Viewpoint

The Significance of Witness Sensors for Mass Casualty Incidents and Epidemic Outbreaks

Chih-Long Pan[1], PhD; Chih-Hao Lin[2], MD; Yan-Ren Lin[3,4,5], MD, PhD; Hsin-Yu Wen[6], BMed; Jet-Chau Wen[1,7], PhD

[1]Research Center for Soil & Water Resources and Natural Disaster Prevention, National Yunlin University of Science & Technology, Douliou, Taiwan

[2]Department of Emergency Medicine, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

[3]Department of Emergency Medicine, Changhua Christian Hospital, Changhua, Taiwan

[4]School of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan

[5]School of Medicine, Chung Shan Medical University, Taichung, Taiwan

[6]Department of Clinical Medicine, West China School of Medicine, Sichuan University, Sichuan, China

[7]Department and Graduate School of Safety and Environment Engineering, National Yunlin University of Science & Technology, Douliou, Taiwan

Corresponding Author:
Jet-Chau Wen, PhD
Research Center for Soil & Water Resources and Natural Disaster Prevention
National Yunlin University of Science & Technology
123, Section 3, University Road
Douliou, 640
Taiwan
Phone: 886 55376915
Email: wenjc@yuntech.edu.tw

Abstract

Due to the increasing number of natural and man-made disasters, mass casualty incidents occur more often than ever before. As a result, health care providers need to adapt in order to cope with the overwhelming patient surge. To ensure quality and safety in health care, accurate information in pandemic disease control, death reduction, and health quality promotion should be highlighted. However, obtaining precise information in real time is an enormous challenge to all researchers of the field. In this paper, innovative strategies are presented to develop a sound information network using the concept of "witness sensors." To overcome the reliability and quality limitations of information obtained through social media, researchers must focus on developing solutions that secure the authenticity of social media messages, especially for matters related to health. To address this challenge, we introduce a novel concept based on the two elements of "witness" and "sensor." Witness sensors can be key players designated to minimize limitations to quality of information and to distinguish fact from fiction during critical events. In order to enhance health communication practices and deliver valid information to end users, the education and management of witness sensors should be further investigated, especially for implementation during mass casualty incidents and epidemic outbreaks.

Background

Due to the increasing number of natural and man-made disasters, mass casualty incidents occur more often than ever before. As a result, health care providers need to adapt in order to cope with the overwhelming patient surge [1]. To ensure quality and safety in health care, accurate information in pandemic disease control, death reduction, and health quality promotion is critical [2-4]. However, obtaining precise information in real time during a mass casualty incident is an enormous challenge to all researchers in the field. In this paper, innovative strategies are presented, in order to develop a sound information network using the concept of "witness sensors."

What Are Witness Sensors?

The term "witness" can be found in vital sectors of several medical fields, especially in emergency and disaster medicine.

For instance, many reports emphasize the crucial role of bystanders in out-of-hospital cardiac arrests. These bystanders perform cardiopulmonary resuscitation or use automated external defibrillators [5-15]. When it comes to disaster medicine, the first witness usually initiates the systems of pre-hospital emergency medical services (EMS). However, while continuous messages from witnesses flood social media, a major dilemma arises. Should quantity of data be valued over quality? In order to overcome the reliability and quality limitations of the information emerging from social media, researchers must pay significant attention to developing solutions that verify the authenticity of the messages, especially for matters related to health. In this research, we introduce a novel concept that is based on the two elements of "witness" and "sensor" to address this challenge.

