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Title: Decoding Twitter: Surveillance and Trends for Cardiac Arrest and Resuscitation Communication

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1 **Title: Decoding Twitter: Surveillance and Trends for Cardiac Arrest and Resuscitation**

2 **Communication**

3 Short title: Decoding Twitter: surveillance for cardiac arrest

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21

21 **ABSTRACT**

22 *Aim of the study*

23 Twitter has over 500 million subscribers but little is known about how it is used to communicate  
24 health information. We sought to characterize how Twitter users seek and share information  
25 related to cardiac arrest, a time-sensitive cardiovascular condition where initial treatment often  
26 relies on public knowledge and response.

27 *Methods*

28 Tweets published April-May, 2011 with keywords: cardiac arrest, CPR, AED, resuscitation,  
29 heart arrest, sudden death and defib were identified. Tweets were characterized by content,  
30 dissemination, and temporal trends. Tweet authors were further characterized by: self-identified  
31 background, tweet volume, and followers.

32 *Results*

33 Of 62,163 tweets, (15,324, 25%) included resuscitation/cardiac arrest-specific information.  
34 These tweets referenced specific cardiac arrest events (1,130, 7%), CPR performance or AED  
35 use (6,896, 44%), resuscitation-related education, research, or news media, (7,449, 48%), or  
36 specific questions about cardiac arrest/resuscitation (270, 2%). Regarding dissemination, (1,980,  
37 13%) of messages were retweeted. Resuscitation specific tweets primarily occurred on  
38 weekdays. Most users (10,282, 93%) contributed three or fewer tweets during the study time  
39 frame. Users with more than 15 resuscitation-specific tweets in the study time frame had a mean  
40 1,787 followers and most self-identified as having a healthcare affiliation.

41 *Conclusion*

42 Despite a large volume of tweets, Twitter can be filtered to identify public knowledge and  
43 information seeking and sharing about cardiac arrest. To better engage via social media,

44 healthcare providers can distill tweets by user, content, temporal trends, and message  
45 dissemination. Further understanding of information shared by the public in this forum could  
46 suggest new approaches for improving resuscitation related education.

47

48 **Keywords:** cardiopulmonary resuscitation; heart arrest; defibrillation; resuscitation; social media

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51 **1. Introduction**

52 Cardiac arrest is a time-sensitive condition in which immediate cardiopulmonary  
53 resuscitation (CPR) provided by bystanders can greatly improve survival.<sup>1</sup> Efforts to engage the  
54 public in bystander resuscitation are widespread, and have included public awareness campaigns,  
55 broadly distributed basic life support training in schools, business, and community groups, and  
56 wall mounted automatic external defibrillators (AEDs) in public settings.<sup>2-5</sup> Despite these efforts,  
57 low rates of bystander CPR, limited utilization of AEDs, and dismal survival rates (median  
58 6.4%) suggest that there is a considerable need for improvement.<sup>6-10</sup> While public health  
59 education will certainly remain an important part of efforts to improve the extent and quality of  
60 bystander CPR, new trends in social media allow us to observe some forms of peer to peer  
61 communication about CPR—observations that may help us improve public understanding and  
62 action.

63 Twitter (<http://www.twitter.com>) is a free social networking platform that allows users to  
64 communicate via 140 character messages called “tweets.”<sup>11</sup> An individual “tweeter” may “tweet”  
65 a short message, which will be received on a desktop or handheld device by anyone who  
66 subscribes to that person’s tweets. With few exceptions, nearly anyone with internet access can  
67 tweet, and nearly anyone can subscribe to that individual’s tweets. Some tweeters, because of  
68 who they are or the content of their tweets, can have large followings. Because tweets that are  
69 received can be re-tweeted, some tweets can propagate rapidly and broadly. At this writing,  
70 Twitter has more than 500 million registered users and distributes over 200 million tweets per  
71 day.<sup>12</sup> Although the sociodemographic characteristics of Twitter users does not completely  
72 represent the general population in the United States (US), the community of Twitter users is

