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Integration of live video tools to help the bystander during the emergency call: Protocol for a mix method simulation study

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Abstract

Background: Early action by bystanders is particularly important for the survival of victims, especially in cases of cardiac arrest or airway obstruction. However, few bystanders are willing to perform cardiopulmonary resuscitation (CPR). The use of a live video during emergency calls appears to have a positive effect on the number of CPR performed by bystanders. **Objectives:** The objective is to propose and evaluate the relevance of a Living Lab methodology for simulated life-threatening emergency video call situations. **Methods:** The first study aimed at analyzing the process of dealing with out-of-hospital cardiac arrest (OHCA) in an dispatch center and at collecting the needs of the dispatchers. The second study is a pre-test of the Living Lab. The third study is the Living-Lab in which 16 situations of cardiac arrest and airway obstruction are simulated. The simulation includes both a live video and a transmission of a video demonstration of emergency procedures. The measures focus on three areas: the impact of video tools, the development of collaboration within the community, and the evaluation of the method. **Results:** The first results show that dispatchers have an interest in visualizing the scene with live video, and in broadcasting a live demonstration video when possible. Initial results also show that collaboration within the community is enhanced by the shared simulation and debriefing experiences, clarifying regulation procedures and improving communication. Finally, an iterative development based on the lessons learned, expectations and constraints of each previous study, promotes the existence of a Living Lab aiming at determining the place of live video tools in the sequence of care performed by the dispatchers. **Conclusions:** The Living Lab offers the opportunity to grasp previously undetected insights and to refine the use of the applications while potentially developing a sense of community among the stakeholders.

KEYWORDS: Emergency care, dispatcher, engaging citizens, Living-Lab, apps

Introduction

Background

The care provided in life-threatening emergencies is constantly evolving, partly because of technological advances that are leading to changes and further improvements in the way dispatchers respond to and handle emergency calls. Current health recommendations emphasize that all available resources, both human and technological, should be used to achieve better outcomes in terms of patient care [1]. For instance, in France, a new law has been in place since July 2020 establishing the status of citizen rescuer, whereby any citizen can and should attempt to rescue a victim in a critical situation and will not be held responsible for any consequences related to this attempt. This legislation has the broader goal of improving survival after out-of-hospital cardiac arrest (OHCA). Additionally, since 2015, European and International recommendations for the treatment of OHCA have included the use of digital applications dedicated to trained citizens to promote rapid response to victims of OHCA [2–4]. This concern stems from the proven fact that a victim of OHCA stands a very low probability of survival (around 10%) despite the numerous measures taken as training citizens in first aid, prevention and massive deployment of automatic electric defibrillators [5–7]. Furthermore, OHCA is not the only situation where rapid intervention, by a bystander, for example, can be crucial. In the case of a sudden airway obstruction (choking), particularly affecting children and elderly who are a high risk population [8,9], it is the speed of the action that is at stake. In choking situations, it is recommended to perform back blows (Mofenson manoeuvres), abdominal thrusts (Heimlich manoeuvre) or chest thrusts. These have been shown to be effective in relieving foreign body airway obstruction [10]. In both of these situations, the direct intervention of the bystander results in better survival rates. For OHCA, 13.6% of patients discharged alive are the ones who received bystander cardiopulmonary resuscitation (CPR), compared to 7.3% of patients who did not receive early CPR. When defibrillation is performed by a bystander using an automated electrical defibrillator (AED), the rate of increase is the same: 47% of victims survived to hospital discharge, compared to 28% of victims initially defibrillated by a first responder who arrived later [11]. For sudden airway obstructions, direct witness action resulted in a 68% survival rate for patients compared to 44.7% for victims receiving a later intervention [12]. Yet bystanders are rare to intervene when they witness an emergency. With cardiac arrest, the rate varies from

1 to 18% for defibrillation and 10 to 40% for CPR [13,14]. Similarly, while bystanders performing the Heimlich maneuver have been shown to be essential in improving the outcome of unconscious or unresponsive choking victims, only 25% of the victims receive this assistance [15].

