Improving cardiopulmonary resuscitation by building trust between dispatchers and citizens through simulation workshop

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ABSTRACT

Improving the survival rate of Out-of-Hospital Cardiac Arrest (OHCA) remains an important public health issue. Indeed, current survival rates are approximately 10% and can be significantly enhanced by early Cardiopulmonary reanimation (CPR) and early defibrillation. Bystanders are most likely to perform these acts, but few resources (such as digital apps) are dedicated to them due to a lack of confidence in their abilities from them and from the professionals. In order to build trust and collaboration between the dispatchers and the bystanders, an OHCA simulation workshop was conducted involving the whole survival chain. The main idea consisted in getting the participants to interact via an application dedicated to bystanders which provided a CPR demonstration video. The aim was to analyze the effects of this video on the CPR itself and especially on the lived-experience of the participants. A further objective was to assess how the shared workshop would affect the relationship between the stakeholders.

Keywords

OHCA, survival chain, engaging bystanders, trust, living-lab, apps

INTRODUCTION

Improving survival of out-of-hospital cardiac arrest is a consistent public health concern. On a global level, the incidence of out-of-hospital cardiac arrest averages 55 per 100,000 persons each year (Yan et al., 2020). Only 7-10% of those survive (Gräsner et al., 2020; Rumsfeld et al., 2016; Berdowski et al., 2010). The three critical elements currently identified to improve the survival rate are early recognition, early cardiopulmonary resuscitation and early defibrillation (Deakin, 2018, Perkins, Handley, et al., 2015). Therefore, the witness or bystander is the individual who can act the most quickly on these three elements. He can indeed call the emergency services and give information to the dispatchers in order to recognize the cardiac arrest and then perform an early cardiac resuscitation as well as a defibrillation if he has the possibility to do so. Even if he is unable to perform defibrillation, chest compressions prolong ventricular fibrillation through blood flow into the myocardium, enhancing the chances of successful defibrillation by paramedics (Berg et al., 2019). Data collected in 2018 by the Cardiac Arrest Registry to Enhance Survival (CARES) in the United States indicates that 13.6% of patients with bystander CPR are discharged from the hospital alive versus 7.3% of patients without bystander CPR. Among those whose primary Automatic Electric Defibrillation (AED) was initiated by a bystander, 47% survived to hospital discharge. In contrast, 28% of victims initially defibrillated by a first responder has survived (Souers et al., 2021). However, bystander rates for defibrillation and CPR remain quite low according to various studies and geographic areas. It ranges from 1 to 18% for defibrillation and from 10 to 40% for CPR (Valeriano et al., 2021; Virani et al., 2020). In light of these data, there is a need to understand which levers can improve these rates. It also involves reviewing the currents tools and resources available to both bystanders and dispatchers in OHCA situations.

STATE OF THE ART

Survival chain in OHCA

Dispatchers are identified as the critical actors in getting bystanders to initiate cardiac resuscitation (Harjanto et al., 2016). However, the chain of survival includes several interveners (bystanders, dispatchers, first responders[1], paramedics) that collaborate (Deakin, 2018). Current European recommendations suggest to "never evaluate the value of (bystander) CPR in isolation but as part of the whole system of healthcare within their region. (Bystander) CPR seems feasible in settings where resources and organization support the integrity of the chain of survival." (Mentzelopoulos et al., 2021). In addition, the context of the intervention in a given region with associated resources must be considered. Thus, not all countries and even regions have access to the same means of action. Some call centers use digital applications that allow first responders to intervene on OHCA as Pulsepoint (US), GoodSam Alerter (UK), HeartbeatNow (Netherlands), Staying Alive (France), Save a Life (Switzerland), MycitySaves (Germany) (Valeriano et al., 2021) which has proven to be effective by increasing the survival rate to 35% (Derkenne et al., 2020). Although there are digital solutions to improve the handling of cardiac arrests on the side of the first responders, the second link in the chain of survival, there are fewer solutions available to improve the response of the first link, the bystanders. Indeed, only 7% of the digital emergency applications are dedicated to them compared to 28% for the first responders (Gómez et al., 2013). As mentioned in the introduction, the survival rate increases when the witness performs CPR. The applications intended for bystanders that allow them to receive videos demonstrating the CPR gestures not only increase the number of CPRs performed (82.7% compared to 77.1% in audio guidance[2]) (Lee et al., 2020); but it also improve the quality of the CPRs (in terms of rhythm, depth of compressions, number of interruptions and positioning of the hands, etc.) (Lin et al., 2018; Stipulante et al., 2016; Bobrow et al., 2011; Yang et al., 2009; Johnsen & Bolle, 2008). However, there are reasons why fewer applications are available to citizens in general than to first responders. There is more reluctance to get bystanders and dispatchers to work together than there is between first responders and dispatchers.