73 diverse and rapidly evolving: in 2011, Twitter was used by 13% of all internet users over the age  
74 of 18, with consistently higher adoption rates among Black (25%) and Hispanic (19%) internet  
75 users compared with Whites (9%), and by those with college degrees (16%) compared with those  
76 with high school diplomas (8%).<sup>13</sup>

77         Because Twitter messages can be publicly viewed and searched, they offer an  
78 opportunity to observe and describe one form of person to person communication, revealing  
79 message content and reach. Prior reports have primarily focused on how Twitter can be used for  
80 public health surveillance.<sup>14-16</sup> Several have used Twitter to track disease activity and public  
81 concern during the H1N1 pandemic in 2009.<sup>17, 18</sup> Twitter has also been used to monitor attitudes  
82 towards influenza vaccination efforts.<sup>19</sup> Further, researchers have documented how Twitter  
83 proved useful in tracking and determining the source of the 2011 Haitian cholera outbreak.<sup>20</sup>  
84 Further, this suggests that Twitter has the potential to inform and educate public health education  
85 efforts in novel ways. Twitter can identify current knowledge deficiencies (areas that require  
86 education), identify key "social influencers" measured by twitter networks (e.g. followers) and  
87 tweet penetration (e.g. retweets), and evaluate the success of public education campaigns.<sup>21-23</sup>

88         Despite the potential for Twitter, little is known however about the prevalence or type of  
89 messages shared on Twitter related to resuscitation and cardiovascular health, topics of major  
90 public health significance. Given the central importance of the public in initiating pre-hospital  
91 resuscitation for cardiac arrest, we sought to characterize cardiac arrest and resuscitation related  
92 public conversation on Twitter by analyzing both tweets (content, dissemination, temporal  
93 trends) and the users posting tweets.

## 94         2. Methods

95 This was a retrospective review of publicly available tweets posted on Twitter. Tweets  
96 can take many forms, including statements, questions, responses, pictures, and web links. Users  
97 can choose to make their tweets available to the general public, or only to specific pre-approved  
98 users. Upon logging in to Twitter, users can read the updated real-time stream of tweets written  
99 by users they follow or posted by others about a specific topic.<sup>11</sup> Tweets can also be directed to  
100 the attention of specific followers by using either a preset list of users with shared interests or by  
101 using the “@” symbol followed by the username of the recipient and then the tweet directed to  
102 that user (e.g. @<Username> <tweet content>). Users can also propagate tweets generated by the  
103 users they follow using the “retweet (RT)” function. “Retweets” then appear with “RT”  
104 preceding them (e.g. RT <tweet content>). Topics of particular interest can be identified by  
105 searching tweets for keywords or usage of specific terms preceded by a hashtag (e.g. #[term]).  
106 Twitter users create hashtags organically to help categorize common themes among tweets.

#### 107 *Study design*

108 A Twitter search engine was used to identify publically available tweets posted April 19-  
109 May 26 2011. Tweets with the following keywords: cardiac arrest, CPR, AED, resuscitation,  
110 heart arrest, sudden death, and defib were downloaded daily for the study time frame. Keywords  
111 were determined by author consensus and a review of tweets identified using cardiac arrest as a  
112 search term, one week prior to study initiation.

#### 113 *Tweet categorization*

114 Using the above keywords, a randomly selected 1% sample of identified tweets was  
115 initially reviewed independently by three study investigators (JB, NZ, RM) to determine tweet  
116 categories. Using these categories, all tweets were then independently reviewed by these  
117 investigators.

118

119 Tweets were first categorized as either related or unrelated to cardiac arrest/resuscitation.

120 Tweets identified as unrelated to cardiac arrest/resuscitation (e.g. extraneous content, non-  
121 sequiturs) were categorized as miscellaneous. For example, “Check out the train schedule at the  
122 CPR, Canadian Pacific Railway website.” Tweets were excluded if they contained non-English  
123 words or terms.

