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Available Anytime Anywhere: Investigating Mobile Volunteer Responders for Out of Hospital Cardiac Arrest

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ABSTRACT

Out of hospital cardiac arrest is a life-threatening event that requires immediate resuscitation actions. Therefore, digital volunteer responder initiatives integrate nearby users who can be activated anytime, anywhere through mobile technologies to assist in administering first aid. While research has found that such initiatives increases the chances of surviving, we know little about how responders use the digital services, and how they organize themselves before, during, and after responding. We conducted interviews with volunteer responders (N=16) to address how they perceive these initiatives and in particular how they negotiate availability temporally (anytime) and spatially (anywhere) for such life-threatening events. Our findings show that our responders exhibited strong perceptions of how and why one should volunteer. Also, the temporal aspect of being available anytime integrates several dimensions, while being available anywhere is highly related to safety, community and group roles. Finally, we discuss implications for design of volunteer responder initiatives.

CCS CONCEPTS

• **Human-centered computing**;

KEYWORDS

health, cardiac, mobile, volunteer, availability

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1 INTRODUCTION

Cardiac arrest is when the heart abruptly stops beating and where every passing minute decreases the chances of survival by 10% [18]. Timely delivered resuscitation efforts has the potential to increase survival from cardiac arrest. Cardiopulmonary Resuscitation (CPR) is recognized as the standard of resuscitation emergency care [1]. Furthermore, automated external defibrillators (AEDs) are effective tools for resuscitation, and are widely distributed in public areas for bystanders to retrieve and use [2].

Activating bystanders in retrieving an AED and initiating CPR can greatly improve the response time to cardiac arrests. However, studies show that bystanders rarely react accordingly to cardiac arrests in a public area due to difficulty in recognizing the arrest and doubting their abilities to perform CPR [4, 26]. To respond to these challenges, mobile technology has been utilized to activate volunteers who have committed to being available to respond to perform resuscitation [2, 4, 5, 21, 24, 26, 33]. Recent studies have investigated implementation challenges [4], bystander defibrillation [2, 24], response time [26, 33], and variation in how notifications are received [5]. These studies all take a clinical perspective, whereas Ozcan et al. conducted a study from a CSCW perspective to uncover barriers to respond through a simulated responder program [21]. Ozcan et al. presents a framework of the temporality of non-response barriers, and furthermore defines design implications for overcoming them. To build on this, our study takes an HCI approach and emphasizes the perception and expectations of actual volunteer responders' commitment to availability based on real-life experiences from an existing volunteer responder scheme.

Multiple examples of separate, region-based volunteer responder schemes utilizing mobile technology for out of hospital cardiac arrests have existed in Denmark throughout the past decade, but currently changes are implemented towards a vision of a uniform national initiative ([2]). In some cases this means merging or substituting existing schemes, in other cases the new scheme is allowed to co-exist with already implemented local schemes. We wanted to explore the interaction between volunteer responders and mobile technology, where the two are dependent on each other to make an impact in a life or death situation, while also being very time sensitive. We conducted interviews with volunteers about their real-life experiences of responding to out-of-hospital cardiac arrests, with a focus on their view of having committed to being available to respond anytime, anywhere. The participants represent five different responder schemes to understand how the implications, benefits and drawbacks of the various organizations are experienced, as well as how the schemes co-exist.

We present an empirical understanding of how volunteer responders negotiate availability in a life-and-death, time sensitive HCI case through various volunteer responder schemes as well as the tensions associated with the introduction of a uniform national scheme. We found that frequency of alarms impacted volunteers readiness to respond. Additionally, we saw the way in which different technologies implement distance had an impact on volunteers perceived availability, and trust in technologies, respectively GPS and SMS. A key finding is volunteers' fear of finding themselves in a situation where they are the sole responder, alone with the many

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demanding tasks on the site of a cardiac arrest. We unfold how local volunteer communities operated and how informal roles were assigned to volunteers within these communities. We discuss the implications for this on design of functionality for mobile technologies and adoption of new to volunteers technological solutions.

2 RELATED WORK

Here we present relevant literature that expands our understanding of mobile technologies and volunteering in a health domain. For the framing of availability, we include literature that unfolds the implications of use of mobile devices both professionally and privately as these often overlap.

2.1 Constant Connectivity, Availability and Negotiating Boundaries

Constant connectivity is afforded by the accessibility of data connections and technologies with connective capabilities. With these follow an expectation of availability. Availability is expected to such a degree in business settings that it is commodified, often to the detriment of workers' health [14].

Mattern et al. understands constant connectivity as *"the inability of individuals to detach effectively from their digital and mobile companions"* ([20]) and found that despite detrimental expectations of availability often being associated with work ethics and culture, study participants were more likely to have an emotional connection to their smartphone rather than viewing it as a tool to conduct work with. In this regard, studies have been willingly subjecting people to let go of that availability e.g. by turning off notifications for 24 hours [22], withholding work e-mails for five consecutive workdays [13] or getting rid of their cellular communication device for years [12]. Pielot and Rellot found that while device notifications often distracted individuals in their work by creating interruptions, they also facilitated feelings of being connected to people you care about. Importantly, notifications were essential for meeting social expectations of availability and if ignored could lead to conflicts with friends, colleagues and partners and even present as a source of anxiety [22].

Cecchinato et al. saw how smartwatch users employed so-called microboundaries to regain control of their availability [6]. These bodily worn devices would be expected, in particular by non-users, to increase the availability to respond - imagined as *"digital handcuffs"*. However, user strategies such as temporal microboundaries (e.g. turning off notifications at night) facilitated users in regaining control through connecting more selectively and reducing the urge to reply immediately to notifications [6]. While a lot of research on availability relates to work - often work extending into the private/domestic sphere - a recent study relates to volunteer work carried out by medical professionals outside of work hours. Ding et al. carried out a study of volunteer patient-provider communication in China, where they emphasized the boundary negotiation strategies that became apparent in interviews with patients and doctors in volunteer follow-up conversations outside of institutional frames. Keeping in mind that doctors were aware and supportive of the fact that this service provided a real benefit for patients [10].

2.2 HCI on mHealth and Volunteering

Research in HCI has focused on the role of mobile technologies in delivering healthcare services or to enable caring for someone. While much of this research concerns obligations due to institutional demands or moral obligations based on relations, some research also concerns volunteering to deliver health service or caring for others out of intrinsic motivations. Often people with no professional health background are obligated to manage their own health or the health of a person they are caring for. The role of the informal caregiver has been vaguely defined in HCI research. To this end, Miller et al. presented five caregiving roles for patients during hospital admissions and emphasized their importance [15]. Technologies can help prepare caregivers for this task. Mobile applications (hereafter referred to as apps) have been advantageous in supporting people with a wide range of health issues ranging from physical well-being to mental disorders and chronic illnesses [3, 8, 16, 25, 27].