Limitations to bystander CPR performance

Effective cooperation between bystanders and dispatchers depends partly on the pre-existing climate of trust between the communities. Karsenty (2015) indicates that there are three determinants to the construction of trust; the characteristics of the one who trusts (here, the professional), the representation that he/she has of the other (here, the bystander) and the representation that he/she has of the situation. The representation that the health professionals have of the bystander is indeed a important obstacle. They are perceived as a hindrance because of their lack of knowledge and experience (Bird et al., 2020; Reuter et al., 2016; McLennan et al., 2016; Scanlon et al., 2014), which makes them " untrustworthy ".This lack of confidence is shared by the bystanders themselves as they admit being reluctant to perform CPR due to their fear of causing harm to the victim and experiencing emotional distress (Berg et al., 2019; Bouland et al., 2017; Kanstad et al., 2011). Several countries have established a law to exempt the citizen from the responsibility of the possible injuries he could inflict to the victim while providing life-saving assistance (the French law of July 3, 2020 created the status of the citizen rescuer). The purpose of these laws is to try to make citizens overcome this fear and take appropriate action. To surpass this, several countries offer regular first aid training to citizens. This has improved the CPR rates in some countries such as Sweden and Denmark (Uny et al., 2022), however, even in countries where this is mandatory, such as Switzerland, the training no longer reduces the fear of bystander after a period of 6 months (Regard et al., 2020). However, the fear and the lack of trust are not the only obstacles to collaboration. Some authors also argue that collaboration is difficult because both populations are not used to encountering each other and interacting (Boin, 2009). Also, when they do interact, tensions emerge due to misunderstandings because there is neither a common language nor a pre-established shared referential (Reuter et al., 2016; Chave, 2011). Moreover, the memory of past collaborative experiences affects the ability of actors to trust similar individuals again. Thus, the less satisfying previous interactions have been for dispatchers, the less they will trust and rely on bystanders in the following interaction (Karsenty, 2015). The collaboration among bystanders and dispatchers as well as between

[1] First responders are trained first-aid providers who are registered and alerted in case of an emergency event (e.g. cardiac arrest) happening within a radius of 200m to 10km from them (depending on the app).

[2] In a simulation study

all members of the chain of survival is essential to increase the chances of survival of a victim of cardiac arrest. This is why we are looking to identify a methodology that can meet the needs identified. Thus, the Living-Lab appeared as an efficient methodology to address the identified needs.

The living-lab: a meeting space for stakeholders enabling them to live shared experiences to build a common frame of reference

The Living-Labs are described as " physical regions or virtual realities in which stakeholders form public-private-people partnerships (4Ps) of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts " (Leminen et al., 2012). This method makes it possible to gather all the partners around a shared situation to test an innovation. In the situation of cardiac arrest, the bystanders, the dispatchers but also all the actors of the survival chain (first responders, ambulance drivers) can be brought together to test an application for example. The purpose is not only to test this application to improve it but also to get these communities to meet and share common experiences, as they are not used to collaborating, especially with the bystanders. Studies on Living-Labs have shown that participating together in the co-creation and testing of a product is associated with positive effects on trust between citizens and public institutions (Fledderus, 2018).. In addition, the shared experience itself leads to the development of a common discourse and frame of reference (Gerhold et al., 2020; Munkvold, 2016). The experiments in health Living-Labs are not conducted in a real context but rather in a semi-real context (simulations) given that it could be hazardous for both citizens and professionals as well as for the victim to experiment in a real-life situation (Leitner et al., 2007). Thus, authors recommend the use of simulations or scenarios to replicate emergency situations (Gerhold et al., 2020; Mentler et al., 2017). This article focuses on the test of OHCA scenario in a semi-real context involving all stakeholders in preparation of setting up a full-scale Living-Lab in the following months. The overall objective is to develop a territory-based community of care that is familiar with all stakeholders (bystanders, first responders, paramedics, dispatchers) and the situations.

METHODOLOGIE

Research questions

In this study, the focus have been made on the interaction between the dispatcher and the intervenes on site (bystander, first responders, paramedics). The literature review oriented our work around three axes.

QR1: What is the current activity of a dispatcher and what is the procedure for handling OHCA?

In order to get as close to reality as possible, it is necessary to understand how a specific regulation service works. Indeed, the emergency call centers are different from one territory or region to another and do not necessarily work with the same partners and procedures. As a first step, we must understand the context of the emergency service concerned by our intervention.