Components affecting the willingness of bystanders to act

Several elements can affect a bystander's willingness to intervene. One study showed that with performing CPR, the fear of hurting the patient is the first issue (reported by 63.1% of respondents for the elderly population and 50.9% for children), followed by a perceived lack of appropriate skills (13.4% for elderly, 23.4% for children) and fear of parental blame for 5.2% in cases involving child CPR [16]. Numerous other studies have indeed shown that bystanders were afraid of causing injury to victims [17–19]. This shows that in order to reduce these barriers, it is therefore necessary to better inform citizens about the consequences for the victim of not receiving adequate assistance and to train the population more widely in first aid. The health professionals themselves also share this limited trust in bystanders, specifically those who are in initial contact with dispatchers. For example, several studies show that dispatchers perceive bystanders as a nuisance due to their inexperience, limited first aid training, and insufficient knowledge [20–23]. This mistrust is compounded by the fact that interactions between both populations are very rare, which can lead to tension and misunderstanding during their communication [24,25]. Also, neither of them is accustomed to collaboration [26]. Moreover, during a call involving an emergency-related interaction, there is no time to build the necessary trust for effective collaboration [27]. In order to improve this relationship between the dispatcher and the bystander who can perform the first aid procedures, two pathways can be considered: 1. Establish a common frame of reference between bystanders and health professionals that allows for more efficient collaboration based on an already established trust. 2. Providing new tools (e.g. live video) in order to overcome the lack of knowledge and training of bystanders and allow them to overcome their fear of acting while providing a sense of confidence to the dispatcher.

Use of live video to enhance communication between the bystander and the dispatcher

The use of live video is an emerging trend in emergency call handling. Live video can be used to assess the condition of the patient or the context and thus provide feedback to the dispatcher, allowing them to have better visibility of the situation. Indeed, there seems to be a discrepancy between the reality of the situation in the field and what the dispatcher perceives by receiving only audio information [28,29]. Live video feedback has also proven to be an asset in guiding CPR [30]. In England and Denmark, video feedback is currently being used in certain dispatch centers with the application GoodSam [30, 31]. The dispatcher also has the option of sending a live video demonstration of the rescue actions that can be performed by the bystander. Studies have shown that viewing a live video demonstration of CPR increases the rate of bystander CPR [31] and improves the quality of chest compressions (rate, frequency, depth of compressions, reduction of interruptions, and the accuracy of one's hand placement) [32–36]. The beneficial effect in terms of medical care is therefore no longer to be proven. However, what interests us in this study is to understand the subjective effect of using such applications in a high fidelity simulation context [38,39]. The high fidelity context refers to the inclusion of all the real actors of the survival chain.

The Living-Lab as a space to create a shared referential

The Living Lab is a method developed in the 1990s at the Massachusetts Institute of Technology which aims to be a meeting place for all the stakeholders involved in a situation to test a technological innovation [37,38]. This method allows a test in a situation close to reality and makes it possible to collect and confront the real constraints even before reaching a more advanced development process. It also provides the opportunity for different populations, varying in their level of familiarity with each other, to interact and collaborate. Living Labs are sometimes used in the medical industry and show positive results on the development of trust between participants thanks to a better understanding of the reality of others [39]. Moreover, Living Labs offer an opportunity to use a diverse set of complementary methodologies. For life-threatening emergencies, simulation seems to be the most appropriate setting. It's important to point out that in order to preserve the safety of the victim and the potentially traumatic effects on the participants, it is not possible to carry out this experimentation in a real context [40]. Simulations with scenarios in a semi-real context seem adequate and can result in a genuine benefit for the participants in moments of emergency or crisis [41,42]. Experiencing the simulations together contributes to the creation of a discourse and a common frame of reference allowing for a more efficient cooperation later on [41,43]. We also hypothesize that learning first aid in this type of setting will allow for a longer retention of skills than in more typical training, where the learning tends to evaporate after six months [46]. Simulation helps induce strong emotions that are a prerequisite for experiential learning [47], demonstrated to be an effective method to retain the acquired knowledge.

Research aim

The objective is to propose and evaluate the relevance of a Living Lab methodology in simulated life-threatening emergency call situations when live video tools are introduced into the call sequence, with the aim of developing skills, trust and collaboration among all emergency chain stakeholders (bystanders, first responders, dispatchers and paramedics).

