Title: A Comparison of Cardiac Arrest Recognition by Emergency Medical Dispatch (EMD) and Non-EMD Systems in Kansas

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Introduction: The timely and accurate recognition of cardiac arrest by 9-1-1 dispatchers is vital for initiating dispatcher-assisted bystander CPR and ensuring an appropriate emergency medical services (EMS) response. Despite its significance, little research exists comparing Emergency Medical Dispatch (EMD) and non-EMD systems in the United States.

Objectives: The primary objective was to ascertain whether Emergency Medical Dispatch (EMD) improves the identification of cardiac arrest compared to dispatch without EMD in Kansas. The secondary objective was to compare the rates of bystander cardiopulmonary resuscitation (CPR) prior to EMS arrival (PTA) and automated external defibrillator (AED) use PTA in patients with dispatch-recognized cardiac arrest under both systems.

Methods: We analyzed 9-1-1 EMS activations in Kansas from 2020-2023. Non-emergency transfers, cancelled calls, and duplicate calls were excluded. Descriptive statistics for age, race, sex, urbanicity and dispatch recognition of cardiac arrest reported for patients in EMS confirmed cardiac arrest. Chi-square difference of proportion test, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for EMD and non-EMD recognition of cardiac arrest. Differences in proportion of CPR PTA and AED PTA assessed on dispatch recognized cardiac arrest confirmed by EMS using chi-square test.

Results: Out of 970,362 activations, 22,141 were confirmed as cardiac arrest by EMS. Of these cardiac arrest patients, EMD was used for 35.6%. EMD recognized 68.1% of cardiac arrests compared to 52.6% by non-EMD dispatch (p<0.001). EMD also had higher accuracy (0.9889 vs 0.9848, p<0.001). Additionally, patients with EMD had higher rates of bystander CPR PTA (45.97% vs 31.12%, p<0.001) and AED use PTA (22.17% vs 19.77%, p=0.001).

Conclusion: EMD outperformed non-EMD demonstrating a 15.5% increase in cardiac arrest recognition, 15.0% higher rate of bystander CPR and a marginal 1.4% improvement in the utilization of AEDs prior to EMS arrival. These results underscore the pivotal role of EMD in the chain of survival for out-of-hospital cardiac arrest. Despite EMDs impressive enhancements to early cardiac arrest care, nearly two thirds of cardiac arrest patients did not have EMD used. Efforts should focus on increasing EMD use in Kansas. However, despite its effectiveness, there remains a scope for optimizing EMD, as evidenced by the 31.9% of cardiac arrests that were not recognized. Future research should explore the impact of EMD on patient outcomes to hospital discharge.

Table 1. Patient and Incident Characteristics for Cardiac Arrest Patients Stratified by Emergency Medical Dispatch (EMD) Use for 9-1-1 EMS Activations in Kansas from 2020-2023

Characteristics	EMD	Non-EMD	Overall
	N = 7,885	N = 14,256	N = 22,141
Cardiac Arrest Recognized by Dispatch	5,371 (68.1%)	7,500 (52.6%)	12,871 (58.1%)
Patient Age median [IQR]	65.0 [25.0]	64.0 [27.0]	64.0 [26.0]
Missing	57 (0.7%)	333 (2.3%)	390 (1.8%)
Sex			
Male	4,954 (62.8%)	9,122 (64.0%)	14,076 (63.6%)
Female	2,885 (36.6%)	5,017 (35.2%)	7,902 (35.7%)
Missing	46 (0.6%)	117 (0.8%)	163 (0.7%)
Race			
White	6,022 (76.4%)	9,653 (67.7%)	15,675 (70.8%)
Black/African American	534 (6.8%)	1,226 (8.6%)	1,760 (7.9%)
Hispanic/Latino	231 (2.9%)	631 (4.4%)	862 (3.9%)
Other/Multiple	1,092 (13.8%)	2,729 (19.1%)	3,821 (17.3%)
Missing	6 (0.1%)	17 (0.1%)	23 (0.1%)
Urbanicity			
Metro	6,416 (81.4%)	9,939 (69.7%)	16,355 (73.9%)
Non-metro	1,165 (14.8%)	2,136 (15.0%)	3,301 (14.9%)
Rural	271 (3.4%)	2,049 (14.4%)	2,320 (10.5%)
Missing	33 (0.4%)	132 (0.9%)	165 (0.7%)

Table 2a. Comparison of Emergency Medical Dispatch (EMD) Cardiac Arrest Recognition

	EMS: Cardiac Arrest	EMS: No Cardiac Arrest	Total
EMD: Cardiac Arrest	5,371	1,732	7,103
EMD: No Cardiac Arrest	2,514	372,086	374,600
Total	7,885	373,818	381,703

Table 2b. Comparison of Non-Emergency Medical Dispatch (Non-EMD) Cardiac Arrest Recognition

	EMS: Cardiac Arrest	EMS: No Cardiac Arrest	Total
Non-EMD: Cardiac Arrest	7,500	2,201	9,701
Non-EMD: No Cardiac Arrest	6,756	572,202	578,958
Total	14,256	574,403	588,659

Table 2c. Comparative Performance Metrics of EMD and Non-EMD for Cardiac Arrest Recognition

	EMD	Non-EMD
Sensitivity	0.6812	0.5261
Specificity	0.9954	0.9962
Positive Predictive Value	0.7516	0.7731
Negative Predictive Value	0.9933	0.9883
Accuracy	0.9889	0.9848
F-Score	0.7167	0.6261

Table 3. Comparing Rates of Cardiopulmonary Resuscitation (CPR) Prior to EMS Arrival (PTA) and Automated External Defibrillator (AED) PTA for Dispatch Recognized Cardiac Arrest Confirmed by EMS Stratified by Emergency Medical Dispatch (EMD) Use

	EMD	Non-EMD	p-value
CPR PTA	0.4597	0.3112	p<0.00001
AED PTA	0.2217	0.1977	p=0.0010