QR2: Which benefits and barriers are associated with the use of a video-based application for the response to OHCA?

The literature on this subject provides answers; video allows the improvement of CPR (better compressions, less interruptions...). Therefore, it is worth investigating whether the dispatchers of this emergency call center actually consider video as a benefit and identify the eventual limitations to its use.

QR3: How do the workshops affect the participants' experiences and the relationship between the stakeholders?

Finally, the central question of our research is based on the premise that trust enables greater collaboration. That confidence stems from previous collaboration as well as a deeper understanding of each other's roles and functions. We aim to identify any effects (positive or negative) on the participants' relationship resulting from our workshops (simulation, joint debriefing).

Presentation of the terrain and application

The Emergency Health Centre 144

The Emergency Health Center 144 is located in Geneva and is part of the University Hospitals of Geneva (HUG). In 2020, the unit responded to 126,000 emergency calls. The emergency center is divided into a regulation room with 11 stations, an overflow room (4 stations) and a health operational center (12 stations in case of major events). In 2021, the staff consists of 47 employees: 26 nurses/ambulance dispatchers, 6 supervisors, 3 managers, 4 physicians and 8 support staff.

For the past two years, the center had a partnership with the Save a Life first responder application, which includes a community of 1,000 individuals (out of 4,500 residents in the canton) in which three groups of volunteers (health professionals, first responders, citizens with BLS) are divided. These volunteers are alerted in case of OHCA via a button integrated in the dispatch system to intervene as soon as possible on the situation.

SARA app

The application we propose for these simulations is the SARA application. This application has been developed by the Brigade des Sapeurs Pompiers de Paris (BSPP) since 2017. It includes a smartphone / web app and a back office for the regulation center. It allows the dispatcher to have access to the position and the camera of the caller. The dispatcher can also send the witness one of eight demonstration gesture videos:

- Cardiopulmonary resuscitation (Adult, child, infant)
- Heimlich maneuver (Adult airway obstruction)
- Mofenson maneuver (Airway obstruction in children under 2 years old)
- Lateral Safety Position
- Placement of a garrot (tourniquet)
- Application of a pressure patch.

This application was selected because the video used in the tutorials is time-optimised and was the subject of a thesis using dummies in experimental situations (Lesaffre, 2014). We want to continue this study in a semi-real context to confirm or deny the benefits of this demonstration video in a context where real constraints appear. Moreovere, the application is situated in a segment of intervention that has been unexploited until now. Indeed, first responder applications only allow to act on the situation when the volunteer arrives on the scene, when SARA allows then to do the initial relay by involving the calling witness in the CPR.

Methodological approach

Protocol

The research protocol was divided into two phases. The first one, a comprehension phase aiming at understanding how the central operates, the dispatcher's function and the actual OHCA procedure. For this purpose, 5 interviews (about 30 minutes) were conducted with 2 dispatchers, 1 coordinator, 1 assistant dispatcher and a physician.

The second one, an lived-test phase, intended to carry out simulations of cardiopulmonary resuscitation using the SARA video. These simulations were conducted during the World Heart Day at Genève. The workshops took place in 2 sites simultaneously with 6 partner patients[3] (noted PP), 5 Save a Life first responders (FR), 6 ambulance drivers (noted P, HUG park) and 2 dispatchers (noted D, 144 central). The participants were recruited by a physician from the emergency dispatch center. He contacted the "patient partners" association to recruit volunteers. Similarly, he recruited volunteers from the first responders' association with whom he currently works. The simulations were all based on the same scenario with different variables (1/2 bystanders, 1/2 first responders, sending the SARA video with audio guidance from the dispatcher vs sending the video without audio guidance from the dispatcher). They were then followed by collective elicitation interviews with all participants per simulation (about 30 minutes) conducted on Zoom. We also conducted one additional elicitation interview with both dispatcher a few weeks later (50 minutes). Elicitation interviews (Vermersch, 1994) are a particular interview technique that allows the interviewee to focus on his or her 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 (Vermersch, 1994; Cahour et al., 2016). This technique can be used with a single person or a group (Balas-Chanel, 2014).

Data collection and analysis

The interviews of the comprehension phase were audio recorded then fully transcribed and analyzed with Atlas according to our research questions. We sought to understand the activity of the dispatchers, to analyze the current management of OHCA, to identify the interests and obstacles in using SARA and finally to identify dispatchers'

[3] Patients' partners are former patients of the HUG who have agreed to be contacted to participate in research conducted by the hospital.

needs.