Method

Research questions and settings

The two objects of study are applications allowing video feedback (Urgentime®) and video demonstration of rescue actions

(SARA®) on vital emergencies (cardiac arrest/FBAO). The emphasis lies on one main research question and two secondary objectives. 1. The practitioner: Does the inclusion of video have an influence on the early treatment of a victim by a bystander in the context of an emergency call? (QR1). The secondary research questions cover: 2. The community: Does the shared workshop have an influence on the building of a common frame of reference between stakeholders? (QR2) 3. The method: Does the Living-Lab methodology adapt to the needs and constraints of the stakeholders during the process? (QR3)

Emergency Medical Communication Centre (EMCC) and Emergency Medical Services

The emergency medical communication center (EMCC) of the Geneva region (emergency number 144) in Switzerland is part of the University Hospitals of Geneva (HUG). In 2021, this center responded to 115,000 emergency calls for the whole region of Geneva (500,000 inhabitants and 120,000 cross-border commuters). Paramedics (50% of the team) or certified nurses (the other 50%), take calls, assess situations and patients, dispatch ambulances and other rescue teams, and assist callers in performing rescue procedures. Geneva's emergency medical system is a two-tier (or three-tier) system, with the paramedic ambulance as the first tier and an emergency doctor as the second tier. A third level consists of a senior specialist physician. In addition to these professional teams, the center can dispatch volunteer first responders for OHCA, or choking situations. A "Save a life" first responder community was created in 2019, which currently consists of 1,500 people, notified by an alarm app (Momentum® from Dos Group®). Instant notification of these first responders is extremely simple (with the push of a button) in the computerized aid dispatch system used by the dispatchers. These first responders usually arrive between 2 and 4 minutes before the paramedic ambulance.

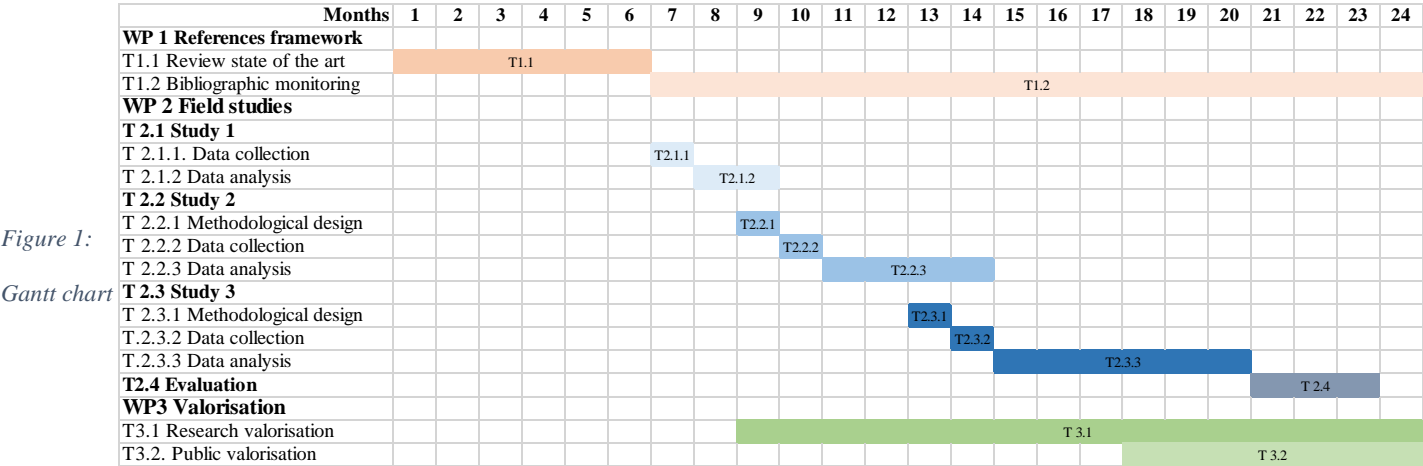
Materiel

SARA® App

The videos used during the experimentation come from SARA, an application developed by The Paris Fire Brigade (BSPP) since 2017. It consists of a smartphone / web application and a back office for the dispatch center. Dispatchers can transmit to the bystander one of the eight videos demonstrating life-saving techniques (CPR, Heimlich maneuver...). The first aid applications only allow acting on the situation when the volunteer arrives on the site, whereas SARA® videos launch an initial relay in communication by involving the calling witness. As the Living-Lab is a living project that evolves with the needs of the end-users (in this case citizens and dispatchers), choosing a flexible and diversified application was important and appealing to us.

Instantview® from the company Urgentime®

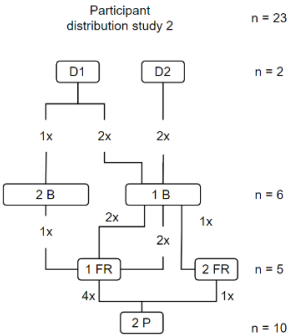
Instantview® is a web application, which allows the dispatcher to see through the caller's smartphone camera. The dispatcher sends a URL via SMS, and when the caller selects this link, the smartphone camera is activated. If the bystander is already calling the EMCC with the same phone, there is no interruption of the audio communication. The video stream is simply added via data exchange (Wi-Fi, 4G, 5G). Once the connection is established, the Instantview® platform can also allow for documents or demonstration videos to be broadcasted on the smartphone, which is connected directly to the EMCC's dispatcher. In light of this innovative context, this is a mix-method study, which is divided into three parts, the first being a comprehension study followed by two experiments (a pre-test and a Living-Lab). The sequence of steps is outlined in Figure 1.