124 Tweets considered to relate to cardiac arrest/resuscitation were categorized as: 1) cardiac  
125 arrest [personal or information sharing], 2) CPR [personal or information sharing], 3) AED  
126 [personal or information sharing], 4) cardiac arrest/CPR/AED [information seeking] 5)  
127 resuscitation education/research/news media.

128 Personal information sharing referred to messages that appeared to be directly related to a  
129 personal experience and included pronouns such as “I,” “my,” or “our.” For example, “My  
130 relative just had a cardiac arrest and is now en route to the hospital.” Tweets classified as  
131 general information sharing lacked a personal focus and included words such as “you,” “others,”  
132 or “the public.” For example, “5 things you should know about automated external defibrillators  
133 in schools are at this website.” Tweets containing questions were categorized as information  
134 seeking. For example, “Which hospitals provide cooling therapy for cardiac arrest patients?”

135 Tweets in categories 1-5 above were considered the final study cohort. Tweets of  
136 uncertain categorization were reviewed and discussed by three study investigators (JB, NZ, RM)  
137 for final adjudication.. Inter-rater reliability for tweet categories assigned by study investigators  
138 (JB, NZ,RM) was assessed using the kappa statistic;  $k=0.78$ ).

139 *Tweet volume*



140 To assess the volume of cardiac arrest/resuscitation related tweets in the study time  
141 frame, tweets were numbered and summed by search term, and then by assigned category (1-5  
142 above).

#### 143 *Tweet dissemination*

144 To quantify dissemination of resuscitation-specific messages, the number of messages in  
145 the final study cohort that were retweeted was evaluated. These messages were identified as  
146 having content preceded by the letters “RT.” Tweets containing a search term with a preceding  
147 hashtag (#) were also identified to quantify how often tweets contained labels that would allow  
148 others searching for resuscitation related content to locate these messages.

#### 149 *Tweet temporal trends*

150 The day of the week of each tweet in the study cohort was recorded to determine when  
151 resuscitation related tweets were occurring and periods of high and low volume. Weekday was  
152 defined as Monday through Friday, and weekend was considered Saturday and Sunday. Tweet  
153 themes on high volume days were reviewed and reported.

#### 154 *Tweeter characterization*

155 The number of tweets per user in the study time frame was assessed to characterize the  
156 users posting tweets in the study cohort and identify high volume tweeters. Tweeters in the top  
157 decile were considered high volume. For this group, data from their publicly posted profile were  
158 evaluated to determine their number of followers and if they self-identified as having a  
159 professional connection with health care as a provider, educator, researcher, or organization.

#### 160 *Statistical analysis*

161 Summary statistics were used to describe tweets by search term (cardiac arrest, CPR,  
162 AED, resuscitation, heart arrest, sudden death, defib) and category (cardiac arrest/CPR/AED

163 personal or general information sharing, information seeking, resuscitation related  
164 education/research/news media, or miscellaneous). To evaluate resuscitation-specific tweet  
165 temporal patterns, tweets were characterized by day of the week. Median tweets per day were  
166 determined.

167 Summary statistics were used to characterize users and user characteristics, volume of  
168 tweets, and potential influence (i.e. number of followers). All statistical analyses were performed  
169 with Stata version 10, College Station, Texas. The institutional review board of the University of  
170 Pennsylvania approved this study.

### 171 3. Results

172 Using seven search terms, we identified 62,163 tweets in the 38 day study time frame.  
173 Many of these tweets, (15,324, 25%) contained actual resuscitation/cardiac arrest-specific  
174 information (Figure 1) and these were considered the final study cohort. The categorization of  
175 tweets by search term is shown in Figure 2.

#### 176 *Tweet content*

177 The distribution of tweet categories is shown in Table 1, along with example tweets:  
178 (1,130, 7%) tweets referred to cardiac arrest events, 6,896 (44%) referred to CPR/AED  
179 performance/use, and (7,449, 48%) referred to resuscitation related education/research/news  
180 media.

181 Of tweets referencing cardiac arrest events (n=1,130), [323, 29%] represented personal  
182 sharing (e.g. “when I or a family member/friend had a cardiac arrest”) and (807, 71%)  
183 represented general information sharing.