Witness sensors respond in a similar way to physical sensors, since they interact and report in real time. Physical sensors are calibrated and modulated prior to any operation so that only the signals from qualified physical sensors are accepted. Likewise, for the witness sensor, training, management, and accreditation policies are critical and should therefore be further investigated prior to executing this concept.
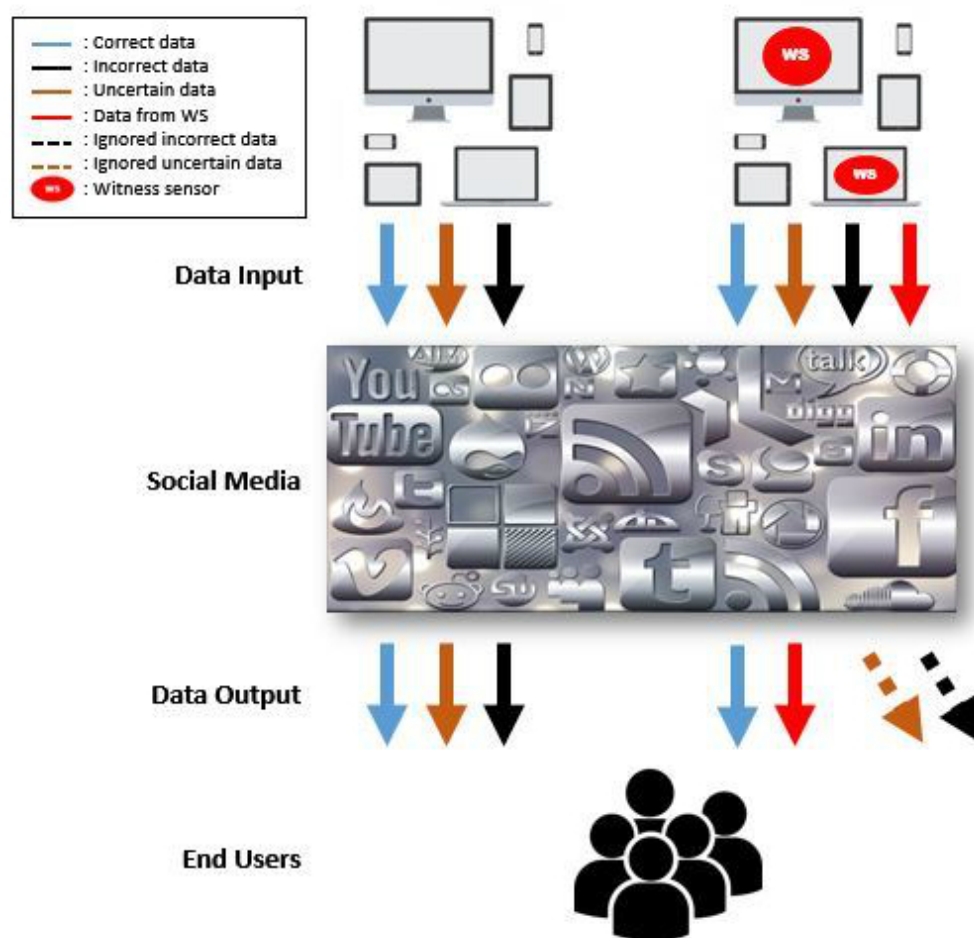
Why Witness Sensors?

These days, the use of social media is an integral part of our daily life. As a consequence, information from witnesses can spread fast and far during catastrophic events [16]. This active and multisourced information is essential during disasters, and it leads to a huge number of messages and posts flooding the Internet. However, the quality and accuracy of some of these data may be questionable.

Nevertheless, the value of witnesses should not be ignored, especially in applied medical practices. For example, a magnitude 6.4 earthquake struck southern Taiwan at 03:57 on Feb. 6, 2016, and caused 513 injuries [17]. Remarkably at 04:05, several messages and images were reported in a discussion group on the widely used instant communication/social media app "LINE" in Taiwan, administered by local emergency medical technicians (EMTs). The major EMS responders were dispatched to the disaster area a few minutes later based on the details provided of the damage. Additionally, all the information was monitored by the fire department, response hospitals, and local government.

Owing to the high-quality information from the local EMTs, a temporary Emergency Response Center was set up immediately by the local government at 06:00 to manage and control the event. The incident command system responded efficiently, due to the precise information given primarily by specific witnesses.

However, this does not always apply in general witness cases. Two individuals shared fake posts on social media causing people to panic during a magnitude 6.0 earthquake that occurred in the same city a year later, at 01:12 on Feb. 11, 2017.

Figure 1. The different information pathways during a disaster between witness sensors and non-witness sensors.

Such phenomena appear globally and although there are mechanisms to prevent such incidents, retrieving and verifying information from witnesses is still a challenge to researchers. The concept of witness sensors is illustrated in Figure 1. Incorrect and questionable information will be ignored while the data from witness sensors are applied as principal references. In addition, qualified witness sensors could ensure the validity and dependability of communication, potentially leading to a paradigm shift in social media.

Similar Cases of Witness Sensors

In Taiwan, several cases based on witnesses and/or volunteers have been applied successfully, mainly for the inspection of traffic and flood events. Real-time reporting of traffic conditions is one such case, which has been well implemented by the Police Broadcasting Service (National Police Agency, Ministry of Interior, Taiwan), online and on radio. The Police Broadcasting Service collects all the incoming information from witnesses and then disseminates that information to road users and to relevant agencies for adequate response and treatment. However, once again, the information quality from general witnesses is not always accurate and truthful, which leads to the need for additional confirmation and accreditation processes by other witnesses or traffic police officers.

This is one of the reasons why the witness sensors should be differentiated from general witnesses; qualification criteria are needed in order to be approved to provide valid information. The precise data collected from witness sensors could produce more reliable and valuable information for all users, especially during or after extreme events.