Technology has been utilized to facilitate the support of volunteer caregivers in the health domain. The motivation for involving volunteers include scarce number of professionals in e.g. rural regions [19], health clinics managed by non-profit organisations for underprivileged populations [29] or to bridge the gap between professionals and lay people in terms of language barriers [11]. Volunteers are also advantageous for medical and caregiving needs that are emergent and time sensitive e.g. for volunteer doula programs [23] or in the case of out-of-hospital cardiac arrests.

2.3 Cardiac Arrest Volunteers Facilitated through Mobile Technology

While efforts go into educating the general public in stepping up to perform first aid and administer CPR, records of bystander CPR are on the rise but remain relatively low, in particular in residential areas [31]. Mobile technologies may aid in locating a publicly available defibrillator. Additionally, mobile technologies have been utilized to activate volunteer responders to locate cardiac arrests based on GPS signal or area code and respond by facilitating timely delivered first aid. This provides a dual-response emergency medical service (EMS) dispatch of local or nearby volunteers and traditional trained EMS e.g. paramedics [2, 4, 5, 24, 26, 33].

Brooks et al. ([4]) studied the PulsePoint Respond mobile application that facilitates volunteer dispatching by means of GPS, notifying volunteers in a 400 meter radius of a person with suspected cardiac arrest, although solely in public places. Based on 1274 surveys from volunteers who received a notification, they concluded that it was feasible for the app to recruit nearby volunteers to perform resuscitation, however a few challenges remained for optimal implementation. Challenges included the technical characteristics of the app resulting in volunteers not noticing the notification, too many false alarms and a low density of volunteers in the community. Furthermore, 42% of volunteers receiving the notification were not able to respond and in 61% of the cases, where volunteers responded, professionals had already arrived before the volunteer [4]. Meanwhile, Ringh et al (2015) studied a similar system where volunteers within a 500 meter radius received a computer-generated phone call as well as an SMS with location information of a suspected cardiac arrest nearby. Ringh et al. ([24]) conducted a blinded, randomized, controlled trial where the intervention group received

the notification while the control group did not. They found that bystander-initiated CPR was significantly improved when volunteers were notified through their mobile devices compared to when not receiving a notification [24]. Similar results where found for Andelius et al. [2]. In both ([4]) and ([24]), about a third of volunteers did not notice the notification, and less than a quarter arrived on site timely. Despite this, Ziljstra et al. ([33]) similarly studied a scheme where laypersons registered with an address <1000 meters from a suspected out of hospital cardiac arrest, were instructed by SMS to retrieve AEDs. They focused mainly on response time and early defibrillation and surprisingly concluded that layperson responders started defibrillation with a mean of 2,39 minutes earlier than EMS responders [33]. Although, Caputo et al. ([5]) found that when comparing SMS and app notifications, lay responders arriving to the site significantly increased with the app notifications.

The above studies are mainly focused on determining the effectiveness or efficiency of volunteer schemes through quantitative data, thus not unfolding volunteers' experiences. Ozcan et al. ([21]) conducted a study to explore the barriers to volunteers not receiving notifications and furthermore, provided design implications for implementation of mobile technology to facilitate volunteer responders to cardiac arrests. [21] identified four categories of barriers based on a diary study and focus groups with 12 participants receiving simulated alarm calls. The identified barriers were related to volunteers wanting to temporarily opt-out of the system, volunteers not noticing the notifications, barriers to leave their current situation and finally, concerns of not being able to correctly perform the resuscitation when arriving on site [21].

Layperson responders will often have received training in CPR but do not always have the psychological training and extensive experience in the same manner as trained professional responders. The commitment to these mobile schemes puts them in a situation of constant availability to respond to cardiac arrests and thus test their physical and psychological competences in responding to these time sensitive, life or death events. Zijlstra et al. noted that layperson responders may experience severe short-term psychological impact, albeit this does not present as PTSD-related symptoms long term [32]. Research has shown that debriefing procedures post-responding have a short-term positive effect as well as retention of this effect over months [17].

3 OVERVIEW OF DANISH HEARTRUNNER SCHEMES

This section gives an overview of the different volunteer cardiac arrest responder schemes that is represented in this study. The information is primarily informed by our participants, where not otherwise stated.

3.1 App-Based Initiatives

Two app-based initiatives are represented in our findings, namely 'Trygfonden' and 'Danmark Redder Liv' (DRL). Whereas DRL was an initiative with combined efforts of the respective regions, a non-profit organisation and a medical equipment company, Trygfonden is a large non-profit foundation that incorporates a taskforce for several nationwide safety-initiatives and the main owner of an insurance company. Both require a smartphone, GPS and data connection. When a suspected cardiac arrest is called in at the nearest emergency dispatch center, the 20 volunteers that are closest within a radius of 1800 meter (Trygfonden) or up to five kilometers (DRL) are called to the site of a suspected cardiac arrest. Volunteers must then confirm the alarm call by choosing to decline or accept the alarm call in the app. Upon accepting alarms, volunteers will be asked to choose from to navigation options; a) retrieve the nearest defibrillator and bring to the site or b) navigate directly to the site of the cardiac arrest. Other features in the current version of the app consists of a demo of receiving an alarm with dummy data to get acquainted with the procedure before receiving alarms. Additionally, the app has a video feature that demonstrate use of a defibrillator and a feature that will facilitate pressure frequency during CPR. Trygfonden scheme was implemented in 2017 in the Capitol Region and followed in the Central Region. Since its implementation more than 80.000 volunteers have downloaded the app [2]. In 2020 the scheme was implemented for Region North Jutland. The DRL project was implemented medio 2018 in Region Zealand and Southern Denmark Region and planned to last for 20 months; it was evaluated in Spring 2019. From May 2020 DRL was replaced by Trygfonden scheme. Thus by 2020 covering all of Denmark. Criteria for volunteering differs as DRL demanded approved documentation of first-aid competences prior to signing up, whereas Trygfonden volunteers sign up by simply downloading the respective app ([2]).

3.2 Local Text Messaging Initiatives

The local text messaging schemes are implemented for region North Jutland. Each individual local group is created bottom-up and consists of one or a few key volunteers, who will typically have been the local initiator(s) and a group of 15-25 local volunteers and up to 50 volunteers if covering a large geographical area. A contact person is tasked with managing the local group of volunteers through a web-portal supplied by the region. This scheme will continue alongside Trygfondens app-based Scheme in Region North Jutland from Spring 2020.

