Communication and information exchange between Emergency Medical Teams during emergency situations in Riyadh, the Kingdom of Saudi Arabia: An explorative qualitative study

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Abstract

There is a lack of knowledge regarding communication and information exchange between the emergency medical teams (EMTs) during emergencies, particularly in the Riyadh region of the Kingdom of Saudi Arabia (KSA). The aim of this study is to explore EMTs' experiences of communication and information exchange during difficult emergency situations in the city of Riyadh.

A qualitative exploratory study was undertaken to explore the experiences of 62 respondents from the Saudi Red Crescent Authority (SRCA) and emergency departments (EDs): a total of 18 were SRCA staff (three call takers, four dispatchers, three field supervisors and eight paramedics), and a total of 44 from hospital EDs, comprising 19 ED nurse managers, 12 ED physician consultants and 13 ED paramedics. Semi-structured interviews were held with the participants, who all had the experience of responding to emergencies and had the authority to communicate with one another. The interviews were tape-recorded and transcribed verbatim and the transcripts were analysed using Braun and Clarke's thematic analysis [1]. NVIVO 11 was used to aid data management.

Three themes were identified comprising central factors that influence coordination and communication between the participants. These themes were (1) the emotional impact on SRCA staff performance, (2) the effectiveness of the emergency response, and (3) perceptions of emergencies preparation. The first theme highlighted important factors related to emotional and well-being, which impact the performance of the SRCA operation centre staff and have an impact on the information shared with other relevant staff. In the second theme, issues that emerged that related to the effectiveness of the emergency response, coordination and communication between the EMTs were highlighted to be limited in effectiveness. Although several communication systems were used, some of them were not formally sanctioned and some were technical issues related to the systems used. The third theme explored participants' perceptions of emergencies preparation, and again the findings demonstrated limited evidence of disaster management training or preparation particularly between EMTs. The training in communication among EMTs staff in preparing for disasters was similarly found to have deficits and could be improved. Finally, the findings from this study demonstrated that the level of debriefing that was put in place following an incident could be substantially improved.

Communication between EMTs not only involves the use of advanced technology but also requires improvements in coordinated communication within and between EMTs in relation to an effective response to emergencies and disasters. This could be achieved if the directors, managers and policymakers appreciated more fully the importance of the factors to be considered in relation to the effective use of ICT, the adverse impact of the ineffective use of communications systems, and how the coordination of services could be improved during emergency situations.

Introduction

The KSA, like the rest of the world, is frequently confronted with a variety of emergency situations, particularly in Riyadh city [2]. Riyadh is the largest city in the KSA and the country's capital, with a population of around 7.8 million [3]. Riyadh has been the location of various emergency situations, making it vulnerable to a range of mass casualty incidents (MCIs) and natural and man-made disasters, for which the healthcare system requires additional preparation [4].

Road traffic incidents (RTIs) account for 4.7 per cent of all fatalities in the KSA [5]. According to Al-Wathinani et al., (2021) the KSA has one of the highest rates of RTI mortality and morbidity in the world. Riyadh has witnessed terrorist incidents and riots in past years which have resulted in large-scale deaths and injuries. According to Alamri, (2010), in 2003, three residential compounds in Riyadh were targeted by terrorists, killing 40 people and seriously injuring over 160. In the following year, another residential compound was targeted, causing 17 deaths and 122 injuries [6] and in 2003 the Ministry of the Interior was subject to an attack that left five dead and 145 injured including a number of police officers [7]. Other forms of human activity have caused unintentional death and injury. In 2012, a fuel-truck accident caused 23 deaths and 139 injuries (Reuters, 2012). In 2013, riots by illegal immigrants from Ethiopia resulted in a number of deaths and injuries [9]. Riyadh experiences severe annual climate events such as floods and sandstorms which affect patients who suffer from acute reactive lung diseases such as asthma (Alangari et al., 2015). As a result, the number of patients seeking care in the ED increases during these adverse weather events and can sometimes lead to death [11].

In the event of an emergency, victims are treated by EMTs, which includes two organizations: EMS and ED personnel [12]. A growing body of literature has recognized the importance of patient information being up-to-date, accurate and communicated efficiently between EMTs following emergency situations and during the transportation of the injured to hospital [13]. Ineffective communication between EMS and hospital staff during emergencies, according to numerous studies (Rowlands, 2003; Pun et al., 2015; Meisel et al., 2015), could result in extra difficulties such as the risk of medical errors, which can result in more injuries or deaths. If communication between EMS and ED workers fails during an incident, critical information may be altered, lost or otherwise unavailable to emergency physicians or advanced practice providers (Martin et al.,2018)

Studies have been already conducted to assess the effectiveness of information sharing in busy environments such as an ED, particularly during the handover between EMS and EDs, and have concluded that challenges exist [18–20]. Evans et al.,(2010) found that some information, such as patient demographics, allergy status and mechanism of injury, was not documented by trauma team members or paramedics, and that information was frequently lost during handovers. A quantitative study conducted by Kalyani et al., (2017) discovered that communication and information sharing between EMS and ED staff was regarded as a problem. That study showed that factors such as overcrowding in the ED, distractions and a lack of effective listening during face-to-face handovers all have an effect on the quality of clinical handover and can result in the loss of critical patient information [20]. According to Bost et al., (2010), communication and information loss during patient handover can cause paramedics to have to remain in the ED longer than necessary, impacting upon them being able to conduct their primary role of protecting patients.

Effective communication between EMS and ED personnel during and after emergency situations can significantly reduce fatalities in the first 24 hours [21]. Martin et al., (2018) indicated that ICTs could help to improve communication and collaboration and facilitate the transition between EMS and ED personnel, as well as help to assess their needs and ensure that adequate resources are available. The use of advanced communication systems, according to Beul, et al., (2010), can facilitate the transmission of patient data to receiving hospitals. As a result, it is necessary to consider the use of ICTs by various emergency organizations in terms of how systems can most effectively support information exchange and coordination between EMTs under time constraints (Abbas, Norris, Parry, 2018).

ICT used in healthcare systems during emergency situations

There are numerous examples of information-sharing systems used by EMTs during emergencies and disasters. The use of mobile phones and landlines enables medical staff to access updated data and disseminate information in life-threatening situations [24], as does the use of a two-way transmitter and receiver such as the Terrestrial Trunked Radio (TETRA) (Protogerakis et al., 2011;Kunavut, 2014). TETRA enables effective and safe wireless communication for all authorities involved in emergency communications, such as ambulance, police, fire and rescue services [27].

The use of computer-based systems has brought about significant change and plays a critical role in the operation of healthcare systems because of the ability to transfer and store considerable amounts of data and monitor transactions in real-time through software systems (Ferreira, 2011; Fragkiadakis et al., 2011). Electronic health records accessible by hospital staff provide an example of communication-based systems. Vos et al., (2020), stated that electronic health records facilitate coordination, cooperation and joint decision-making. These resources have enabled real-time sharing of integrated patient information between HCPs, enabling the provision of high-value care [31]. In the EMS, Staff in the emergency communication centre use software called computer-aided dispatch (CAD) to determine the location of an incident through a global positioning system (GPS), record the status of a patient or injured person, and triage casualties effectively ([32, 33].

The role of EMTs and the emergency notification process in the KSA

Emergencies responses are not limited just to the use of ICT; each medical team has a role to play to respond more effectively. Effective emergency management, from a healthcare perspective, requires collaboration between EMS and ED with the primary goal of saving lives during and following an emergency [34, 35]. In addition, EMS responders are the first HCPs on the scene following an event [36]. When EMS workers transfer patients to receiving hospitals, the EMS is responsible for patient care until the patients arrive at the hospital's ED. Thus, the EMS is an essential component of health care since it is instrumental in saving lives and reducing mortality and morbidity rates (Aringhieri et al., 2017).

In healthcare systems, notification processes begin with emergency control room staff such as call-takers and medical dispatchers, whose job is to receive and distribute information to the appropriate personnel (Clawson, and Dernocoeur, 2014).Call-takers are tasked with the responsibility for gathering critical information about patients' condition and location from callers and then entering it into a CAD system, and then emergency medical dispatchers classify the reported information and dispatch it to the paramedics and hospitals [39]. This notification process between EMTs is shown in (Fig1).

The challenges of communication and information exchange between EMTs

Emergency management requires quick and timely coordination not only among team members but also between different organizations [40]. A number of studies have identified the need to investigate how ICTs can promote increased information flow, improve communication and coordination between organizations and improve the overall effectiveness of emergency management networks (Abbas et al., 2018; Baseman et al., 2016; Bellini et al., 2013). According to [43], a clear rule for coordination is necessary to facilitate information-sharing between emergency organisations and to ensure the privacy and confidentiality of shared information. During emergency situations, coordination between EMS and ED team members needs to be within a context where clear roles for EMS and ED personnel are delineated [44].

Dawes,Cresswell, and Pardo, (2009) stated that when there are no clear rules with regard to coordination between different organizations, that has an influence on how they share information and knowledge related to an incident, including information mismanagement, resource allocation issues, and ineffective communication [44]. These challenges collectively can lead to coordination and communication failures between these teams (Salmon et al.,2011) . In addition, difficulties can arise in preparation for the immediate assessment and treatment of patients inside the hospital [18].

Emergency organizations' rules regarding technology use and information-sharing between HCPs could be viewed as a necessary requirement for effective coordination and communication [47]. Abbas et al., (2018) demonstrated that the various ICTs used in healthcare systems are incompatible with one another, which can result in scattered health data and double recording of patient data. An earlier study by (Abbas et al., 2016) demonstrated that in order to share information between different organizations, establishing cross-sectorial horizontal information exchange between intervening agencies provides a holistic picture of the situation and reduces response costs through agency sharing of knowledge and expertise, which results in improved decision-making and action.

In addition, sharing information contributes to the reflection of the degree of confidence among emergency organizations during accidents in the efficiency with which they perform their work (Hermansson, 2016). Reay et al., (2020) showed that relationships and communication between EMS providers and ED nurses have an effect on the quality of information communicated, which is contingent upon the level of trust and relationship between staff members in these two organizations. Another challenge to using ICT in an emergency is the important nature of technical infrastructure availability [43]. Advances in technology and increased access to new technologies have aided the advancement of information-sharing efforts in the field of disaster response (Bjerge et al., 2016), as well as the coordination and collaboration functions between EMS and EDs during emergency and disaster management (Donnelly et al., 2014; Abbas et al., 2016). However, this potential is only realized if challenges related to using technology are resolved.

When participating organisations use a variety of different types of information systems and technologies, challenges can arise [43]. The perceived usefulness, belief, willingness and attitude of HCPs can influence their decision to use a technology [53].

ICT is always used in a specific psychosocial context, which means that one's beliefs about and perceptions of technical aspects can affect one's ability to communicate effectively (Berg-Beckhoff et al., 2017). For instance, users' attitudes toward technology can influence their intention to adopt and use technology and can be based on the technology's perceived usefulness [53].

Thus, organisational norms and the framing of what is appropriate and acceptable can influence attitudes and behaviours toward information sharing [55]. A challenge related to information security and the confidentiality of patients' data which are shared between HCPs needs to be addressed (Donahue et al., 2012). Due to the dearth of literature on communication and organizational issues, coordination and collaboration among the various experts in the EMTs, as well as variables affecting the usage of ICTs, the abilities and acceptance for EMTs to use technology in emergencies will be examined next in the context of Riyadh.