For the second phase, all simulations and debriefing situations were audio recorded, filmed and then transcribed. They have been analyzed using Atlas software with theses following focuses:

- Describe the course of the simulations and the difficulties
- Analyze the impact of SARA on cardiac massage
- Understand the application's effects on the participants' experience
- Evaluate the effects of the workshop

RESULTS

The findings section consists of a first part presenting the results of the analysis of the understanding phase based on the four points mentioned earlier: dispatcher activity, ACR handling, views on SARA and identified needs. The second part of the results presents the findings related to the workshops and is divided as follows: a description of the simulations and their technical problems, the benefits of the SARA demonstration video for cardiac massage, the workshop effects on the participants' experience and lastly, the unintended side benefits of the workshops.

Understanding phase

Dispatcher's activity

The dispatchers of the Emergency Health Center 144 are ambulance drivers or nurses. The dispatch team has 3 dispatchers in simultaneous shifts of 12 hours each. They are in charge of a single phone line (from answering the phone to getting the patient into the hospital). During the day, they are joined by a supervisor (expert dispatcher), a doctor and 2 transfer assistants. At night, they work alone and can request the assistance of 2 people on call in case of need. The dispatcher's workstation includes a dispatch system with a computer and 4 screens dedicated to call taking, specifically to cartography, the emergency phone and the current intervention sheet, the handrail (of means and interventions) as well as the planning of the canton's means and web applications used for the emergency. Save a Life application is integrated on this screen. The dispatcher also disposes of complementary systems, a HUG computer (patient files), a state computer (administrative network) in which SARA is installed and a radio communication station.

The dispatcher's mission is to handle a call "*from the moment the phone is picked up to the moment the mission is assigned, received and acknowledged*". He is then in charge of coordinating and following up the intervention. This process consists of picking up the call and identifying the location as a first step. The dispatcher must then understand the context of the intervention: what is the situation, what is the environment? Next, the dispatcher needs to assess «*the emergency quantity* ". In order to evaluate the emergency level, the operator has two scales:

- The Swiss scale of sorting which corresponds to a "*code that matches a pathology, a degree of urgency and a destination*" categorizing the situations in priority (P1: maximum priority taken care of 90”, P2: 20’, P3: 2h, P4: beyond 2h).
- The NACA scale, which evaluates the gravity of the patient's condition; from 0 (unharmed) to 7 (dead).

As soon as the patient's condition is established, the dispatcher selects the appropriate means, sends it to the victim’s location, and monitors the intervention until the patient arrives at the hospital. This process is the generic procedure of responding to an emergency call. The next paragraph provides a more detailed description of the cardiac arrest procedure.

Handling a cardiac arrest call

There are approximately 2 cardiac arrests per day in the canton of Geneva, 67% of which are at home. Cardiac arrests are a P1 in the Swiss triage scale. This means that the dispatcher has 90 seconds from the moment the phone is picked-up to recognize the cardiac arrest and then send the appropriate means. The procedure is automated with pre-established questions that appear on the screen ("*Is he conscious?* ", "*Is he breathing? Abnormally/not?* » The answers to these questions determine whether or not the patient should be resuscitated and allow a quick dispatch of resources while alerting the Save A Life first responders through an integrated button displayed on the engagement system (on the same screen as the intervention).

At this point, the dispatcher is able to try to start cardiopulmonary resuscitation with the witness. Throughout the interviews, it became apparent that this task is often challenging for the dispatchers. They explained that witnesses might not even dare to approach the victim for the assessment phase "*even to put their hand on the stomach [to* *check for respiration]*". They further elaborate on the fact that the witness often refuses to massage because « *he doesn't want to do anything stupid* ". Consequently, they emphasize that the focus is placed on the rapid recognition of cardiac arrests so that professionals can be sent to the victim's location as quickly as possible, since at this stage "*continuing to perform telephone-guided procedures is not the easiest thing to do* "

Benefits and barriers to using SARA

The first benefit mentioned by the dispatchers is the possibility to send videos to witnesses. Indeed, one of the dispatchers reports that some witnesses act because they are trained, others refuse to act and others are hesitant and can perform CPR " *with a little bit of verbal help on the part of the dispatcher".* He believes that video can help convince more bystanders that are hesitant.

The main obstacle mentioned is the target population of the application, which is young people "*who are familiar with cell phones [...] who are quite geeky*"; whereas the population suffering from cardiac arrest is elderly and arrests tend to take place at home "*it might be complicated for grandpa or grandma to master this kind of technology".* Especially as the procedure implies opening an SMS to access the application, a feature that has already been tested elsewhere and whose feedback has been mixed.

