Applying the American Heart Association's Recommended Hands-on-Chest Time Performance Measures

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Although it makes up only about 1-2% of all emergency calls for help, sudden cardiac arrest (SCA) remains one of the most deadly[1]—and one of the most hotly debated—topics in emergency services. Emergency Medical Dispatchers (EMDs) can play a critical role in improving survival rates for victims of SCA. In order to provide the most timely, effective care, EMDs must first identify that an SCA is occurring, then move quickly to provide instructions for bystander CPR. To support the achievement of these twin goals, the American Heart Association (AHA) has recently released proposed standards for EMD management of SCA calls. In total, the AHA released five proposed Performance Recommendations for measuring dispatch responses to cardiac arrest calls. Two relate to identifying cardiac arrest, one to the percentage of cardiac arrest cases receiving dispatcher-assisted CPR, and one to the time it takes the dispatcher to identify the SCA. These will be addressed in future case studies.

The current case study applies the fifth Performance Recommendation, which sets the goal of getting "hands on chest" (i.e., starting bystander chest compressions) in less than 180 seconds from the start of the call—or less than 120 seconds from the time the address is acquired and verified. Hands-on-chest (HOC) time is a critical performance measure for EMDs because research has demonstrated that the less time it takes to begin chest compressions in cases of SCA, the better the patients' outcomes are likely to be.[2]

We applied the standard to all cases in which CPR was provided between January and July, 2016 in a metropolitan dispatch agency in the eastern United States. The agency is an Accredited Center of Excellence (ACE) with the International Academies of Emergency Dispatch, meaning that it maintains a very high level of compliance to protocol. Moreover, all cases were handled using the current, most up-to-date version of the Medical Priority Dispatch System (MPDS), version 13.0.

The objective of this case study is twofold. The first objective is to determine how well an ACE agency using MPDS v13.0 meets the proposed AHA Performance Requirement for HOC time, before the requirement is released as official. The second objective is to provide insight for agencies hoping to apply the standard, particularly in terms of how the standard is meant to be applied and where it is either not applicable or incomplete. Hopefully, this insight will help agencies apply the new standards effectively and appropriately in their own centers, when and if they become official.

WHICH VERSION OF THE RECOMMENDATION APPLIES?

The proposed Performance Recommendation calls for the first dispatcher-assisted chest compression to occur less than 180 seconds from the initial time of the call, or less than 120 seconds from the time the address is acquired and verified. For many centers, identifying the time of the initial call will present issues, as the AHA itself notes. Whether because of transfers from Primary PSAPs, differences in time stamps recorded by different CAD systems, or differences in phone technology, centers will vary widely in their ability to identify the time of the initial call, and different centers may define that time differently.

Moreover, anyone with experience in dispatching knows that the time it takes to acquire and verify an address can vary so widely that it is difficult to create standards for this portion of the call. Rural areas, cities with large numbers of tourists and visitors, and states containing large wilderness areas are among those that can expect longer overall address acquisition times. For these reasons, we suggest using the second version of the proposed Recommendation: ensuring that EMDs are getting the bystander

to provide the first chest compression within 120 seconds after address verification. That is the version we apply here.

CARDIAC ARREST VS NON-CARDIAC ARREST CPR CALLS

Another question to consider before applying the proposed Recommendations is the question of which calls and call types they actually refer to. In the Recommendation document provided by AHA, sudden cardiac arrest is defined as "the sudden, unexpected loss of heart function, breathing and consciousness" that is "commonly the result of an electrical disturbance in the heart." In other words, the Performance Recommendation proposed by the AHA is intended to apply specifically to SCA, a cardiac condition. Such a limitation makes sense, given that the Recommendation calls for compressions-only CPR and for reducing the amount of time to get hands on the patient's chest. True cardiac-based SCA is the condition that most readily responds to compressions-only CPR, and in these cases, getting compressions started as quickly as possible is, indeed, potentially life-saving.

