

## RESEARCH ARTICLE

## Healthcare resilience to extreme events: a hospital staff perspective

Afsar Ali<sup>a</sup>, Nebil Achour<sup>a</sup><sup>a</sup> Faculty of Health, Education, Medicine and Social Care, Anglia Ruskin University, Cambridge, United Kingdom**ABSTRACT**

The coronavirus (COVID-19) pandemic demonstrated how vulnerable and unprepared most healthcare sectors are to major disasters. Several studies have been published reporting factors that affect staff attendance during extreme events. However, these factors are limited and do not provide a full picture of why staff do or do not attend workplaces during major emergencies nor the impact of staff absences on healthcare service delivery. This study presents the factors influencing staff attendance during an extreme event and the impact staff attendance has on the continuity of healthcare services in one of the several independent British Isles hospitals. This study highlights that staff attendance depends on many contributors such as workload, stress, motivation, proximity of work to home, transportation networks, and dependents. The absence of any staff member, despite their role, level, or background, will have an impact on the functionality of a hospital. The study concludes that staff absence severely impedes the continuity of healthcare service, impacting services that provide ventilators and other essential services required during extreme events such as the COVID-19 pandemic and extreme weather events.

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Most of us are now aware during these challenging times of COVID-19 how vulnerable the global healthcare sector can be. COVID-19 cases and death rates varied, Italy initially being the worst affected with their healthcare service crippled (Al-Thobaity & Alshammari, 2020). In some ways, this has reflected and exposed many countries' crisis management plans. Likewise, many other types of hazards such as earthquakes and extreme weather events can stretch healthcare services, including staffing and supplies (UNICEF, 2020). Achour and Miyajima (2020) proposed and illustrated five fundamental and imperative contributors required for the continuity of healthcare service: building integrity, critical systems (e.g., power, water, and gas supplies), equipment, supplies (e.g., PPE, medicine, and food), and staff (see Figure 1). They also highlighted other hidden contributors such as accessibility networks (e.g., roads and trains) and suppliers. These contributors must perform very well before an event occurs to keep the flow of healthcare functioning (Achour & Miyajima, 2020). Staff are one of these five fundamental and pivotal contributors as they are responsible for dealing with patients (i.e., frontline of patient care) and for ensuring the continuous operation of the hospital.

Researchers such as Powell (2008) have argued staff attendance to have diminished and healthcare authorities to have yet to appreciate this. Reasons for the diminishing of healthcare staff (e.g., doctors, nurses, and clerical) attendance may result from numerous factors such as work-to-home proximity, transportation, type of disaster, infrastructure, fear, family commitments, and even commodities such as food and water. Davidson et al. (2009) found healthcare staff with dependents to be less likely to show up. Ochi et al. (2016) suggested availability of physiological resources such as food and water to contribute to healthcare staff attrition.

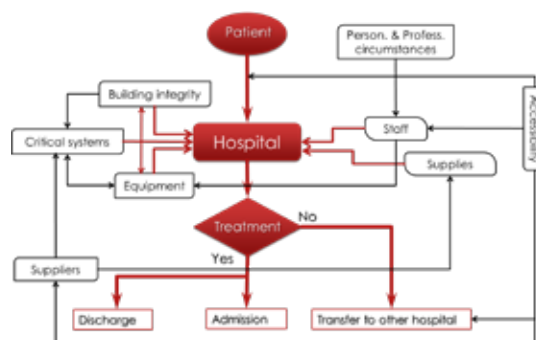


Figure 1. A simplified model for hospital operation factors (Achour & Miyajima, 2020).

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Extreme events can cause a paucity of resources such as medication, equipment, and more importantly the staff who need to deal with the patient frontline (i.e., clinical staff) and with maintaining the functionality of the hospital behind the scene (e.g., engineers, hygiene, and security). Health authorities should assume a shortage of staff will occur during extreme events (Achour & Miyajima, 2020; Chaffee, 2009; Davidson et al., 2009; Powell, 2008; Unlu et al., 2010), combined with a potential surge in demand. Data from the mega-triple disaster in Japan in March 2011 showed that doctors' best attendance reached 58% and that clerical staff had the worst attendance at 38%. Healthcare staff are less willing to work during chemical, biological, contagious, and radiological situations (45-52%) compared to meteorological and geophysical hazards (e.g., floods and earthquakes at 83-90%; Chaffee, 2009). Japanese hospital staff had much fear from radiation exposure and decided not to report to work due to psychological fear of radiation; the closer the staff lived to the point of radiation, the greater the fear (Unlu et al., 2010). Moreover, many healthcare staff members feared for their families and some could not attend due to pet care; if they had to report to work then they would also need to consider pet care arrangements (Achour et al., 2018; Davidson, 2009; Ochi et al., 2016; UNISON, 2021), while others had eldercare obligations (Achour et al., 2018).