Dispatchers' needs

First, it is imperative to integrate the application into the dispatch system in order for it to be functional in the emergency call center. It should not be on a computer (state) that is separate from this system, which would lengthen the procedure for sending the video and waste precious time for the dispatcher and the victim.

Furthermore, the dispatchers would like to have the option of a video feedback to "*keep the connection with the caller*". This would allow them to get a better view of the guidance they are performing and to catch any mistakes in the actual delivery of the massage.

Simulation phase

Course and duration of the simulations

Initially, the different sequences of actions during the rescue were identified (Table 1): the opening and identification (location), the request for intervention, the evaluation of the victim's condition, the response (initiation of cardiac massage), the arrival of the first responders and finally the arrival of the paramedics. The simulations lasted from 7'12 to 8'32. We also noted the arrival of Save-a-Life first responders (between 3'59 and 5'49). The pick-up call and situation assessment phase (which should not exceed 1'30 for cardiac arrest) lasts 1'09 for S1, 1'32 for S2, 1'21 for S3, 2'51 for S4 and 1'56 for S5. The start of cardiac massage is 3'15, 4' and 4'30, after the initial stall, (S3 and S5 are not representative of a real situation since the partner patients started massaging at the beginning of the simulation). Furthermore, we looked at the time between the SMS sending and the reading of the video, which lasted between 24" and 1'57 (with the sending of the video and not the link to the webapp). It seems more relevant to send the link to the webapp rather than an SMS link to the video.

Actions	***S1***	***S2***	***S3***	***S4***	***S5***
Recognition of cardiac arrest	*01:09*	*01:32*	*01:21*	*02:51*	*01:56*
Sending the video link	*01:59*	*01:48*	*02:38*	*03:12*	*02:26*
Playing the video	*02:53*	*03:45*	*03:02*	*03:58*	*03:53*
Starting CPR	*03:15*	*04:00*	*00:05*	*04:30*	*01:31*
First responder arrival	*05:49*	*05:41*	*03:59*	*05:33*	*05:12*
Defibrillator patch setup	*06:01*	*06:03*	*04:16*	*06:20*	*05:17*
EMS arrival	*08:32*	*08:29*	*07:29*	*07:53*	*07:12*
Time between sending the SMS and playing the video	*00:54*	*01:57*	*00:24*	*00:46*	*01:27*
Time between the reading of the video and the cardiac massage	*00:22*	*00:15*	*NA*	*00:32*	*NA*

