Assessing the Impact of Crowd Tasking Apps on Resuscitation Success: The Case of Sudden Cardiac Arrests in Germany

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ABSTRACT

Sudden cardiac arrest (SCA) is among the three most prominent causes of death in industrialized nations. Therefore, experts are calling for solutions, including IT-systems to mobilize volunteers. SCA emergencies require immediate action and advanced first aid skills. As of today, emergency services are often unable to arrive at the victim in time, and laypeople on the scene frequently fail to conduct resuscitation properly. One approach to solve this problem is to rely on skilled volunteers, who are alerted by smartphone apps. Among others, German researchers are currently developing a crisis response system with a crowd tasking app. It aims to help reduce the effects of large-scale events, but also of ad-hoc incidents including SCA. This paper describes an approach to determine the potential of the system to increase the survival rate of SCA illustrated based upon data from Germany. Its concept was analyzed by experts and benefited from their feedback.

KEYWORDS

Benefit Analysis, Crisis Communication, ENSURE Project, Rescue, Resuscitation, Volunteers, Warning App

INTRODUCTION

Modern societies are increasingly threatened by a wide range of natural and man-made risks. In this context, ‘mitigation’ is an important concept (Van de Walle & Turoff, 2008). According to Labaka, Hernantes, Laugé & Sarriégı (2013), mitigation/prevention ‘refers to the actions taken to identify risks, avoid their occurrence and reduce possible negative effects on human life and personal property’ (p. 132). Van de Walle & Turoff (2008) consider specific large-scale events with a significant impact on life and property. Labaka et al.’s (2013) definition also allows for referring to large numbers of small risks whose significant impact results from high incidence rates.

Sudden cardiac arrest (SCA) is among the three most prominent causes of death after cancer and other cardiovascular diseases in industrialized nations (see Van Aken & Böttiger, 2015). Consistent with Labaka et al.’s definition of mitigation, ‘actions to … reduce possible negative effects on human life’ are required, in particular because attempts of cardiopulmonary resuscitation are often unsuccessful in those SCA incidents that take place out of hospital.

Helbing (2015) propagates a paradigm shift from power to societal empowerment in disaster risk mitigation. In this context, Neubauer, Nowak, Jager, Kloyber, Flachberger, Foitik & Schimak
(2013), identified new processes called ‘crowd tasking,’ ‘dedicated to the improvement of volunteer management applying new media’ (p. 345).

German researchers are developing app-based Early Warning and Alerting System (EWAS) to mobilize registered volunteers. The first such system was “Mobile Retter” (mobile rescuers), which was specifically designed to save lives in case of SCAs, and has been used in practice since 2013 (Stroop, Strickmann, Horst kotter, Kuhlbusch, Hartweg, & Kerner 2015). A similar system which has been designed for a broader range of scenarios beyond SCA, including large-scale incidents and disasters is the ENSURE system which is currently being tested in the city of Berlin (Jendreck, Meissen, Rösler et al., 2016).

Although the positive effects of systems like “Mobile Retter” and ENSURE are unquestioned, implementing such a system, as well as EWAS in general, requires a justification of the costs (see e.g. Klafft & Meissen, 2011). This paper provides a holistic approach to assess EWAS-based SCA risk mitigation activities. It also gives an estimation of the increase in the survival rates in Germany, if volunteers are mobilized by such a service. The paper is organized as follows: the next section discusses the need for warning apps to alert volunteers in case of sudden cardiac arrests. Thereafter, existing approaches for assessing alerting systems are discussed. These approaches lack a discussion of legal and ethical aspects, which is why specific attention is given to these aspects in a separate section. After having completed the discussion of key success factors, an assessment model is developed, and subsequently applied to the case of Germany. The impact assessment of crowdtasking apps for Germany is based on two scenarios: a conservative one based on what has already been achieved in areas where the “Mobile Retter” system is operational, and an optimistic scenario with increased volunteer participation due to potential changes in the legal framework. Finally, the paper concludes with an evaluation, a summary and outlook.

**NEED FOR WARNING APPS TO SAVE LIVES IN CASES OF SUDDEN CARDIAC ARREST**

In Europe and the U.S., at least 1.4 million people die each year following SCA with unsuccessful out-of-hospital cardiopulmonary resuscitation (see Van Aken & Böttiger, 2015 and Weber, Bein, Möllenberg, Geldner, Andresen, Bohn, Braun, Ruppert, Scholz, Strauss, Beckers, Frey & Böttiger, 2014). The tragedy of this statistic is increased by the fact that the potential of successful mitigation measures is not fully exploited yet, while the potential benefits of appropriate reaction strategies are overwhelming. Besides saving lives, the probability that successfully treated patients (i.e., long-term survivors) return to work is high. 52.7% of the 530 patients in the study of Smith, Andrew, Lijovic et al. (2014) worked prior to the cardiac arrest. 76.6% returned to work and 65.2% returned to the same role. However, only a small fraction of patients are currently long-term survivors, mostly due to the fact that resuscitation is initiated too late.

In Germany, approximately 75,000 people suffer an out-of-hospital SCA every year. Although the cardiovascular function may be initially restored in many cases, the majority of these patients nevertheless die within 30 days after being admitted to hospital. Only about 5,000 patients survive this scenario with an acceptable neurological outcome, i.e., without suffering from severe brain injuries and impairments (Stroop, Strickmann, & Kerner, 2015). A key factor for this unsatisfactory outcome is that resuscitation efforts begin too late, which is why researchers estimate that there is potential to save 10,000-15,000 additional people annually if reanimation measures are initiated immediately (see Perkins, Handley, Koster et al., 2015).

Germany has very well-structured emergency services with a dense network of rescue stations. However, the delay between receiving the emergency call at the control centers and the arrival of professional first responders can still be up to 8 minutes in cities. In rural areas, the response time is considerably higher and reaches 12 minutes on average. The chance of survival in a cardiovascular arrest decreases by 10% per minute. After three to five minutes without oxygen, irreparable brain...
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