In New Zealand, the 2011 earthquake caused significant strain on doctors, some of whom lost their homes and were themselves receiving help from their local community. Hospital staff have a higher chance to respond effectively to major emergencies when they are physically and mentally sound prior to the disaster. Increased workload and stricter performance measures with less flexibility tend to cause stress and will most likely place staff in an unfavorable position to work effectively as well as in an unhealthy manner post-disaster due to the stress associated with disasters (Achour et al., 2018). Furthermore, staff who continue to work post-disaster are susceptible to stress and psychological disorders and may need to be treated by mental health professionals alongside the disaster victims.

Researchers suggest sleep and treatment of insomnia to be important interventions for maintaining healthcare teams' physiological state to effectively manage the continuity of healthcare (Valdez & Nichols, 2013). Awareness has also been recommended as an approach to help reduce staff stress and assist in delivering high-quality service (Achour et al., 2018). Training and education have a positive effect on minimizing stress; once knowledge is attained, staff are reported to be willing to work during a disaster (Martens et al., 2003). These issues exhibit work pressure and prevent staff from learning how to deal with a major incident.

Recognition and motivation are other elements that influence the effectiveness of staff; however, these do not seem to be well retained by hospital senior staff, leading to less loyalty to the workplace and thus a higher chance to not attend during major events (Achour et al., 2018). Achour et al. (2018) recommended that staff should be given opportunities to acquire new knowledge and develop new skills that will enable them to deal with major emergencies. Valdez and Nichols (2013) supported this argument, stating that developing preparedness through effective training as a way to augment attendance. Monetary rewards will motivate some workers to report for work, but alternative rewards such as promotions and recognition of service awards may be offered instead (Valdez & Nichols, 2013). Offering job opportunities to healthcare staff and assisting with child care has been suggested as an approach to entice staff who tend to prioritize their family members (Achour & Miyajima, 2020; Ochi et al., 2016). Organizations such as in Maryland and South Carolina in the U.S. have established legislative mandates to ameliorate poor staff attendance in the event of a public health crisis (Powell, 2008). Meanwhile, the United Kingdom's (2020) legislative directive (UNISON, 2021) encouraged staff to take time off to self-isolate and supported them by offering financial support to prevent the further spread of COVID-19.

The literature reveals a substantial amount of information about healthcare staff (e.g., clinicians and clerical) overseeing the contribution of those who work behind the screen to ensure the hospital operates effectively, such as in regard to engineers, hygiene, and security staff members. COVID-19 has highlighted the important role these play in overcoming issues with oxygen systems, maintaining a clean hospital environment, and ensuring that access to hospitals is well under control. Very limited information is found about the impact staff absences in a hospital have on hospital operations (i.e., healthcare service delivery). This study presents the factors that influence staff attendance during extreme events and the impact staff absence has on the continuity of the healthcare service delivery in one of the several independent British Isles hospitals.

## Methods

Data was collected from staff at an independent hospital that is part of the British National Health Services' independent state-run hospitals. The hospital authorities agreed to the survey being conducted and the publication of the results on condition that the name of the hospital is kept confidential. The survey was conducted in March 2020. Staff were sent a questionnaire with 49 questions covering demographic information (e.g., age, gender), travel, job stress, professional factors (e.g., training, peer confidence), and personal factors (e.g., dependents, proximity between home and hospital). The survey encompasses closed and open questions to allow staff to express their opinions and provide further details as deemed necessary. Participants were requested to rate their knowledge and confidence using a 5-point Likert-type scale. Data were screened and found to be eligible for the analyses. Pivot tables are used to correlate the factors affecting staff attendance with factors such as age and gender. Qualitative data (staff feedback) have been analyzed based on a thematic flow diagram. The diverse range of answers was narrowed down to codes, and these codes were further organized into themes. Additionally, a frequency table was applied to the qualitative data to arrange correlations from most popular to least popular. The frequency table included all factors thought to ameliorate attendance.

