

# Response Center Services: An Exploratory Study

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**Abstract.** The population aging has facilitated a growing number of welfare technologies and smart home solutions. These technologies enable clinical staff and health care professionals to provide health services in an intelligent way with the trend of patient-centric digital health platforms. As one of the health services, response center service is facing new challenges when connected with welfare technologies, such as false alarms, security threats, privacy leakage, etc. This paper introduces the mechanism of the response center and the role it plays in healthcare. We conduct an exploratory study to find out the benefits and challenges of the response center service from the results of a structured interview. Based on the findings, we identify the required services to improve the intelligent response center mechanism

**Keywords.** Welfare technology, smart home, privacy, response center, healthcare

## 1. Introduction

There is an increasing number of the elderly and patients in demand of health services in aging societies. Long-term care (LTC) has therefore been set as a key policy priority by governments in different countries to meet the growing care needs of population aging [1]. In Norway, health services, such as LTC, are provided according to the principle of the lowest and more effective level of care [2, 3]. As patients are provided with sufficient but no more than necessary services, long-term care service is offered to patients in their ordinary private homes prior to care homes or nursing homes. Also, patients in nursing homes are motivated to go back to their ordinary private homes [2]. Thus, long-term care service, a service supporting “aging in place” with a growing range of assisted living technologies (ALTs), constitutes an important part of LTC.

The response units, or response centers, play a significant role when providing long-term care services worldwide. To illustrate, there are various response centers providing different types of services today. For example, the Emergency Response Unit (ERU) deals with emergency situations including medical emergencies, firefighting [4]. Microsoft Security Response Center (MSRC) aims at protecting customers and Microsoft from privacy and security threats [5], Refugee First Response Center (RFRC) provides medical first aid and live video translation services [6], National Response Center (NRC) from the U.S. takes the responsibility of all reports on oil, chemical, radiological biological and etiological discharges as well as maritime reports of

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suspicious activity and security breaches [7], Health Response Center (HRC) provides family welfare services [8], disease control and prevention [9]. Some of the response centers have a combination of services like the Emergency Response Unit (ERU). However, we focus on the health related response center services in this paper. The health response centers, sometimes also called healthcare call centers or medical call centers [10, 11], can provide timely response services to patients and distinguish the emergency level. The health response center personnel will help handle the daily needs of the users and their family members and if necessary, deliver the message to health care providers for further medical aid and in this way help reduce their workload.

In Norway, municipalities take the responsibility of providing long-term care services, and the politicians and administrators plan and decide on local care services structures including the delivery of the services in different municipalities around the country [12]. The response centers are driven by local authorities in these municipalities [13]. They provide 24-hour care services for users continuously. Though the services provided by response centers vary among different municipalities, they have the following functionalities in general [14]: (1) Receiving incoming calls and inquiries and implementing necessary and effective follow-ups, (2) Taking the role of coordinating when emergency services are needed in addition to municipal services, (3) Technology-enabled remote monitoring and notify the users or vendors in time in case of technical errors or provide help when abnormal activities are detected. The welfare technologies used for remote monitoring include but are not limited to digital security alarms, image sensors, bed sensors, door alarms, global positioning systems (GPS), seizure or fall alarms, smoke alarms, electronic drug dosing, and electronic door locks [15]. These technologies enable more accurate assessments to be presented and more effective measures to be provided by the response centers. Meanwhile, they save the cost of health services.

Despite the benefits that the response centers and the welfare technologies bring, the service support mechanisms are faced with various challenges. According to the Norwegian explorative case study conducted date back in 2018 [16], response center personnel's concerns about the services they delivered include irregular reporting or under-reporting by patients, inappropriate support systems like lack of integration between different systems used at the response center, unexpected work demands like providing psychological support to those patients struggling with anxiety or depression.

