Improving performance of emergency medical services personnel during resuscitation of cardiac arrest patients: the McMAID approach

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Current Opinion in Critical Care 2009, 15:216–220

Purpose of review
The article presents the method we developed to improve emergency medical service personnel training.

Recent findings
Following the introduction of new prehospital protocol for emergency medical services that initially dramatically improved survival of patients with witnessed out-of-hospital cardiac arrest, we found that without an adequate training and retraining program, survival rates decreased. A new training methodology called McMAID was developed to improve the quality of the resuscitation effort.

Summary
It is possible to train personnel to routinely execute an organized resuscitation if the approach to training is modified.

Keywords
cardiocerebral resuscitation, McMAID, training methodology

Curr Opin Crit Care 15:216–220

1070-5295

Introduction

> [The] two main organizing principles for social insect colonies [are] division of labor and communication [1].

A perfectly run code is a thing of beauty; but this 'creature', although sometimes observed in captivity (on the carpets or tables in training centers), is unfortunately seldom seen in the wild [2–8]. This is not good. Some patients are deprived of the benefits embodied in resuscitation protocols; some rescuers are deprived of the greatest motivation and reinforcement to improve performance – a successful code – and some resuscitation study conclusions may be weakened by the confounding impact of suboptimal cardiopulmonary resuscitation performance.

Failure to resuscitate a patient from a witnessed out-of-hospital cardiac arrest should not be accepted as an inevitable consequence of either the disease process or the complexity of the organized chaos we call resuscitation. We are more than willing to take credit for a successful resuscitation; but when the patient dies it is simply too easy to attribute failure to the disease, to elevated adrenaline levels of rescuers, or to the fact that personnel experience only a few codes a year. Such rationalizations may protect us emotionally but they foster clinical nihilism [9] that in turn justifies a failure to improve performance.

In 2004 we implemented a new protocol, now known as cardiocerebral resuscitation (CCR), for the prehospital management of cardiac arrest victims [10]. We and others have subsequently shown that a great number of individuals suffering a witnessed initially shockable cardiac arrest can indeed be successfully resuscitated when this CCR protocol is used [11•,12]. We have also learned what should have been obvious earlier: outcomes ultimately depend upon how well the protocol is implemented by emergency medical service (EMS) providers in the field. We assumed that basic life support (BLS) and advanced life support (ALS) training would ensure skill competency; and since CCR did not add any new skills to the resuscitation protocol, we assumed that training in the newly prioritized set of existing skills would be sufficient. Wrong! We continued to experience suboptimal CCR performance. The 'megacode' approach to training was just not working.

In this article we describe an alternative approach to cardiac arrest resuscitation training called 'McMAID'. We will not discuss the content or merits of CCR and instead will focus exclusively upon the training process itself.

Why change was needed

During 2004 our overall survival rates in initially shockable patients rose from 23 to 58%; but in 2005 survival had dropped to 38%. A 'code commander' role was implemented; but that still was not enough. The 2006 survival rates rose to 44% but did not return to the 58% seen in 2004 [11•].

While observing groups of rescuers during re-training, it became painfully obvious that 'perfectly' run codes were a rarity. Personnel knew the protocol and requisite skills but they failed to function smoothly as a team. Even the most competent code commanders had difficulty because too many things were going on simultaneously in a short span of time. What was needed was a workable 'division of labor'. 'Tasks' that individual rescuers would perform had to be defined and simplified so that they could be learned, recalled, and executed perfectly with a minimum of real-time prompting.

Defining accomplishable individual tasks was surprisingly simple: chest compressions, defibrillator usage, airway management, and drug administration. These tasks were then prioritized and bundled into a memorable pneumonic – 'McMAID'. Tasks are assigned and individuals are expected to do their job. This sounds simple but in reality it is difficult because most EMS training emphasizes knowing and responding to the 'whole' instead of the parts; the 'megacode' attitude needs to be unlearned.

Individuals must approach their role with a specific mindset: 'this is your task – this is all you are expected to do – so know it, do it, complete it, and keep your nose out the business of other rescuers'. With four or five rescuers available, the initial McMAID tasks can be completed within 2 min of arrival; three paramedics can accomplish this with practice.

The details of each task included in McMAID are presented below.

Metronome

Chest compression rates exceeding 120 per minute are common [13•,14,15]. Therefore metronomes, providing both audible and visible guidance, were attached to all defibrillators.

