

Update on Resuscitation Medicine- Can We Improve Survival?

Chaitra Mohan, MD

Cardiac Electrophysiology
Jackson Memorial Hospital
Miami, FL

Case

- 18 year-old female with no significant PMH presents with an out of hospital cardiac arrest (OHCA) while running the Miami half marathon.
- Bystander CPR was initiated emergently. AED was notable for ventricular fibrillation for which the patient was defibrillated x2 with ROSC.
- The patient was transferred to Jackson Memorial Hospital for further management.

Introduction

- Cardiac arrest is the third leading cause of death in the United States, following cancer and heart disease.
- In-hospital cardiac arrest (IHCA) accounts for approximately 200,000 cardiac arrests a year.

Cardiac Arrest Chain of Survival



CPR Training Rates in the United States

Original Investigation

February 2014

Rates of Cardiopulmonary Resuscitation Training in the United States

Monique L. Anderson, MD¹; Margueritte Cox, MS¹; Sana M. Al-Khatib, MD, MHS¹; [et al](#)

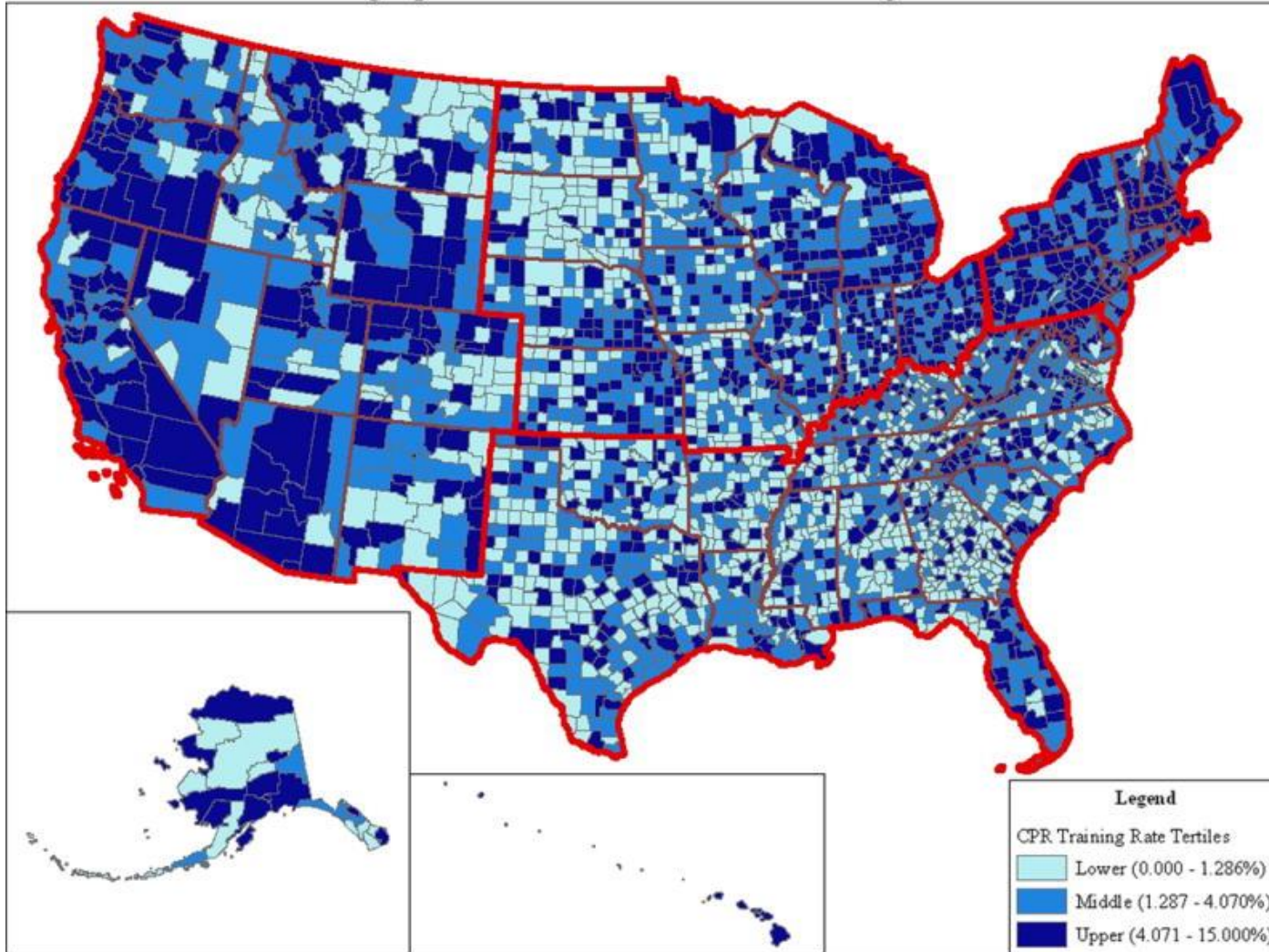
» [Author Affiliations](#) | [Article Information](#)