Table 1: Sequence duration

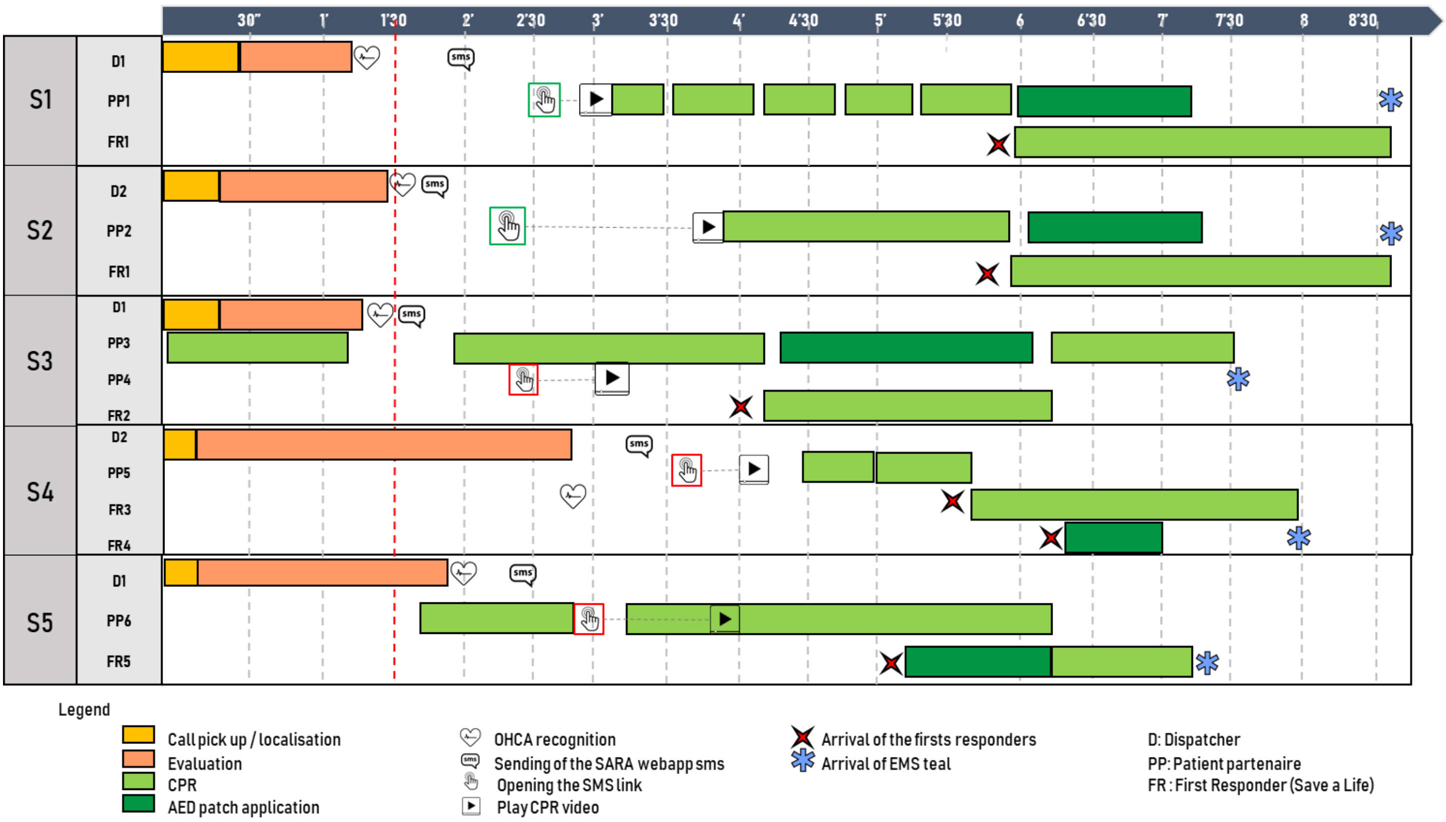

Figure 1: Course of the simulations

Figure 1 represent the different stages of the simulation. In simulation 1, the recognition of the cardiac arrest was achieved before 1'30, the SMS was then received quickly, the video was opened, the video started after 24". PP1 then began to perform CPR but stopped many times until a first responder arrived and continued the CPR. The first responder then suggested to PP1 to put the patches of the defibrillator on the mannequin. FR1 continues to massage until the arrival of the EMS team. In simulation 2, cardiac arrest was identified before 90" and then the video was sent to PP2's mobile phone. However, the video took more than 1'57 to start, which greatly delayed the initiation of cardiac massage (at 4' after pickup). CPR was then continuous until the first responder arrived. Simulation 3 presented special conditions since it was a simulation in front of an official audience and there were 2 partner patients. Therefore, PP4 interacted with the dispatcher on the phone while PP3 performed the massage on the patient from the beginning of the simulation. Still, we can see that the cardiac arrest was detected before the 90" and the video was started after 24" from the click at the link. Simulation 4 did not identify the OHCA before 2'51 for several reasons (sound and comprehension problems) that we will develop more extensively in the next section. On the other hand, the SMS sent after the recognition of the cardiac arrest allowed the video to be triggered 46" later and the playing enabled the massage to start in 32", i.e. 4'30 from the beginning of the call. The massage was then interrupted due to sound problems. Two first responders then arrived, one resumed the cardiac massage and the other placed the defibrillator patches until the arrival of the paramedics. Finally, simulation 5 shows that the cardiac arrest was identified in 1'56. However, even before its recognition, the patient partner started the massage (1'30) and stopped to open the SMS and view the video at 2'30. The first responder arrived and applied the defibrillator patches while the partner patient kept on massaging.

Technical problems leading to extended processing times

SARA's use appears to be only partly responsible for prolonged treatment times. When SARA is functioning at its optimum, as it did in S1, cardiac massage can begin in 3'15. Sound-related problems were more prominent than problems with SARA itself. It affected negatively two essential elements of the response.

<u>The efficiency of the treatment process</u>

The poor call quality may require the dispatcher to repeat the request many times. In S1, the dispatcher had to repeat 5 times what he was asking the caller during the cardiac massage, which resulted in 5 interruptions. Indeed, PP1 had to lean towards the phone to listen and say, "*excuse me?"* which naturally interrupted the cardiac massage.

Sound problems can also have an impact on the comprehension of the dispatcher's instructions and lead to an error or inaction from the bystander. This is particularly apparent in the assessment phase, where the dispatcher asks a series of questions and actions to be performed: "*Is he breathing? Pinch his hand hard. Put your hand on his belly and tell me "top" every time his belly rises*". The sound problems made it impossible for 3 participants (PP3/PP5/PP6) to understand the actions required as we can see in the example below.