Population

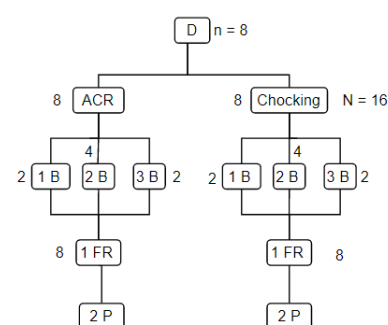
In the first study, there were 5 participants, 2 dispatchers, 1 dispatch coordinator, 1 assistant dispatcher and 1 physician. Our objective was to obtain an overall view of the stakeholders in the center. We solicited the individuals currently working in the dispatch center and interviewed them on a volunteer basis. For the second study, we recruited 23 participants, 6 citizens (B), 2 dispatchers (D), 6 first responders (FR) and 10 paramedics (P) distributed as shown in Figure 2.

Figure 2: Participants distribution study 2



The citizens were solicited via the Geneva Association of Partner Patients, which is a network of former hospital patients who have registered as volunteers to participate in studies conducted at the HUG. There were no exclusion criteria in this study. The regulators were the volunteer regulators working that day. As this study was planned within the context of the National Heart Day, jointly organized by the University Hospitals of Geneva, the ambulance service, and the Save a Life Association, we previously solicited first responders and ambulance attendants to participate in the simulations if they volunteered. Concerning the third study, the distribution of participants was planned as shown in Figure 3. We recruited 34 citizens via the social networks of the Geneva hospitals. We invited citizens who wanted to participate to a simulation to register online. The exclusion criteria were having been trained in first aids in the previous 5 years and being a health care professional. We set the threshold of 30 participants minimum in congruence with studies on qualitative methods demonstrating saturation (the absence of contribution of new elements) beyond this number [48,49]. We planned for 8 dispatchers (each dispatcher carried out 2 simulations), 8 first responders and 6 ambulance attendants who were recruited on a voluntary basis.

Figure 3: Participants distribution study 3



Methodological approaches and data collection

Interviews (study 1)

For the exploratory study, we constructed a semi-structured interview guide that allowed us to collect the information below:

- Description of the current procedure of a cardiac arrest call (e.g. "Can you describe how a call is taken?")
- Perceived benefits and barriers to using an app to send emergency actions (e.g., "In what situation do you think it would be beneficial to use SARA?")
- Dispatcher needs (e.g., "Would there be any other apps that you perceive as useful? Why?")

We conducted 5 interviews (mean length of 30 minutes).

Simulation scenario (studies 2 and 3)

During the pre-test, one scenario was tested:

"You find a 60-year-old unconscious man in Chaumettes Park. You call 144 and follow the instructions the dispatcher gives you."

The dispatcher carries out the victim's assessment via audio communication. The patient turns out to be in cardiac arrest, the dispatcher sends the video of SARA demonstration gestures. He then asks the participants to perform CPR on the mannequin until the paramedics arrive (8 minutes in the Geneva region). Save-a-Life first responders join the participant around the 6-minute mark.

The Living Lab tests 2 scenarios:

"You find a 60-year-old unconscious man. You call 144 and follow the instructions the dispatcher gives you."

A live video feed allows for the assessment (Urgentime®). Once the dispatcher diagnoses the patient as being in cardiac arrest, he sends the SARA CPR recorded video demonstration. Participants start to perform CPR on the mannequin until the arrival of the ambulance (8 minutes in the Geneva region). Save-a-Life first responders join the participant around the 6-minute mark. 8 situations are performed with 1 participant and 8 with 2 participants.

"You encounter a panicked person with an infant who appears to be choking. You call 144 and follow the instructions the dispatcher gives you".

A live video feed allows for the assessment (Urgentime®). The dispatcher determines that the infant is experiencing sudden airway obstruction. The dispatcher sends the recorded video demonstration of the Mofenson manoeuvre. The participants are invited to carry out the manoeuvre until the child cries (responsive mannequin) or until the situation deteriorates into CBA (2 situations out of 8). 8 situations are performed with 1 participant and 8 with 2 participants.