Researchers in the KSA identified communication between HCPs in hospitals as a critical issue requiring evaluation in relation to emergency response because it has a negative impact on the response [56–58]. This

includes issues such as transportation inefficiencies, poor communication and diminished cooperative arrangements [59]. However, these studies discussed communication during various types of emergencies in broad terms and made no specific recommendations regarding areas of communication that could be improved. To the writer's knowledge, no study has been conducted on measuring communication and information exchange amongst EMTs in emergency situations in the KSA, despite the fact that Riyadh is routinely exposed to various sorts of emergency incidents.

This study conducted in Riyadh is considered to be of value as a means of gaining a better understanding of the various factors which can influence effective communication and coordination between EMTs during emergencies. The purpose of the current study is to explore the topic from a variety of perspectives in order to gain a holistic understanding of the issue. It is hoped that the extensive data gathered from EMTs will help practitioners and policymakers to have a better grasp of this complex problem.

The aim of this research study is to explore the experiences of communication and information exchange between EMTs during emergency situations in Riyadh in the KSA. The study will pursue the following specific objectives:

- to explore the effectiveness of available ICT used in information sharing within and between EMTs when responding to emergency situations.
- to understand EMTs' perceptions regarding communication and co-ordination in emergency situations; and
- to use the findings of this research to explore and suggest ways in which communications between EMTs during emergencies might be improved.

Methods

Study design & methodology

The use of a qualitative exploratory approach was compatible with the objectives of the study. The rationale for using a qualitative exploratory approach in this study was based on the lack of empirical knowledge about the phenomenon in relation to the situation, group, activity or processes which needed to be explored and examined and contained elements worth discovering [60]. Reid-Searl & Happell, (2012) suggested that a qualitative exploratory design enables the researcher to investigate and comprehend a subject when the literature is limited and enables participants to contribute to the development of new knowledge in the area under investigation. This shows that exploratory researchers who focus on the study's intended phenomenon have better capability in expressing and reporting findings [62]. Polit & Beck, (2012) stated that exploratory research fits within the naturalistic approach because it seeks to understand a phenomenon in depth and incorporates the perspectives of participants, particularly those who are experiencing the phenomenon under investigation [60]. Lederman, (1993) stated that exploratory research can be beneficial when the phenomenon is unclear or has received little investigation, as was the case in this study.

Data Collection

In exploratory research, individual face-to-face interviews and focus groups are used, and in this study a series of individual semi-structured interviews were completed with SRCA and ED staff. Semi-structured interviews are used when the researcher has a broad question which needs to be addressed, as was the case in this current

study [65]. Face-to-face interviews are the most common data collection technique in qualitative research because of the informal and comfortable atmosphere created between an interviewer and the interviewee [62]. This technique was appropriate for use in this study because time and place are sensitive issues for HCPs who work in the SRCA and hospital EDs [66]. A semi-structured interview guide provided a set of questions which was informed by the aim and objectives of this study.

Research settings and sampling

This study was undertaken in two different healthcare organizations, the SRCA and three ED in Riyadh. Riyadh is the capital city of the KSA and is located in the centre of the kingdom. It has previously experienced a number of emergency situations [4]. In Riyadh, there is one operations centre and 46 ambulance care services.

This study included participants from the operations centre and two of the ambulance stations. The remaining ambulance care centres were not included in this study because of their wide geographical spread.

The second population involved in data collection was HCPs in three ED (these hospitals are referred to as A, B and C respectively in the current study). The participants recruited were those who were authorised to communicate and coordinate with various professionals during emergency situations in terms of response and disaster management priorities.

The inclusion criteria for a sampling strategy should be developed in such a way that they contribute to the generation of detailed information and are consistent with the methodological approach used [67]. Using the SRCA's own classification of the professionals who work in the SRCA, Researchers identified the professionals involved in communications as potential participants. These were call takers, medical dispatchers, field supervisors and paramedics.

In the ED, the inclusion criteria helped me to identify different professionals who were responsible for communicating with various key personnel inside and outside the hospital environment. These were ED nursing managers, ED physicians/consultants and senior paramedics

Data Analysis

Qualitative data analysis involves a range of processes whereby the researcher moves from data collection into a form of explanation, understanding and interpretation of the phenomenon being investigated [68]. According to [69], data analysis in qualitative research is a continuous process which lasts from the beginning to the end of data collection. The purpose of qualitative data analysis is to organize and provide a structure for eliciting meaning from the data [63]. Patton, (2014) confirmed that qualitative analysis involves transforming data into findings. Speziale et al., (2011) pointed out that qualitative data analysis highlights the experience of the participants whose lives are deeply involved with the phenomenon under investigation. The data analysis approach adopted in this study was thematic analysis. This has been defined by [1] as an approach designed to identify, analyse and discover models within the data in order to organise and describe the data set in an in-depth way.

These models can provide the researcher with a greater insight into the interpretations and experiences put forward by the participants involved in the study [1]. The thematic analysis method developed by [1] involves six phases: familiarizing oneself with data, generating initial codes, searching for themes, reviewing themes,

defining and naming themes, and producing a report. A total of 62 interviews were fully transcribed and translated and the transcripts were read and re-read line by line and imported into NVivo 11 software (NVivo, 2021). This was phase one of Braun & Clarke, (2006) thematic analysis approach. This was followed by phase two, which involved generating initial codes from the data [1].

Saldaña, (2021) described a code in qualitative research as a word or short phrase which symbolises and captures an attribute from language or visual data, in this case, the interview transcripts. After completing the coding process, an initial list of codes and the frequency of their occurrence was produced. I then moved to searching for themes, which is phase three of the thematic analysis framework. During this stage, I created a table of codes to help to generate themes and related sub-themes. The themes generated at this stage were reviewed and further refined with the research team (BA, KG, GP and KM) to ensure that codes were relevant to each theme. In phase four, all the themes generated in phase three were reviewed, information which was deemed irrelevant was removed and some themes were collapsed into each other. The final themes were then checked by the supervisory team. A written analysis was produced relating to the theme-based analysis of the literature and research questions.

Findings

Participants

Semi-structured interviews were conducted with 62 participants from both the SRCA (n=18) and from ED hospitals (n=44). Data were collected from face-to-face interviews with participants from SRCA settings. Ten were recruited from the SRCA operations centre and included call-takers, dispatchers and field supervisors, and eight paramedics were recruited from two ambulance care services. All participants from the SRCA were Saudi, male and aged between 25 and 40+ years (in the KSA, before 2020, females were not permitted to work in the SRCA as paramedics or in the operations centre). All participants from the SRCA had more than five years of experience of working with the SRCA. (Table 1)

In the EDs hospitals, a total of 44 participants aged between 25 and 40+ years participated. The sample comprised 19 ED nurse managers (males and females) from diverse backgrounds; six were from the Philippines, four from India, two from South Africa, one from Egypt, with five from Jordan and one from the KSA. The study also included 12 ED physician consultants and 13 ED paramedics, all of whom were male (there are female ED physicians in KSA, but all of the ED physician consultants who volunteered to participate in this study were male). ED participants were recruited from three different ED hospitals referred to as A, B and C (Table 2, Table3, and Table4)

In this study, data saturation was achieved once no new themes or subthemes were identified by the research team [66]. The interviews were completed between February and April 2019.

Key themes

Findings are presented in three themes with illustrative quotes to convey the perspectives ideas and beliefs of the participants captured through the thematic analysis.

Theme 1. The emotional impact on SRCA staff performance

This theme focuses on the emotional well-being of SRCA operations centre staff. These staff members described feelings of anxiety, nervousness, sadness, fearfulness, frustration and/or tiredness in relation to their work. These workplace-related emotions appeared to have consequences for their decisions regarding receiving and dispatching emergency medical calls to the relevant staff and also played a role in the delayed response discussed below in theme 2. SRCA operations centre staff described the degree to which they felt supported by their organisation. Daily work in an environment which required them to constantly understand and relay information about traumatic incidents appeared to have an impact on their emotional state. This was illustrated by one of the call-takers:

I start my day receiving bad information about incidents ... can you imagine that we spend eight hours every shift just listening to negative news? Receiving calls about the injured, families telling us their loved one has died, or someone reporting a mass causality incident, and more than this ... sometimes I think about these incidents and I feel fear, and I call my wife to check on her and my children.

 RCC2, call-taker, SRCA

In addition to the distress caused by the content of the telephone calls, many structural factors appeared to compound the stress. Among these factors were the limited number of staff at the SRCA operations centre (two call-takers and two dispatchers per shift) and the 60-second time limit for each call prescribed by their organisation. SRCA participants indicated that they receive a huge number of emergency calls for the entire Riyadh region, and the majority of the call-takers and dispatchers described how these issues increased their anxiety:

We cover all the Riyadh emergency medical calls. Usually, two call-takers work each shift, and sometimes one person will cover all the Riyadh emergency medical calls, if the other staff are on sick leave or absent, or any reason ... in each shift, we receive 800-1000 calls.

RCD1, dispatcher, SRCA

it's stressful that our performance related to the time spent on a call is monitored. If we spend more than 60 seconds on each call, we will be under investigation.

RCC3, call-taker, SRCA

SRCA operations centre staff described how callers' misbehaviour combined with the burden of the workload were particularly stressful during emergency situations. A number of call-takers described instances of callers raising their voices over the phone, making it difficult for them to retrieve important information. These call-takers explained that they kept telling some callers not to raise their voice when they became emotional, and they reported that some female callers cried on the phone. These participants said that this behaviour from

callers made them feel tense and sometimes led to them receiving unclear information, making their task of providing the appropriate help to the caller more difficult. One of the call-takers stated that:

… some people will keep shouting all the time, but I keep reminding them that if you want help, you must calm down and let me help you.

RSC3, call-taker, SRCA

… Sometimes the information on the location that we get from the caller is not clear. If the caller is a female, she will cry and scream during the call, which makes me feel nervous.

RCD1, dispatcher, SRCA

Non-emergency calls such as prank and fake calls made some of the call-takers uncomfortable as they were required to respond to each call and there were no protocols in place in the SRCA in relation to how to deal with such nuisance calls. It appears that this may have added to the workload of the call-takers and potentially increased the emotional impact as it limited their ability to respond to genuine emergencies in a suitable time frame:

… we receive hundreds of hoax calls, and there is no way to know if a call is genuine or not. We still send our paramedics based on the information that we get, and they will tell us if there is a genuine incident or not …

RCC1, call-taker, SRCA

… we are required to respond to all calls and not to ignore any … sometimes, which happens a lot, there are some callers who just want to talk and make a joke … and the only thing I can do is to close the telephone, like this call may hinder another serious call.

RCC3, call-taker, SRCA

A similar issue was found with a number of SRCA paramedics who said that they felt discouraged when they arrived at the location of an incident and there was no incident. The need to respond to all incident reports, whether they are real or not, seemed to cause distress:

I feel frustrated when we receive a notification from the dispatcher about a case that needs to be transported and then it turns out not to be genuine. It is a stressful feeling that we must respond to all notifications, whether true or not.

RCP4, paramedic, SRCA

Limitations on organizational support made some call-takers feel frustrated in the absence of protection from these inappropriate calls. These call-takers mentioned that the only possible recourse is to complain about these prank or fake calls, not to the SRCA, but instead to the Emirate of the Riyadh region, which is a difficult and time-consuming process. It would seem that due to the serious impact which these hoax calls have on both call-takers' and paramedics' time, and the impact this might have on their ability to respond to real emergencies, the participants felt that they should have a mechanism in place to support them in dealing with such nuisance callers:

… There is one way to do this, which is to take the details of these callers and then to complain to the Emirate of the Riyadh region. But it takes time to get disciplinary action against those callers, it's a complex, bureaucratic process.