When a suspected cardiac arrest is recognized at the dispatch centre, a text message via short message service (hereafter abbreviated SMS) is sent to every volunteer covering the respective local area. The SMS states the condition in a few words and a location and volunteers are expected to take appropriate action without giving a response. No documentation of first aid competences is needed for signing up, however a clean criminal record must be obtained. Volunteers are approved by local key persons, who are also often volunteers themselves.

3.3 Other Initiatives

Trygfonden is in charge of keeping a register of all defibrillators nationwide, this register is a separate initiative that predates the heart runner scheme, although the functionality is also implemented in the app. When a person registers a defibrillator they are asked to provide a phone number for one or more people who will be available to bring out the defibrillator if a cardiac arrest happens nearby ([2, 31]). The fourth scheme present in our study, is based on this register and resembles the local text messaging scheme in its composition, however instead of push messages one contact

person will be contacted by the dispatch centre and initiate a phone chain to alert volunteers to an incident.

The fifth scheme, referred to as Acute scheme, concerns volunteers who are called for multiple incidents, including cardiac arrests. Geographically they cover areas that are furthest away from ambulance dispatch centrals. These volunteers have been trained extensively and regularly in first aid and have access to more advanced medical tools.

4 METHOD

This study explores how volunteers in various heart runner schemes consider and negotiate availability before, during and after being called to an out-of-hospital cardiac arrest. We present ethical and methodological considerations for this study design *e.g.* discussions of obtrusiveness and facilitating respect for participants professional secrecy oath, as well as reflections on researchers' role. We account for the recruitment of participants, the interviews carried out by declaring their aims and ongoing changes to procedures.

4.1 Ethical and Methodological Considerations

Like previous HCI studies (e.g.[28]), we had some ethical and methodological considerations before carrying out the study. People participating in these heart runner schemes are faced with time-sensitive and life-critical situations and thus, our participants could have faced situations of receiving calls on real life alarms. Waycott et al. note the necessity of HCI researchers' adherence to ethical principles while studying HCI in sensitive settings with participants who might be considered vulnerable in varying degrees [30].

We chose to conduct traditional interviews as an unobtrusive way of collecting data as opposed to contextual interviews or observational studies. Further, all our participants had been subject to professional secrecy as part of the heart runner volunteer agreement, which we discussed with all participants before or during the interview. We informed them about data processing in accordance with the EU General Data Protection Regulation (GDPR) and ensured that no personal identifiable information, such as street names or local affiliations, could be identified from the interviews. We took care not to encourage violations of secrecy by advising participants to not mention compromising details of alarms received or accepted. Finally, transcripts were sent to the individual participant for transparency and approval. For one interview we had to redact a portion of the transcription per request of the participant.

Dickson-Swift et al. draw attention to how qualitative researchers should deal with situations in which sensitive and emotional distressing topics occur during data collection [9]. During interviews researchers should aim to suppress their own felt emotions to seem more professional in interactions with participants. Inspired by [9], we conducted debriefings among the involved researchers immediately after each interview, as participants' narratives at times triggered emotional responses. Such examples could be when conversation concerned the death of a close relative or witnessing suicide attempts, car accidents or other incidents with severe or fatal outcomes.

4.2 Participants

16 people (10 females) participated in our study (age between 22-74, M=43.4). Participants were recruited based on three conditions 1) being 18+, 2) currently affiliated with a scheme and 3) having received an alarm call. Although not adhering to condition 3, P8 was included because s/he helped show a diversity of schemes and technologies, representing the phone chain scheme. We found that her interview added to issues related to e.g. motivation, anticipation and concerns of recognizing and receiving notifications that was broguht up in related work. Eight volunteers represented a local text message scheme (two of these were also volunteers for Trygfonden scheme), five volunteers represented the app-based scheme by Trygfonden only and one from DRL (later merged with Trygfonden). Two participants represented other schemes.

Eight of the 16 participants (P1, P5, P8, P9, P13-P16) self-identified as having a professional background in healthcare (e.g. paramedic, nurse, carer for patients with complications and medical lab technician). The other half self-identified as not having a professional background in health (e.g. entrepreneur, student, teacher, firefighter, coach or retired). Almost all of them (15/16) had received and responded to at least one alarm, and this varied significantly from one to 48 alarms. They had been volunteering between one to six and a half years. One participant (P15) had received a disproportionate number of alarms due to the nature of the volunteer scheme.

Eleven participants were recruited through private local social media pages, where site administrators accepted to pass on our study and contact information to volunteers in closed forums. An additional five participants were recruited through authors' social network. All participants were presented with written information on study purpose, activities and processing of data prior to interviews. Participants did not receive compensation for participation.

4.3 Procedure

Our procedure followed two steps where we conducted our main interviews followed by interviews on how participants dealt with the restrictions related to social distancing after the COVID-19 outbreak in Europe.

Main Interviews. We carried out a total of 16 interviews over the phone and in one case in-person. Interviews were semi-structured and followed an interview guide that, besides demographics, featured questions regarding motivation for volunteering, organization of schemes and preferences, thoughts about future directions and wishes for technology facilitation. For example: *"What guidelines have you set for yourself regarding use of your mobile phone following volunteering?"/"If given the choice, would you prefer a scheme organized around GPS technology or text messaging?"*. Interviews lasted between 25 and 50 minutes. Interviews were carried out in the researchers' and participants' native language (not english). One participant additionally supplied documents that were handed out to volunteers prior to a meeting in their local organization.

Follow-Up Interviews. As eight of our participants were interviewed prior to the COVID-19 outbreak, they were invited to participate in an individual follow-up phone interview specifically investigating (self-)imposed guidelines. Five participated in these follow-up interviews that were held in week 15 during a national lock down with state recommendations of social distancing.

Table 1: Table of participants demographics; age, gender, approximate years of volunteering, scheme affiliation(s). Additionally, alarms received and accepted (from memory).

