiyama 2023	15	1730	22	1637	10.1%	0.64 [0.33, 1.24]
Sultanian 2021	12	1016	13	930	8.5%	0.84 [0.38, 1.86]
Sun 2021	7	298	28	440	7.9%	0.35 [0.15, 0.82]
Talikowska 2021	5	145	22	501	6.5%	0.78 [0.29, 2.09]
Yu 2021	197	622	134	570	16.4%	1.51 [1.17, 1.95]
Total (95% CI)		**17123**		**17740**	**100.0%**	**0.78 [0.57, 1.07]**
Total events	861		1094			

Heterogeneity: $Tau^2 = 0.14$; $Chi^2 = 34.70$, df = 8 ($P < 0.0001$); $I^2 = 77\%$
Test for overall effect: Z = 1.56 (P = 0.12)

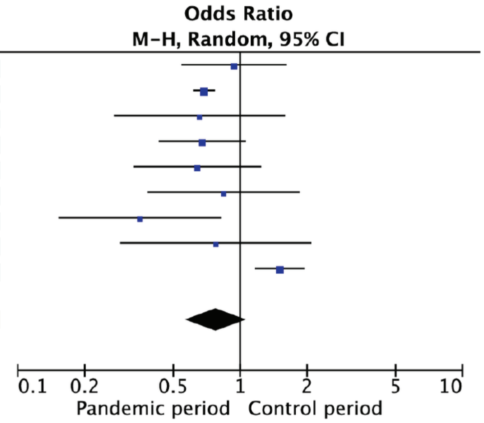

Figure 5. Forest plot of defibrillation with AED among COVID-19 pandemic vs. pre-pandemic periods. The center of each square represents the odds ratios for individual trials, and the corresponding horizontal line stands for a 95% confidence interval. The diamonds represent pooled results

AED: Automated external defibrillators, COVID-19: Coronavirus disease-2019, CI: Confidence interval

which contributes to the severity and complications in infected patients, including an increased risk of thrombotic events (54-56). Additionally, the pandemic has led to a dramatic reduction in the availability of healthcare for seniors, particularly concerning the access and restructuring of different hospital departments (57). This reduction in healthcare accessibility has profound implications for patient outcomes, particularly for the elderly who are already at higher risk of developing COVID-19.

Another point worth emphasizing here-even though it is not the immediate focus of this study-is the impact of increased EMS response time during a pandemic. The rapid response of emergency medical teams is crucial for increasing the chances of survival in OHCA cases, where the optimal response time is usually a few minutes after the event. However, during a pandemic, many emergency medical systems experienced delays because of additional safety procedures, such as the need for staff to wear appropriate protective gear, and because of the increased burden on health systems. These delays in response directly impact the effectiveness of resuscitation. Therefore, early defibrillation and advanced CPR are key to improving the prognosis of OHCA. Delays in initiating CPR can limit the duration of the therapeutic window, which is critical to the effectiveness of these interventions. When emergency medical teams arrive late, the likelihood of resuscitation success decreases significantly. Finally, the overall greater strain on health systems caused by the pandemic may have contributed to a slower response to medical emergencies. Hospitals and emergency teams are often overburdened with treating patients with COVID-19, affecting availability and responsiveness to emergencies such as OHCA. As a result, the COVID-19 pandemic led to increased response times for emergency medical teams, which had a direct impact on reduced survival rates in OHCA cases. This increase in response time, coupled with delays in access to key resuscitation interventions, reduced witness readiness to provide first aid, and overall strain on health systems, is a key factor in the lower survival rates for OHCA cases during the pandemic.

Study Limitations

The primary limitations of our study relate to the limitations of the studies and data included in our systematic review and meta-analysis. This comprehensive review and meta-analysis used data from 15 countries and did not include any studies conducted in Africa or South America. In addition, European studies mostly concentrated on nations located in Western Europe. The limitations inherent in this study present difficulties generalizing the results worldwide. Moreover, it is important to acknowledge that the introduction of COVID-19 vaccines and notable viral subvariants might have had a considerable influence on the course of the pandemic. Nevertheless, it is crucial to emphasize that none of the studies included in the meta-analysis focused on this topic. This work is a comprehensive analysis and synthesis of previously published non-randomized controlled trials conducted methodically. Nevertheless, its ability to depict overall patterns is restricted.

Conclusion

These data indicate a substantial decrease in the activation of PAD during the pandemic. Furthermore, there were no statistically significant variations in the usage of shock using AEDs, suggesting that the use of AEDs remained similar to that in the pre-pandemic periods when they were available. It is essential to promote the usage of AEDs among bystanders and perform societal initiatives to achieve this objective.

Ethics

Ethics Committee Approval and Informed Consent: Systematic reviews and meta-analysis do not require approval by institutional review committees, nor do study subjects need to reconsent and this was therefore not sought.

Authorship Contributions

Concept: A.K., Design: A.K., M.T., Data Collection or Processing: A.K., F.C., Analysis or Interpretation: A.K., A.G-K., Literature Search: A.K., D,K., A.G-K., F.C., M.P., Writing: A.K., D,K., A.G-K., N.L.B., F.C., M.P., B.C., M.T., S.G., L.S., K.K.

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