However, the case study does not fit the development of smart home technologies and the growing need of long-term care services in the past few years. In the era of COVID-19 pandemic, the healthcare systems have been transformed worldwide with telemedicine and virtual healthcare integrated into the health delivery service [17]. Also because of the digitalization of the services, patients and their family members as well as the health care providers have shown more privacy concerns on welfare technologies. In the past two years, there are also growing trends of studies by researchers on patients' and bystanders' security and privacy concerns in different scientific databases (ACM digital library, PubMed, Semantic, etc.).

In this paper, we present the results of a exploratory qualitative, structured interview with response center personnel from four different Norwegian municipalities' response centers. The four representatives provide the views from the health care providers' perspective on the smart home technology-enabled response center services. A list of services provided by the response centers are identified by us from the benefits and challenges we collect according to the needs of the users (including the patients, the response center personnel, and the relatives of the patients). After that, we discuss the

room for improvement. The main contribution of the paper includes presenting the interview results and extracting core functionalities of the service system from the interview.

## 2. Method

We performed exploratory, qualitative, email-based, structured interviews to collect views of the health response center personnel on the response center services, complemented with a design method to identify and analyze the services as well as present the intelligent response center service mechanism.

Four response center personnel from different municipalities across Norway were contacted by us via email with attaching questions. The questions were sent directly to the interviewees without extra testing. The demographic characteristics of the interviewees were not required in the interview. After receiving their responses from email, content analysis was adopted to code data and generate categories. To be specific, the attaching questions in the email were classified into four categories by us (see tables 1 to 4 below): (1) Current status of the response center services, (2) Challenge 1 - Technology education and technical support, (3) Challenge 2 - Security and privacy concerns, (4) Challenge 3 - Efficiency and effectiveness of the service system. Each question in different categories has corresponding answers. Based on interviewees' answers to the questions, we summarized the competencies and problems of the current response center service in the next section.

**Table 1.** Current status of the response center services

<b>Classification</b>	<b>Questions</b>
Benefits	Q1: What do you think is the best value brought by the current response center services to users (patients and their family members, for instance)?
Requests distribution	Q2: Do you have statistics about the distribution of question types/requests from the patients? Q3: How does a typical first-line worker prioritize the questions/requests?
Challenges (in general)	Q4: What are the most frequent requests from the users? Q5: What do you think are the current and future challenges that the current response center service is facing (not well addressed and likely hard to address in the next decade)?
Emergency handling	Q6: Do you have any collaboration with the emergency medical communication centers particularly in coping with emergencies?

**Table 2.** Challenge 1 - Technology education and technical support

<b>Classification</b>	<b>Questions</b>
Backup solution	Q7: In case the care receiver or health professional does not know how to use or maintain the welfare technology, are there any backup solutions? (e.g., sending a technician, using phone calls or video communication to guide the users.)
Training program	Q8: Do you have any training programs or technologies aiding the users (care receivers or caregivers from municipalities) to learn and adapt to day-to-day changing care needs?

**Table 3.** Challenge 2 - Security and privacy concerns

Classification	Questions
Consent management	Q9: Do you/patients/patients' family members have any security and privacy concerns on the welfare technologies used in your services or difficulty in consent management?

**Table 4.** Challenge 3 - Efficiency and effectiveness of the service system

Classification	Questions
False alarms	Q10: Is false alarm a challenge to the operation of a response center? Q11: Are most false alarms from the phone call report from the phone calls or from the sensors applied (e.g., fall detection sensors, image sensors, etc.)?
Vague requirements	Q12: How to deal with the situation that patients' request from the phone call is unclear? Q13: Do you have technology such as data collection before or right in the phone call conversation to help you make better judgement?
Identification authentication	and Q14: How to make sure the phone caller is the correct patient (how to identify a patient in a remote way)?