P#	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Age, Gender	63, F	33, M	52, M	74, M	27, F	23, F	55, M	25, F	47, F	37, F	22, F	37, M	55, F	47, M	72, F	26, F
Years of Volunteering	3	6, 5	1	3	1, 5	1, 5	2	1, 5	1	1, 5	0, 5	4	3	0, 5	3	0, 5
Scheme Affiliation(s)	SMS	SMS	SMS	SMS	App	App	DRL	Phone Chain	SMS, App	SMS	App	SMS, App	SMS	App	Acute, App	App
Alarms Received	17	48	3	17	1	2	2	0	4	16	3	35	25	1	700	2
Alarms Accepted	7	37	3	6	1	1	0	0	1	15	3	N/A	15	1	N/A	2

4.4 Data Collection and Analysis

All interviews were audio-recorded with consent from participants. Interviews were transcribed verbatim by the authors for analysis. Analysis was carried out as the thematic analysis mentioned in [7]. First, authors familiarized themselves with the data by condensing the transcripts into units of meaning. Secondly, authors compared the condensed transcriptions and in collaboration worked out a mind map of initial codes and sub-codes. These were; availability, use of technology, safety, motivation and expectations, practical organization of schemes, preference of schemes. Thirdly, full transcriptions were coded in Nvivo. To align understanding of codes, the coders separately analyzed the same paragraph of transcription and discussed until consensus was reached. Ensuing, coding was divided between two of the authors, who discussed their applied codes on few occasions of doubt. Codes were reviewed and grouped based on relations through affinity diagramming and iteratively formed the themes that were found relevant to report in our findings.

5 FINDINGS

Our findings are presented in five main themes: 1) Motivation and Expectations, 2) Responding to Alarms and Returning to Life, 3) Area and Familiarity, 4) Safety and Role Assignment, 5) Technology Opportunities and Challenges. Participants are referred to as P1-P16, in accordance with table 1.

5.1 Motivations and Expectations

All participants (16/16) expressed a clear motivation for joining the heart runner schemes, which took an outset in the intrinsic value of helping other people and thus potentially saving lives. Seven of them articulated that they were motivated by putting their professional health competences into use outside of work hours, as an example **P1**: *"I was already working within cardiology and cardiac rehabilitation as part of my job, so it was straightforward to also volunteer in this area"*, while four participants were primarily motivated based on their previous experiences from intervening as bystanders in cases of road or workplace accidents, or relatives experiencing sudden medical emergencies. A few of them were either prompted by reacting to advertisements, or as **P2** who was prompted to initiate a local group based on the knowledge of infrequent use of otherwise available defibrillators in the local area.

Besides own motivation, interestingly we found that several participants (8/16) were concerned with the motivation of other volunteers. Most remarkably, participants who were key organizers of local groups stated that they would regularly check up on volunteers motivations, particularly in cases of repeated *"no-show"* in connection with alarm calls. Thus, for these participants it was important to determine actual availability to avoid having passive runners in their schemes, as an example **P3** argues: *"It is easy to volunteer for an app or an initiative, but to feel ownership and the right commitment, I think that is the hard part"*. Somewhat surprisingly, it was even suggested that people might volunteer just out of morbid curiosity, as **P2** asked fellow volunteers: *"Is this something that you would like to do, or are you just curious about where cardiac arrests happen?"* In particular they request more demands on sign-up procedures to validate identity, proof of first aid competences and a clear criminal record. A few of the participants had heard rumours of the possibility in the app-based scheme that they implemented such a relaxed validation feature that you could sign up fictional characters, pets or even deceased relatives. The other half of the participants emphasized that although they can't know volunteers' motivations, they have to assume that they are there for the same reasons as themselves. **P7** in particular rejected scrutinizing volunteers intentions and motivations: *"Here you have the volunteer amateur help... You don't need to set the bar higher than necessary"* (**P7**). S/he had experienced how demands on volunteers to report a number of documents had introduced bottlenecks in administration.

In continuation of their motivation, participants expressed that their expectations regarding receiving alarm calls were characterized by contradictions; on one hand, they wanted to help others by putting their competences to use as exemplified by **P3** who argued that the CPR training efforts will otherwise have been wasted. On the other hand, **P11** underlined that no volunteer wished for a cardiac arrest to happen to anyone: *"When you volunteer, however odd it may sound, you hope to be called on and of course you shouldn't hope for that, but it is new and exciting"* **(P11)**.

Participants mentioned that expectations of how they would react to receiving alarm calls and reality clashed. **P16** explained that for weeks after their first alarm call, they would constantly check their phone, to a degree that they deemed unhealthy and noted feeling like their body was in heightened stress in response to the anticipation of another alarm call. A few of the participants

who joined recently (e.g. **P11, P14, P16**) could clearly recall their first alarm received and connected it with some to a large degree of confusion and anxiety, however noted that it passed over time and with more experience.

5.2 Responding to Alarms and Returning to Life

All participants (16/16) stressed the importance of noticing incoming alarms as soon as they were received. Quick response is extremely important for the survival rates according to previous research (e.g. [2, 31]), and all our participants were strongly aware of this fact. To address this, they deliberately used functionality inherent in mobile phones to distinguish the heart runner alarm calls from all other notifications. Participants from the text messaging schemes (8/16) would set specific sounds, lights or vibration patterns in their mobile phones to easily recognise alarms, for example **P2**: *"It [phone] has a specific sound when the SMS arrives and it vibrates in a certain way and it blinks in a certain way. So I can tell them apart"*, and most of them assisted each other with this. We only noted one instance where this manual setting was not ideal, **P1** missed two alarms as their newly acquired phone did not transfer the settings from their previous phone. On the other hand, the app participants would receive a loud and very distinct siren-like notification (set as default in the app), while the phone chain scheme did not have any immediate way of distinguishing alarm calls from regular incoming phone calls: *"... you just pick the phone up immediately when the call comes."* - **P8**.

Responding to an alarm basically required the participant to decide whether to run or not and particularly two considerations were highlighted. First, most participants said that they had experienced receiving an alarm while occupied with activities that could not be easily terminated, e.g. **P5** mentioned taking a shower or **P9** being at home while looking after young children. **P6** illustrated it like this; *"... can I respond when at work, and I am the only adult at work ... can I then leave the store to make a difference?"*. Most participants stated that they had a (domestic) spouse, partner, older siblings or someone they could inform when running for an alarm, which they could trust to inform others when e.g. leaving a dinner party or who could supervise younger children. Secondly, all participants stressed that they would normally be available any time of the day, however and interestingly, they also all agreed upon the fact that they would not be available at times where they had consumed alcohol as they would not trust themselves to perform critical work (resuscitation), and some also argued that they would not be available if they were unable to transport themselves to the site of the patient by car. The latter was surprising as the schemes are referred to as heart *runners*, but transportation by car was argued as the preferred mode of transportation and for few participants essential to manage the physical strain of transporting themselves - "*I am too old to run for these alarms ... I don't have the fitness level or lung capacity to run for example one kilometer*" **P1**. Volunteers do their best to facilitate patients in returning to life and a normal cardiac rythm, afterwards the volunteers return to their (everyday) life - whatever activities preceded and proceeds alarm calls. These might be sleeping, cooking, or working, etc. **P15** stressed that it was (sometimes) necessary to prepare for a safe return from responding to an alarm; one time s/he came home to a burnt meal in the oven that s/he had completely forgotten when s/he got the alarm and responded immediately. While the core of the heart runner schemes is that anyone can aid in saving lives, we also found that the efforts could be draining on the participants. In particular, not knowing the outcome of the efforts as illustrated by: "*We don't get any information on how everything went, this is also something that you should be able to deal with, namely that you never know whether you actually succeeded [in resuscitating] or not.*" **P1**. Except for one occasion where **P10** mentioned that an elderly man, at the anniversary of the alarm call, showed up and even brought flowers as thanks.