184 Of tweets referencing CPR/AED use (n=6,896), most, [4,687, 68%] represented personal  
185 sharing (e.g. actual or classroom provision of CPR/AED, likes/dislikes regarding CPR/AED

186 courses) and (2,216, 32%) represented general information sharing (e.g., observation of CPR  
187 delivery or AED use, commentary regarding hands-only CPR).

188 Of tweets referencing resuscitation specific education/research/news media articles  
189 (n=7,172), the content primarily related to advocacy group events, heart health surveys, research  
190 publications, and news reports of celebrities, athletes, and young adults affected by cardiac  
191 arrest.

192 Some (270, 2%), tweets included resuscitation-specific questions and were characterized  
193 as “information seeking.” These inquiries were distributed across the study time period with a  
194 mean 4.8 questions daily. Of these tweets, (122, 45%) were questions directed at specific users  
195 via “@” tags while the remaining (148, 55%) were questions posed more generally to the public.  
196 Regarding information-seeking questions, (86, 32%) inquiries were related to CPR education,  
197 training, and certification, (27, 10%) to clarifications about definitions for resuscitation related  
198 terms or acronyms such as CPR and AED, and (16, 6%) represented queries about if others knew  
199 how to perform CPR or use an AED. Few (13, 5%), questions represented users seeking  
200 clarification about signs, symptoms, or risk factors for cardiac arrest and sudden death. There  
201 were also (13, 5%) tweets from users seeking subjective opinions or advice, such as how to cope  
202 after sudden cardiac death events. Example tweets are listed in Table 2.

### 203 *Tweet message dissemination*

204 As an indicator for message dissemination, we evaluated retweeting and use of hashtags.  
205 Of the study cohort, (1,980, 13%) represented retweets. The most frequently retweeted messages  
206 related to education about cardiac arrest mortality and news reports about celebrities affiliated  
207 with adult and pediatric cardiac arrest events (Table 3). Few (307, 2%), messages contained  
208 hashtags. Of this group, “#CPR” (209, 68%) was the most common.

209 *Tweet temporal trends*

210 Most tweets were posted during the week: Mondays, Thursdays, and Fridays (Figure 3).  
211 During the study time frame, there were three distinct increases in resuscitation-specific tweet  
212 volume. These were related to mainstream media stories about the successful use of an AED to  
213 revive a fan at a Lady Gaga concert in Tennessee; the story of a 9 year-old boy saving his sister  
214 using CPR emulated from watching the Jerry Bruckheimer movie “*Blackhawk Down*,” and the  
215 use of CPR on the United Kingdom based television show “*Dr. Who*.”

216 *User (tweeter) characteristics*

217 A total of 11,036 users contributed resuscitation relevant tweets; (8,856, 80%)  
218 contributed a single tweet, (1,426, 13%) contributed two tweets, and (714, 6%) contributed 3-10  
219 tweets. A small group of (40, 0.4%) users contributed more than 10 tweets. The top decile of  
220 tweeters had a mean 1,787 followers (range: 54-6,759) and most (37,95%) self-identified in their  
221 profiles as healthcare providers, emergency responders, or medical device manufacturers.

222 **4. Discussion**

223 This study has four main findings. First, the public is using Twitter to both seek and  
224 share a wide variety of information about cardiac arrest and resuscitation. Prior work has  
225 primarily focused on Twitter as a surveillance tool or means for data tracking in public health  
226 disasters and emergencies.<sup>14, 17, 18, 24</sup> This study found that Twitter users discussed a wide variety  
227 of topics related to cardiac arrest and resuscitation including symptoms, risk factors, personal  
228 experiences, training, education, news media events, research articles, cardiac arrest/AED  
229 locations, fundraising opportunities, conference notifications, and screenings.