RCC1, call-taker, SRCA

Unfortunately, there is no certain law in the SRCA to stop those people [hoaxers] from behaving like this … we are disappointed from no support for us in this regard.

RCC2, call-taker, SRCA

It also seemed that many participants were worried about the impact of the workplace environment on their physical health. The majority of the SRCA operations centre staff described feeling unwell as a result of being in an enclosed space surrounded by communication devices with high oscillation. They described having some negative health symptoms and attributed these to the devices which they used at work:

When I receive a lot of calls by phone, I get earaches from time to time.

RCC1, call-taker, SRCA

We are surrounded by these devices and our room is full of high electronics and I always have headaches and sleep problems.

RCD1, dispatcher, SRCA

It is interesting to note that although these participants attributed these physical problems to their devices, they did not mention the possibility that working in a stressful environment could give rise to these issues. During the interviews, some participants from the SRCA operations centre said that they were aware that counselling for SRCA staff is present within the system, but this is mainly for on-site paramedics and not for operations centre staff. These staff used various strategies to deal with stress. One of the dispatchers explained that he reduced stress by engaging in some activities such as travelling in his free time and turning his phone off and not thinking about work when he was at home:

In the SRCA there is psychological support, but it is only given to the paramedics who need it …

RCC3, call-taker, SRCA

… the only thing I do is travel on my days off, or when I go home I detach my mind from the work and I switch off my mobile.

RCD4, dispatcher, SRCA

counselling because of the ways that issues surrounding mental health and well-being are framed in Saudi culture. These participants believed that if colleagues learnt that they were seeking psychological support, their emotional stability might be put into question and they might lose the confidence of colleagues regarding their ability to perform their work effectively:

We suffer psychologically from seeing accident scenes and feel upset about some crisis situations … The problem is that as soon as you say that you want psychological support no one will trust you because they think that those who ask for help are suffering from a mental illness, meaning that they're crazy. This concept [seeking support] is still not acceptable in our culture … so there's nothing you can do except try to forget what you saw, which is difficult.

RCF3, field supervisor, SRCA

Theme 2. The effectiveness of the emergency response

Concerns with coordination and communication between SRCA and ED staff during disasters were described as often leading to unnecessary delays in responding to emergencies and in reaching and transporting casualties to EDs. Two subthemes, coordination between SRCA and EDs in responding to disasters, and the perceived effectiveness of the ICT used by EMTs, are included and discussed in detail in the section below along with related quotes.

Coordination between SRCA and EDs in responding to emergency situations

Coordination between SRCA medical dispatchers, SRCA paramedics and ED staff was found to be crucial for a fast response and the sharing of important information about an incident in a timely manner. Coordination between SRCA and EDs in relation to incident notification mainly occurs through SRCA dispatchers liaising between the ambulance services centre and ED hospital staff. The SRCA paramedics said that in the past they were informed only about an incident and that their responsibility after that was to communicate with the hospital and directly arrange the transportation of casualties. They described this process as being a waste of their time which impacted patients' lives. Eventually, their organization delegated the tasks of searching for other hospitals to the SRCA dispatchers:

Before, we were only informed about an incident, and we had to respond and find a hospital that was able to accept the patient. This process was time-consuming for us and for the patient, and sometimes when we went to a hospital, they refused to receive the transferred case, either due to their lack of appropriate medical specialization or because there wasn't enough bed capacity in the hospital.

RCP4, paramedic, SRCA

To facilitate patient transportation, it is important that ED staff are updated about the patient's status. With this in mind, SRCA dispatchers provide ED staff with some information about the patients. However, SRCA paramedics are not permitted to call ED paramedics directly while on route from the site of an incident to the ED. As illustrated by some comments of SRCA paramedics below, this has an impact on the relationships between SRCA paramedics and ED staff because paramedics with injured patients often appear unannounced at the ED without having been able to give the ED prior warning:

… we are not allowed to contact ED paramedics to update them about the patient who's being transported. Our dispatcher contacts the ED paramedics.

RCP6, paramedic, SRCA

… when we hand over a patient to the ED paramedics or ED nurses, they ask us why we didn't call them first, but we are not allowed to.

RCP4, paramedic, SRCA

Some of the SRCA paramedics perceived that permitting them to make calls to the ED to update about the case transported might decrease the intensity of the conflict which happens with some hospitals during the handover between them. This was illustrated by some of SRCA paramedics as follows:

… I think if there is a prior call between us and with ED staff, just to update about injured that we transport, that may not have a conflict during the handover.

RCP2, paramedic, SRCA

As a result of this, ED physician consultants felt anxious about some SRCA paramedics not providing accurate information about the transported injured. According to some ED paramedics, exchange of patient information occurs during a face-to-face handover immediately upon the ambulance's arrival at the hospital:

… There is no clear information in the handover with SRCA paramedics. In some cases, some of the SRCA paramedics bring the patient without handover, and some of the SRCA paramedics do the handover …

EDC1, ED physician consultant, hospital C

… Sometimes the SRCA operations centre sends us incomplete information or wrong diagnoses.

EDC1, ED physician consultant, hospital C

Some of the ED paramedics highlighted difficulties related to coordination with dispatchers.   Participants stated that they received casualties in the emergency ward from the SRCA paramedics without being informed about them beforehand by the dispatcher:

… our problem with the dispatchers is always in coordination. Sometimes they inform us about incoming patients in five minutes before their paramedics arrive at our ED gate, and sometimes they will surprise us when we see them in the triage area with a patient without any prior call …

EBP2, ED supervisor paramedic, hospital B

In circumstances where prior notification from the SRCA is not provided, some of the ED nursing supervisors stated that this caused significant challenges and pressure related to a lack of forward information about new arrivals. One ED nursing supervisor said that preparing to receive a patient is time-consuming in the ED and involves the process of coordinating with other hospital wards to facilitate the evacuation of patients who had been admitted before the disaster and whose conditions were not related to the disaster:

… in major incidents, the process of patients' admission takes some time. We have to evacuate the old patients in the ED to another ward in the hospital, and we have to contact the bed management, extra staff, and speciality team …

EAN2, nursing supervisor, hospital A

As a result of the lack of communication, one ED nursing supervisor stated that on one occasion they received a number of critically injured cases at the same time due to RTIs which impacted on their ability to handle these patients, and during that incident, the hospital disaster code was set off:

… one time, we received twelve RTIs from the Red Crescent and it is not logical to send twelve injuries to one hospital without a prior call … and we activated the hospital disaster code.

EAN5, nursing supervisor, hospital A

Most of the participating SRCA paramedics highlighted issues related to coordination, saying that the information which they received from dispatchers was incomplete and sometimes incorrect, and that in some incidents which they attended did not conform to what the dispatcher had described. Participants said that they are only required to share information with the dispatcher on four occasions: to record the time of departure, to record the time of arrival at the incident, to record the time of departure from the incident, and finally to report arrival at the hospital and to seek guidance about where to go next:

… and unfortunately, some incidents that I attended were different from the information I received, and it depends on who informed the call-taker. The call-taker has the responsibility to clarify more about the information from the callers … The dispatcher will inform the paramedics about the basics of an incident, just the type of incident and the name of the street, and no other details.

RCP4, paramedic, SRCA

… we report to the dispatcher about the time of arrival, the time when we move from the location, and the time we leave the hospital after we transported the injured. Then we wait for the dispatcher's order either to return to the location of the incident or to go to another incident site.

RCP7, paramedic, SRCA

Coordination between ED staff and other hospital departments often occurs through the Chief Executive Officer (CEO). ED nursing supervisors perceived that contacting the CEO facilitates their coordination with other hospital departments Some ED nursing supervisors reported difficulties when trying to contact some hospital departments such as the pharmacy in relation to accessing required medication for their patients when they had an influx of patients. This was illustrated by one of the ED nursing supervisors:

… we receive many different types of disaster on a daily basis … when the CEO is present, he solves everything very quickly with some departments in the hospital … he gives us the power to act, and each department in the hospital works collaboratively with us …

EDB6, ED physician consultant, hospital B

One time, within four hours we received 130 patients with bronchial asthma who'd had an adverse effect from the heavy rain. There was a delayed response from the pharmacy when we requested medical supplies like Ventolin, magnesium sulphate and oxygen cylinders. I contacted the CEO after the pharmacy refused to supply us because they said that we had used large quantities of these medications …

EDN2, ED nursing supervisor, hospital C

Although ED nursing supervisors felt confident about contacting the CEO directly, a number of ED paramedics felt frustrated that their work was not being valued and many suggested that their role was reduced to providing patient transportation within the hospital. The ED physician consultants are informed by ED paramedics about medical cases received from SRCA dispatchers. ED physician consultants alone have the power to decide whether or not to receive patients inside the hospitals. The opinions of ED paramedics are not given any importance and these ED paramedics believe that they are not treated as members of the professional health-care team:

... in relation to cases transported to us by SRCA paramedics, our responsibility as the EMS in the hospital is only to relay information that we have received from the SRCA dispatcher to the ED physician consultants ... We don't have any authority to accept or refuse a case and we have no authority to provide care to transported patients. We are frustrated that our work in the hospital is limited to internal and external transportation ... we feel undervalued by other hospital staff who see us only as ambulance drivers.

EBP2, ED supervisor paramedic, hospital B

ED paramedics within each health sector have their own rules which provide them with little authority. This was explained by a number of paramedics, who said that there are some differences in what they are permitted to do and that for some the restrictions are less than others. For example, paramedics working in hospitals not under the control of MoH management (for example, military hospitals and the King Faisal research specialist hospital) it appears have more scope for extended practice:

We are different from the ED paramedics who are working in different hospitals which are not under the MoH rule, such as King Faisal and in military hospitals, where they are allowed to treat the critical patients and they can help the ED physicians, they are more skilful than us ...

EBP3, ED paramedic, hospital B

The perceived effectiveness of the ICT used by EMTs

The data acquired from the interviews demonstrated that SRCA staff and hospital EDs communicate primarily through telephone systems, including landlines, a wireless radio system called TETRA and mobile phones. A significant number of participants reported how using these tools facilitates their needs in response through communication within and between SRCA and ED hospital staff. A number of participants thought that the provision of accurate information from the dispatcher to the paramedics regarding the location of the incident was important for a fast response. SRCA staff described how they felt that unnecessary delays in response to incidents were related to the communication systems which they used. For example, some of the SRCA paramedics stated that they were not provided with navigation devices in their ambulances, which meant that they had to receive information on the location of an incident verbally from the dispatchers on their TETRA device. The location information which was received from the SRCA dispatchers was often inaccurate, leading to time being wasted trying to find the incident location. As a result, these participants reported that they used Google Maps on their mobile phones, which they regarded as being easier to use than having to listen for the location of the incident through the TETRA device:

… we receive the location of the incident from the dispatcher through TETRA. Sometimes the location of the incident that we receive is unclear and it takes time for us to get to the location … we are not provided with screen navigation in our ambulances. We use Google maps on our personal mobile phones to identify the location of the incident, which is better than getting the location from the dispatcher through TETRA.

RSP6, paramedic, SRCA

The inappropriateness of the CAD system for determining the location of an incident was identified as an issue by some of the call takers. The CAD system is dependent on GPS, which does not always relay information about the exact location of an incident. As one of the call takers said:

… the problem is that our GPS navigator in the CAD system is not accurate, and it shows us the nearest cell tower from the location of the caller not the location of the incident.

RCC4, call taker, SRCA

As can be seen from the next quotation from one of the ED physician consultants, limited coordination between SRCA and the police in facilitating measures to reach an incident fast can impact on lives:

… in a major oil tank explosion, people were stuck in the entrance and exit of the road that goes to the incident, and no arrangements were made for the movement of traffic during the first moments of the incident. I remember that the first patient who went to the nearest ED had 90% burns. He walked to the hospital by himself and when he got to the gate of the ED, he died. The ambulance arrived too late to transport that patient.