Arriving on site can be hectic due to the severity of the situation, but the participants also stressed the need to make quick judgement calls, and the uncertainty of the situation. All text message participants reported that they would be wearing a brightly colored reflective vest with writing, while only a few from the app based initiatives had access to one. A background in healthcare might not be sufficient to prepare volunteers for the pressure when arriving on site **P2, P5** and **P13** noted, as the setting is unlike a hospital and the same medical tools are not available. Even **P13** experienced an initial barrier to enter a strangers house in a rush, but s/he found that wearing the vest had an immense signal value of legitimacy, as well as facilitated getting into a certain state of mind. Several participants articulated that an important task when arriving is clearing the site, as next of kin, bystanders, or furniture may be in the way of properly administering CPR and creating a clear path for ambulance handover. In these cases more volunteers might be needed, as **P3** exemplifies: "*... last time I responded to an alarm was an afternoon and we were approximately 10 heart runners present at the site, and therefore we could also handle family members including children and pets*". **P5**, who is also a paramedic, agreed that the volunteers on site may provide useful assistance before, during and after handover to paramedics, they may also assist in psychological first aid.

Participants indicated that there was an inherent temporality concerning frequency of alarms received and perceived readiness to respond. While participants expressed that they signed up with an expectation of being *"activated"* (to run), the frequency of calls varied greatly and participants argued feeling either like being on *"standby"* for several months at a time or being called several times in one week. Participants (**P10, P11, P12, P13 and P15**) noted that when alarms were received infrequently, their sense of availability and perceived readiness would steadily increase. **P10** argued that since it had been two months without an alarm, s/he was expecting an alarm very soon. Although, when alarms were received too frequently, it would present as a nuisance. Despite that, more participants noted that it would rarely deter them from responding to run, as articulated by **P13**: "*... when you have responded to alarms several nights during the last couple of weeks, you start to think about alarms when you go to bed ... tonight I hope there will be no alarms as I don't have the energy for it*".

Due to the sensitivity of the contexts to which the volunteers are called, they needed to consider the emotional strain that comes with committing to being available for responding to resuscitation. Participants generally argued that it was especially difficult when called to younger patients. The included Volunteer schemes

in our study do not dispatch volunteers to children under 8 years old. The local schemes had varying organization around debriefing after responding to an alarm. Either one person was in charge of contacting affected volunteers, or volunteers were expected to organize themselves afterwards based on assessed needs. For the local scheme of **P2**, they had an implemented a routine where volunteers would meet up afterwards and reconstruct a narrative starting with the first volunteer on site, then the next one, and so on. Although **P2** also recognized that for some volunteers that have been on call extensively debriefing had perhaps become more of a routine than an urgent, actual need. Meanwhile, **P3** and **P8** recognized that there might be a need to make debriefing a standard practice in their respective schemes. In the app-schemes, after responding to an alarm call volunteers were asked to fill out a questionnaire inquiring about their perceived psychological strain and if they required a professional consultation. While not all volunteers express a need for professional help, volunteers agree on the need to talk to at least someone about their experience: *"I think that there is a need for talking together to avoid having these experiences alone ... especially for such activities that pushes boundaries of what we normally do for each other"* **P7**. **P14** (app) expressed a fondness for the acknowledgement of their efforts in the message that followed the questionnaire, although aware that it was a generated message.

5.3 Area and Familiarity

The geographical area in which heart runners would receive alarms played an important role for the participants. In general, they expressed a strong awareness that the areas where they were most likely to be called were areas they spent time in (lived) and therefore they could know or be familiar with people living or working there. Thus, when running on an alarm, several of them said that it often happened that it was someone they knew, e.g. friends, neighbors or just acquaintances. While all participants imagined the thought of recognizing the address as uncomfortable and their response worth extra consideration, they all clearly articulated that they would most likely respond to an alarm where they know the victim, illustrated by **P2**: *"Some [runners] will rather not respond to an alarm where they know the person, but that is completely up to them ... I will definitely respond, because you can really make a difference."*. However, a potential disadvantage of the local communities was expressed by **P9** as s/he had heard someone state that they did not want heart runners in their homes, as they were afraid that they would judge them and gossip about their *"ugly curtains"*. To this end, s/he firmly noted that volunteers were sworn to professional secrecy. On the other hand, familiarity with the area of operation had other advantages as participants argued that they knew the physical surroundings, and in fact a few of them were not at all comfortable responding in areas they were less familiar with, although 12/16 participants said they would respond but they would have increased focus on their own safety and would depend on technology for way-finding.

Participants emphasized repeatedly that while defibrillation is invaluable when administered timely, CPR was perceived as the most important task to start immediately. Locating and retrieving defibrillators in the area was first and foremost an individual decision in-situ. The app-based solutions demanded that volunteers reported their decision up front and was guided accordingly. The local text messaging scheme featured little negotiations within the groups on this responsibility. Here, participants (e.g. **P2**) argued that it was a waste of time with fatal consequences if attention was directed to retrieving defibrillators rather than going straight to the site of the cardiac arrest. In particular for the schemes fixed on a local area, volunteers have had a say in the strategic placement of defibrillators and have memorized where they are placed. Whereas, **P6** from the app-based scheme mentioned that they were not familiar with the placement of defibrillators at their specific location (during the interview). That being said, **P6, P8** and **P11** (app and phone chain-scheme) also argued that they have adopted a heightened awareness of where defibrillators are placed when they enter a new area or building.

A common theme for the local text message schemes was a strong desire to feel a sense of local anchoring and a shared belief that it will have negative consequences if someone from the outside was dictating their local practice, and this was argued in two ways. One was security in the known; geographic area, fellow volunteers: *"... when you arrive in private homes, I find it comforting if I am acquainted with the area in advance"* **P1**. The other way that local anchoring manifested was on site of a cardiac arrest, where volunteers had practiced or routinely been on calls together. Although the local text message participants expressed that it was to their advantage that they knew each other well within the groups, none of the other participants saw this as a disadvantage for them.