230 Second, considering the large volume of tweets (200 million per day) our findings also  
231 demonstrated that Twitter can be mined to identify resuscitation related content. Using seven

232 search terms, 25% of the reviewed content was identified to be relevant to resuscitation/cardiac  
233 arrest. While much of the content on Twitter is related to non-healthcare topics, our findings  
234 demonstrate that Twitter can be used to identify a “signal among the noise.” This suggests that  
235 Twitter can be used to better understand how not just cardiac arrest, but other cardiovascular  
236 health related information is being disseminated and discussed. Further, considering that Twitter  
237 is publically available, this tool is readily accessible for scientific evaluations of other medical  
238 topics. There is already a presence of physicians on Twitter who actively discuss medical  
239 information and new literature.<sup>25-27</sup>

240 Third, the public will propagate resuscitation related messages through retweeting.  
241 Previous reports suggest that an estimated 2% of messages are retweets on the broader Twitter  
242 platform.<sup>28</sup> However, in our study, retweets represented 13% of resuscitation related. This  
243 suggests that the public may be more likely to disseminate previous resuscitation and cardiac  
244 health information than generate original content, which presents a new opportunity for  
245 healthcare professionals to engage in the social media health community through the creation of  
246 targeted messages for propagation.

247 Fourth, an additional finding is that Twitter may serve as a window into one part of  
248 public interest and communication in health in real time. Our study adds to the current literature  
249 in demonstrating how Twitter can identify knowledge and concerns about individual public  
250 health issues, how communication is stimulated by public circumstances and propagated through  
251 social networks.

252 A few tweets in the study cohort were identified as question-containing or information-  
253 seeking. This subset represents an important piece of the overall conversation because these  
254 public questions could pave the way for other individuals or organizations to respond. The

255 regular screening of such questions could provide a unique opportunity for health professionals  
256 to reach, respond to, and educate a community of online individuals.

257         Prior data suggests that tweeting behavior differs depending on the day of the week and  
258 the time of day.<sup>25</sup> As illustrated with non-health related topics, tweet spikes also coincided with  
259 mass media events.<sup>29</sup> Monitoring these and other temporal patterns could then help maximize  
260 efforts to share validated information and provide context for ideal times for tweeting new  
261 content or disseminating previously published content.

262         Finally, previous studies have also shown that the health-related traffic on Twitter is a  
263 mix of individuals and organizations.<sup>8</sup> In our study, we found that while most users contributed  
264 single tweets, those who tweeted frequently (15 or more tweets during the study time period)  
265 were often self-identified as having an affiliation with the healthcare field (e.g. medical  
266 providers, emergency responders, or medical device manufacturers). These high-volume users  
267 had a substantial number of followers—this supports the idea that healthcare professionals are an  
268 important part of the online health conversation. Fostering physician and healthcare professional  
269 involvement in social media to disseminate valid health information may be beneficial in  
270 supporting public health interventions routed through social media. –

271         The options for using Twitter for future research are vast and include applications that  
272 would allow for real time promotion and analysis of targeted messaging (e.g. CPR education  
273 campaigns), the use of GIS to identify areas of high cardiac arrest through the use of social  
274 media influencers, and many others.

#### 275 *Limitations*

276         This study has several limitations. First we analyzed only publicly available tweets and  
277 were unable to access tweets by users who elected to make their content private and accessible

278 only to pre-approved contacts. Nevertheless, our purpose was to view the transmission of  
279 information across publicly accessible channels, the same ones that would be used if Twitter  
280 were deployed in a messaging campaign. Second, the search terms selected may not include all  
281 of the words used by the lay public when discussing cardiac arrest and resuscitation (e.g. heart  
282 attack, heart stop, heart thump, chest compression). We did not however, uncover a prevalence  
283 of alternate terms within our study cohort. Third, tweet days of the week were reported relative  
284 to the time frame of the authors which may differ from the time zone of the tweet. Unless  
285 specifically stated in the tweet, the time zone of the tweeter is not able to be definitively  
286 determined. No comprehensive measures exist to determine when tweets are actually read or  
287 baseline temporal trends for all tweets. This study provides insights about when resuscitation  
288 specific tweets could be posted relative to day of the week of the study authors (eastern standard  
289 time). Third, we sampled over a limited time frame. Given the rapid evolution of social media,  
290 it will be instructive to repeat these analyses in several years. Finally, although Twitter users are  
291 a large and growing number, they are not representative of the general population in the US or  
292 elsewhere. A disadvantage of Twitter is its unrepresentative scope. An advantage is that it  
293 allows researchers access into person to person communication that would otherwise be out of  
294 reach.