All simulations were filmed and recorded in an audio format.

Group interviews (studies 2 and 3)

Collective elicitation interviews follow the simulations with all participants per simulation (about 30 minutes). Elicitation interviews [44] are an interview technique aiming for the interviewee to focus on their experiences and feelings during a particular event. The interviewer aims on deepening the lived-experience and sensations while avoiding questions that lead to a rationalization of discourse [44,45]. This technique can be used with a single person or a group [46].

We built an interview guide allowing us to collect the following elements:

- Feelings related to the use of the applications: benefits, constraints, perceived helping elements (e.g. to the citizen "When you received the SARA video, how did you feel?")

- Subjective contributions of the method: perceived contributions in terms of learning, understanding of the course of an action, feeling of community (e.g.: to the dispatcher "Did the simulation make you aware of elements that you had not perceived until then?")

The interviews (5 lasting a mean of 40 minutes for study 2 and 16 lasting a mean of 45 minutes for study 3) were audio recorded.

Artistic approach (study 3)

Throughout the construction process of the Living-Lab, an artist follows the preparatory meetings between researchers and stakeholders and collects information on how the Living-Lab evolves based on the results of the preliminary experiment. They contribute to the added value by proposing to photograph a particularly significant scene co-constructed with the participants during the Living-Lab.

Data analysis

First, we transcribed all the audio recordings (interviews and debriefings), which allowed us to obtain a corpus for our studies 1, 2 and 3. In the filmed sequences (studies 2 and 3), we also recorded the times from the moment the dispatcher picked up the phone including the recognition of the cardiac arrest, the implementation of the emergency procedures, the sending of the video and the reception of the video. We then compare our data with the data from the literature. We also noted the number of times the applications were not successful. We then categorized the different simulations into action sequences (discovery of the victim, the call for help, the 144 call, the evaluation of the victim's condition, the implementation of gestures, the arrival of the first responder, the implementation of the defibrillator, and the arrival of the paramedics) in order to compare the situations between them in terms of actions carried out (observations) and feelings (debriefings). Secondly, we carried out a thematic analysis using Atlas.ti® 8.1 on our corpus. Thematic analysis is a method which "consists of systematically identifying, grouping and, subsidiarily, examining the discourse of the themes addressed in a corpus" [53] by categorizing the verbatim accounts according to the themes of our research questions. Thus, for study 1, we had 3 main themes (OHCA procedure, interest and obstacles of SARA and the needs for regulators), which we were able to divide into sub-themes (for example, for the OHCA procedure: an evaluation procedure, a procedure for implementing the gestures, difficulties mentioned, etc.). For study 2, the three themes were the impact of SARA on care (with sub-themes: difficulties, obstacles, and benefits mentioned), the benefits for the community (with sub-themes: learning, awareness, and confidence) and the subjective evaluation of the method (with sub-themes: obstacles mentioned, bias, and elements to be modified). Finally, for study 3, the three axes were impacts of the applications (with sub-themes: SARA, Instantview, feelings related to use, and evoked benefits), evoked benefits of the method (confrontation with reality, training, feeling of federation, discovery of the chain of survival) and subjective evaluation of the method with the same sub-themes as for study 2. This categorization into sub-themes allowed us to link the sequences of actions and the related feelings in order to understand which elements allowed for a positive feeling and which ones were more of an obstacle. Finally, for study 2 and 3, we used the times we recorded to evaluate the reliability of the applications and their temporal impact. For the quantitative analysis, we used Microsoft® Excel® 2016 (16.0.5356.1000).

Ethical considerations

We provided a document to all participants explaining that we were collecting data (photographic, audio and video) as part of the research and that this data would be used only to analyze the process and also as support for scientific presentations. At the beginning of the session, all participants were asked to read and then sign these consents or indicate their opposition before conducting the experiment. The analysis and presentation of the data and their results is anonymized (participants are identified via a coding system). The offer of compensation was to get one hour of free training in first aid and emergency procedures by certified professionals.

Results

Here we present the results of the first two phases and then an elaboration of the expected results from the Living-Lab.