> *"The times we've been out [on alarm calls], we've learned how we're supposed to work together and practiced the routines around what you do, that is time saved."* - **P3**
> *"... and we don't talk about it, we're just going, because we've practiced this on our courses. You know, we've been rolling around on the floor and climbing under all sorts of stuff, because patients rarely just collapse in the middle of the room."* - **P13**

Geographical areas were also portrayed in terms of population density and addressed as urban or rural. For example, **P7** mentioned feeling more responsible to respond in less populated and local areas due to a lower number of volunteers, but s/he also pointed out that s/he did not perceive this as a flaw of the scheme itself. Traffic flow and population density was also mentioned, as these would impact the response time from receiving the alarm to arriving on the site of the suspected cardiac arrest. In line with this, participants argued that slower EMS/ambulance response times motivated locals in rural areas to engage more in the scheme, e.g. *"I believe that smaller communities are in extra need of these services ... because the response time [ambulance] is longer"* **P6**.

5.4 Safety and Role Assignment

While safety and familiarity played important roles for the geographical areas, we further found other dimensions of safety, and in particular perceived safety was stressed by all 16 participants as a crucial element when conducting this type of volunteer work. For participants this meant having the right equipment, that private insurance would cover you in case you injured yourself or made damage to possessions, or even in cases of 'do not resuscitate' legal

Table 2: Table of key and illustrative findings for each theme.

Motivations and Expectations	Participants' emotions concerning receiving alarms were characterized by contradictions; they were excited to put their training to use, but they sadly knew it also meant that a person was in a life-threatening situation.
	Many participants experienced doubts about whether other volunteers are motivated for extrinsic reasons, such as being perceived as 'heroes' or even out of morbid curiosity.
Responding to Alarms and Returning to Life	Participants expressed two imminent considerations when receiving an alarm; First, that current activities could be responsibly left in a hurry. Secondly, that their competences were not imparied e.g. by any amount of alcohol consumption or showing symptoms of illness.
	Most participants stated that for debriefing, local SMS volunteers lean on their community of volunteers and the app volunteers rely more on their personal network. While the local schemes pointed to their model as a clear advantage, the app participants didn't express a lack of debriefing.
Area and Familiarity	Most participants were aware of the fact that they are often called to respond in familiar areas, and therefore it is likely that they may risk knowing the patient.
	Some participants expressed a stronger obligation to respond in rural areas due to a lower volunteer pool, but also due to the fact that ambulance response times are often longer.
Safety and Role Assignment	Most participants emphasized that one thing they feared was being the sole responder to a cardiac arrest, as the many tasks and physical strain was too demanding for one person.
	Some participants expressed that they feel more comfortable with certain tasks, e.g. providing psychological first-aid or CPR - as such participants assigned roles ad-hoc based on their knowledge of other volunteers' strengths. However, there was no transparency on these decisions between volunteers prior to arriving on site.
Technology Opportunities and Challenges	Although not an explicit demand, all participants had changed their habits around mobile phone use after signing up to volunteer e.g. frequent charging, phone always nearby, notification settings.
	Some participants had experienced technical difficulties e.g. GPS coordinates not updating frequently enough to have a correct overview of available nearby heart runners or had experienced receiving the wrong address or none at all. Although mobile navigation and positioning via GPS are crucial elements.

measures (as mentioned by **P4**), as well as managing and overcoming guilt from non-response. But the single most important aspect of safety and being insecure was the experience (and thought) of being the only volunteer on site of a cardiac arrest, as illustrated by **P13**: *"It's incredibly comforting that we're a group, because then you don't have to be on your own with this..."* and *"... Their fear is not that they are called on [to run], but that they arrive as the only one"* (on new volunteers in particular). Being alone in such a situation was considered mentally, but also physically demanding. Several of the participants argued that administering CPR is hard work and rotation between volunteers is usually needed. **P10** stressed that it was not unusual to have to administer CPR to someone who was almost double their own weight and usually after five minutes s/he needed a break. But also, being alone at the site made it difficult or even impossible to carry out all the different tasks that are necessary beyond the actual CPR, which was illustrated by **P13** in this way: "*the difficult part is not the 30 pushes of chest compression and two mouth-to-mouth breathing, the difficult part is to work effectively together ... what does the first person do, and what does the second person, but also where do you put the cars - small practical problems that actually means a lot ...*"

While the app-based schemes only send alarms to 20 volunteers at a time. Some of the local text message groups have had to set up rules for how many volunteers should be on site, as the entire local volunteer pool receives alarms simultaneously. e.g. **P2** mentions that they locally agreed on five volunteers in total, while **P3, P4, P9, P13** mentioned that it's not clearly agreed upon beforehand. **P13** express a very organized approach depending on whether volunteers arrive first, second or fifth, etc. To accommodate several people working together during alarms, participants assigned roles to themselves and others - usually based on shared experiences from previous alarms. As an example, **P9** (text-message) mentioned that s/he was aware that two local volunteers (a couple) were hospital staff and both had professional healthcare equipment that they usually brought along when called for an alarm. S/he also told that one was an incredibly fast runner, whereas the other would often follow in car or on bike with the equipment. Additionally, **P6** (app) recalled an experience where s/he recognized that two volunteers were already administering CPR, so instead s/he comforted the patient's wife. **P6** further emphasized that s/he did not feel inadequate in this situation, although there was no hands-on contact with the patient. On the contrary, one somewhat mocking role assigned by **P7** underlined how s/he got the impression that some people craved to assume the "*hero*" role, liked to be "*where the action is*", or "*be acknowledged*". Additionally, some expressed a desire to be first on site to work directly with administering CPR (e.g.**P13**). As they admitted, that the rush of adrenaline when receiving an alarm could be a little exciting - *"... because we all get this adrenaline kick, which makes us somehow excited ..."* - **P13**. But also because they expressed that they have confidence in their competences in managing the situation.

While all app volunteers have to accept or reject alarms and to respond whether to bring a defibrillator, there is no transparency on these decisions between volunteers prior to arriving on site. For the text message schemes no response is required, however for the local group of **P3** they had implemented their own system of responding within the group on a private chat with a thumbs up for *"on the way"* and a heart for *"bringing a defibrillator"*. Meanwhile, one participant (**P6**) suggested a functionality to be implemented in the app that would provide transparency of volunteers, in the form of a counter. Despite this, **P14** acknowledged that in the rare case that no one responded it would be a disadvantage. Additionally, it

would not be transparent across schemes how many volunteers in total would show up and if some non-registered bystanders had stepped in while the volunteers where on their way, *"... you can sometimes feel guilty for having signed up for this ... I may be a little cynical, but you need time off once in a while and I am not employed [in the scheme]..."* **P14**

While the focus in our study was not on COVID-19, it became inevitable to talk about the effects of the global pandemic on the heart runner schemes and the associated volunteer work. Perhaps somewhat surprisingly, only one participant (**P1**) had deliberately declined alarm calls during the pandemic due to being a person with increased risk. All participants had received information on COVID-19 guidelines, and some of them had modified or changed the way they handled alarms. Nine participants had become more reluctant to provide assisted breathing (mouth-to-mouth), more aware of washing and/or sanitizing often and properly before arriving and upon returning to not expose other people (in the household). But three of the participants had not implemented any changes to their practice and they were rather skeptical about the provided guidelines, as they argued that if not all usual measures were taken patients would not get the best possible resuscitation effort. That being said, **P5** who worked as a paramedic, questioned the effect of volunteers' access to safety measures as s/he was used to wearing a great deal of professional safety equipment in their daily work.