The key here is that the recommendations are not intended, nor should they be applied, to cases that are not actually SCA cases. For good reason, the AHA places considerable emphasis on the correct identification of SCA by the EMD. As in any case handled by EMDs, it is of critical (perhaps even ultimate) importance to accurately identify the actual problem before beginning any treatment or question sequence. Not taking the very small amount of time to actually identify the problem, and for example to distinguish SCA from other conditions that may cause unconsciousness and/or abnormal breathing, can cause EMDs to overlook other, potentially equally serious and treatable, conditions.

Some organizations—the AHA included—lean toward a definition of SCA that drives dispatchers to provide CPR instructions immediately for any patient who is "unresponsive" and not breathing normally. Doing so has a very high sensitivity rate; it captures most SCAs. We must remember, though, that correct identification goes both ways—it includes the correct identification of cases that are cardiac arrests, but it also includes the correct identification of cases that are not. This second aspect of identification has been either overlooked or actively disregarded by many researchers. In fact, following a paper by White et al,[3] there is a belief that unnecessary CPR does not hurt patients, and that therefore performing CPR any time a patient is unresponsive with abnormal breathing has no downsides.

Unfortunately, such an approach overlooks the harm that comes from the failure to provide other kinds of care.

Prior research has demonstrated, for example, that a large number of cases assumed to be SCA (or even diagnosed as SCA by emergency room physicians) are actually respiratory or neurological problems, physical cases of respiratory arrest (such as hanging, drowning, or choking), traumatic events, overdoses, or other non-cardiac problems.[4,5] If there were nothing else the EMD or bystander could do for these patients, immediately getting hands on the chest, even if not necessary or effective, would do no harm. The fact is, though, that for many of these cases, compressions-only CPR is not only ineffective but potentially highly dangerous, as the victim's airway is left unattended. Moreover, proven treatments are available for conditions such as severe allergy and overdose—treatments that are often available on the scene, and that will not be provided if the EMD proceeds immediately to getting hands on the chest.

Another consideration is the identification of potential threats to bystander or rescuer safety. The first law of emergency dispatch, after all, is "Don't send more victims to the scene." Electrocutions, situations occuring in dangerous locations or as a result of a suicide attempt, in-progress violent crimes, car accidents, and many other types of incidents may well involve patients who are unconscious and not breathing—yet we would never want to send layperson rescuers into such scenes.

Fortunately, the AHA has (albeit subtly) provided for differentiating between true SCA cases and other conditions with similar symptoms. By defining SCA as an "unexpected loss of heart function, breathing, and consciousness," they exclude all cases with the obvious, expected outcome of lack of breathing or consciousness, such as hangings, drownings, electrocutions, car accidents, extreme falls, and so on. Moreover, their definition of SCA as "commonly the result of an electrical disturbance in the heart" indicates that they intend for the Performance Recommendations to apply to cases of true SCA—that is, cardiac-caused arrests. Cases of obvious respiratory or traumatic origin, including for example overdoses, allergic reactions, and severe asthma attacks may thus be excluded from the Performance Recommendations as well, which is a good thing, since these types of cases require immediate alternate treatment if available.

Recognizing this distinction will make an enormous difference in your center's evaluation of its HOC times, as you can see in the case study data below. While all of the types of excluded conditions mentioned above may well require compressions at some point or in some instances, they should not be included in the evaluation of your center's HOC time because most require other treatment, a scene safety assessment, or interim scene management (such as cutting down a hanging person) before beginning, or even evaluating the need for, chest compressions.

HOW ARE CARDIAC ARRESTS IDENTIFIED?

The final consideration to take into account when determining how to apply the proposed Performance Recommendations to an individual center's performance is the question of how to identify which cases are cardiac arrests in the first place. The AHA Recommendations call for EMS recognition as the "gold standard" against which dispatcher identification should be measured. Aside from the fact that some agencies will have a harder time accessing EMS data for all their CPR cases, it does make sense for dispatch agencies, wherever possible, to provide dispatchers with feedback on all types of critical calls, including feedback about what the EMS responders found when they arrived on the scene. In this sense, using EMS recognition of cardiac arrest as a measure for EMD identification accuracy is appropriate.