EDB4, ED physician consultant, hospital B

Another ED physician described his negative experience; however, this was not directly related to a disaster, rather it was when he called for an ambulance because his father was having a heart attack (a myocardial infarction). According to this participant, because of the delay on the part of the ambulance staff searching for the location of their house, his father died:

I lived it as a physician and as a relative of the patient. My experience with the Red Crescent was not good. My father was very sick, and I was doing CPR for him, my mother phoned the SRCA, they were not able to identify our location. I stopped doing the chest compressions for my father and I described the location of our house to them … and my father died in front of me.

EDC1, ED physician consultant, hospital C

According to some EMTs, because EDs were often delayed in responding to their telephone calls, the SRCA introduced TETRA devices as a unified communication system between the two organisations to be used alongside the telephones:

… when we contact the hospital through the landline, it is difficult to get a response … sometimes they don't answer our calls …

RCD3, dispatcher, SRCA

… in [2018] … SRCA distributed this device to some of the tertiary hospitals in Riyadh … each of the hospitals has a dedicated channel that we can contact them through.

RCD1, dispatcher, SRCA

Positive experiences of using TETRA were reported by some of ED paramedics because it contributed to linking them with SRCA dispatchers:

… we used TETRA … It's become easy to be in contact with the dispatcher …

RCP1, paramedic, SRCA

However, SRCA field supervisors said that the process of receiving and sending information through TETRA was sometimes slower. These participants explained that when the TETRA is down during updates, calls might be unexpectedly cut off for a few seconds:

… the device has some disadvantages – it constantly updates automatically, and if I am calling, I will be cut off for up to 60 seconds.

RCF1, field supervisor, SRCA

The majority of SRCA paramedics and ED paramedics stated that because of poor network connections in some parts of Riyadh and in some areas in the EDs, TETRA was rarely used. SRCA paramedics pointed out that because there were no backup communication systems in place, if they encountered a technical issue, they had to use their personal mobile phones to contact the dispatchers:

… in some areas in the Riyadh region and inside the city, the TETRA network is not well covered … we are not supported with an alternative device … we use our mobile phone to call the dispatcher if there is no signal.

RCP8, paramedic, SRCA

In addition to the need for prior notification, one of the ED nursing directors suggested a system electronically connected with SRCA which they could use for tracking the patients that they will receive:

I suggest that we have a patient tracking system connected with the Red Crescent, rather than getting the information about the incoming patient through phones or TETRA.

EAN1, ED nursing director, hospital A

All hospitals use electronic patient records systems. Despite this, some ED physician consultants said that during a disaster they often turn to using paper because the computer systems have not been tested in disaster drills. According to a number of ED nurses, although the use of paper is reliable compared with a potentially failing computer system, it is time-consuming to have to manually enter all the information into the systems from paper records:

… We have a system for recording and storing patient health records, but we don't use it during disasters. We do everything manually because we don't know if the system can work with an influx of patients.

EDA1, ED physician consultant, hospital A

... we are not using the computer for patient registration and for other processes in disasters, we use paper instead ... we put all the patients' documents in a new file. Later on, we enter them into the system this process. It takes time but it is trustworthy.

EBN1, ED nursing supervisor, hospital B

The use of the mobile phones provided to ED physicians at hospitals as a tool for internal communication was perceived to be faster than landlines. One of the ED physicians stated that:

We use landlines and mobile phones. In fact, the hospital mobile phone is the main device that we use and we can depend on the use of it more than the landline ... you know, it is quicker to find someone through it ...

EDP3, ED physician consultant, hospital B

However, the majority of the ED nursing supervisors stated that unlike ED physicians, they were not provided with official communication systems, which led them to use non-official systems such as WhatsApp on their personal smartphones. WhatsApp was perceived as easy to use and useful with multiple functionalities including voicemail and video. ED nursing supervisors reported creating a WhatsApp chat group, and they included the key personnel in the hospital. They perceived that the participation of the key personnel in the WhatsApp group contributed to them sharing information about incidents with other ED staff:

... We are not supported with an official system such as that given to the ED physicians.

ENB3, ED nursing director, hospital B

... we created a WhatsApp group and included key personnel such as ED physicians, the CEO, he CNO [chief nursing officer], and the manager on duty along with the ED manager. The WhatsApp group made things easier and in emergency situations, it helped us much more than before, as staff information is more updated.

ENC1, ED nursing director, hospital C

Not all the ED staff wanted to use WhatsApp; some ED nursing managers for example, perceived WhatsApp as not a trustworthy tool for sharing patient information because it could be easily accessed and had confidentiality issues. These participants also added that WhatsApp relies on an internet connection and their hospital currently lacks reliable and comprehensive internet coverage. These participants highlighted that they used their own internet resources and when they ran out of credit or data, they were not able to use WhatsApp:

... I prefer not to use WhatsApp groups to send information related to an incident. It is not safe to share patients' information through it.

EAN7, in-charge nurse, hospital A

... there are no internet services covering the entire ED. There are some internet services in some areas of the hospital but not everywhere. I use the WhatsApp group from my internet but if I run out of data, this is a big problem.

EBN6, ED nursing supervisor, hospital B

Language barriers and inaccuracies in locating the incident were identified as an issue by a number of call-takers, which again led to delays in responses. These participants experienced difficulties understanding the callers who did not speak Arabic:

One time, I received a call from a resident who was not an Arabic speaker, and she did not know exactly where her location was. It took time for us to get her location ... I contacted the Emirate of Riyadh Province, and they identified her location exactly. They have advanced and high-quality communication systems, which were able to determine her exact location.

RCC3, call taker, SRCA

... all call-takers speak Arabic, we are not provided with a multi-language service.

RCC1, call taker, SRCA

Furthermore, the limited understanding of the Arabic language by non-Arabic-speaking staff influenced their relationship and coordination with Arabic-speaking staff in the hospital. This was described by non-Arabic-speaking ED nursing supervisors who pointed out that the majority of the hospital workforce are non-Saudi nationals, but that despite this they commented that the administrative staff in their hospitals would make announcements in Arabic, which was highlighted as a further cause of concern:

... I do not speak Arabic. One time when there was an announcement for patient evacuation because of a fire, the instruction was in Arabic and we could not understand what they wanted.

EBN6, ED head nurse, hospital A

A number of ED head nurses who also did not speak Arabic commented that ED paramedics do not speak English very well, and because they have difficulties understanding each other, ED nurses sometimes have to ask other members of staff to act as interpreters. Clearly these participants were dissatisfied with the written English produced by some paramedics in documents:

Some of our paramedics don't speak English ... I ask other staff who speak Arabic to help me if I need anything ... they have problems in writing documentation. What they write is not clear and they have a weakness in understanding some medical terminology.

ECN3, ED head nurse, hospital C

... nurses who do not speak Arabic are always asking me to translate what paramedics want or vice versa ...

ECN4, ED head nurse, hospital C

To resolve this issue, there had been some attempts to encourage staff to learn Arabic and this was perceived as important for facilitating better communication and to address this issue, one ED nursing supervisor reported that they had taken the initiative and learned just some basic Arabic words which were considered to be valuable:

There are a number of staff in hospitals who do not speak Arabic … I've learned some basic words … it is difficult for me … we face some challenges with staff who speak Arabic only …

EBN6, ED nursing supervisor, hospital B

Theme 3. EMTs' perceptions of the emergency preparation

Two subthemes emerged from the data under this theme: (1) disaster simulation exercises, which describes what training SRCA, and ED received and their experiences of these training courses; and (2) debriefing following an incident in order to provide SRCA paramedics and ED staff with opportunities to share their experiences. These themes are discussed separately next.

Disaster simulation exercises

This subtheme discusses the disaster simulation exercises available for EMTs related to disaster preparedness. There are some training courses for all the emergency services and some courses are mainly for hospital staff or for SRCA staff. This section starts by describing simulation exercise courses which have been provided for all the emergency services, then discusses the training courses for operations centre staff, and finally the simulation exercise courses for hospital staff are outlined. In relation to simulation exercises, one-day courses on disaster preparedness are provided by the hospitals for SRCA and MoH staff, involving SRCA paramedics, ED hospital staff and key stakeholders from the Ministry of Interior (MoI), such as the civil defence force and the police. These courses were discussed by the majority of the SRCA paramedics and ED hospital staff who stated that they were related to disaster preparedness and that parts of the courses dealt with communication. These participants also commented that although these courses were provided within the hospital, they were mostly unrelated to their speciality. They described these courses as unclear in their message. In addition, a number of SRCA paramedics stated that the communication devices which were used for training purposes during these courses were not the same as those used in their everyday working lives:

… SRCA and MoH provided some one-day disaster training courses with the participation of the police and civil defence … these courses have theory and practice elements such as drills and table-top training … classes were conducted in hospitals … communication formed part of these courses, but it was more related to the incident commanders from each sector …

RCP5, paramedic, SRCA

I have attended one course about disaster preparedness, and in those courses, they taught us about how to use the wireless communication device that they gave to us. I have never seen this device in reality and I think it is for training purposes only.

RCP6, paramedic, SRCA

One of the ED nursing heads highlighted the fact that ED nursing staff who participated in these courses had not been provided with an opportunity to take part in simulations. One nursing head said that the material covered in these courses did not reflect their needs and consequently their value was questionable:

… I have had some training. Actually, these courses do not include details such as communication with the Red Crescent, and I don't know why nurses on these courses are excluded from practice in the communication scenarios. In reality we have to deal with more than what is in these courses.

EAN5, ED nursing head, hospital A

In the operations centre, the staff took part in a training course which was mostly related to the use of the CAD system. The call takers and dispatchers in the operations centre said that they had attended a short training course in relation to receiving information from callers. These participants acknowledged that apart from this short training course, there were no specific courses for them, and that the available courses were for field staff such as field supervisors and paramedics:

… I never attend any courses related to disasters. Our department is more focused on educating the paramedics and field supervisors and other leaders in the operation centre … the only thing that we received is training about how to use the CAD system, during which we were under supervision for one to two weeks. This was related to how to handle calls from callers including call input, call dispatching, filling in event notes, tracking calls, and following up with SRC paramedics. After that, they allowed me to work alone without supervision.

RCC1, call taker, SRCA

Call takers highlighted that there was no training in how to deal with traumatized family members, who will be in severe distress and require specific and meaningful care and support. This was reported as a considerable weakness in the range of supportive care and support that can be provided:

We don't have training related to how to deal with families when they scream and cry. Our skills are based on only our prior experience.

RCC3, call taker, SRCA

It was considered important for most of the paramedics and dispatchers to have training based on protocols which offer clear guidance on how communication with dispatchers and field supervisors should be operationalised and in doing so to ensure better communication in relation to their responses. This training and preparation were absent in their workplace, and staff were required to rely solely on their personal experiences and what they feel is best in communicating with each other. This ad hoc strategy by individuals clearly impacts upon the quality of service and was illustrated by one SRCA paramedic who said:

… we were not given training in a specific protocol that we could follow regarding the best way to communicate when reporting through TETRA. What we have comes through our experience.

RCP5, paramedic, SRCA

Although ED paramedics had apparently received the TETRA device from the SRCA without training related its use, some of these participants reported that training was minimal in that they were only shown the channel number and how to turn it off and on, which meant that there was complete lack of guidance and the equipment was consequently useless:

… when SRCA gave us the TETRA device, they just showed us … the number of our channel and the 'off' and 'on' switches, and that's all.