JAMA Intern Med. 2014;174(2):194-201. doi:10.1001/jamainternmed.2013.11320

- African Americans and low income individuals with OHCA are significantly less likely to receive bystander CPR.
- People who have an OHCA in a predominantly low income neighborhood are the least likely group to receive bystander CPR.
- The strongest factor associated with low CPR training rates was high proportions of rural residents.
 - Rural areas: <2500 persons

CPR Training Rates in the United States

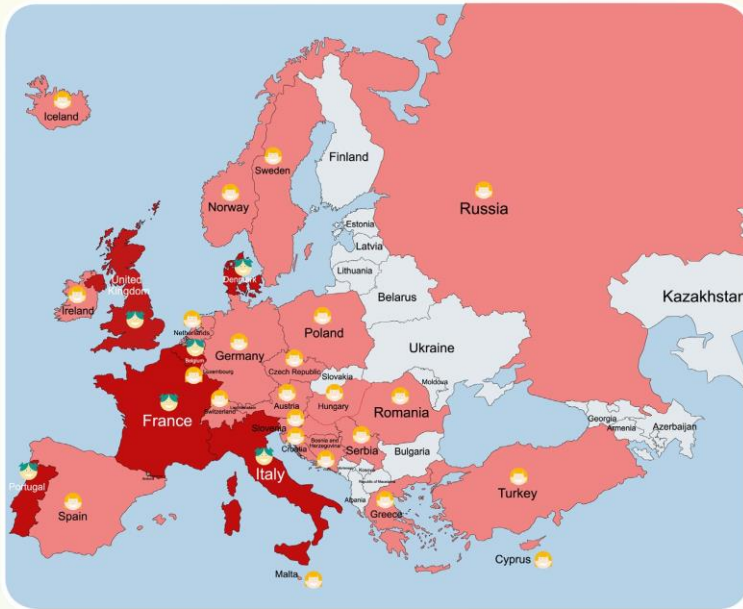
Geographic Distribution of CPR Training Rates



- Counties with a higher proportion of rural, Hispanic, African American, and lower income residents had lower CPR training rates.
- These differences in CPR training by race and income may contribute to disparities in bystander CPR treatment of OHCA survival.
- **Median annual CPR training rate for all U.S. counties was 2.39%.**
 - Of those lower tertile counties, 57% were located in the Southern U.S.

CPR Training Rates in Europe

European Map of CPR Education 2020



- Some European countries mandate first aid training, resulting in as many as 95 percent (Norway) and 80 percent (Germany) of the public trained in CPR and AED use.
- In Norway:
 - First aid training is mandatory in grades 7-10.
 - First aid training is also mandatory for obtaining a drivers license.
- Employees in school are required by law to be able to perform first aid.