Moreover, although it does not eliminate it entirely, the use of EMS data as the gold standard does address another potential performance measurement issue: the realities of changes in the patients' condition. In most cases, the caller will be reporting an arrest that occurred prior to the call; these are the cases for which the AHA Recommendations are intended. In these cases, the caller almost always reports unconsciousness at the beginning of the call, and often breathing status as well, and these are the cases the AHA (rightly) intends dispatchers to be able to identify quickly.

In some other cases, though, the patient may be unconscious or experiencing breathing problems, lack of alertness, or other symptoms, and then arrest either during the call or after the call is terminated. Depending on the individual agency's policies for remaining on the line (and keeping in mind that the MPDS generally recommends remaining on the line, if possible, with patients in unstable condition), the EMD may handle the call for anywhere from several seconds to several minutes before the patient actually arrests. It is important for agencies to use their case review (Quality Assurance) process to identify these cases and perhaps treat them differently, when evaluating HOC time, than cases that present initially as SCA.

Finally, agencies may wish to separate out those cases that appear in their database as second calls for the same situation, or "reopened" calls. In these cases, the caller reports a medical condition that is not cardiac arrest, often with a conscious patient, and is told to call back if anything changes. Between the time of the call and the arrival of responders on the scene, the patient arrests, at which point the caller makes another call to 911. Often, in these cases, the same case is opened again, the code reconfigured, and the CPR instructions given. As a result, these cases may report HOC time as starting at the initiation of the first call, and if several minutes elapsed between that time and the second call, those several minutes may be included in the HOC time. With an appropriate process and full end-to-end call sequencing, this pitfall may be avoided.

Using EMS recognition of cardiac arrest as the gold standard against which EMD identification is measured makes sense. Nonetheless, a robust and standards-based quality assurance case review system is a requirement for the effective application of these Performance Recommendations.

CASE STUDY FINDINGS

Our case study included all cases for which any form of CPR instructions were provided by the EMD at any point during the call. In this way, we captured all of the call types that may sometimes be labeled as "cardiac arrest," including those that are more accurately categorized as respiratory arrests, overdoses, traumatic arrests, neurological events, and so on. The purpose of including all of these call types is to demonstrate the importance of distinguishing among them in evaluating any center's performance on HOC times.

HOC time in both of the figures below is measured according to the second option included in the well-stated AHA Performance Recommendation—that the median for all true SCA cases should fall under 120 seconds following address verification. We selected this standard for the case study not only because it better captures the time utilized by the MPDS call process, but also because applying a single standard for address verification can be problematic, especially given the differences between land line and cell phone call location reporting accuracy.

Figure 1 reports HOC median times for every case involving CPR, while Figure 2 reports median HOC times for case types that are more likely to include true sudden cardiac arrests (all reported times are medians for the Chief Complaint Protocols listed). Traumatic incidents or those involving scene safety, such as Traffic Incidents and Stab/Gunshot cases, are not included in Figure 2, nor are those requiring other potential treatments and those more likely to be respiratory arrests (and therefore require ventilations or airway maintenance initially), including choking, drowning, asthma attacks, and overdose. This group would also include hangings, although none occurred during the study period. Finally, pregnancy cases are also excluded from the second group because calls handled on the Pregnancy Chief Complaint Protocol and ending in CPR were found to almost always involve CPR following the birth—often for the newborn (not for the initial patient, the mother). In these cases, the pregnancy instructions were of much greater importance, before CPR even became necessary.

Falls represent a special consideration for the identification of SCA because there are two very different types of falls that EMDs may be called upon to handle. Either of these types may result in lack of breathing and/or loss of consciousness. Long or extreme falls, including suicide attempts and industrial accidents, are clearly traumatic events and may well require scene safety assessments, technical rescue, or other interventions before CPR is provided. Ground-level falls, on the other hand, are very often the result of underlying medical conditions, and a ground-level fall resulting in (or from) a sudden loss of consciousness and/or breathing very often is, or rapidly becomes, a cardiac arrest. In the cases reported here, all falls were included in the second group.