EBP3, ED paramedic, hospital B

ED hospital nurse directors perceived hospital disaster simulation exercises and routine emergency drills as not very meaningful or helpful mostly because they did not reflect reality, and they were not convinced that staff were better prepared for emergency events having gone through an agreed drill. This was reported by one of ED hospital nurse directors as follows:

… the last time we had a drill in the hospital it was very weak, and there was no collaboration between hospital departments … our disaster drill is not related to our daily work.

EAN2, ED nursing director, hospital A

Furthermore, hospital disaster simulation exercises were conducted too infrequently. The majority of the ED nursing supervisors and ED heads of nursing staff said that a hospital disaster simulation exercise was conducted only once a year and that in all probability they would not remember the instructions which they received during those exercises in the event of a real disaster:

we need to have a disaster drill frequently to test the system and at the same time to sort out all the issues that come up from this drill.

 EDB1, ED physician consultant, hospital B

… you know, the problem with our disaster drill is that it's conducted once a year. Of course, I'm going to forget what I've learned if there's no continuous training.

EBN5, ED nursing supervisor, hospital B

In addition, the simulation exercises were under the command of the Hospital Incident Command Systems (HICS), a system based on the existing hierarchy in a hospital and headed by the CEO which has been established in order to ensure co-ordination and speed of response in communications between leaders and their subordinates during a disaster. One of the ED physicians stated that HICS is not given a high priority by hospital leaders and described how the CEO had allowed him only ten minutes to explain the importance of HICS training for key personnel in the hospital:

… once I asked to meet the CEO to explain the importance of training the key persons for the incident command. He told me that I had ten minutes to explain it. Impossible! He did not give more time, and I refused his offer.

EDB3, ED physician, hospital B

Debriefing following an incident

Ideally, debriefing following an incident should allow responders to discuss and reflect on an event and attempt to assimilate what they have learned into preparation for the next event. EMTs participants described their involvement in several types of debriefing session following an incident: some debriefing sessions involved

stakeholders, others took place between staff from the SRCA and ED hospitals, and there were also separate debriefing sessions for each ED hospital.

Some of the SRCA field supervisors and ED staff spoke about the importance of debriefing with other emergency services following an incident. They stated that there are debriefings at the regional level after each major incident which are attended by leaders from each emergency service, including the SRCA and the MoH. These participants highlighted that debriefing following an incident among professionals from multiple agencies helps to highlight both negative and positive aspects related to their response in an incident, which in turn provides some solutions for preparedness:

… there is an incident debriefing after each an MCI, but I have never been involved in these debriefings … they are held at regional level … They usually include the leadership such as the representatives from each sector … debriefing can help to spread the lessons learnt from an incident…

EDB3, ED physician, hospital B

… the debriefing is helpful for improving our preparedness for all incidents. After debriefing, each organization will know their deficiencies.

RCF3, field supervisor, SRCA

However, both SRCA field supervisors and ED physician consultants stated that they were not invited to participate in the debriefings conducted at the regional level. In addition, one field supervisor stated that they were not made aware of any change in practice or protocols as a result of these debriefings:

… there was an incident debriefing that took place in the Emirate of Riyadh province. The attendance at this meeting was limited to the leaders of each side … we were not asked to participate, and we don't know about the recommendations that came out from this debriefing …

RCF1, field supervisor, SRCA

Field supervisors reported that issues relating to communication did not receive much attention from either SRCA or ED in the recommendations presented at the debriefings:

Communication during a disaster is a problem with hospitals … issues related to communication are very rarely discussed in the debriefing.

RCF3, field supervisor, SRCA

The findings showed that there is no debriefing between hospitals and the SRCA. One of the ED physician consultants described some factors which fail to encourage participation in debriefings between ED hospitals and the SRCA. This consultant said that representatives of the hospitals, such as ED directors, were too busy to attend debriefings and had to give up their days off to attend and did not receive any remuneration for attending:

Ideally, all stakeholders have to do a debriefing after each incident, mainly between SRCA and ED, but usually they don't because people get exhausted, ED physicians don't have time, and it is difficult to bring them back

together after the incident because they are busy with their work, and they have a shortage of staff. Also, they don't get paid overtime for a meeting or anything that they do for an extra hour.

EDC1, ED physician consultant, hospital C

Each ED hospital has its own debriefing meetings and exercises during which ED staff share, discuss and reflect on their response to an event with other departments in the hospitals. To provide future and appropriate solutions and ensure proper preparedness such as improving the disaster simulation exercises, much greater planning and scheduling of sessions is required. During debriefings, there is a further issue with some representatives of departmental managers who are quite defensive and resistant to change in practice in preparing for disaster simulation exercises. This was articulated by some of the ED nursing supervisors and ED physician consultants who said:

… even though we have a debriefing in the hospital after each incident and after each disaster drill, some departmental managers do not accept criticism of their work and they continue to defend their work and their team.

EDB2, ED physician consultant, hospital B

Additionally, some of the ED physician consultants stated that some of these departmental managers do not seem to want to quickly solve issues which are raised in relation to real incidents or disaster drills; it appears that they would rather delay the implementation of recommendations, whilst other recommendations are disregarded, which is very concerning:

In fact, the problem is that whilst some of the departmental managers took the time to implement the recommendations raised in the meeting, some of them took it personally and ignored it.

EDA1, ED physician consultant, hospital A

Discussion

This study has explored EMTs' experiences of communication and information exchange during emergency events, in Riyadh. This is the first study to examine this phenomenon in the KSA. Using a qualitative exploratory design, this study contributes to current knowledge and understanding of the critical factors that influence EMTs' decision-making processes regarding coordination and communication during emergencies. The three themes that emerged in this study will explained in detail below.

1) The emotional impact and the effect on the mental health and performance of SRCA staff

The data strengthen the idea that mental health, wellbeing and related physical symptoms had a negative impact on the performance of the call takers and medical dispatchers in relation to information sharing with related medical staff [73]. This study emphasised the importance of emotional well-being for SRCA operations centre staff, who described feelings of work-related anxiety, nervousness, sadness, fearfulness, frustration and exhaustion. Among previous researchers who have highlighted the importance of mental health in these

contexts, (Bedini et al., 2017) found that stress levels were particularly high among emergency medical dispatchers, who regularly receive calls relating to a wide range of medical emergencies and are required to assess and categorise the severity of the situation within a limited time without seeing patients or key informants.

Similarly, Farquharson et al., (2012) reported the negative consequences of reduced job satisfaction, poor work performance and emotional fatigue among emergency operations centre staff. (Allan et al., 2014) emphasized that stress can result in poor decision-making among call centre staff. A study conducted in Australia identified that employers support their staff through encouraging self-efficacy and providing social support [76]. Although formal psychological support mechanisms in the form of counselling sessions exist in the SRCA, these are mainly for paramedics and not for the staff in the operations centre.

SRCA paramedic participants were concerned that they would be seen as having a mental health problem if they reported their feelings through such formal mechanisms and many in the present study said that they preferred not to admit to any form of psychological problems. This result can be explained by the fact that in Saudi culture, seeking psychotherapy remains stigmatised and is often equated with 'having a psychiatric illness'. This finding confirms that of (Al-Habeeb et al., 2015) who found that in the KSA, psychotherapy has been associated in popular culture with stigmatized notions of mental illness. This fear of stigma may provide an explanation for SRCA participants not seeking psychological help and instead adopting their own personal stress management strategies such as switching off their mobile phones after work, travelling for relaxation, or not thinking about the events of the day when they got home.

The importance of effective promotion of wellbeing has been highlighted by a number of studies including one by (Behnke et al., 2019) who found that when staff avoid thinking about an incident, this tends to heighten levels of stress. Anshel et al., (2013) had earlier found that 'confronting coping', a coping style involving directly confronting stress, can have more positive outcomes than 'avoidance coping'. It may be that the SRCA staff in this study were unaware of the benefits of psychological support. One study indicated that the stigma associated with psychological therapy has an impact on health practitioners' willingness to seek help and has a negative impact on their work environment (Adams et al., 2010). Algahtani et al., (2017) recommended that to achieve effective psychological support for HCPs, psychotherapy needs to address cultural issues which might be in conflict with the specific principles and techniques of different therapeutic modalities.

It is arguable that treatment programmes such as psychological resilience training which include physical self-care and increased staff awareness would be of benefit. Two studies have found that resilience training was effective in reducing anxiety and stress caused by the consequences of experiencing trauma [82, 83]. In addition, training can provide staff with a supportive means to respond to a range of psychological issues [84, 85]. Equally, staff in high-stress jobs who do not receive adequate psychological support might continue to suffer from stress and associated psychological problems (Bilsker et al., 2019). All these findings indicate that paramedics' and dispatchers' coping abilities could be enhanced by adequate support and training in minimisation strategies and how to deal with difficult situations [52].

Another vital aspect of workplace stress is legal protection. The findings of this study revealed that receiving hoax and prank calls increased SRCA staff stress. Due to a lack of legal protection afforded to SRCA operations centre staff, these staff members can often feel undervalued by their organisations in relation to how they are

expected to deal with hoax emergency calls. The SRCA participants mentioned another way to deal with unnecessary calls involving making a complaint to the Emirate of the region. However, this can involve a lengthy bureaucratic procedure and thus these staff were not motivated to follow this route [87] said that receiving abusive calls can expose emergency medical dispatchers to psychological distress. Therefore, some studies reported on steps that some countries have taken to stop hoax calls. A retrospective study conducted in Pakistan by [88] utilized software-based blacklisting and auto-blocking for habitual callers to mitigate abusive phone calls. Despite the implementation of this technology, staff continued to receive regular hoax calls, Tahir et al., (2016) suggested that a mass awareness campaign might help to educate the public regarding the dangers and sensitivity of the issue.

In a study in Israel a review of emergency calls made to the national emergency service confirmed that the use of call-tracker technology based on an automatic protocol to identify calls was effective [89]. Blushtein et al., (2020) demonstrated that calls which 'fit' and are classified as hoax calls are then blocked from the regular emergency dispatch number system and redirected to an automated toll number, a regular phone number which will incur a charge for placing the call which, according to Blushtein et al., (2020), will continue to provide service in the event of a real emergency.

Along with psychological stress, SRCA operation centre staff reported experiencing problems with sleeping and earaches which they attributed to their daily proximity to high-vibration devices. In a study of medical dispatchers working in an emergency dispatch centre in France, (Bedini et al., 2017)found a significant increase in cortisol levels throughout the day related to dispatchers receiving incoming emergency calls.

Additionally, work-related stressors have been shown to disrupt sleep, resulting in poor sleep patterns which have a negative impact on the health of emergency service call takers and dispatchers [91]. Other studies have confirmed that the physical consequences of continuous occupational stress are manifested primarily as somatic symptoms such as headaches, sleeping problems and fatigue, which had associated effects on work performance [92, 93]. According to (Baan et al.,2011), the use of various electronic communication devices has increased the likelihood of electromagnetic wave exposure, which can have an adverse effect on the user's physical health. For instance, several studies have documented the adverse effects of the consistent use of wireless communication technologies, such as computers, two-way radios and smartphones, including neurological disease [95, 96], reproductive disorders (Altun et al., 2018; Falzone et al., 2011), immune dysfunction [99, 100].

2) Effectiveness of the emergency response

Several barriers to coordination and communication between EMTs during an emergency response were identified in this current study. Three factors contribute to unnecessary emergency response delays: the first is insufficient coordination between EMTs and among hospital staff, and the second is issues related to the communication systems used. The third is related to the fact that language barriers between HCPs and those receiving assistance are a significant impediment, each factor will be discussed separately next.