**KIDS
SAVE
LIVES**



A LEGISLATION

Belgium
Denmark
France
Italy
Portugal
United Kingdom



A SUGGESTION

Austria
Bosnia and Herzegovina
Croatia
Cyprus
Czech Republic
Germany
Greece
Hungary
Iceland
Ireland
Luxembourg
Malta
Netherlands
Norway
Poland
Romania
Russia
Serbia
Slovenia
Spain
Sweden
Switzerland
Turkey

The countries with kids with green hair have a legislation about CPR education, the countries with kids with yellow hair have CPR education as a suggestion.

Strategies to Improve Cardiac Arrest Survival

Public Education and Training

- Evidence indicates that bystander CPR and AED use can significantly improve survival and outcomes from cardiac arrest.
 - Rates of bystander training in CPR and AED use remain less than 3 percent annually in the United States. State and local education departments could facilitate CPR and AED training as a graduation requirement for middle and high school students.
- Employers should provide CPR/AED training to their employees and include cardiac arrest in formal emergency response plans.
- Local health departments should engage with the community to expand the types and locations of available CPR and AED training to populations over age 65.

National Cardiac Arrest Registry

- Establishing a national cardiac arrest surveillance system that includes IHCA and OHCA could lead to the following:
 - Increase public awareness about cardiac arrest incidence and treatments
 - Improve accountability for EMS and health care system performance
 - Target interventions to reduce disparities and improve patient outcomes
- State and local health departments could mandate tracking and reporting of all cardiac arrest events and publicly report the incidence and outcomes of IHCA and OHCA.

Heads-up CPR

[Health Sci Rep](#). 2022 May; 5(3): e644. Published online 2022 May 24.

doi: [10.1002/hsr2.644](https://doi.org/10.1002/hsr2.644)

PMCID: PMC9128396 | PMID: [35620549](https://pubmed.ncbi.nlm.nih.gov/35620549/)

Efficacy of heads-up CPR compared to supine CPR positions:
Systematic review and meta-analysis

[Joseph Varney](#),¹ [Karam R. Motawea](#),² [Mostafa R. Mostafa](#),³ [Yossef H. AbdelQadir](#),²
[Merna Aboelenein](#),² [Omneya A. Kandil](#),² [Nancy Ibrahim](#),² [Hashim T. Hashim](#),⁴
[Kimberly Murry](#),⁵ [Garrett Jackson](#),¹ [Jaffer Shah](#),^{6,7} [Maty Boury](#),¹ [Ahmed K. Awad](#),⁸
[Priya Patel](#),¹ [Dina M. Awad](#),² [Samah S. Rozan](#),² and [Nesreen E. Talat](#)²

▶ [Author information](#) ▶ [Article notes](#) ▶ [Copyright and License information](#) [Disclaimer](#)

- Elevating the head and chest of the patient during CPR increases blood flow to the brain while also increasing venous runoff.
- Improved cerebral perfusion pressure was due to increased mean aortic pressure and decreased intracranial pressure in the heads-up CPR group.
- With head elevation, venous blood rapidly drains from the brain to the heart, reduces ICP, and lowers the arterial and venous pressure waves.
- The authors found a significant association between heads-up CPR and increased cerebral blood flow as combined to supine CPR.
 - However, no difference in survival was detected between the two groups.

Use of Machine Learning in Recognizing Cardiac Arrest

- Survival after OHCA has increased in multiple countries following improvements in bystander interventions, the response of EMS, and post-resuscitation care.
 - Of these, early bystander interventions with CPR and early defibrillation have the greatest impact on outcomes.
- One limitation to initiation of bystander CPR and expediting EMS is the recognition of OHCA by dispatchers.
- Artificial intelligence is a strategy currently being studied in Denmark to improve recognition of cardiac arrests to the dispatchers.