Training Plan for Witness Sensors

The central dogma of witness sensors is to prevent or reduce the loss of lives during extreme events. The information given by qualified witness sensors could act as a reliable and safe source to corresponding decision makers, compared to data obtained from average social media users. The information pathway is similar to that of social networks, but the response behavior and purpose aim to direct accurate observations to emergency needs instead of personal opinions and embellishments.

Based on our strategy, volunteers will be invited and classified to three levels of witness sensor (WS): WS I, WS II, and WS III. The training goal of WS I is to report on-scene events with true facts, while WS II must report substantial evidence, as well as participate in measurement and evaluation practices. The WS III is a professional level of witness sensors, responsible for in-depth investigations and comprehensive interpretations. In this case, EMTs and members of Disaster Medical Assistance

Teams would be the most appropriate candidates for WS III. Each level of witness sensor may not only act as an information peer, but also contribute to the emergency response of affected groups, when necessary.

Benefits to Health Quality and Safety

Many researchers have welcomed the general benefits of social media to public health [18,19]. Some of the benefits include increased interaction with different groups, open source information, increased accessibility to global health information, support at multiple levels (eg, peer, social, emotional, as well as public health surveillance), and potential to enhance health policies. Even so, there are many limitations when using social media, especially in developing a robust and comprehensive evaluation mechanism to complement the quality concerns and lack of reliability [20].

Hence, the messages and details from witness sensors could not only promote quality information shared through social media, but also become a prototype model for screening the enormously uncertain health information that resides on the Internet. The witness sensors could improve the reliability of primary data and accelerate the tracking of information sources, since these are fundamental issues during pandemic outbreaks or catastrophic events.

Conclusions

Social media and information exchanges on the Internet have become a major communication tool for health providers and users. In this paper, we proposed witness sensors as key players designated to alleviate possible limitations to accuracy of information and to distinguish fact from fiction during critical events. In order to enhance health communication practices and deliver valid information to end users, the education and management of witness sensors should be further investigated, especially for implementation during mass casualty incidents and epidemic outbreaks.

Authors' Contributions

C-LP and J-CW conceived the study, and this concept was first constructed by C-LP. C-HL and Y-RL collected the data and shared their experience in emergency medical responses during a disaster. Their contribution and ideas were extremely important to understanding the real conditions of medical information translation during catastrophic events. J-CW supervised all the details of this research. C-LP and H-YW performed a literature review and drafted the initial manuscript. All authors revised the manuscript. J-CW takes responsibility for the paper as a whole.

Conflicts of Interest

None declared.

References

1. Pan CL, Chiu CW, Wen JC. Adaptation and promotion of emergency medical service transportation for climate change. Medicine (Baltimore). Dec 2014;93(27):e186. [FREE Full text] [doi: 10.1097/MD.0000000000000186] [Medline: 25501065]
2. Broniatowski DA, Paul MJ, Dredze M. National and local influenza surveillance through Twitter: an analysis of the 2012-2013 influenza epidemic. PLoS One. 2013;8(12):e83672. [FREE Full text] [doi: 10.1371/journal.pone.0083672] [Medline: 24349542]
3. Chou WYS, Hunt YM, Beckjord EB, Moser RP, Hesse BW. Social media use in the United States: implications for health communication. J Med Internet Res. Nov 27, 2009;11(4):e48. [FREE Full text] [doi: 10.2196/jmir.1249] [Medline: 19945947]
4. Paul MJ, Dredze M, Broniatowski D. Twitter improves influenza forecasting. PLoS Curr. Oct 28, 2014;6:-. [FREE Full text] [doi: 10.1371/currents.outbreaks.90b9ed0f59bae4ccaa683a39865d9117] [Medline: 25642377]
5. Wissenberg M, Lippert FK, Folke F, Weeke P, Hansen CM, Christensen EF, et al. Association of national initiatives to improve cardiac arrest management with rates of bystander intervention and patient survival after out-of-hospital cardiac arrest. JAMA. Oct 02, 2013;310(13):1377-1384. [doi: 10.1001/jama.2013.278483] [Medline: 24084923]
6. Hansen CM, Kragholm K, Granger CB, Pearson DA, Tyson C, Monk L, et al. The role of bystanders, first responders, and emergency medical service providers in timely defibrillation and related outcomes after out-of-hospital cardiac arrest: Results from a statewide registry. Resuscitation. Nov 2015;96:303-309. [doi: 10.1016/j.resuscitation.2015.09.002] [Medline: 26386371]
7. Nakahara S, Taniguchi A, Sakamoto T. Public-access automated external defibrillators and defibrillation for out-of-hospital cardiac arrest. Am J Emerg Med. Oct 2016;34(10):2041-2042. [doi: 10.1016/j.ajem.2016.07.044] [Medline: 27519452]