• Coordination between SRCA and ED in responding to emergency situations

The findings showed that there was poor coordination between SRCA and ED staff with regards to information sharing, and poor coordination between ED staff and other hospital department managers with regards to facilitating logistical support for ED staff.

The issue of coordination between SRCA and ED staff during an emergency was highlighted by the fact that medical dispatchers' provision of limited information to SRCA paramedics and ED staff impacted on EDs' readiness to receive patients. Additionally, SRCA paramedics transporting casualties from an event are not permitted to communicate directly with ED paramedics prior to their arrival at the hospital. In accordance with SRCA policy, SRCA operations centre staff coordinate with ED by transmitting information about an incident to ED paramedics. These problems related to the sharing of information between EMS and ED have also been identified in previous studies, which found that due to not receiving an accurate expected arrival time some of the ED staff were unnecessarily kept on stand-by (Pouraghaei et al., 2017; Reddy et al., 2009; Skryabina et al., 2020; Sorani et al., 2018; Zhang et al., 2013; Zhang et al.,2017). However, because organizations differ in their rules in relation to information sharing, sharing clear information related to an incident can be difficult [107]. Therefore, during emergency response, it is important that medical teams have clear roles with regard to joint coordination because clearly delineated roles improve preparedness and facilitate effective responses. Cunningham et al., (2010) suggested that the most effective way to achieve medical care coordination is to establish proper medical authority between EMS and ED at the state level.

In addition to these inter-organizational factors, this study discovered some issues with coordination among hospital staff regarding logistical support in relation to the provision of medicines and medical equipment for ED staff. When ED staff encountered a problem with other hospital departments hindering their ability to obtain important resources, staff members such as nurses and physicians frequently communicated their concerns directly to the CEO, who frequently communicated directly with the relevant departments to ensure that their needs were met.

This is in line with the findings of a previous study by Pouraghaei et al., (2017) that there were challenges in coordination among hospital staff during disasters which led to chaotic situations due to the absence of clear rules. This current study's findings indicate that it would be preferable for staff to have a defined role in assisting other hospital staff with their needs during emergencies. In the absence of this, poor organisational management and coordination were the primary obstacles to effective outcomes in hospitals, which could have a negative impact on patient care [109].

• The perceived effectiveness of the ICT used by EMTs

In relation to the communication systems used between EMTs, the interview data demonstrated that SRCA staff and hospital ED communicate primarily through telephone systems, including mobiles, a wireless radio system called TETRA and computer-based system. The findings showed that mobile phones were the most widely used communication tool among hospital staff and SRCA paramedics during emergencies for two reasons, their relatability and their multi-functionality .

Previous studies have similarly shown that HCPs regarded smartphones as being more reliable because of their many functions which enable the sharing of information in different forms, such as videos, photos and voice calls [103, 110, 111]. An additional advantage is that mobile phones can be used to locate the exact location of an incident via Google Maps. Because the SRCA paramedics who were interviewed were not provided with a

navigation screen, they faced challenges and delays in getting to the site quickly because they had to obtain information about the site of the incident by communicating with the medical dispatcher through TETRA.

Moreover, according to the SRCA operation centre staff, the GPS in the computer-aided design (CAD) system locates the nearest cell tower to the notifier calling the SRCA call takers, which can lead to the misidentification of a site. This finding is consistent to those of Dean, (2008); Fragkiadakis et al.,(2011); Lawner et al., (2016), who all stated that CADs are unable to provide information to dispatchers regarding the location of the nearest available ambulance. Patel et al., (2012) suggested that the CAD systems need to be able to provide a more accurate location of pre-hospital emergency incidents.

Another significant aspect of mobile phones is that they give access to social media platforms. 'Social media' refers to websites and computer programmes which enable people to communicate with each other and share information, ideas, personal messages, photos and videos on the internet using a computer or mobile phone applications such as WhatsApp [115]. As stated in the literature review, all these features facilitate communication between paramedics, physicians and nursing staff [106, 116, 117]. The analysis of the current data was extended to investigate the differences in views among ED staff regarding the use of WhatsApp. In this study, ED nurses were found not to be provided with official hospital mobile phones as ED physicians were. As a result, the ED nurses had to use their personal phones for calls and for text messaging via WhatsApp.

The participants stated that WhatsApp is an unsafe and unreliable mechanism for sharing confidential information about patients because such platforms are vulnerable to hacking. This finding was reported by [118, 119], who indicated negative aspects of using WhatsApp in the healthcare setting, particularly possible issues related to undermining privacy and data protection, the need for robust internet connections and the impossibility of printing off a record of the chat. Even so, some of the ED staff interviewees preferred to use WhatsApp because it has useful and easy-to-use features such as conversation groups which enable group discussions among relevant staff. WhatsApp also enables users to share information, images and videos related to an incident. A number of previous studies have evaluated the use of WhatsApp in healthcare and some have highlighted the benefits of using WhatsApp in ED. According to Masoni & Guelfi, (2020); and Nikolic et al., (2018), WhatsApp plays a supportive and additional role for ED consultations regarding response acceleration and engagement decisions. Gulacti et al., (2016) evaluated the use of WhatsApp between emergency physicians and found that using WhatsApp gives the ability to transfer large amounts of information data during a short period of time.

In addition to mobile phones and related applications, TETRA was another system being used for the communication between EMTs according to the data. However, the findings showed that due to TETRA's complexity, some ED paramedics decided not to use it in communications with the SRCA, preferring instead to use landlines. This finding is consistent with those of previous studies by Reddy et al., (2009); Yamamura et al., (2014) and Zhang et al., (2017) that radio systems can be ineffective and unreliable during extreme weather conditions and natural disasters such as earthquakes, indicating the need to support stronger communications infrastructures. These studies are contrary to previous studies which have suggested that radio was effectively used during natural disasters (for example, Zhou et al., 2014).

Drawing from the communication systems discussed above, the current study showed how ED staff viewed the usage of computer systems in hospitals during disasters in order to save patient information, by describing

Health Information Systems (HIS) as unreliable and untested in disasters.

As a result of these perceptions, paper communication was used in order to record patient information. It is necessary here to clarify exactly what is meant by HIS; they are defined as the information processing and information storing subsystem of a health care organization, which may be a single institution, for example, a hospital, or a group of health care institutions like a health care network [122]. HIS are widely used in health-care systems around the world in addition to telephone systems [123].

The participants in the current study preferred to use paper rather than HIS and a similar attitude was reported in two previous studies. Reddy et al., (2009) and Zhang et al., (2017) found that the use of computer systems was not preferred by ED staff because MCIs necessitated rapid response and computer systems might not save much patient data because of technical deficiencies, so patient information was recorded manually, and each patient was assigned a code. In a more recent study, however, it was argued that giving patients multiple different identifying numbers on their route from the scene of the incident to the hospital could present a serious risk to patient safety [106].

• Language barriers

There are additional findings in this study which to the researcher's best knowledge have not been previously explored; they relate to language barriers. Participants in the SRCA operations centre faced challenges in obtaining clear information from non-Arabic-speaking foreign notifiers. In addition, non-Arabic-speaking staff in the hospitals faced some challenges over understanding instructions in Arabic. In the KSA, the majority of the population speaks Arabic. However, since the establishment of the first medical school in 1967, the English language has been the sole medium of instruction and communication within hospitals among health care professionals [124], so it is the official language in Saudi Arabian hospitals, both in writing and in speaking (Alshareef et al.,2018). The findings of the current study showed that the language barrier generates a great deal of frustration between non-Arabic-speakers and non-medical staff who do not speak English.

Very few previous studies have discussed the importance of language issues between call-takers and notifiers and none of these were conducted in a disaster context [126, 127]. In addition to the language barrier in the SRCA, ED participants in the current study spoke about language barriers in the hospitals, where the majority of the workforce are expatriates from countries such as India, the Philippines and South Africa who do not speak Arabic. These staff members therefore face a language barrier because they speak English and do not understand Arabic. Several previous studies have discussed the importance of language barriers in the health-care context in countries including Sweden [128] ,Canada [129], the US [130] and the UK [131].

Most of those studies were published in relation to language barriers in the health-care context between HCPs and immigrants, but the Saudi context in the current study is different because the language barriers in health care are caused by the diverse backgrounds of the HCPs, many of whom do not speak Arabic. Saudi Arabia's deep multilingualism is caused in part by the fact that so many workers are not immigrant workers but are instead contract workers who do not intend to stay in the country and therefore do not learn Arabic [132]. In this study, the non-Arabic-speaking staff said that they would like interpreters. Alhamami, (2020) suggested that professional interpreters should be used in hospital contexts.

3) EMTs' perceptions of an emergency preparation

To enable EMTs to respond effectively in different emergency situations, several factors are critical, including disaster simulation exercises and response evaluation through post-an incident debriefing [44]. The current study showed that disaster simulation exercises and post- incident debriefings are significant factors in disaster preparation, and they will be discussed separately in the sections that follow.

• Disaster simulation exercises

The findings of this current study showed that although disaster preparedness training is available, it focuses on how to use devices such as radio phones rather than on improving EMTs' emergency communication skills. Furthermore, communication training in the practical part of these courses is only available to paramedics and ED physicians, as a result of which not all EMTs were able to participate. Previous studies have also found that communication training was mainly focused on training related to particular devices. Homier et al., (2018) and Jung et al., (2016) assessed the use of some communication systems between nurses, physicians and paramedics such as radio, manual phone trees and the use of social media platforms such as WhatsApp and SMS. Although these studies highlighted which systems were preferred, they did not suggest ways of improving communication skills. Communication is a critical skill in any healthcare process; it ensures effectiveness, efficiency, patient satisfaction and patient safety (Beckett & Kipnis, 2009; Bagnasco et al., 2013). Although communication is frequently thought of in terms of nurse-patient relationships, it encompasses a broad range of skills and tasks that contribute to improving communication between HPCs and to providing quality patient care [136].

Studies included in the literature review stated that the practice of conducting disaster drills for nurses and physicians in hospitals was insufficient [103, 137, 138]. It is necessary here to clarify exactly what is meant by 'disaster simulation exercises'. Dubovsky et al., (2017) stated that simulation exercises are the main way to test major event plans, keep response skills and knowledge up to date, and improve systemic response capabilities simply because of the rarity of mass-casualty big catastrophes [140]. Skryabina et al., (2020) found that HCPs who participated in disaster exercises gained a better understanding of their own responsibilities as well as the responsibilities of their teams and departments, and a better understanding of system reaction and increased confidence in their ability to respond.

Disaster simulation training at the system level is also necessary for establishing clarity about the available resources, testing response plans and identifying system strengths and weaknesses. Noureldin et al., (2018) confirmed that in disaster medicine, simulation-based training consists of exercises that replicate a scenario or process, enabling HCPs to develop the knowledge and skills which they will need to apply in real situations. The participants in such courses are exposed to the same stresses as they would be in their actual work environment, including time constraints, patient surges and other characteristics, in order to develop the cognition, skills and attitudes necessary for improved outcomes [142]. So communication in disaster simulation training for HCPs should not just focus on how to use the devices; it should enhance and improve their skills overall.

Additionally, it is critical to include staff from the SRCA operations centre in disaster simulation exercises. The interviewees stated that they lacked the training necessary to respond to a variety of emergency calls. The training provided by the SRCA operation centre was limited to how to use computer systems such as CAD, and they received one week of training on how to use this system before being required to work on it alone without

further training. Training call takers and medical dispatchers on how to handle emergency calls is critical for receiving accurate information and relaying it to the appropriate personnel [143].