Understanding study

Current cardiac arrest procedure for dispatchers

According to the physician who participated in our study, around 2 cardiac arrests occur each day in the Geneva area, 33% of which are in public areas (streets, public transport, etc.). With cardiac arrest being top priority, the dispatcher has 90 seconds to send resources from the moment the telephone call starts. An automated cardiac arrest procedure appears when the dispatcher completes the information related to the patient's condition, which they collect following a specific process. Currently, dispatchers can do the assessment via video feed (Urgentime®) or via an audio phone call. First, they must obtain the patient's location then assess their state of consciousness and breathing. If the patient is unconscious and if there's a breathing anomaly (or not), the dispatcher sends an ambulance as priority 1 and also sends a first responder via the Save a life button, and then tries to set up CPR with the bystander.

Barriers for relying on citizens for cardiac massage

It appeared throughout the interviews that asking the bystander to do the CPR is a difficult task for the dispatchers. They described

witnesses who were not always willing to come close to the victim during the assessment phase, "even to put their hand on the stomach [to check for breathing]." They specify that the bystander often doesn't perform CPR because they do not want to take responsibility of the action and they are frightened.

Dispatchers' expectation

When asked about the use of SARA® videos, dispatchers expressed that they would need integrated videos directly in the Computer-Aided Dispatch system to avoid going to a separate computer for the video. They also raised concerns about the target population of the application; cardiac arrest victims are more likely to be at home and senior citizens. Nevertheless, they believed that the CPR video offered a benefit and could be an asset in motivating some hesitant witnesses. Dispatchers also expressed a need to be able to receive video feedback to "keep the connection with the caller". They could gain more insight on their guidance: "you can see the CPR being performed and guide it further" and identify potential mistakes in the execution of CPR. "We think people understand and at the end of the day, what is done in reality may not look so good."

Preliminary study

Effects of the CPR video demonstration on the victim's treatment.

Dispatchers recognized the cardiac arrests in 1'09, 1'32, 1'21, 2'51, and 1'56 after call pickup. The video was described as "useful," "a good input" and "stimulating" by 5 of 6 participants. Overall, they identified two advantages of using a video during CPR: a better posture and more accurate performance of CPR. Participants also valued having a sound that signaled each compression to perform. It was thus easier for them to follow the right chest compression rhythm compared to if they were alone. It aids participants to synchronize with the video and follow the "right rhythm".

Joint simulation and debriefing effects on the CPR lived experience and relationship between participants

Early feedback shows that the video had a reassuring effect on participants emotionally affected by the situation: "emotionally it is quite strong, we imagine the person lying down.". As dispatchers hinted during the exploratory study, the video does help to initiate a massage in cases of hesitation by the witness. It also seems to reassure the bystander with the gestures they perform: "I was glad that I could have a link, to be able to see it, it made me feel secure". Lastly, the video provides comfort through the words of support implemented "I felt more like I was getting good support, even encouragement to keep doing well". The dispatchers also found that sending the video was reassuring: "the fact that they are watching, they are going to correct themselves and for us it is reassuring". They also sensed more "serene", "reassured" witnesses on the phone. However, in the subsequent interview with the dispatchers, they actually described being "falsely reassured" because they were ultimately unsure that CPR was occurring and the fact that they were sending the video prevented them from providing voice guidance over the phone. The simulations also allowed all stakeholders within the survival chain to interact and collaborate. In opposition to what appears in the literature, professionals (first responders, paramedics, dispatchers) have not considered the witness to be an obstacle but rather an additional resource to accomplish an essential act. A first respondent told us, "I have other skills; I will let the bystander do the massage". The bystander can also establish and maintain the link with the emergency services "By the time the ambulance arrives, you start to get tired and being able to have someone who has a contact with the professionals, even psychologically, helps". The bystander is therefore an additional resource that enables a more optimal distribution of the tasks carried out (a relay for compressions, placing the defibrillator patches, etc.). Yet, both the first responder and the dispatcher must have confidence in the bystander to delegate. The first respondent obtains this trust by the active or inactive position of the witness. For the dispatchers, confidence is based on the witness's ability to understand and respond. The simulation also led some participants to gain a better understanding of the regulation process. This could help prevent frustration in the future. For example, two participants did not understand why they should not act immediately. The joint debriefing gave the dispatchers the opportunity to explain this process.