## 295 **5. Conclusion**

296 This study represents an initial step in understanding the intersection of social media and  
297 public health as it relates to resuscitation science. We illustrated that Twitter messages can be  
298 collected and analyzed to better understand the public's thoughts and feelings about cardiac  
299 arrest and resuscitation. These messages can also be identified to characterize the reach of public

300 health information that is derived organically. These analyses may help shape organized public  
301 health messages designed to improve resuscitation or other cardiovascular health goals.

### 302 **Conflicts of Interest**

303 **Merchant:** Grant/Research support: NIH, K23 Grant 10714038, Pilot funding: Physio-Control  
304 Seattle, Washington; Zoll Medical, Boston MA; Cardiac Science, Bothell, Washington; Philips  
305 Medical Seattle, Washington.

306 **Becker:** Speaker honoraria/consultant fees: Philips Healthcare, Seattle, WA. Institutional  
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311

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320

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410 **Figure legend**

411 **Figure 1. Flow diagram of the cardiac arrest/ resuscitation tweet study cohort**

412 This figure illustrates the tweet categories identified from all downloaded tweets.

413

414 **Figure 2. Tweets identified by search term**

415 This figure illustrates the total tweets identified by search term. The light gray bars represent

416 tweets identified per search term for the entire sample. The dark gray bars indicate the tweets

417 identified per search term for the study cohort of actual resuscitation specific content.

418

419 **Figure 3. Median cardiac arrest/ resuscitation related tweets by day of the week**

420 This figure represents median tweets by day of the week. Day of the week is on the x-axis and

421 median tweets are on the y-axis.

422

422 **Table 1. Characterization of resuscitation related tweets by category**

<b>Category</b>	<b>Description</b>	<b>Example tweets</b>
<b>n(%)</b>		
<b>Cardiac arrest</b>		
<b>(n=1,130)</b>		
<b>Cardiac arrest:</b>	Tweet shares	“@[user] my dad went under cardiac arrest and is in icu”
<b>personal information sharing</b>	information about a cardiac arrest event with presumed personal significance to the tweeter.	“@[user] I can't even imagine my mom was 51 just made 51...fighting cancer...but she had a bloodclot on her lung..it burst. Cardiac arrest.” “Being a part in saving a patient with cardiac arrest just made my day :)” “Heading to VA hosp. 2 visit Dad. Had full cardiac arrest last mo. Looks like he'll see his 90th B'day on May 2. All there mentally. Pray.”
<b>323(2%)</b>		
<b>Cardiac arrest:</b>	Tweet shares	“A 33 yr old Tennessee woman's Heart Stopped for 5 mins at
<b>information sharing</b>	general information about a cardiac arrest event	Gaga concert, as she went into cardiac arrest..her temp dropped to 86 deg. :/” “Chief: cops helped save man in cardiac arrest - msnbc.com [link] #hashtag #hashtag “3 kids struck by lightning in [location] when playing soccer. 1 or 2 went into cardiac arrest but now revived and being taken to hospital.”
<b>802(5%)</b>		

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“22-year old goalkeeper dies of cardiac arrest. 22? That's the youngest I've heard so far.”