Chest compressions

Whenever possible two individuals are assigned this task. One performs compressions and the other devotes their sole attention to observing and correcting the quality of each and every compression, focusing specifically upon rate, depth, and recoil. CCR uses continuous compressions at a rate of 100 per minute. This is hard work and we alternate compressors every minute, using the defibrillator's elapsed clock as a guide. When additional rescuers become free, they are included in the rotation of compressors. It is imperative that the code commander keep the 'observing' member of the compression team on task.

Proper rate and recoil are relatively easy to assess and correct; but shallow compressions [13•,16] are easy to overlook if the compression observer is not specifically trained to watch for them. Rescuers must learn that shallow compressions decrease survival [8] and that their 'personal sense of correct depth', stemming from a fear of causing harm, will be in error and result in shallow compressions [17]. Finally, pausing compressions is only allowed for rhythm analysis and shocking; all other requests to pause are to be ignored.

Monitor (automated external defibrillator or manual defibrillator)

The monitor is turned on when chest compressions are initiated. It then functions as an elapsed time clock guiding other rescuer's activities. It should be physically located so as to be visible to others and should be placed in 'pads' mode. Actual pad placement can be delayed, if necessary, but this interferes with recordings useful for subsequent analyses. When only one rescuer is on scene the decision to place or defer pad placement depends upon when other rescuers are expected to arrive: if help will be forthcoming before defibrillation is needed then the single rescuer can defer placement and instead concentrate upon compressions.

Rhythm analysis and shocking is performed every 2 min. With manual defibrillators, charging is performed during the last few seconds of compressions; analysis is accomplished during a 2–4 s pause; and if indicated, a shock is delivered. Compressions are then immediately resumed. Rescuers are informed before charging that an 'OFF' command followed by a 'BACK ON' will be forthcoming. This eliminates the time consuming 'I'm clear, you're clear ...' babble. Postshock pulse checks and rhythm analyses are not performed. Using this approach, compressions are performed 97% of the time during each 2 min interval.

Individuals trained in ALS will stumble here. They must learn that the purpose of rhythm analysis is simply to decide to shock or not to shock; and this question is asked only once every 2 min. They must suppress their instinctual desire to stare at the monitor and name and treat rhythms that with few exceptions are irrelevant to the success of resuscitation. This is especially true in the postshock period [18]. The code commander must be prepared to intercede to avoid this detrimental detour. The automated external defibrillator (AED) simplifies this issue but because of the long pauses in chest compressions existing units introduce [19], manual defibrillators are preferred if available.

Airway

Initial airway management facilitates passive oxygen insufflations: insert an oral–pharyngeal airway, apply oxygen using a nonrebreather mask, and assess patency. If no fogging of the mask is seen with compressions, a single breath looking for chest rise is given.

Positive pressure ventilations are not performed during the first 2 min in CCR. If the initial rhythm is nonshockable, an invasive airway is inserted and ventilations begun. We do not use bag-mask ventilations. If the initial rhythm is shockable, no airway insertion or ventilations are allowed until after the third analysis or about 6 min after arrival. We permit endotracheal intubation in initially nonshockable patients; but if the initial rhythm is shockable, only a supraglottic airway (e.g. Combitube) is permitted. This avoids a common source of compromised quality of compressions.

Hyperventilation must absolutely be avoided [20]. The importance of proper ventilation technique rivals that of delivering quality compressions. Therefore, when positive pressure ventilations are begun, one person is assigned to that task and does nothing else. Delivering six breaths per minute is simplified by using the monitor's elapsed clock – ventilate on the 10 s. The need to avoid both excessive volumes and prolonged delivery times are taught.

Intravenous–interosseous access

Only one attempt at a peripheral intravenous insertion is allowed. If this is not successful or is unlikely to be successful after initial assessment, an intraosseous device [21] is inserted. Although the benefit of ALS medications has been challenged [22–24], this conclusion may reflect the delay in intravenous access instead of the efficacy of the drugs themselves [25•].

Drugs

One individual is assigned to this task and is responsible for both the administration of medication and documentation using the monitor's elapsed clock. Epinephrine is usually given just before or after the first rhythm analysis (2 min after compressions were started). If indicated, it is then repeated every other cycle. When a shockable rhythm is encountered, amiodarone is given and repeat doses follow local protocols. We administer vasopressin after the epinephrine dose. However, if the patient initially has agonal respirations, vasopressin is given before epinephrine and epinephrine is delayed until after the first shock. We do this because gasping individuals are more likely to be at an earlier stage of arrest and therefore more likely to respond to the first shock.