Obstacles identified

One of the first obstacles to consider are technical difficulties, as they cause a lengthening of response time. When fully functional, as it was in Simulation 1, the app enabled cardiac massage to start in 3.15 minutes. However, dispatchers stated they were unsure whether they saved any time compared to audio guidance. In addition, as the application is still at the prototype stage, its stability is uncertain and the transmission of video is not always optimal in terms of time or quality. We also chose to give participants the same "standardized" cell phone to avoid any differences in participants' personal phones. However, this led to two problems: a difficulty in handling the new phone in an emergency and a very low output sound. Dealing with a phone that was not their own was described as an additional challenge, and even stressful, as the participants were not always able to identify where the speaker was located and where to go to get the SMS to open the video/webapp on the phone loaned for the test. While in a real-emergency situation it can be more complex to perform these simple gestures on one's own phone, we can assume that the fact that they were given a new phone accentuated these confusing effects. Sound-related problems further affected negatively the handling of the victim. Participants also reported experiencing trouble hearing the instructions given by the dispatcher. As a result, the dispatcher sometimes had to repeat the instructions several times, and in some cases, participants were unable to understand the action to carry out (especially in the evaluation phase). These elements led to a deterioration of the relationship between the dispatcher and the participant as these elements prevented a proper establishment of communication. This can result in a feeling of isolation on both sides.

Living-Lab expected results

Effects of interacting via video on the handling of emergencies

The expected results for the practitioner are oriented towards a better handling of the victim by the bystander both in time and in performance of the emergency procedures. For this purpose, a comparison will be made between OHCA and FBAO control situations (audio tapes of real situations) and simulations to understand if the video saves time during the patient-condition assessment (Urgentime®) and on the execution of first aid actions (SARA®). A comparison of one-witness situations with two-witness situations has also been carried out to determine the most appropriate context in which to use video. We therefore expect the situation to be easier to manage when there are two witnesses (one holding the phone and the other performing first aid). We also evaluate whether the use of live video and demonstration video can reassure the witness and possibly convince them if they are hesitant to perform emergency actions. Finally, we will evaluate whether the use of two functionalities (live video and demonstration video) leads to cognitive overload for the dispatcher.

Effects of simulation and joint debriefing on the experience of dealing with an emergency and on the relationship between stakeholders

As in the preliminary study, we expect that the shared experiences (simulations, debriefing and artistic staging) allow both populations to exchange and learn to collaborate. We expect effects in terms of knowledge transfer with a better understanding of emergency procedures for the participants and that also enhance communication (with video) lead to better and faster trust building between the stakeholders. Analyzing the debriefings and the construction of the re-staging process provide insights into the key elements for the participants as well as clues for future Living-Lab focused activities.

Living-Lab constraints, benefits and value

As in the previous study, the stakeholders review and analyze the challenges encountered to facilitate the replication of the Living-Lab toolkit in other emergency dispatch centers. In addition, they assess the direct benefits (expected) and the secondary benefits (reported by the participants but not anticipated).

Discussion

We collected results in three areas. The first provided us with subjective elements of understanding on the effects of the inclusion of video on the early treatment of a victim by a bystander. We were interested in understanding the effects on the experience of the different stakeholders and in particular on the dispatchers. A second area focused on gathering evidence on whether or not the simulation developed a sense of community and collaboration among the participants. Finally, the third highlighted the contributions of the Living Lab methodology in terms of learning and confrontation with reality.

Principals findings

Regarding the use of applications, the main results concern the discovery of the dispatcher's feeling when they use an application to help with emergency procedures. Indeed, they expressed that they felt substituted by the application because it took precedence over them, allowing them neither to follow the patient's treatment, nor to realize that there was a need to restart the guidance of the cardiac massage when there was a technical failure. From a community perspective, we found that all stakeholders were willing to work together and that there was no reluctance on the part of dispatchers, paramedics, or first responders to work together. The citizen is seen as a full member of the chain of survival. Regarding the methodological aspect, we found that the approach is flexible and allows for the adaptation of scenarios according to new inputs from previous steps. As a result, we were able to integrate the needs of the regulators (feedback) and address the identified constraints. At this stage, the main results concern the fact that the simulation allows us to apprehend difficulties beyond those addressed; it allows us to see the constraints of internal procedures or the effect of having three different tools at the same time. This advantage is related to a confrontation to the reality with all the stakeholders. It could not have been detected in simulations with a single citizen and a dummy.