“cardiac arrest now at [address]”

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**CPR/AED<sup>a,b</sup>**

**(n=6,903)**

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<p><b>CPR/AED<sup>a,b</sup>:</b></p> <p>Tweet shares</p> <p>personal information sharing</p> <p>4,687(30%)</p>	<p>about CPR or AED<sup>a,b</sup> use with presumed personal significance to the tweeter</p>	<p>“@[user] I just got my CPR/AED, was the AHA Heartsaver CPR/AED course, was in a classroom, hands on, all that. Cost \$55”</p> <p>“@[user] I'm doing cpr at my school :p”</p> <p>“@[user] things have changed since I took it. Daughter just did lifeguard training and got certified. We all should learn or relearn CPR.”</p> <p>“Class went late :( now at least I know first aid, cpr for infants, children, &amp; adults with the AED... I could never be an MD in the ER!”</p> <p>“So not only am I CPR certified, but I think I can handle an AED now. Those things are cool and if they weren't a grand I'd get one for home!”</p>
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<p><b>CPR/AED<sup>a,b</sup>:</b></p> <p>information sharing</p> <p>2,216(14%)</p>	<p>Tweet shares</p> <p>information about CPR or AED<sup>a,b</sup> use without personal</p>	<p>“CPR has changed... oh great”</p> <p>“They say doing CPR outside of the hospitals work 7% of the time! WTH!”</p> <p>“Updated First Aid/Choking/CPR Chart now available u should check it out”</p>
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significance to the tweeter “@[user] AEDs are awesome and provide the ability to actually save a life, unlike CPR which generally just delays death.”

“There is a lot of AED units @ [amusement park]”

“@[user] That's the ratio. 30 breaths, two compressions to essentially act as their heart till a defib arrives.”

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<b>Cardiac arrest and CPR/AED<sup>a,b</sup>:</b>	Tweet shares information about cardiac arrest, resuscitation, CPR, or AEDs <sup>a,b</sup> related to education, research, or a news media link	<p>“Young Tennis Players Could Be At Risk For Sudden Cardiac Arrest” [news link] With no real symptoms, this is a serious matter”</p> <p>“#news: Improving Survival after Out-of-Hospital Cardiac Arrest [news link]”</p> <p>“Prepared for cardiac emergencies? Learn CPR/AED skills FREE CPR Saturday April 30 [news link] Bring friends + family!”</p> <p>“Hands-Only CPR - Create Your Own Hands Symphony [news link]”</p>
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424 <sup>a</sup>CPR indicates cardiopulmonary resuscitation425 <sup>b</sup>AED, automated external defibrillator

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427 **Table 2. Characterization of resuscitation related tweet questions (i.e. information seeking**  
 428 **tweets)**

Category %(n)	Description	Examples
Definition 27 (10%)	Tweet seeks definition or meaning of unknown terms	“what's aed?” “CPR? whats that? sorry :P” “It would be cool if i knew what cardiac arrest was”
Skill knowledge 16 (6%)	Tweet contains question about general knowledge of CPR, AED, <sup>a,b</sup> and resuscitation. Excludes tweets on education and training classes.	“do you know cpr?” “Anyone AED certified? I may need it.” “Who knows about continuous chest compression CPR?”
Follow-up 39 (14%)	Tweet seeks clarification or further information on a presumed past event involving resuscitation	“@[user] what!!! When did u have cardiac arrest?” “where was this code? What level of EMS? general practice is to continue CPR, as long as AED shocks stay on scene then call ERP.” “I really don't want to see the footage... but are there any more updates on [person] after the CPR?”
Education and training 86 (32%)	Tweet seeks information related to CPR <sup>a</sup> training or certification. Includes questions on time,	“@[user] where you do your CPR classes at and how much?” “@[user] you going to cpr training ??” “Who wants to take a free cpr training class with me at

	location, participants, price, materials	[location]?" "@[user] Did they send you home with one of the creepy CPR babies?"
Procedure, technique, or use 17% (46)	Tweet seeks information on resuscitation procedure or technique or use. Includes questions on efficacy and portrayals of CPR <sup>a</sup> on television	"How long can u give a person cpr before u pronounced them dead?" "CPR is one breath for every five compressions again??" "If the person is having a cardiac arrest, do you do CPR, or just CR?" "Why do they never do CPR properly on Tv?"
Symptoms and risks 5% (13)	Tweet seeks clarification on signs, symptoms, and risk factors for cardiac arrest or sudden death	"anyone knows what a heart attack feels like? I may be going into cardiac arrest; my chest feels all tight.." "Is it normal that the stress of this week is giving me pre-signs of cardiac arrest? Cant breathe" "I have high blood pressure and pretty much in under control.Can I still get heart attack or cardiac arrest?"
Advice and opinion 5% (13)	Tweet seeks subjective advice or personal opinions that does not fall into the above categories	"Should I Buy a Used or New AED? [link]" "tell me how to cope with all these sudden death around especially when I'm not there for them." "What are some good ideas for some fund raisers. My sister in law's sister went into cardiac arrest two weeks ago? [link]"
Jobs or	Tweet queries about	"...Looking for a Babysitter?: I am a First Aid/CPR