The cases identified by EMDs as cardiac arrests at the onset of the call are being handled very effectively. Moreover, these are the strong majority of all the CPR cases (68.5%). The overall median HOC time for all cases handled on the Cardiac Arrest Protocol is 117.5 seconds—already well within the proposed Performance Recommendation. Given that the agency studied here has a very strong QA case review program, and very high compliance to protocol, it is likely that these represent the vast majority of cases in which the patient was in true SCA at the time of the call. Besides Unconscious/Fainting (Near), no other Chief Complaint was used to handle more than 15 CPR cases (2.8% of the total)—and these 15 were Overdoses, which generally require other treatment before CPR is started.

Interestingly, comparing these findings to EMS recognition of cardiac arrest (as proposed by the AHA) may add little information about which cases were correctly identified by the EMD. For example, the patients handled as "Unconscious" received CPR 110 times (19.8% of all the cases). If these patients arrested during the call, EMS would find a cardiac arrest on scene, and

Chief Complaint (CC)	Non-Reopened Cases (Q_1, Q_3)		Reopened Cases (Q_1, Q_3)		Overall (Q_1, (Q_3)	
	N	Median HOC Time	N	Median HOC Time	N	Median HOC Time
Abdominal Pain	1	191 (191, 191)	-	-	1	191 (191, 191)
Breathing Problems	12	214.5 (181.5, 294)	1	548 (548, 548)	13	218 (197, 336)
Cardiac Arrest	349	117 (83, 179)	31	127 (81, 175)	380	117.5 (82.5, 177.5)
Chest Pain	2	264.5 (234, 295)	-	-	2	264.5 (234, 295)
Choking	4	223.5 (202, 252.5)	-	-	4	223.5 (202, 252.5)
Seizures	8	272 (174.5, 374.5)	2	267 (152, 382)	10	272 (156, 382)
Diabetic Problems	5	200 (179, 309)	-	-	5	200 (179, 309)
Drowning	1	106 (106, 106)	-	-	1	106 (106, 106)
Falls	2	374 (270, 478)	-	-	2	374 (270, 478)
Heart Problems	2	361 (197, 525)	-	-	2	361 (197, 525)
Overdose	15	263 (191, 263)	1	292 (292, 292)	16	267 (204, 339.5)
Pregnancy	1	581 (581, 581)	-	-	1	581 (581, 581)
Sick Person	5	274 (224, 503)	-	-	5	274 (224, 503)
Stab/Gunshot	1	386 (386, 386)	-	-	1	386 (386, 386)
Stroke/TIA	1	103 (103, 103)	-	-	1	103 (103, 103)
Traffic Incidents	1	160 (160, 160)	-	-	1	160 (160, 160)
Unconscious	106	222 (154, 299)	4	249.5 (194, 364)	110	222 (156, 299)
Total	516	149 (95, 225)	39	138 (84, 249)	555	148 (95, 225)

*Median Hands-On-Chest time measures in seconds
** Calls most likely to be relevant to the proposed Performance Recommendations

Table 1. Chief Complaint: reopened vs non-reopened cases (trauma/death median Hands-On-Chest time)

Fig. 1 Overall Median HOC Times for All Cases with CPR Instructions Given

would report it that way—and the EMD might not get credit for timely identification of the cardiac arrest because the arrest may not have occurred until a minute or more into the call. Indeed, given the difference in HOC time between those calls identified initially as Cardiac Arrest and those handled initially as Unconscious patients, it is likely that some of them arrested later in the call.

The same is true for cases reported as seizures, breathing problems, chest pain, abdominal pain, or sick person. Callers very often report these symptoms when a patient is in the final stage of a cardiac event—the peri-arrest stage—just prior to the actual cardiac arrest.

A comparison between the first and second figures shows the effect of eliminating trauma, scene safety, and other non-SCA case types from HOC time analysis under this standard. These cases very often require ventilations-first CPR and/or airway management, scene safety evaluation, or other treatments such as epinephrine or naloxone. Including them in the HOC time analysis misrepresents the EMDs' ability to identify, and quickly begin chest compression instructions for, true cardiac arrests.