Simulation 4
D2: Okay, pinch the back of his hand very hard. When you pinch the back of his hand very hard, is there any movement, any reaction?
PP5: By pressing on the chest ?
D2: No no, you pinch the back of her hand very hard and tell me if she reacts or not
PP5: I do not understand very well.

Additionally, in all situations, first responders arrived with external defibrillators. The use of the external defibrillator simultaneously with the SARA video tutorial, the dispatcher on the phone and the first responder caused interference and did not allow to hear the instructions, however essential, of the defibrillator (FR1, S2 : " *every time I massage, I try to count with the defibrillator and I was waiting for "next analysis in ... " to stop and actually I was hearing a voice saying " keep massaging", I thought it was the defibrillator, so it can be a little confusing* "). Not being able to hear the defibrillator can be deleterious for the patient who will not receive the shock if he/she can benefit from it, but also for the person who massages as expressed by FR4 in simulation 4: "*if it was an automatic defibrillator, where the shock goes automatically, it says, "Do not touch the victim" but we do not hear anything, it can be dangerous*". Moreover, the sometimes contradictory instructions of the dispatcher, the SARA video and the defibrillator bring conflict for the interveners, especially for novices.

<u>The dispatcher-witness relationship</u>

There are four main effects of poor sound quality on the relationship: a rupture in communication, a feeling of loneliness for the bystander, a sense of helplessness and uncertainty about the initiation of CPR for the dispatcher. Communication breakdown occurs most often in situations where the patient partner is performing CPR; the dispatcher asks questions without getting an answer.

The absence of response provokes uncertainty for the regulator, as expressed later in the debriefing. At that moment "*[He] wasn't convinced that the massage was there, that it was going well[...]it's total uncertainty of knowing if it's well done or not done at all"* (D2, S4). He believes that "*this loss of communication was harmful for [the bystander] as well as for me, and perhaps for the patient*". On the bystander side, not being able to contact the dispatcher efficiently combined with the inability to hear the video, led to a feeling of loneliness in the patient partner (PP5 "*I said to myself let's go let's go 'goalkeeper loneliness'*").

During the debriefing, the dispatcher referred to this moment and said that he felt "*helpless*" as he was unable to assist the volunteer, he explained that he tried to " *speak louder than the video to be able to give you the indications that were on the video and to accompany you but I felt that it was not working*". The problems related to sound and their consequences are essential to take into account, as in real life situations these difficulties can arise, especially when the victim is on the street where the surrounding noise can be similar (cars, passers-by...).

Effects of the CPR demonstration video on the efficiency

Despite the technical problems, 5 out of 6 participants (PP6) appreciate the video, it was described as *"helpful", "a good input", "stimulating".* The benefits of using a video to perform CPR are identifiable in two elements. The first one is the improvement of the position and gestures performed. Several participants reported that seeing the video had enabled them to rectify their position and thus press harder. PP1 said : *"It was surprising, I started to do it with my arms not outstretched, and I've been corrected [...] The clue he gave me that I should perhaps press a little harder was to put my arms outstretched* (Figure 2) *because I was like that* (Figure 3) *and I was doing my massage quietly ".*

Figure 2: Outstretched arms

Figure 3: Soft arms

The second benefit is the presence of sound to signal every compression as well as the sight of someone performing a massage. It helps the participants to synchronize with the video and find the "*right rhythm*". Such was the case for PP3 " *I heard the beep, that's when I saw that I had to go much faster*", PP1: "*we have to go very, very quickly, press very hard, the rhythm, we follow it with the video, it's something very pleasant* " or PP2: " *it really gives me the right rhythm for a cardiac massage*".

Effects of the CPR demonstration video on the lived experience

A very interesting effect is that the presence of the video reassures the witness in a complex and stressful situation. This was expressed by PP1: *"we are a little bit, not in a state of panic, but saying to ourselves 'what more can I do' seeing an inert person*", or by PP3: "*emotionally it's quite strong, we imagine the person lying there. [...] Thanks to your help, the sound that I heard behind, it relaxed me a lot. It put the level [of stress] where it should be to be effective anyway*". The video helps to start cardiac massage in case of hesitation: "*I was a bit hesitant but they offered me a link very quickly to see a video that shows exactly how to do cardiac massage so I started to do it*" (PP1). It also seems to reassure the masseur in these gestures: "*I was happy to be able to have a link, to be able to see it, it made me feel more secure*" (PP1), "*this application seems to be really well done because at one point I was thinking "I'm connected to this application?" because he said "yes, it's good, you have a good rhythm"* (PP2). Finally, it brings comfort thanks to the support words implemented "*it adds something comforting to us with us, as if we have someone with us finally who assists us somewhere*" (PP2), "*I rather had the impression of being well supported, even encouraged to continue doing well*" (PP1).