services	work or occupation	certified nanny looking for full-time summer work”
3% (7)	related topics	“...Childcare opening: I have an opening for a child starting the first week of June. I am cpr first aid certified
Data and facts	Tweet poses a question involving objective information that does not fall into the above categories	“@[user] is this value worldwide or just in america. I think more than 90 percent of my patients don't survive a cardiac arrest..” “a few statistical questions about sudden cardiac arrest? what... [link] #hashtag” “@[user] What's the most common cause of sudden death in athletes >30 ? Nevermind. One sudden death thingie per year is good enough! :)”

429 <sup>a</sup>CPR indicates cardiopulmonary resuscitation

430 <sup>b</sup>AED, automated external defibrillator

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437 **Table 3: Retweets by category**

Category	Retweets n(%)	Examples of frequently retweeted tweets
<b>Cardiac</b>		
<b>arrest</b>		
Personal sharing (n=323)	19 (6%)	<p>“RT @[user]: just saw a man receiving resuscitation on the side of the [interstate] a mile from [town]. Hope he's ok.”</p> <p>“RT @[user]: Hi guys! Pls say a prayer for our dear friend [name] of [town] who's in a coma right now following a cardiac arrest :( ”</p> <p>“RT @[user]: #[hashtag] our team doctor [name] saved a life today at the [name] track meet. [name] coach went into cardiac arrest. [name] &amp; staff saved him # hashtag”</p>
Information sharing (n=802)	136 (17%)	<p>“RT @[user]: All of our thoughts &amp; prayers are with @[celebrity] after he suffered cardiac arrest yesterday in [city]. He's still hospitalized there”</p>
<b>CPR/AED<sup>a,b</sup></b>		
Personal sharing (n=4687)	28 (<1%)	<p>“RT @[user]: #[hashtag] In my opinion - All practices MUST have a maintained defib, training &amp; an emergency plan [link]”</p>
Information sharing (n=2216)	92 (4%)	<p>“RT @[user]: LOVE that the ideal tempo to perform CPR is 100 bpm aka the tempo of "Stayin' Alive" by The BeeGees OR "Another One Bites the Dust" by Queen”</p>
<b>Cardiac</b>		

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**arrest and**
**CPR/AED**<sup>a,b</sup>

Information 8 (3%) “RT @[user]: Who's ready for Easter? We sure are, but what if seeking someone chokes at your family meal? Do you know CPR? Get (n=270) trained! [\[link\]](#)”

“RT @[user]: Anyone know of a place in Charlotte that a free class on CPR could be held? Please let @[user] know. (Pls RT)”

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**Cardiac****arrest and****CPR/AED**<sup>a,b</sup>

Education, 1692 “RT @[news org] The answer to this week's Myth or matter-of-fact research, news (24%) question, Only 10 % of people survive cardiac arrest. media [\[link\]](#)#hashtag” (n=7172) “RT @[news org]: 9-Year-Old Boy, [name], Saved Sister With CPR, Congratulated by Movie Producer @[user]: [\[link\]](#)”

“RT @[user]: [name] used defibrilator & perf CPR on unresponsv 3-mo-old girl at [intersection name] crash on [street] this morn. She regained pulse & @ [hospital name] ICU.”

“RT @[user]: Helicopter is flying in to take [celebrity athlete], who is not responding to CPR. #hashtag”

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438 <sup>a</sup>CPR indicates cardiopulmonary resuscitation

439 <sup>b</sup>AED, automated external defibrillator