Use of Machine Learning in Recognizing Cardiac Arrest

- Clinical decision tools using machine learning models have been tested in Copenhagen.
 - Identified OHCA with better sensitivity and slightly lower specificity than medical dispatchers.
- Though the potential for clinical decision tools driven by artificial intelligence or machine learning models is high, almost all had failed to do so in practice.

Original Investigation | Emergency Medicine

Effect of Machine Learning on Dispatcher Recognition of Out-of-Hospital Cardiac Arrest During Calls to Emergency Medical Services

A Randomized Clinical Trial

Stig Nikolaj Blomberg, MSc; Helle Collatz Christensen, MD, PhD; Freddy Lippert, MD; Annette Kjær Ersbøll, MSc, PhD; Christian Torp-Petersen, MD, PhD; Michael R. Sayre, MD; Peter J. Kudenchuk, MD; Fredrik Folke, MD, PhD

Objective: To observe how a machine learning model trained to identify OHCA and alert dispatchers during emergency calls affected OHCA recognition and response.

Intervention: Dispatchers in the intervention group were alerted when the machine learning model identified OHCA, and those in the control group followed normal protocols without alert.

RCT: Effect of Machine Learning (ML) Alert on Dispatcher Recognition of Out-of-Hospital Cardiac Arrest During Calls to Emergency Medical Services (EMS)

POPULATION

419 Men, 235 Women



EMS calls about adults with suspected cardiac arrest

Mean, 70 y

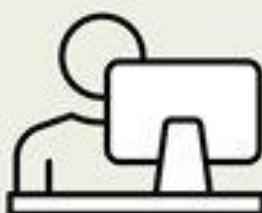
SETTINGS / LOCATIONS



EMS in Copenhagen, Denmark

INTERVENTION

654 Calls randomized and analyzed



336 Protocol with ML alert suppressed

ML algorithm suspects cardiac arrest but does not warn dispatchers during the emergency call

318 Protocol with ML alert shown

ML algorithm suspects a cardiac arrest and displays an alert on dispatcher's monitor during the emergency call

PRIMARY OUTCOME

Rate of dispatcher recognition of subsequently confirmed out-of-hospital cardiac arrest

FINDINGS

There was no difference between EMS dispatcher recognition of out-of-hospital cardiac arrest among the group of dispatchers who receive the ML-generated alert and the group that did not receive the alert.