5.5 Technology Opportunities and Challenges

Despite our expectations there seem to exist no explicit rules or guidelines for volunteers in regard to mobile phone use in order to be available. All participants express that as the work is volunteer work, it is counterproductive to dictate changes that intervene with their personal lives. However, all participants mentioned that they had experienced a change in habits around use of the mobile phone after volunteering in order to be easier to reach at all times, e.g. always charged (**P8**) or always carried with them or set up to ignore *"do not disturb"* modes at night (**P9**). On the other hand, for events where phone alarms were not considered appropriate participants used simple strategies, for example, phone in flight mode when attending class (**P11, P14**), or simply blocking the number where text messages were received for going on vacation or taking breaks from the scheme for whatever reason.

Interestingly, one participant mentioned using technologies on the site of a cardiac arrest (besides a defibrillator). The local group of **P2** was instructing each other to use a CPR-tempo app; *"... There are always three-four smartphones around the patient."*. Other participants relied on the help program in defibrillators that guide the user both in administering defibrillation but also in monitoring the pulse and the quality of the CPR administered (pressure, frequency). While **P7**, who was also a local first aid instructor, urged volunteers to keep it as simple as possible in order not to let technologies distract from intervening.

Participants expressed that the information received in connection with an alarm is short and simple across all schemes, it will usually display an address with a hyperlink to a map and for the text message schemes additionally, the current condition of the patient e.g. unconscious, abnormal breathing. All participants were satisfied with the amount of information received. Although, participants had on a few occasions experienced that the address was incorrect or that a hyperlink was missing and they had to look up the address themselves. For example, **P2** recalls a situation where the received address was not actionable, as the call was received from a stretch of country road with no nearby buildings or houses. 10/16 participants critiqued the navigation feature across schemes, as they would like the opportunity to choose the transportation form, to more accurately display convenient routes. Illustrated by **P6** who emphasized that some routes could be easier navigated while biking or on foot than by car.

The biggest difference between schemes is the use of either app or text message to send alarms and whether or not volunteers were located via GPS or not. Participants repeatedly stressed that for this highly time-sensitive task it is vital that the technology is working correctly. For the interviews prior to the national implementation of the app-based scheme, text message participants voiced concerns and assumptions about the GPS technology, as they had read on social media forums or discussed among themselves that GPS was not working as intended. After the implementation, we interviewed eight participants where three had signed up for both schemes and thus experienced these issues first-hand (**P10, P12, P13**). All three had experienced GPS not updating frequently enough to be reliable, as **P10** experienced a shocking 25 minute delay from initial text-message to app-notification to an alarm regarding their neighbor - at the time of the app-notification an emergency helicopter had already arrived. **P12** experienced that when opening the app to accept the alarm, the GPS signal updated to their current position and consequently disappeared as it was too far from the originally registered position. Despite these accounts, none of the participants from the app-based schemes experienced being consistently delayed. **P11** mentioned having heard about problems with the app, but have not experienced them, but **P16** had experienced being guided to the wrong address by the app. Participants stressed often that on site all volunteers must work together regardless of affiliation, **P10** mentions aiding *"our colleagues from the app"*. **P13** adds that it must never come down to *"us versus them"*, but express a commonly noted worry that the app-based schemes are not adequately equipped to take care of the individual volunteer in the same way that local text message groups do.

6 DISCUSSION

Committing to availability through mobile technology has been a central point for this study, as previous studies have centered on non-response in connection with volunteering to be called for delivering first aid. We present the ways availability is argued temporally and spatially, as well as the role we imagine establishing volunteer communities may have on individual increased safety.

6.1 Extending Existing Framework of Temporal Barriers to Respond

Ozcan et al. conducted a simulated study of volunteer responders and constructed a temporal framework based on their work including commitment, notification, leave, and perform [21]. Our study compliments this work, primarily on frequency of alarms and perceived readiness, negotiating micro-boundaries and what

role technology play in this negotiation as well as introduce an additional temporal barrier that emerged from our findings. Our findings indicate a relation between frequency of alarm calls and perceived readiness, as infrequent alarm calls would cause participants to have a heightened awareness of the lack of alarms received. Whereas alarm calls clustering on a daily or weekly basis would leave participants exhausted and more prone to consider not responding. Our findings underscores that the frequency of alarm calls introduced in the study by [21] was disproportionately higher than our responder initiatives, potentially introducing a higher level of response fatigue. That being said, factors like population density, socio-demographic composition, etc. may be factors in the frequency of cardiac arrests and is not easy to generalize to all geographical contexts. Although all our participants emphasized that they were not *"on call"* and that response was completely voluntary, we noticed that non-responses (rejecting alarms or missing alarms) would sometimes provoke feelings of guilt. In line with Mattern et al. [20] and Pielot and Rellot [22], our findings show that social expectations of availability do exist, in particular within local groups. However, it was also evident that participants had a clear perception that *someone* would always respond, that non-response is status quo and that volunteer response is an addition to existing EMS response. This comes up when volunteers negotiate micro-boundaries for when they are available to respond, similar to the study by Ding et al. [10]. In contrast to ([4, 21, 24]) which assert that barriers related to receiving notifications was by far the most eventful, our findings point instead towards barriers related to leaving current engagements. In line with Ozcan et al., we believe that the two have very different design implications [21]. In contrast to the suggestion made by Ozcan et al. to implement functionality of marking time slots when the individual volunteer is not available, our findings showed that manual, low-tech solutions were utilized successfully for this purpose. Our Findings show that it is rarely a pre-determined time frame of availability, but rather a situational judgement and in worst case time boxing features can increase volunteers' *fear of missing out* and add to non-response guilt if informed of missed calls by other volunteers.