### 3. Results

#### 3.1. Benefits

The invited response center personnel list the benefits of the services they provide as follows (We mark the four interviewees as P1, P2, P3, P4 when presenting their opinions. The findings are all summarized by us from the interviewees' answers corresponding to each question. They are marked at the end of the sentence.):

- **Equal treatment**  
For patients, they will be treated equally and get the same help regardless of where they stay in the country (Q1-P1). For operators (response center personnel), they will focus on each user so that they can provide services of good quality (Q1-P1).
- **Security and competence**  
For patients, they are confident and feel secure as they know the professional personnel will guide them when they need help (Q1-P2, P4). For relatives (like patients' family members), they feel secure as they know users can call for help or report needs via the response center using various technologies (Q1-P1, P4).
- **Quick contact and response**  
As the response centers enable patients to have quick contact with the health services, patients will be able to stay at home longer (Q1-P3). With welfare technology, response center personnel will be able to clarify what the patients need help with and send the right expertise to the patients (Q1-P3).
- **Burden easement**

It enables relatives to be confident when they are on holiday or during sleep because they are confident that patients will get the help they need in time (Q1-P2). Welfare technology enables response center personnel to send the right services, e.g., medicine dispensers will help with the correct medication at the right time instead of human intervention to deliver the health services (Q1-P3).

- **Emergency handling**

By easing the burden of the clinical staff, the response center services enable a more efficient emergency handling mechanism. At the same time, the response centers have close collaboration with other organizations, and the personnel can call the emergency medical communication centers daily when necessary (Q6-P1, P2, P3).

### 3.2. Challenges

Nonetheless, these benefits are brought together with a variety of challenges. When asked about the challenges that the current response center service is facing, the interviewees have more insights in addition to the challenges we have summarized in the previous section.

- **Increasing needs of response center personnel**

The increasing number of older people will add up the workload of the response center personnel and more qualified personnel are needed (Q5-P1)

- **Difficulty in adapting to the changing technology**

The updated and developed technologies and technical systems make it difficult for users and response center personnel to adapt to them (Q5-P1, P4). The fact is patients and response center personnel lack technical competence (Q5-P4, Q7-P1). Also, the changing work is time-consuming and there's not enough time to train qualified personnel (Q5-P4).

- **Lacking backup solutions for technology education and aid mechanism**

The technology education and aid mechanism are different among the response centers that the interviewees belong to. In general, the municipalities rather than the response centers take most of the responsibility for educating and aiding people with welfare technology (Q7-P1, P2). Though some municipalities have set up outpatient teams to assist with anything including equipment configuration, training, and troubleshooting (Q7-P2, P3), some do not have any technicians linked to the response center (Q7-P1). Even if some backup solutions have been made like having backup telephones in the event of loss of the response center reception, the response centers need better solutions with the increasing number of service recipients (Q5-P3).

- **Complex service processes, vague requirement identification, and inaccurate decision support**

With an increasing number of alerts from different technologies, and with different service processes for the response center personnel to follow up, the current decision support and the possibility of announcing or communicating

assignments can be a challenge (Q5-P2, P3). The use of an established decision support system is desired but not yet suitably developed for response center service use currently (Q3-P4). Moreover, response center personnel have difficulty in understanding patients' vague requirements, which adds up to the complexity of service processes and decision making. The solution that the response centers adopt now is integrating the service system with the electronic health records, so that the personnel can access the important information they need to help the patients and send health providers daily to the patients who have unresolved situations, if necessary (Q12-P1, P2, P3, P4). Mostly, the decision or judgment is made by the personnel relying on their experience. However, no technology is used to collect data right in the phone call conversation to help the personnel to make better assessments or decisions (Q13-P1). Also, in emergency cases when the response center personnel need to contact other organizations for help, it is pointed out that calls over the alarm box in some cases result in poor sound quality (Q6-P3). In all, it seems that more simplified technology solutions are needed to help personnel to make better decisions and ensure good communication quality between patients and personnel.

- Potential applications for incident assessment needed

It has been identified as a need for the personnel to communicate with the patients with an image in addition to sound (Q5-P3). Currently, it is the response center personnel who assess as accurate as possible the severity of the incidents (Q3-P1). As one of the methods to assist assessment, visualization of incoming incidents can help the personnel with prioritization of alarms or requests more accurately (Q5-P3).