In our experience, without delegation of drug administration and documentation as a specific task, appropriate timing of repeat doses is lost. Drug administration time is documented to the second so it can be correlated with defibrillator download information in later review of performance.

System issues

Defibrillators and AEDs must be re-programmed. Some AEDs deliver prompts for actions not found in McMAID, and if these cannot be suppressed rescuers must be taught to ignore such commands. We deliver single shocks at maximum joules. Whatever energy a system chooses, it is important to have the defibrillators default to this energy setting when they are turned on. Rescuers must be taught how to 'dump' a charge from manual defibrillators when no shock is advised. Manual defibrillators should, if possible, start up in pads mode. Voice recordings are invaluable when analyzing performance.

Whenever both AEDs and manual defibrillators may be used in a single case, defibrillator pad compatibility issues must be anticipated. This may not be needed with newer AEDs that analyze and charge during compressions.

If patients collapse in a location that precludes optimal delivery of care and an alternative site is available, we recommend that they be moved before initiating compressions.

Finally, the issue of when to transport patients from the scene to an emergency facility or intercepting paramedic ambulance must be addressed. Factors to consider include the loss of quality of manual compressions during a move [26•], the in-field availability of ALS resources, and the probability a patient will survive. Because initially shockable patients are those most likely to survive, our protocol advocates, when ALS care is present, that these patients are worked at the scene until they are either dead or alive. We currently transport initially nonshockable patients after three cycles of 200 compressions and after the invasive airway is inserted.

Training process

Expect problems when training highly BLS/ALS qualified individuals because they tend to view the resuscitation effort as something they accomplish. It is hard to convince them that there may be something better than the 'megacode' approach they have been exposed to for decades. Sometimes it is necessary to have such doubters demonstrate their ability to command a mock code before proceeding further. Questions routinely arise during training about various combinations of both the number and EMS level of responders. Because McMAID is a prioritized sequence of interventions; the answer is simply to complete each step before proceeding to the next.

We have found it best to train each task individually and only later 'put it all together'. Didactic presentations should complement and not detract from learning the task itself. Learning and performing a task properly develops confidence. Those who have experienced the often overwhelming burden of responsibility of managing a 'megacode' rapidly appreciate the division of labor McMAID fosters.

Next comes a 'put it all together' session using groups of four or five rescuers. Trainers are silent observers at this stage and the teams are expected to do their own critiques. Newly trained teams rarely need more than three tries before they function well. Some squads include McMAID task assignment as part of the daily duty roster, thus generating realistic expectations of performance when a code actually occurs. Personnel are encouraged to use McMAID as the basis for critiquing their performance and discussing obstacles they encountered. Crews are encouraged to review McMAID tasks on a regular basis.

The other indispensable component of training is feedback about their successful cases. Nothing will motivate a crew to desire to perform optimally more than a true 'save'; and that will spread like wildfire throughout an EMS system. We have seen it and it is absolutely the most crucial thing that cements 'buy in' for protocol and performance.

Conclusion

McMAID evolved to solve a problem – suboptimal in-field performance. Knowledge, skills, and training were necessary but by themselves were insufficient. We needed rescuers to behave as a unit. They needed to reliably accomplish, with little or no coaching, all of the initial tasks within 2 min of arrival. The tasks are not scenario-based – they are performed the same every time; and when the team internalizes this fact the tendency to chaos dissipates. Correctional prompts for crucial activities such as compressions and ventilations are provided. Unnecessary pauses, known to reduce survival [3,8,27], are eliminated because compressions are only interrupted for rhythm analysis and shocking. The ever present tendency to analyze and chase rhythms is subdued by understanding that the purpose of analysis is to shock or not shock. The single most difficult intervention to monitor and correct is depth of compressions [17]. Having a designated compression observer who specifically monitors depth is the best we could do in this regard. Devices that actually measure depth would be very useful [28•] – but unfortunately they are expensive and therefore not widely available.

We have not 'studied' the impact of McMAID upon in-field performance but reviews of defibrillator downloads and run reports now routinely demonstrate an organization not seen earlier that parallels McMAID. Retraining sessions are briefer, especially for squads that practice McMAID with some regularity

We wholeheartedly agree that '... the increasing availability of ancillary techniques for resuscitation, that should enhance results, has distracted rescuers from the maintenance of standards in essential basic procedures' [13•]. We also conclude that '... CPR performance problems may reside in the effectiveness of the very courses used to improve care' [28•]. A perfectly run code is possible in the wild, and when rescuers participate in the performance of one they seldom revert to the chaos they once knew.

References and recommended reading

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- • of special interest
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