Previous studies have reported that training for emergency medical dispatchers in response to any emergency situations took a long time [144, 145]. In comparison with the training received by SRCA operations centre staff, in France, medical dispatcher training takes a minimum of twelve months and requires them to attend 259 hours of specific training (Ageron et al., 2016; Montassier et al., 2015). The Northern Ireland Ambulance Service also offers extensive training courses which combine theory and observation. These training programmes are designed to ensure that medical dispatchers are equipped with the necessary skills and knowledge and are confident in their ability to handle 999 calls and dispatch ambulance resources. Following the training, dispatchers are placed under supervision until they are able to handle calls and dispatch ambulance resources independently [147].

• Debriefing following an incident

The current study's findings indicate that the SRCA and ED teams continue to face the same issues when responding to disasters and emergencies because no lessons are learned and subsequently applied between disasters. Regardless of the existence of debriefing mechanisms, EMTs face the same obstacles from incident to incident in terms of information sharing, patient transportation coordination, and communication system usage. According to Lederman, (1993), debriefing is a process that guides individuals who have had an experience through a purposeful discussion about it. Following a simulated or real-life experience, debriefing allows for reflection on the experience and the opportunity to learn from mistakes. The facilitators guide the process by probing into the conceptual framework and asking pertinent questions about an incident [148]. Debriefing was developed to bridge the gap between experiencing an event and making sense of it; thus, those who are debriefed reflect on the experience and identify the strengths and weaknesses of their performance [149].

According to the participants in the current study, two types of debriefing session, regional and local, do occur following disasters. Both, however, have been demonstrated to be ineffective. SRCA and ED staff are not invited to these regional debriefing sessions; their perspectives on the factors impeding effective response are not discussed. Additionally, recommendations and actions taken during these sessions are not communicated to all staff. Similarly, Skryabina et al., (2020) discovered that responders felt excluded from opportunities to share their perspectives and contribute to organisational learning following an incident. Salas et al., (2008) recommend that all team members who actively participated in a clinical event be invited to participate in the debriefing so that they can benefit from the identified errors and develop a plan to improve their next performance.

Local debriefings were described as 'poor' by the participants in this study because some senior members of staff at the hospital do not accept the ideas and critical points expressed in departmental debriefings, which they interpret as personal criticism. The second most frequently cited barrier to debriefing, according to Sandhu et al., (2014), is a lack of trained or qualified debriefing facilitators. Kessler et al., (2015) recommended that facilitators of debriefing sessions should cultivate debriefing skills through experiential learning. Additionally, debriefing should be conducted in a friendly environment with open-ended questions, candid dialogue and the identification of behaviours or perceptions that contribute to improved outcomes [148].

Hicks et al. (2018) discovered that when leaders are designated as those accountable for any actions suggested during a post-incident debriefing session, their position can bias or impair their ability to lead post-incident debriefings effectively. To address this, it has been suggested that a member of the team who is less active or an external provider facilitate discussions in order to reduce bias in relation to decisions made and actions taken following the debriefing [153, 154]. Several studies have agreed that debriefing training should highlight issues related to response. According to Shinnick et al., (2011), debriefing is used in health care to facilitate discussion of actions and cognitive processes, to foster reflection and to result in improved practice. Mullan et al., (2013) recommended that debriefing should result in future improvements in clinical performance, education, team morale and emotional processing. Gilmartin et al.,(2020)found that debriefing was an effective tool for promoting quality improvement and improving patient care within the department, as it allowed participants to share their perspectives and contribute to continuous improvement.

In relation to the context of this study, the coordination and communication difficulties which the SRCA and ED participants faced during each emergency should be discussed during debriefings. This study emphasised the critical importance of discussing mental health issues as a performance factor with SRCA operations centre staff during debriefings. Furthermore, in recognition of the growing evidence that stress and anxiety can have a profound effect on HCPs who work in high-stress environments, there is a need to discuss the factors that contribute to SRCA paramedics' and ED workers' high levels of work pressure, which can result in stress and anxiety.

Adverse work conditions contribute to the high levels of stress experienced by ED staff (Basu et al., (2017). Johnston et al., (2016) concluded from an integrative review that ED are high-stress work environments which present face unique risks to provider well-being and quality of care. Coggins et al., (2020) stated that debriefing following an incident is a necessary component of the learning process for all staff because it results in positive outcomes such as increased team performance. Moreover, it contributes to the resilience of health-care providers in the face of adversity and contributes to the development of defence mechanisms against overwhelming experiences [159]. Tannenbaum & Cerasoli, (2013) said that a debriefing's success is contingent upon the implementation of the ideas and suggestions made during the meeting. When the objective is to increase team effectiveness, it makes sense to conduct debriefing sessions with teams, to focus on team improvement and to track the team's overall performance [160].

It was evident in the findings that there are issues in relation to communication within and between SRCA and EDs in terms of information sharing about the transported injured and the handover of patients between SRCA paramedics and ED staff. Future work should improve the communication skills and knowledge of SRCA operations centre staff in how to manage calls from notifiers who have different reactions and behaviour in order to share clear information related to an incident with other medical teams. In addition, there is a need to enhance the integration communication system between EMTs, and when a new communication subsystem is put in place, relevant EMTs should be trained on how to use it and they should be made aware of any barriers to communication which might exist in relation to that system.

Disaster simulation exercises involving both SRCA and EDs should be conducted frequently, which would enable the staff to be updated with new skills and knowledge.

There is a need to train hospital department managers on the hospital incident command system training, which will enable them to know how to manage disaster events within their departments and with the ED staff.

The public should be educated about the role and responsibilities of SRCA staff and how the use of non-emergency calls such as hoax or pranks calls can impede important emergency calls. This could be done through a promotional campaign on television, such as a short educational video, as well as using social media in the educational process.

Strengths of the study

The key strength of this study involved the collection of qualitative data from a wide range of relevant participants, namely, SRCA and ED staff who are authorized to send and receive communications in emergency situations, including call takers, medical dispatchers, field supervisors, SRCA paramedics, ED paramedics, ED nursing managers, ED physician consultants. This enabled the gathering of diverse perspectives in a more comprehensive manner than in previous studies.

In addition, the supervisory team (KG, GP, and KM) served as peer reviewers. The team had comprehensive experience of qualitative research methods and this influenced the study from the outset. The supervisory team reviewed 12 transcripts and the associated coding in order to confirm or otherwise the trustworthiness of the interpretations of the data at the analysis stage. Peer review is conducted with the purpose of offering peers an opportunity to highlight instances of subjective bias and to understand how the interpretations of research findings were arrived at by the researcher (Holloway et al., 2016).

Audit trails, including notes on where and when the interviews were taken and details about their progress, helped the researcher with data analysis. The researcher independently performed the initial coding process, after which all codes, themes and subthemes were discussed with the supervisory team until a consensus was reached through discussion. All these processes add to the rigor of the findings and increase their credibility and trustworthiness.

The findings of this study might not be generalizable to a wider population because of the inherent nature of qualitative research, which does not attempt to generalize the findings to other populations. However, these findings may be transferrable to policymakers, SRCA, ED staff or other key stakeholders across the KSA and in other countries which have similar contexts.

Limitations of the Study

This study was limited in various ways. In terms of demography, all of the respondents came from one region of KSA, Riyadh. The research might have benefitted from inclusion of participants from other hospitals which are under the control of different sectors such as the Ministry of Defence, the National Guard Hospital, King Faisal Specialist Hospital & Research Centre, and also some private hospitals such as Al-Habib, and Dalah hospitals. However, difficulties in getting ethical approval in these hospitals made their inclusion in this study unfeasible. Additionally, because data were collected in a single region of the KSA, the findings cannot be generalised. The research's sponsor indicated that they would support the study only if data collection was limited to a single location within Saudi Arabia. As a result, this study was conducted in Riyadh, with three hospitals and the SRCA participating. Additional research including participants from these other sectors might have provided valuable insights.

In this study, many of the interviewees were male, but the age and gender profiles of the sample were not analysed as factors in relation to the participants' experiences in the use of the current technology, and subsequently, there was no assessment of the relationship between staff experience and age or gender.

Another limitation of the study could relate to possible loss of meaning when translating from Arabic into English. This limitation might affect our understanding of what participants actually meant during the interviews. Most interviews were conducted in Arabic (n = 50) as these participants preferred to use Arabic and were then transcribed and translated into English. Twelve interviews were conducted in English, which is the second language of both the researcher and the participants. Hence most of the findings of the interview study were translated from Arabic into English. It is possible that the real meanings of Arabic words might have been misinterpreted when translated. Participants often used metaphorical expressions and idiomatic language in Arabic to relate their experiences and express their feelings. The complexity and the differences between cultures might make understanding these expressions confusing and cause them to lose their original meaning when translated into the target language.

In an attempt to keep the original meaning by independently checking the quality of the translated work, the researcher asked another bilingual translator to confirm the veracity of the transcriptions. The researcher also provided an explanation of the metaphorical and idiomatic language as much as possible in order to translate the emotions and ideas expressed in the participants' mother language into the principal language of this study, English. It was hoped that this might assist the reader to engage as fully as possible with the participants and their explanations of their experiences as expressed in their first language.

Conclusion

The study established that operations centre staff, call takers and medical dispatchers, are exposed to a variety of factors which affect their performance and their coordination with SRCA paramedics and ED staff. Although as first responders who receive and transmit information to SRCA paramedics and ED staff, operations centre staff play a critical role in information sharing but they were found to lack support in the form of a well-developed training programme to improve their communication skills, psychological support, and legal protection against humiliation or prank calls, which has a negative impact on both SRCA operations centre staff and paramedics' emotional well-being, as well as hindering a fast response to serious emergency calls.

Although some formal communication systems do exist between SRCA and ED staff, this study discovered a need to enhance communication systems' reliability, usability and utility. The majority of the participants preferred to use their personal mobile phones because they offer a variety of options for sharing information, including voice calls, SMS, and various forms of social media platforms such as WhatsApp, and they are perceived to be effective at detecting location accuracy using Google Maps. However, the study participants' identified a number of negative elements which persist in every incident and coordination and communication issues remain unresolved.

Despite the fact that disaster simulation exercises were conducted, neither SRCA nor ED staff had received training on how to improve communication skills during a disaster. This study made several recommendations and suggested ways to improve communication between EMTs during an emergency response.

In conclusion, this thesis has examined staff experiences with ICT use within and between SRCA and ED during emergency situations. The findings of this research, as well as the recommendations which follow, will be used to inform the MOH, SRCA, policymakers, researchers and health-care personnel about how to address the issue of effectively utilising ICT in emergency health care in the KSA.

Declarations

Competing Interests

There are no competing interests among the authors

Ethics approval and consent to participate

Ethical approval for this study was sought and obtained from Queens University Belfast in October 2018 (Ref No. 13. BAlshehri 07.18.M6) see (File.1). Similarly, the ethical approval from SRCA see (File.2), and hospitals that are belong to the Ministry of Health (MOH) see (File.3) and the Ministry of Education (MOE) (File.4) were obtained. Participants completed the consent to be contacted form and returned it to the gatekeepers for me to collect later. Additionally, several willing participants from the SRCA and EDs contacted me via the contact information provided on the information sheet, and a time to meet was arranged. All participants were willing to be audio-taping and signed an informed consent form. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Attached.