- Difficulty in identifying false alarms (either from bystanders or technical dysfunction) and repeated alarms (from patients' phone call reports)

One of the interviewees regards the false alarms and repeated alarms as challenges as they are time-consuming (Q2-P1, Q11-P1). Another interviewee also identifies the false alarms caused by technical dysfunction and admits the possibility of the sensors being triggered accidentally but does not consider false alarms as big challenges themselves (Q11-P3).

- Identification and authentication risks

Among the four response centers that our interviewees work for, one of the response centers has a more developed identification and verification mechanism for both patients and the health personnel compared to others. The measurement it takes includes asking for the name of the patients rather than saying the name of the patient to get a confirmation, linking the identity from the sensors to the identity from the electronic health records, and recording the follow-up of the care services via electronic health records (Q14-P3). However, not all the response centers regard the mechanism they adopt as a challenge (Q14-P1, P2), which can cause information security risks consequently. The technical suggestion put forward by personnel is to get a video connection to the user so that they can have visual contact (Q14-P2).

- Security and privacy concerns

Though the risk and vulnerability analysis [18], as well as data protection impact assessment, has been conducted in the response centers (Q9-P2, P3) in compliance with the legal requirements (the patient and the user's rights act [19]), there are still some security and privacy concerns from the patients and their family members (Q9-P2, P3, P4). There are some cases where patients can be skeptical as their family members are being monitored at the same time (Q9-P1). It increases municipalities' and response centers' difficulty in managing multi-users consent when being monitored.

- Specific solutions needed for different types of requests:

Because of the frequent requests from patients, more categories of solutions are needed for better services. The personnel list respiratory distress, pain, malfunction on various nutrition pumps, nausea, falling, elimination of produced body fluids, displacement of the patient (in bed or to toilet chair), psychological support, etc. (Q4-P3)

### 3.3. *Service Identification*

With the challenges above, we extracted the services required in an intelligent response center service system. We split the services into services currently available and planned for improvement (though some of them are also available by now, they remain to be improved) in the future (Table 5). The proposed solutions aim to reduce the current burden. For example, image visualization will help health providers to identify incidents or vague requirements, which have been raised by the interviewees as a challenge, so as to provide appropriate health services. Furthermore, in some cases, multi-users needs should be considered at the same time. Therefore, both service recipients and providers' needs were considered. After that, the detailed support solutions were analyzed corresponding to each service.

Though more intelligent solutions and software services can be integrated into the current response center system design with the emerging technology management solutions, more services provided by other organizations or platforms should be linked to the response center system in support of professional consultation, such as mental health disorders or feeling of isolation (online social media and mental health center). In the meantime, external technical center as well as cloud storage are linked to provide backup solutions. To ease the burden of the personnel and save medical resources, more incidents need to be classified and handled on a machine level before being escalated to the human level.

With the aspects considered, the mechanism of the system is visualized in Figure 1. In general, the solid lines represent the internal information system of the response center, while the external platforms or organizations in support of the response center services are marked with dashed lines. The machine-level incident processing with optimized video analytics and incident assessment algorithms are expected to not only help reduce the burden of response center personnel but also service providers from external organizations.

**Table 5.** Service Identification

Service	Currently available	Planned for improvement	Based on patients' needs	Based on response center personnel's needs	Based on other users' needs	Corresponding support
Daily living assistance	X		X	X		Medical sensors, smart devices, wireless network, disease management systems
Daily contact	X		X			Medical sensors, smart devices, wireless network, backup telephone
Incident assessment	X		X	X		Self-report and shared decision-making system
Emergency handling	X		X			Incident audio/video recording
Technology education	X		X	X		Technology training
Technology aid	X		X	X		File/data automated backup, automated technical incident report, remote support
Requirement identification and clarification		X	X	X	X	Access control, Video enabled communication
Psychological support		X	X			Online social media
Identify false alarms		X		X		False alarm filtering - AI video analytics [20]
Identify repeated alarm		X		X		Fatigue management system - repeated alarm scheduling and clustering [21]
Security and privacy protection		X	X		X	Consent management platform (CMP), privacy preserving technology