ML alert suppressed

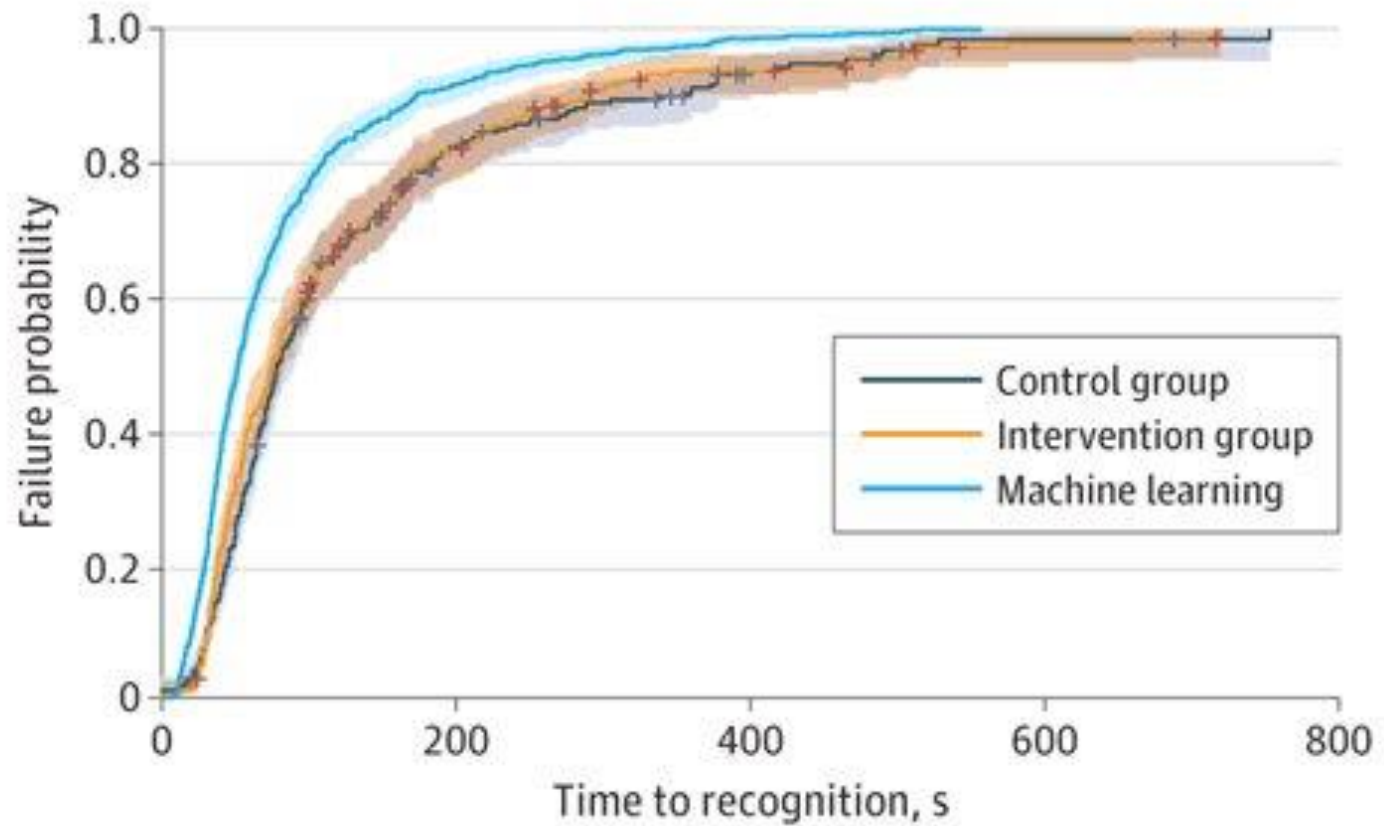


ML alert shown



P = .15

Numbers of dispatchers who recognized out-of-hospital arrest
Control group with ML alert suppressed: 304 of 336 cases
Intervention group with ML alert shown: 296 of 318 cases



No. at risk	0	200	400	600	800
Control group	335	48	12	2	0
Intervention group	316	52	15	3	0
Machine learning	654	55	10	0	0

- 22 additional OHCAs would have been recognized by the dispatcher with the use of the alert.
- 296 OHCAs would have been recognized 20 seconds sooner than in the absence of the alert.

Results

- Compared with medical dispatchers, the machine learning model had:
 - Significantly higher sensitivity (77.5% vs 85%; $P < 0.001$)
 - Lower specificity (99.6% vs 97.4%; $P < 0.001$)
 - Significantly lower positive predictive value than dispatchers (17.8% vs 55.8%; $P < 0.001$)
- If the dispatchers had heeded the machine learning model, 54 additional OHCA that were not recognized by dispatchers would have been recognized.
- The machine learning model resulted in a sizeable number of false alerts in which an OHCA had not occurred.

Conclusion

- The machine learning model was found to correctly recognize more OHCA's significantly faster than the dispatchers.
- No significant improvement in dispatcher recognition of OHCA when supported by machine learning.
- This study suggests that machine learning has the potential to positively affect the recognition rate of OHCA while also improving the rate of CPR.
- Further studies are needed to improve human - computer interaction and to improve the specificity of the machine.

Summary

- We know that bystander CPR and AED use can significantly improve survival and outcomes from cardiac arrest.
- OHCA treatment is a community issue. Promoting public education and training on management of cardiac arrest would provide an immense value to the overall health of the nation.
- Technology such as the use of artificial intelligence may lead to early detection of OHCA by emergency dispatchers.

Thank You