Availability of data and materials

The dataset extracted from the audio-record material regarding the participants. The audio record material is not published due to privacy considerations for the participants. Participants responses were audio-recorded (with their consent) during the interviews to ensure that all data were retained for future analysis. Audio record stored the recordings in a password-protected laptop after each interview. Other materials associated with the project were secured in a locked filing cabinet in the researcher's office in the School of Nursing and Midwifery, QUB. In addition, I used the One-drive from the official email of QUB to download all the transcripts. No data were lost during the study. However, the datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Funding

Authors' Contributions

Research design: BA,KG,GP,KM, Data collection, BA, Analysed the data: BA, KG, KM, GP, Wrote the paper: BA, Assessed and revised the whole document: KG&, KM & and GP .

Acknowledgments

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Tables

Table 1: Profile of SRCA participants

No.	Code	Health care organizations	Age	Gender	Nationality	Title of position	Year of experiences	Date of interview
1.	RCF1	Saudi Red Crescent	35-40	Male	Saudi	Field supervisor	18 years	21/03/2019
2.	RCF2	Saudi Red Crescent	35-40	Male	Saudi	Field supervisor	20 Year	02/04/2019
3.	RCF3	Saudi Red Crescent	35-40	Male	Saudi	Field supervisor	16 Year	25/02/2019
4.	RCD1	Saudi Red Crescent	35-40	Male	Saudi	Dispatcher	7 Years	12/02/2019
5.	RCD2	Saudi Red Crescent	35-40	Male	Saudi	Dispatcher	15 Years	14/02/2019
6.	RCD3	Saudi Red Crescent	35-40	Male	Saudi	Dispatcher	10 years	18/02/2019
7.	RCD4	Saudi Red Crescent	30-35	Male	Saudi	Dispatcher	8 YEARS	18/02/2019
8.	RCC1	Saudi Red Crescent	35-40	Male	Saudi	Call taker	15 YEARS	01/04/2019
9.	RCC2	Saudi Red Crescent	35-40	Male	Saudi	Call taker	8 Years	04/02/2019
10.	RCC3	Saudi Red Crescent	35-40	Male	Saudi	Call taker	15years	27/03/2019
11.	RCP1	Ambulance care centre1	35-40	Male	Saudi	paramedic	7years	28/02/2019
12.	RCP2	Ambulance care centre 1	25-30	Male	Saudi	paramedic	9years	13/02/2019
13.	RCP3	Ambulance care centre 1	35-40	Male	Saudi	paramedic	12 years	04/02/2019
14.	RCP4	Ambulance care centre 1	35-40	Male	Saudi	paramedic	10years	19/02/2019
15.	RCP5	Ambulance care centre 2	35-40	Male	Saudi	paramedic	9years	21/03/2019
16.	RCP6	Ambulance care centre 2	25-30	Male	Saudi	paramedic	10years	02/04/2019
17.	RCP7	Ambulance care centre 2	40	Male	Saudi	paramedic	30year	25/03/2019
18.	RCP8	Ambulance care centre 2	30-35	Male	Saudi	paramedic	7years	07/03/2019

Table 2: Profile of ED paramedics participants

No.	Code	Health care organizations	Age	Gender	Nationality	Title of position	Year of experiences	Date of interview
1.	EPC1	Hospital C	25-30	Male	Saudi	Senior paramedic	5 years	10/03/2019
2.	EPC2	Hospital C	40+	Male	Saudi	EMS head unit	16 years	11/03/2019
3.	EPC3	Hospital C	30-35	Male	Saudi	Senior paramedic	6 years	11/03/2019
4.	EPC4	Hospital C	35-40	Male	Saudi	EMS Physician	14 years	13/03/2019
5.	EPB1	Hospital B	25-30	Male	Saudi	Senior paramedic	6 years	05/02/2019
6.	EPB2	Hospital B	25-30	Male	Saudi	Senior paramedic	6 years	05/02/2019
7.	EPB3	Hospital B	30-35	Male	Saudi	Senior paramedic	5 Years	07/02/2019
8.	EPB4	Hospital B	25-30	Male	Saudi	Senior paramedic	12 years	26/02/2019
9.	EPB5	Hospital B	30-35	Male	Saudi	Senior paramedic	10 years	10/03/2019
10	EPB6	Hospital B	30-35	Male	Saudi	Chairperson of EMS	10+ years	12/02/2019
11.	EPB7	Hospital B	25-30	Male	Saudi	Senior paramedic	5 + years	26/02/2019
12.	EPA1	Hospital A	25-30	Male	Saudi	Senior paramedic	7 Year	26/03/2019
13.	EPA2	Hospital A	30-35	Male	Saudi	Senior paramedic	5 years	26/03/2019

Table 3: Profile of ED physicians' consultant participants

No.	Code	Health care organizations	Age	Gender	Nationality	Title of position	Year of experiences	Date of interview
1.	EDA1	Hospital A	30-35	Male	Saudi	ED consultant	10+ years	04/03/2019
2.	EDA2	Hospital A	35-40	Male	Saudi	ED consultant	10+ years	12/03/2019
3.	EDB1	Hospital B	30-35	Male	Saudi	ED consultant	5 Years	28/02/2019
4.	EDB2	Hospital B	35-40	Male	Saudi	ED consultant	10+ years	13/02/2019
5.	EDB3	Hospital B	35-40	Male	Saudi	ED consultant	10 years	01/04/2019
6.	EDB4	Hospital B	30-35	Male	Saudi	ED consultant	10 years	24/02/2019
7.	EDB5	Hospital B	35-40	Male	Saudi	ED consultant	10+ years	04/04/2019
8.	EDC1	Hospital C	30-35	Male	Saudi	ED consultant chairman	5 Years	09/04/2019
9.	EDC2	Hospital C	30-35	Male	Saudi	ED consultant	10 years	25/03/2019
10.	EDC3	Hospital C	30-35	Male	Saudi	ED consultant	6 years	24/03/2019
11.	EDC4	Hospital C	35-40	Male	Saudi	ED consultant	10+ years	01/04/2019
12.	EDC5	Hospital C	30-35	Male	Saudi	ED consultant	10+ years	01/04/2019
13.	EDC6	Hospital C	30-35	Male	Saudi	ED consultant	10 years	27/03/2019

Table 4: Profile of ED Nursing managers' participants

No.	Code	Health care organizations	Age	Gender	Nationality	Title of position	Year of experiences	Date of interview
1.	ENA1	Hospital A	35-40	Male	Saudi	ED nursing director	10+ years	11/03/2019
2.	ENA2	Hospital A	35-40	Male	Jordanian	Nursing supervisor	5-10 years	28/02/2019
3.	ENA3	Hospital A	30-35	Male	Jordanian	Nursing supervisor	5-10 years	12/03/2019
4.	ENA4	Hospital A	30-35	Female	India	Nursing supervisor	5-10 years	12/03/2019
5.	ENA5	Hospital A	35-40	Female	Egypt	Head Nursing	5-10 years	26/03/2019
6.	ENA6	Hospital A	35-40	Male	Jordanian	Nursing supervisor	5-10 years	26/03/2019
7.	ENA7	Hospital A	30-35	Female	Philippine	In-charge nurse	5-10 years	03/03/2019
8.	ENB1	Hospital B	35-40	Female	Philippine	Head Nursing	5-10 years	10/10/2019
9.	ENB2	Hospital B	40+	Female	South Africa	ED nursing director	10+ years	27/02/2019
10.	ENB3	Hospital B	35-40	Female	Philippine	Head Nursing	5-10 years	28/02/2019
11.	ENB4	Hospital B	30-35	Female	India	In-charge nurse	5-10 years	29/02/2019
12.	ENB5	Hospital B	35-40	Male	Jordanian	Nursing supervisor	10+ years	04/03/2019
13.	ENB6	Hospital B	35-40	Female	South Africa	Head Nursing	5-10 years	16/02/2019
14.	ENC1	Hospital C	30-35	Female	Philippine	Head Nursing	5-10 years	15/03/2019
15.	ENC2	Hospital C	30-35	Female	Philippine	Head Nursing	5-10 years	24/03/2019
16.	ENC3	Hospital C	30-35	Female	India	Head Nursing	5-10 years	26/03/2019
17.	ENC4	Hospital C	30-35	Female	India	In-charge nurse	5-10 years	24/03/2019
18.	ENC5	Hospital C	30-35	Female	Philippine	Head Nursing	5-10 years	24/03/2019
19.	ENC6	Hospital C	35-40	Male	Jordanian	ED nursing director	10+ years	24/03/2019

Figures

The notification process between EMTs flowchart includes the following steps:

A notifier call the ambulance operation center reporting about an incident → Call taker -Receive information of an incident -Identify the location through (CAD) - Information is passed to a medical dispatcher → Medical dispatcher -Classifies the reported information. See box 1 → Paramedics → liaison officer at the hospital - Notify ED physician and nurse → ED physician activating the disaster plan and hospital staff are alert to receive cases

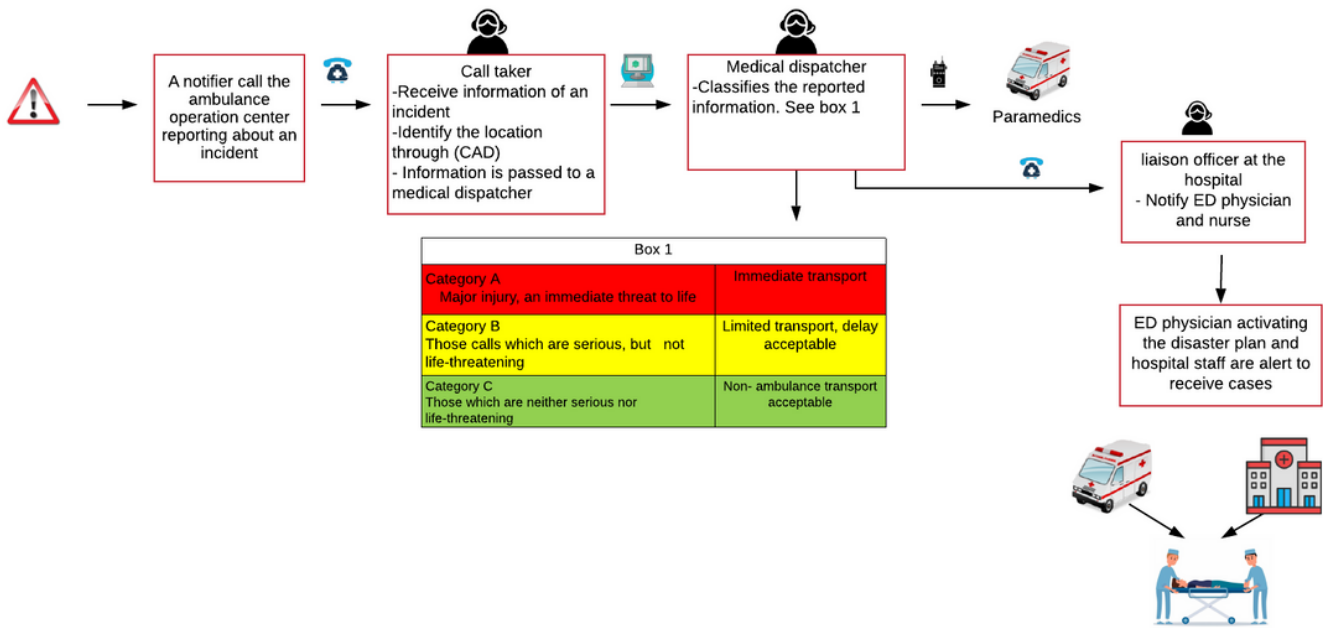| Box 1	
Category A Major injury, an immediate threat to life	Immediate transport
Category B Those calls which are serious, but not life-threatening	Limited transport, delay acceptable
Category C Those which are neither serious nor life-threatening	Non- ambulance transport acceptable

Figure 1

The notification process between EMTs