All 1,841 staff were invited to complete the questionnaire through the hospital's global email. A total of 197 participants took part in the study, representing 10.8% of the entire hospital staff. The sample size from the various sectors are: medical staff 4% ( $n = 8$ ), nursing staff 38% ( $n = 75$ ), allied health professionals (AHP) 15% ( $n = 30$ ), clerical staff 11% ( $n = 22$ ), management staff 6% ( $n = 11$ ), estates and facilities staff 1% ( $n = 2$ ) and others (e.g., facilities staff, accommodation staff, finance staff) 22% ( $n = 44$ ). Respondents' age ranges are: 65+ (3%,  $n = 5$ ), 55-65 (34%,  $n = 66$ ), 46-55 (25%,  $n = 48$ ), 36-45 (22%,  $n = 44$ ), 18-25 (2%,  $n = 4$ ), and unspecified (14%,  $n = 198$ ).

## Results

The data analyses show that dependents, work stress, and distance to work are factors that may impede staff attendance during and after an extreme event. These factors add additional responsibility, commitment, and time to staff's workload. Approximately 34% ( $n = 68$ ) of the staff who live within 10 miles stated being able to come to work during a disaster. Although this means that hospitals have a chance to operate, the risk of ineffectiveness is high as hospitals require 100% of staff if not more to operate during disasters, which often causes a surge in demand.

Figure 2 illustrates a self-evaluation of the staff who stated being overworked and unable to undertake duties during a disaster. Work stress figures for those unable to attend due to stress (44%,  $n = 86$ ) are almost equal to those able to attend (49%,  $n = 96$ ); others were unsure (7%,  $n = 13$ ). This indicates the hospital is at risk of losing approximately half of its staff, as they may refuse to assist with additional duties/hours. Even if they wished to help, they would find it very difficult to do so. A further analysis established that 39% ( $n = 77$ ) of staff have dependents (e.g., children, spouses, parents, and pets), indicating them to be at high risk of not being able to attend compared to those with no dependents (59%,  $n = 116$ ).

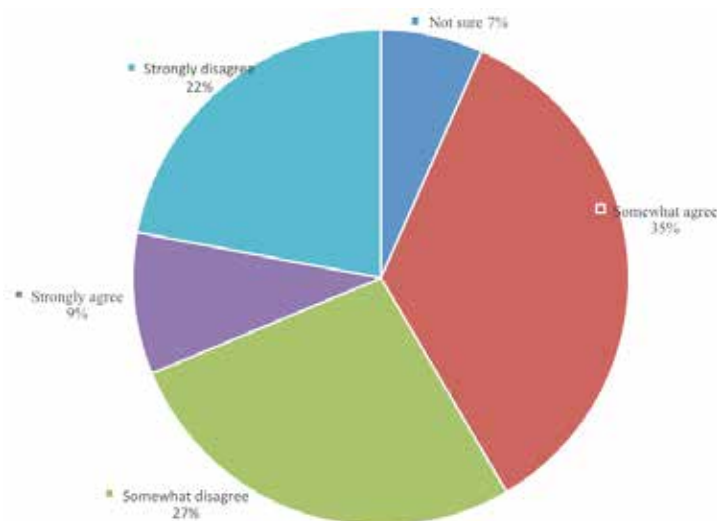


Figure 2. Staff percentages regarding their ability to undertake duties during a disaster.