8.   Takei Y, Kamikura T, Nishi T, Maeda T, Inaba H. Are qualities of bystander CPR associated with low chance of neurologically favourable 1-Y survival of EMS-unwitnessed OHCAs during nighttime? Resuscitation. Sep 2017;118:e52. [doi: 10.1016/j.resuscitation.2017.08.129]

9.   Geri G, Fahrenbruch C, Meischke H, Painter I, White L, Rea TD, et al. Effects of bystander CPR following out-of-hospital cardiac arrest on hospital costs and long-term survival. Resuscitation. Jun 2017;115:129-134. [doi: 10.1016/j.resuscitation.2017.04.016] [Medline: 28427882]

10.   Malta HC, Rosenkranz SM, Folke F, Zinckernagel L, Tjørnhøj-Thomsen T, Torp-Pedersen C, et al. Lay Bystanders' Perspectives on What Facilitates Cardiopulmonary Resuscitation and Use of Automated External Defibrillators in Real Cardiac Arrests. J Am Heart Assoc. Mar 13, 2017;6(3):-. [FREE Full text] [doi: 10.1161/JAHA.116.004572] [Medline: 28288975]

11.   Lwanga A, Garcia-Sayan E, Lwanga S, Karreman E, Mohamed A. Automated External Defibrillators and Survival After Nonresidential Out of Hospital Cardiac Arrest in a Small North American City. Am J Cardiol. Jun 15, 2017;119(12):1979-1982. [doi: 10.1016/j.amjcard.2017.03.023] [Medline: 28483206]

12.   Boutilier JJ, Brooks SC, Janmohamed A, Byers A, Buick JE, Zhan C, et al. Rescu Epistry Investigators. Optimizing a Drone Network to Deliver Automated External Defibrillators. Circulation. Jun 20, 2017;135(25):2454-2465. [doi: 10.1161/CIRCULATIONAHA.116.026318] [Medline: 28254836]

13.   Mowjood T, Garofalo D, Gagliardi K, Fisher N, Pegg T. Poor Actual Availability of Publicly Accessible Automated External Defibrillators Limit Their Value in the Treatment of Out-of-Hospital Cardiac Arrest. Heart, Lung and Circulation. 2017;26:S9. [doi: 10.1016/j.hlc.2017.05.023]

14.   Holmberg MJ, Vognsen M, Andersen MS, Donnino MW, Andersen LW. Bystander automated external defibrillator use and clinical outcomes after out-of-hospital cardiac arrest: A systematic review and meta-analysis. Resuscitation. Nov 2017;120:77-87. [doi: 10.1016/j.resuscitation.2017.09.003] [Medline: 28888810]

15.   Zinckernagel L, Hansen CM, Rod MH, Folke F, Torp-Pedersen C, Tjørnhøj-Thomsen T. A qualitative study to identify barriers to deployment and student training in the use of automated external defibrillators in schools. BMC Emerg Med. Jan 19, 2017;17(1):3. [FREE Full text] [doi: 10.1186/s12873-017-0114-9] [Medline: 28103818]

16.   Merchant RM, Elmer S, Lurie N. Integrating social media into emergency-preparedness efforts. N Engl J Med. Jul 28, 2011;365(4):289-291. [doi: 10.1056/NEJMp1103591] [Medline: 21793742]

17.   Lin CH, Chang WH, Wu CL, Pan ST, Chi CH. Medical response to 2016 earthquake in Taiwan. Lancet. Jul 09, 2016;388(10040):129-130. [doi: 10.1016/S0140-6736(16)30978-3] [Medline: 27411878]

18.   Giustini D. How Web 2.0 is changing medicine. BMJ. Dec 23, 2006;333(7582):1283-1284. [FREE Full text] [doi: 10.1136/bmj.39062.555405.80] [Medline: 17185707]

19.   Liu BF, Kim S. How organizations framed the 2009 H1N1 pandemic via social and traditional media: Implications for U.S. health communicators. Public Relations Review. Sep 2011;37(3):233-244. [doi: 10.1016/j.pubrev.2011.03.005]

20.   Moorhead SA, Hazlett DE, Harrison L, Carroll JK, Irwin A, Hoving C. A new dimension of health care: systematic review of the uses, benefits, and limitations of social media for health communication. J Med Internet Res. Apr 23, 2013;15(4):e85. [FREE Full text] [doi: 10.2196/jmir.1933] [Medline: 23615206]

Abbreviations

EMS: emergency medical service
EMT: emergency medical technician
WS I-III: witness sensor level I to III

XSL•FO

RenderX

XSL•FO

RenderX