#### 4. Discussion

Despite the improvement of the system, privacy is one of the barriers to the proposed functionalities. Better automated services are brought with more privacy leakage possibilities during electronic health records and video data processing. Being linked with external services raise the possibility of privacy leakage regarding information sharing as well. In other scenarios, like when family members are living with patients, or when daily health service or emergency aid is delivered, the privacy-preserving dilemma also exists. The fact that different user roles (patients, bystanders like family members or health care providers) have different duties and privacy concerns has led the users to make different decisions under the same scenarios. For instance, medical help will be highly prioritized by clinical staff when an emergency happens despite considering patients' privacy concerns. Meanwhile, when different users are being monitored, the privacy-related consent management become more complicated so as to monitor all the users legally. In the proposed mechanism (highlighted in red), a shared decision-making mechanism which enables different parties to make decisions together,



as well as the consent management system, should be integrated to synchronize different parties' decisions and privacy concerns.

As one of the limitations, the figure has not covered detailed solutions for different types of incident identification. In falling accidents, for example, the alarms can be sent either by the sensors automatically once the event is detected or sent by the patients manually. Under some circumstances, the alarms can even be sent by the sensors to the health care providers with more details reported by users. Thus, the final reports that will be sent extremely rely on the urgent level of the incidents. Also, we are faced with the same challenge when applying privacy-preserving technology to different types of incidents as users have different privacy concerns in different incidents.

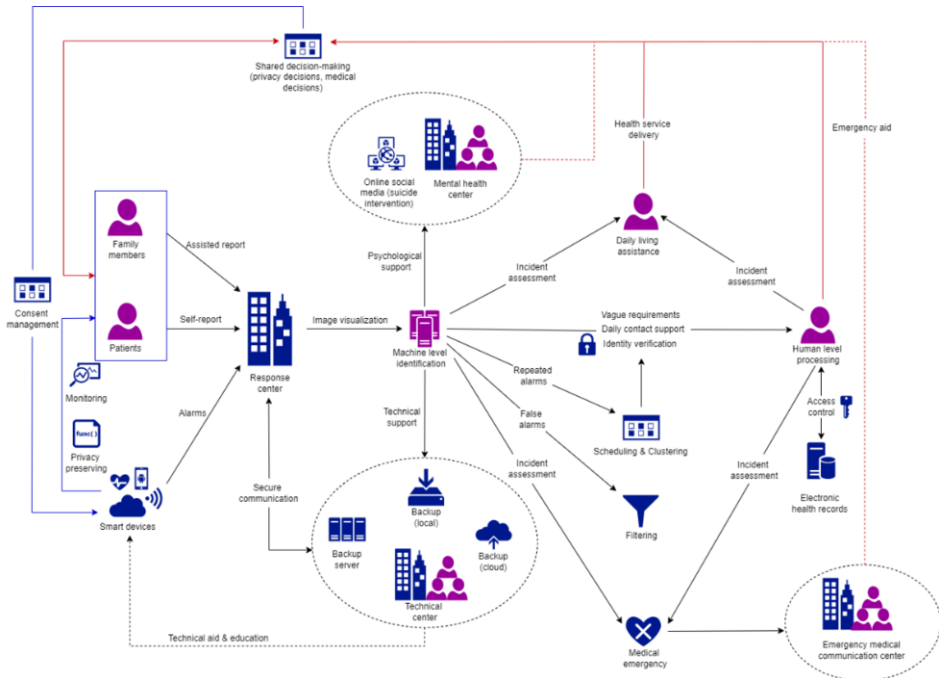


Figure 1. Intelligent Response Center Service Mechanism

## 5. Conclusion

In this paper, we conduct an exploratory study that will help improve the intelligent response center service. We identify and analyze the services in the technology-enabled response center system from a structured interview with four representatives of the response center personnel. Based on the views we collect, the benefits and challenges with current response center services are extracted. According to the findings, we identify the required services to improve the response center systems. The results and analysis are presented from the technical perspective, with privacy and security leakage and different technology platforms considered. Finally, we emphasize the core efforts that need to be made for improving the system.

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