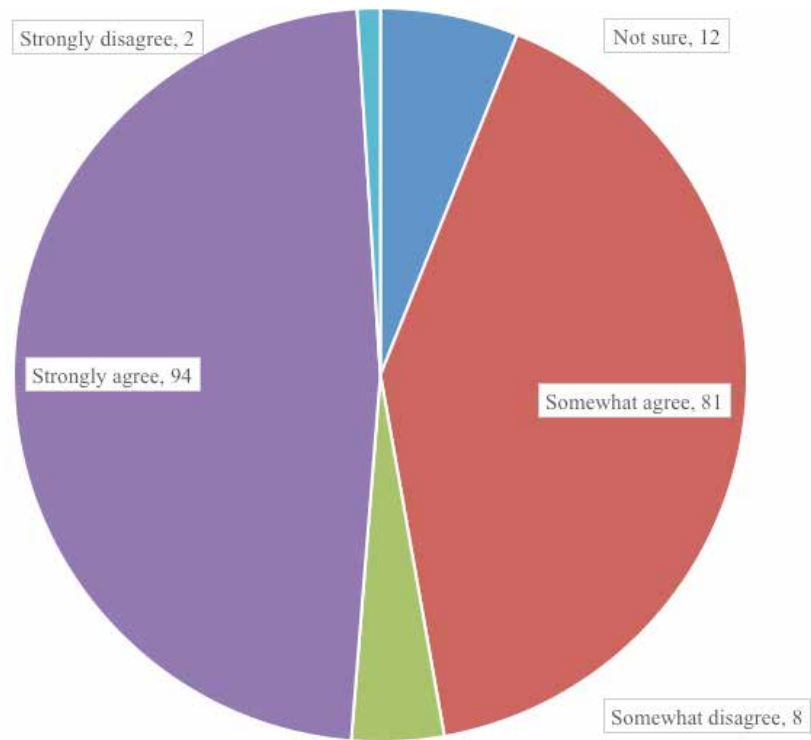


Figure 3. Staff percentages regarding finding their work to be rewarding.

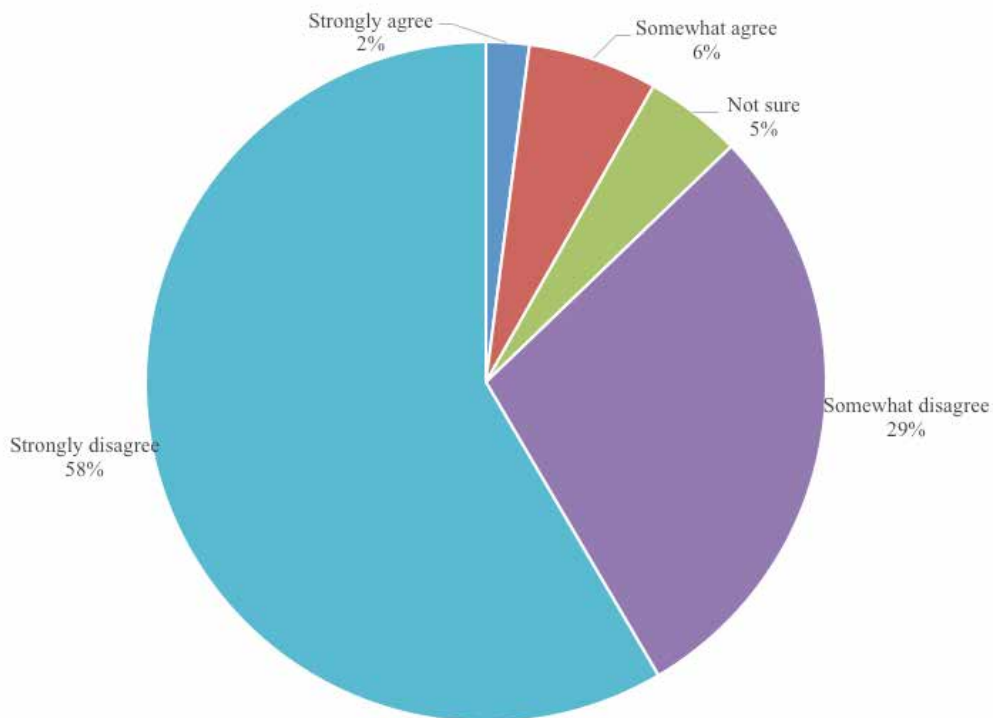


Figure 4. Staff percentages regarding feeling that they've lost the ability and willingness to attend work.

The vast majority of the staff find their jobs rewarding and meaningful (89%,  $n = 175$ ; see Figure 3). According to the results, a significant number of staff (87%,  $n = 171$ ; see Figure 4) are willing to attend work. This demonstrates a significant strength, which should be used to enhance the hospital's resilience. Another strength was found in the level of loyalty to this hospital. The vast majority of respondents have worked at this hospital for at least 11 years (66%,  $n = 130$ ); only 7% ( $n = 14$ ) had worked for less than one year (see Table 1).