Comparison to prior work

Dispatchers expressed a strong interest in using a video feedback app to gain visibility of the situation and of CPR guidance, which is consistent with the literature reviewed [28,29]. Since the time this study was carried out, the central office has implemented the Urgentime® application that allows this video feedback. Instantview achieves results similar to those described in the literature for the GoodSAM application. [30, 31], a reliability of 80%, and allows the dispatcher to recover the view and facilitates the evaluation and guidance. In this setting, we coupled SARA (video demonstration) and Instantview (visual feedback), which has never been done to our knowledge. Dispatchers showed an interest in testing an application that would allow them to send demonstrations of emergency procedures as they admitted finding it difficult to convince a bystander to perform CPR just by audio-guidance. Indeed, in the preliminary study, one reluctant bystander did perform CPR because he felt "reassured" by the video. Research indicates that a demonstration video can improve CPR quality in terms of rhythm, number, and depth of the compressions, reduction of interruptions and placement accuracy [32–36]. The depth and number of compressions could not be assessed in the preliminary study. However, a more adequate and sustained rhythm was observed when participants followed the video (thanks to the rhythmic sound they heard), and their posture was more adequate (by

mimicking the expert they saw). To conclude this section, we would like to highlight that there is a high level of investment by the EMCC in the deployment of all possible technological (Save a Life, SARA®, Urgentime®) and human resources to improve the handling of cardiac arrests in line with recent European and international recommendations [2–4]. Researchers point out three main reasons behind the limited reliance on bystanders in emergency situations: citizens' fear of taking any action [17–19], professionals' mistrust towards them [20–23], and the absence of any prior collaboration [24,25]. While the dispatchers confirmed this fear of action on the part of citizens during the exploratory study, the results of the preliminary study did not show this element. Some participants expressed that they were intimidated by the situation but felt reassured by the dispatchers' assistance. The dispatchers and first responders never reported any reluctance to rely on a bystander, in contrast with the literature. Furthermore, health professionals have developed skills to quickly assess whether the witness present can be a trustworthy relay or not. For first-responders, it is a matter of seeing an active, calm, and focused person on the task. For the dispatcher, this consists of evaluating how the individual understands and responds to their questions while assessing the victim's condition. Within this short period of time, which, in Geneva, is limited to 90 seconds in order to recognize cardiac arrest and start CPR, the dispatcher already knows if they are communicating with a reliable bystander or not. Throughout the preparation of the Living-Labs, it became apparent that adapting to the needs of the different stakeholders was crucial in order to come as close to reality as possible and to try to secure a better commitment from the participants [41,42]. Initially, the selected end users for the Living Labs were only dispatchers and citizens. However, during the exploratory study, we became aware that the Geneva EMCC was working closely with the first responder application Save-a-Life. Consequently, first responders were integrated into the simulations in order to remain as close as possible to a real-life cardiac arrest in the Geneva region where first responders would be alerted. This highlights how the Living-Lab is built upon a pre-existing territory and is constantly evolving according to the feedback, difficulties encountered as well as the needs and expectations of the stakeholders. Regarding experiential learning [47] we found that the simulations provoked strong emotions in the participants, which is a prerequisite for this learning to take place. We also found that the debriefings were a space to exchange and offer new knowledge to the bystanders, potentially facilitating future collaboration [41,43]. In order to evaluate the retention rate of knowledge, we will do a debriefing with the participants in six months.

Strengths

The main strength of these studies is to adopt an angle that allows to understand the emotions and to evaluate subjectively the impact of the applications and of the methods used among the various stakeholders. This angle makes it possible to document aspects that were not previously addressed. In particular, it allowed us to discover that the use of applications provoked uncertainty in the dispatcher, an aspect that had not been detected in simulation in the other studies mentioned in the literature. The fact of integrating all the actors of the chain can potentially have a concrete effect on the real care in Geneva as it enables the community to gain a better understanding of each other and to collaborate more efficiently. The aims of our studies are not only to evaluate an application in technical terms but to use these experiments as a pathway to work on the development of collaboration.

Limitations

The main limitations of this study are that the pre-test was conducted in the context of National Heart Day, so the citizen volunteers were all sensitive to the issue and none refused to perform cardiac massage. Moreover, the fact that it was only the dispatchers that wanted to participate biased the results since we could not know the possible resistance to use this application. Finally, in order to achieve broader community development, a regular Living-Lab would be required with various communities and this process is costly in terms of time and investment from all stakeholders, making the method difficult to apply on a large scale.

Data availability

The data sets generated during and/or analyzed during the current study are not publicly available due to the right to privacy but are available from the corresponding author upon reasonable request.

Ethical Considerations

Each participant signed a General Data Protection Regulation consent form giving permission for audio and video recording and use for research purposes.

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Abbreviations

AED : automated electrical defibrillator

CPR: cardio pulmonary resuscitation

EMCC: emergency medical communication centre

FBOA: foreign body obstructed airway

OHCA: out of hospital cardiac arrest