Our findings seem to point to an additional element compared to the framework of Ozcan et al. that introduces a fifth temporality - after responding and upon returning to what you were previously engaged in. This is afforded by our study design, as simulated alarm calls do not cover all temporalities of the framework. Here lies interesting implications both for response and non-response for debriefing practices, where technologies may play a role in accommodating non-response guilt.

6.2 The Implications of Area and Familiarity on Availability

While Ozcan et al. indicate some spatial and geographical aspects, we identify two dimensions related to this. First, we argue that familiarity with an area and understanding of local traffic flow have an impact on response. Secondly, how technologies currently incorporate distance and how this conflicts with how volunteers understand distance. These understandings have the potential to lead to better design of technologies that support increased perceived and actual availability to respond timely.

Our findings showed that participants emphasized how they felt better equipped to respond in areas they were familiar with. In areas where volunteers were less familiar, they were more dependent on mobile technology for way-finding and locating defibrillators. The navigational features are therefore essential to the volunteers. Despite that, our findings show a request to have navigational features be more customizable to transportation forms, while still taking into account that the circumstances are time-sensitive and the interaction must be accordingly fast. As our findings suggest that most transportation is done by car, real-time traffic information could be ideal for route planning. Additionally, some major technical issues in regard to updating GPS position across operating systems have already been reported but still presents as a critical concern. As opposed to findings from [5], showing that app notifications (utilizing GPS) were preferred over SMS.

A core difference between the schemes is how distance is built into the technologies. For the app-based schemes relying on GPS, volunteers are called based on their proximity to the cardiac arrest, while the text message volunteers are called based on their local affiliation. Our findings show that when participants speak of distance, many other factors than proximity are crucial. Two important factors are EMS/ambulance response time and population density. The local schemes, in particular, voiced concerns that the way the app-based schemes considers distance presents a different reality than the one they are facing in more rural areas with a low population-density. From spring 2020, the app-based scheme features nationwide coverage. If the goal is to consider a uniform national effort towards responding to out-of-hospital cardiac arrest, this is one of the main reasons why participants are unwilling to adopt this.

6.3 Increasing Individual Safety Through Establishing Communities

A key finding for this study was, what volunteers feared most of all is to be the sole responder on site, as many diverse tasks are imminent and CPR is physically straining. In response to this, we highlight findings concerned with assigning roles and imagining means to increase individual safety.

Our findings revealed that mainly on-site but also prior to response, informal roles are assigned to volunteers. Some volunteers are fast runners for fetching defibrillators or arriving first on site to gain an overview, while others are good at administering CPR and checking vital signs, some due to a health professional background some from a lot of experience. Not least, some are very good at providing psychological first aid and comforting both bystanders and fellow volunteers. One volunteer may be assigned multiple roles, but some feel most comfortable in the same role. The local schemes expressed a higher awareness of fellow volunteers and their preferred role and underlined this as an advantage on-site. They have often engaged in first aid courses, scenario drills and socializing together, in comparison to the app-based schemes. The now discontinued DRL-scheme (app-based) operated in a sort of geographically determined cluster formation not unlike the local schemes, however the participant (**P7**) who was head of their local cluster expressed that it was mainly for administrative reasons. While other participants from the app-based scheme mentioned

social media, it was never accentuated as an essential part of their volunteer experience.

We argue that these group formations and communities may come to play an essential part in networking with other volunteers and keeping up to date with first aid competences, to increase confidence to intervene, familiarity with preferred roles and perceived safety on-site.

6.4 Implications and Future Work

Based on our work and also previous research, we see a number of implications for heart runner schemes. In the following, we consolidate our findings by listing three implications and future work directions. These include volunteer qualifications, transportation and navigation, and organization between schemes.

First, we saw that our participants were split on whether volunteers should undergo more rigorous validation of their qualifications, for example their first aid competences, or whether schemes should continue to be highly trust-based with few demands or requirements as a trade-off in order to ease central administration tasks, but also to maximize the volunteer pool.

Secondly, we saw that transportation and navigation when responding to an alarm was both a conceptual and implementation issue for the participants. In fact, participants knowledge and perception of distance in urban and rural areas affects how the schemes should assign volunteers, as more than just proximity defines volunteer availability to respond. Future work could investigate navigation that is better suited for certain modes of transportation, for example by considering how to relay real-time traffic information.

Thirdly, we saw that volunteers with different scheme affiliations may result in conflicts or misunderstandings partly due to the fact that these schemes currently co-exist. While some participants had strong opinions on their scheme preference, they would like to see more collaborations between schemes or even a uniform model where the local experiences and differences are better accounted for, e.g. community building or role assigning. Future work may study what functionalities from different schemes may be implemented into either a uniform scheme and how these translate from local scale to national scale. One example is whether transparency of response can be disclosed to other volunteers. One such instance is mentioned by Ozcan et al. in the form of a suggestion of a system pairing up volunteers to augment actual safety[21]. For role assignment, we encourage future work to specify the different existing roles, with inspiration from *e.g.* [15]. We see the potential for these suggestion and implore future work to envision these types of functionalities. Another challenge for future work will be how to accommodate non-response guilt and who has this responsibility.

6.5 Limitations

We acknowledge that this study has limitations in the fact that we have no control over alarm calls received, although we also view this is a great strength. However, it presents itself as a weakness in the form of potential recall bias, as we did not inquire about the duration from the last alarm call received and some participants have had to recall experiences. While it would have been interesting to study responders in-situ or as a participant, we could not defend this ethically. Additionally, a large part of our participants hold key positions in their local groups with regard to administration and planning and have in most cases constituted these. They may hold different perspectives than participants who are not as engaged with these tasks, but we don't have sufficient empirical evidence that this is the case. Geographically, our recruitment did not represent a national coverage and is not directly generalizable to all areas of Denmark. We imagine that there can be differences on schemes that cover variations on rural or coastal areas and schemes that cover capitol or dense urban areas.

7 CONCLUSION

For this study we interviewed 16 volunteer responders across different heart runner schemes, to investigate how they organize themselves through mobile technologies and the consequences of being available anytime, anywhere. We found that temporal (anytime), as well as spatial (anywhere) aspects play key roles for volunteers. We argue that social expectations of availability exist within these initiatives and distrust in motivations and commitment exist both within, but in particular across schemes. We extend previous frameworks for similar volunteer initiatives, supplementing barriers to response concerning returning to (everyday) life. We also conclude on how familiarity with a (local) area impacts volunteers barriers of response, in particular how current navigation features often conflicts with practice. Additionally, we empirically underscore the role of community in heart runner volunteer initiatives. We urge future research to engage in imagining suitable community-building features on- and offline to encourage volunteers to feel prepared for, and confident in, taking on emergent, urgent and collaborative tasks.

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