Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

American Journal of Emergency Medicine 42 (2021) 254–255

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Application of termination of resuscitation rules during the COVID-19 pandemic by emergency medical service

The COVID-19 pandemic is placing unprecedented burdens on the healthcare system in some parts of the United States, one of which is the infection and quarantining of healthcare workers. Emergency medical service (EMS) providers are at a greater risk of contracting COVID-19 due to their proximity to critically ill patients while performing life-saving medical interventions, such as cardiac resuscitation. EMS providers in New York City (NYC) have been especially vulnerable, as approximately 20% of their emergency medicine technicians (EMTs), paramedics, and supervisors have been out of work in early April due to illness with this number continuing to rise [1]. The Fire Department of NYC reported responding to an average of 300 cardiac arrest calls a day with over 200 deaths, compared to a range of 65 cardiac arrest calls per day with an average of 27 deaths per day one year ago [2]. First responders in Boston, MA, reported that the number of infected personnel doubled in the first week of April [3] with 25 of the city's 385 EMTs and paramedics infected or quarantined on April 7th [4]. Los Angeles County reported that 324 healthcare workers tested positive for COVID-19 [5]. The Centers for Disease Control and Prevention recently issued a report describing that healthcare providers make up 10–20% of COVID-19 cases in the U.S. and this is likely an underestimation given the incomplete reporting by participating states [6].

Approximately 60% of the 330,000 annual cardiac arrests occur out of hospital, [7] and providers are at an increased risk of exposure to pathogens due to the inherently invasive resuscitation interventions required and scarcity of personal protective equipment (PPE) supplies [8]. For instance, the Centers for Disease Control and Prevention (CDC) has issued recommendations on conserving PPE resources as shortages continue to pose a challenge to U.S. healthcare workers during this pandemic [9]. Survival from out-of-hospital cardiac arrest (OHCA) is approximately 5% for most communities [10], however it ranges from 0 to 20.4% depending on location and local resources [11]. Yates et al. demonstrated that the overall survival of patients transported to the emergency department (ED) for OHCA with cardiopulmonary resuscitation (CPR) in progress is 1.3% [12]. Transport of an OHCA incurs the added risks of occupational injury to EMS providers and decreases the effectiveness of CPR with frequent interruptions in compressions with few patients receiving treatments or interventions in the ED that they did not receive in the field [12]. In the context of COVID-19, the invasive and aerosol-producing interventions performed during an OCHA in an enclosed transport space (BVM oxygenation, establishment of an airway, administration of parenteral therapy, and manual CPR or positioning of a LUCAS device) poses further risk of occupational exposure.

In the mid-2000s, several guidelines for termination of resuscitation (TOR) rules were developed for EMS providers performing basic and advanced life support (BLS and ALS, respectively) [10,13]. The American Heart Association (AHA) codified these rules into its own guidelines for CPR and emergency cardiovascular care. These rules predominately apply towards non-traumatic, cardiogenic causes of OHCA with greater limitation in application for non-traumatic, non-cardiogenic causes [14]. The AHA BLS TOR rule requires that the following criteria for adult victims of OHCA be met: 1) un-witnessed cardiac arrest by EMS or first responder, 2) no return of spontaneous circulation (ROSC) after 3 full rounds of CPR and automated external defibrillator (AED) analysis, and 3) no AED shocks delivered. The ALS TOR rule requires four criteria to be met for OHCA adult victims: 1) un-witnessed arrest, 2) no bystander CPR was performed, 3) no ROSC after full ACLS care in the field, and 4) no AED shocks were delivered [15]. The National Association of EMS Physicians recommends that full ACLS care (including establishing an advanced airway, high quality CPR, epinephrine, amiodarone or lidocaine IV/IO, and defibrillation) may be discontinued after at least 20 min of resuscitative efforts if the patient does not respond [16,17]. EMS providers apply these rules to OHCA patients to determine transport of the patient to the ED or to terminate resuscitation, often in conjunction with a base physician providing online medical support, though that varies region to region.

It is critical during the COVID-19 pandemic that EMS providers employ extreme caution with PPE to prevent unnecessary exposure. All providers should don and doff PPE per protocol, respective of the EMS agency's guidelines and equipment availability, to guard against airborne and droplet particles as well as utilize interventions that are less aerosol generating, such as mechanical chest compressions, cuffed endotracheal tube, or supraglottic airways [17]. These actions must be followed with each OHCA patient while recognizing the high-stress situation in order to limit gaps in infection-control measures [16].

An imbalance exists with applying the AHA TOR rules consistently across EMS systems. Eckstein et al. showed that there was tremendous variability amongst hospitals in Los Angeles applying the TOR rules with EMS personnel, where rates of termination varied from 5 to 37% depending on which hospital took the EMS call [18]. The decentralized system of hospital-based intensive care nurses and physicians providing medical control to the EMS units assigned to their hospital may be contributory to the inconsistency in application of TOR rules [18]. However, Morrison et al. demonstrated that EMS providers do feel comfortable applying these TOR rules (74% of the time) and are even more comfortable when two EMS providers on-scene apply the rules together (95.6%) [10]. Family members also showed a preference for receiving bad news related to OHCA death on-scene rather than in an ED or hospital waiting room, and they generally accept EMS providers' decision to terminate resuscitation after delivering appropriate care [10]. Physicians may become more comfortable with TOR decisions with the establishment of a standardized process and training combined with the consistent application of field termination, such as the BLS TOR rule is considered a universal clinical prediction rule [18,19]. Uniform implementation of the TOR rules would provide more consistency nationwide and strengthen the decision-making by physicians and EMS providers.

https://doi.org/10.1016/j.ajem.2020.06.029

The importance of the appropriate application of the TOR rules has only intensified during the COVID-19 pandemic. These rules allow EMS agencies to ethically triage their resources in an evidence-based manner to only those patients who meet inclusion criteria for the TOR rules and would have higher survivability with continued resuscitation. The TOR rules have been validated in numerous studies and their successful implementation during this pandemic would minimize unnecessary risk to healthcare workers. EMS agencies in the hardest hit areas of the COVID-19 pandemic, New York and California, are implementing new guidelines for their personnel to curb futile transport of OHCA patients to the ED by reinforcing the principles of the BLS and ALS TOR rules [20,21].

COVID-19 presents a unique challenge to EMS providers in responding to OHCA in terms of medical management and personal safety. This pandemic more acutely illustrates the necessity of providers to apply evidence-based tools to OHCA patients in order to identify those that will have a significant improvement in mortality with transport to the ED. The TOR rules provide clear inclusion criteria that can be efficiently applied by EMS and base physicians to appropriately determine the risks and benefits for each OHCA case. As COVID-19 spreads from its initial epicenters in California and New York to different parts of the US, it remains critical for agencies to understand TOR guidelines and empower their providers to identify the cases where survival is unlikely and to reduce unnecessary exposure. The TOR rules continue to be an integral tool for EMS and healthcare workers to provide optimum care for OHCA patients while simultaneously maintaining their safety.

Financial support

This is a non-funded study, with no compensation or honoraria for conducting the study.

Declaration of Competing Interest

The authors do not have a financial interest or relationship to disclose regarding this research project.

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29 April 2020