Separating the reopened cases from the others also provides additional insight into the HOC performance of the EMDs. By definition, CPR cases that were reopened have two things in common: they tend to have longer overall times because of the elapsed time between the first and second calls, and the second call tends to lead to CPR very quickly because the caller almost always calls back specifically because the patient has arrested. While the overall median is lower for reopened cases, this is because of the small number of cases and the fact that some longer call types require staying on the line and tend not to have reopened instances.

CONCLUSIONS

Cases identified as cardiac arrest at the time of the call are clearly being handled within the proposed time frame given by the Performance Recommendation at this agency. These also make up the majority of the calls for which CPR is provided. The second-largest group, patients handled on the Unconscious/Fainting Protocol, would require detailed audio case review to determine which, if any, were "identifiable cardiac

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Abdominal Pain	1	191 (191, 191)	-	-	1	191 (191, 191)
Breathing Problems	12	214.5 (181.5, 294)	1	548 (548, 548)	13	218 (197, 336)
Cardiac Arrest**	343¥	116 (83, 176)	30	127 (83, 175)	380	117 (82.5, 177.5)
Chest Pain	2	264.5 (234, 295)	-	-	2	264.5 (234, 295)
Seizures	8	272 (174.5, 374.5)	2	267 (152, 382)	10	272 (156, 382)
Diabetic Problems	5	200 (179, 309)	-	-	5	200 (179, 309)
Falls	2	374 (270, 478)	-	-	2	374 (270, 478)
Heart Problems	2	361 (197, 525)	-	-	2	361 (197, 525)
Sick Person	5	274 (224, 503)	-	-	5	274 (224, 503)
Stroke/TIA	1	103 (103, 103)	-	-	1	103 (103, 103)
Unconscious	106	222 (154, 299)	4	249.5 (194, 364)	110	222 (156, 299)
Total	487	144 (93, 221)	37	138 (84, 249)	524	140 (92, 217)

*Median Hands-On-Chest time measures in seconds
** Calls most likely to be relevant to the proposed Performance Recommendations
¥ Obvious Death calls excluded in this analysis

Table 1. Chief Complaint: reopened vs non-reopened cases (trauma/death median Hands-On-Chest time)

Fig. 2 Overall Median HOC Times, Excluding Clearly Non-SCA Call Types

arrests" at the time of the initial call, according to the AHA's definition. And even taking into account all call types that may have included any true SCAs (Fig. 2), the overall median HOC time is only 140 seconds.

Though limited, the findings of this case study suggest that call review, by certified quality assurance personnel, is the most important element in evaluating EMD performance on these time-critical calls. Patients who arrest during the call (or between a call and a call-back), callers reporting a situation that requires other types of immediate care or treatment, and situations involving potential safety hazards for callers and bystanders can only be recognized by a review of the call. None of these situations can be accurately identified, or useful feedback provided to the EMD, by measuring them against the EMS responder's report of finding "cardiac arrest" or "no cardiac arrest" on the scene.

Another important implication of this case study is that measuring HOC time performance is not as simple as calculating median times for all CPR cases. Many factors, including call type, timing of the arrest, other treatment requirements, scene safety considerations, and reopening of cases can cause a simple HOC time analysis to misrepresent the agency's performance at beginning chest compressions quickly for cases of true SCA.

Finally, it is important to remember that in any medical situation, gathering less than the necessary amount of information can have serious ramifications. For example, if a doctor does not take the time to listen carefully and misdiagnoses a patient, he or she will treat the wrong disease (and may be liable as a result). Encouraging EMDs to be so focused on HOC time that they miss the signals of other treatable conditions or safety issues leads dispatch in the same, potentially dangerous, direction.

The fact that the AHA is providing (or even proposing) Performance Recommendation guidelines for improved dispatch cardiac arrest identification, increased bystander CPR, and faster bystander HOC times is laudable. This case study should provide guidance for individual agencies as they consider applying the new recommendations in their own centers.

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