Sending the video also reassures the regulator, as D1 says: "*For us at 144, sending the link is also reassuring because we know that the cardiac massage will be well done by mimicry. We know that in any case the witness, by watching the video, will perform a rather effective massage and that is probably what will save the patient"*. This dispatcher also perceived that the bystander was more serene. However, in the later interview with the dispatchers, they actually described being "*falsely reassured*" as they were ultimately not confident that the CPR was occurring and the fact that they were sending the video prevented them from guiding by voice over the phone.

The bystander: an essential link in a rescue team that is built up over time

Unlike what has been said in the literature, the bystander is not seen as a hindrance but rather as an additional resource for performing an essential act. For the first responders and the regulators, he appears as an opportunity. The bystander can perform CPR in place of a more qualified person and establish a liaison with the emergency services " *by the time the ambulance arrives, we are starting to get tired, to be able to have someone who has contact with the professionals, even psychologically, that helps*" (FR1, S1).

The bystander is an additional resource that allows a more optimal distribution of the tasks to be carried out. He can be used as a relay for the massage; he can put the defibrillator patches. However, in order for the first responder to delegate, he must trust the bystander. This confidence is obtained by his active position: "*We arrived on the scene, the lady was at work, so I thought she understood the instructions well, she had one eye on the cell phone and one eye on the victim. She was watching the video and massaging at the same time. That was very important."* (FR3, S5). For the dispatchers, trust is based on the witness's ability to understand and respond: "*the quality of the witness we have on the phone is felt in the first exchanges we have and we see right away that the person who was there, she understood, she was efficient, she did the things that were asked of her with a lot of calm and seriousness*." (R2, S2).

Benefits of the confrontation with reality in a common simulation between the stakeholders

Simulation revealed difficulties that were previously unnoticed. One example is that 2 out of 6 participants did not understand the instruction "*put the arm in a cross*" which leads to the right position to perform cardiac massage. Some of the participants also realized how difficult it is to apply defibrillator patches in a stressful situation: "*it's incredible because in real life you can't see which way to put the stuff, in the heat of the moment, it put me under a little stress."* (PP2, S2). In addition, the simulation gives the participants the opportunity to learn and train, including how to use the application: *"I think it's something to try several times, we gain in efficiency. Because at the beginning, when you're not used to the application, it always takes more time. You do it 3 times 10 times and you save 10 seconds, 30 seconds*" (D2). For the participants, it gives them a glimpse of the regulation processes. Thus, in the future, could avoid some frustration. This was the case for two participants who did not understand why they should not act immediately. The joint debriefing gave space to the dispatchers to explain this process: "*We went back to steps that you may have done before calling 144. Nevertheless for us it's important because there are plenty of people calling us for victims who are perfectly conscious*" (D2, S4).

Finally, this first step engaged all the participants in a Living-Lab approach, the regulators, the first responders as well as the patient partners are all willing to come back to test new modalities and to continue the simulations with the aim of improving the overall emergency response.

CONCLUSION

To conclude, we will review our research questions and answer them in light of the findings and associated literature. Regarding the dispatcher activity at the 144 emergency center and the OHCA treatment procedure, we found that the emergency center has been associated with a first responder application for 2 years (Save a Life) which is activated at each cardiac arrest. The dispatchers of the central office are pro-active with anything that could make the procedures evolve positively and are not reluctant to rely on bystanders. However, they have expressed some concerns about the willingness of bystanders to perform CPR. Furthermore, they fear mental overload from implementing a new application on their engagement system. Regarding the application use itself, some time delays were observed (partly due to technical problems). However, as suggested by the literature, there were also positive outcomes concerning CPR performance (adequate rhythm, optimal position, less interruptions) and especially concerning the bystanders' feelings (less hesitant, comforted, feeling supported) and the regulators (reassured by a well done massage by mimicry). Finally, we have found that participating in workshops together does indeed provide a better overall understanding of the response chain and procedures that apply to this emergency situation. It also enables training on the application in a safe environment and familiarizing all the interveners to the handling of a complex situation with multiple contributors (dispatcher, first responders, paramedics, defibrillator, application and bystander).

The results of this study are limited in their generalisability as they are dependent upon the country in which the study was carried out and because of the small sample size. The scope of this research was to explore the different points to be studied in depth in the next living lab Our perspectives are to conduct one Living-Lab with the 144 Emergency central using several scenarios (ACR, stroke, anaphylactic shock) with various modalities (SARA, video feedback for the regulator) while improving the workshops based on the results of this initial pre-test.

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