Table 1

*Staff's Years of Experience at the Hospital*

Year in Service	Count (person)	Percentage
0-1	14	7%
11-20	39	19%
21-30	52	26%
2-5	29	14%
30+	39	19%
6-10	24	12%
<b>Grand Total</b>	<b>197</b>	<b>100%</b>

**Impact on Service Delivery**

The staff were asked to assess the effect their absence has on service delivery. Results showed that 9% ( $n = 17$ ) felt hospital services would suffer a severe impact. This increases to 50% ( $n = 98$ ) if moderate and severe impact percentages are combined (see Table 2). This is primarily because some of the staff working on this island are the only providers trained for the service, so if a member of a certain staff is absent, then that service becomes unavailable.

Table 2

*Severity Impact on Hospital Services as a Result of Individual Staff Absences*

Severity impact	Count (person)	Percentage
Moderate	81	41%
Limited	62	31%
Not sure	31	16%
Severe	17	9%
No impact	4	2%
Other*	2	1%
<b>Grand total</b>	<b>197</b>	<b>100%</b>

\* Other: Participant did not specify

Table 3

*Services That Would Be Affected*

Services that would be affected	Count (person)	Percentages
Computer access to electronic patient records, email, phone lines.	25	13%
Feeding & IV pumps	11	6%
ECGs & Ventilators	9	5%
Diagnostic imaging (e.g., x-ray machines, CT scans, MRIs)	8	4%
Biochemistry/hematology/transfusion analyzers, manual blood cross matching	5	3%
Dialysis machines	5	3%
Medication supply	4	2%

Providing anesthesia & sterilization services	4	2%
Obstetrics machines	3	2%
Defibrillator	3	2%
Chemotherapy systems	1	1%
Other*	119	60%
Grand total	197	100%

\* Other: Participant who did not specify

**Incentives**

Table 4 presents the factors that may improve staff attendance during extreme events. Participants had various concerns, most of which are related to different risk scenarios such as extreme weather events and pandemics. For example, 22% of the staff (n = 44), when considering extreme weather events (e.g., snow and flooding), thought alternative transport could be a way to help them overcome roads risks. The staff elaborated on this by requesting enhanced road safety (e.g., use of salt/sand) as part of the emergency plan and preparedness procedures. When considering pandemics, 4% (n = 8) expressed the need to protect themselves and their families by having the workplace provide them with adequate PPE during their duties. They understand that, by being exposed to certain diseases, they could risk their health and thus need clear guidance on how to keep safe and remain healthy during certain major incidents. This opinion was most probably influenced by the experience of Italian hospitals, which had lost more than 100 doctors and nurses to COVID-19 (Lockwood, 2020) around the same time the data was collected.

One participant articulated that some managers only focus on performance and targets so much so that they can be blind to the safety of their employees, referring to the absolute measures set by the NHS for monitoring performance (e.g., 4-hour wait-time policy). Leaders and managers should assess the nature and severity of the situation and take actions while considering the safety of their staff. Participants highlighted the issue of childcare and suggested flexible work hours (e.g., early and late work shifts) instead of the typical fixed 9 a.m. to 5 p.m. shift, suggesting that this could not only improve staff attendance but also issues related to childcare. Approximately 11% (n = 22) of the participants reported being care givers for children or elderly, stating that flexible work hours and providing care assistance would enhance their attendance. This explains the reason for UK authorities deciding to keep schools open for keyworkers despite the lockdowns in fall of 2020 and spring of 2021 when schools had to make arrangements to care for their children.

Participants connected their decision to attend work to their confidence and ability to respond to the training sessions and learning opportunities provided by their hospital. Approximately 3% (n = 6) emphasized the need to have regular training sessions to provide them with knowledge training about extreme events and associated emergencies and how these can be managed. Such training sessions should be comprehensive enough to include a variety of extreme events, as articulated for another issue informing about staff decision making (3%, n = 6).

Table 4

*Staff Opinions on How to Improve Attendance During Extreme Events*

What would increase your chances to attend work during extreme events?	Count (person)	Percentage
If alternative transport is provided	44	22%
Childcare and elderly care are provided	22	11%
Safer roads	12	6%
Flexible work hours	6	3%
Work from home	6	3%
Adequate PPE	8	4%

Dependent upon the type of extreme event	6	3%
Good communication from team leader / managers	4	2%
Support from management	6	3%
Financial incentives	3	2%
Accommodations within the hospital	2	1%
Need-to-work basis	2	1%
No overtime pressure	1	1%
Emotional support	1	1%
Training	1	1%
Other*	73	37%
Grand Total	197	100%

\* *Other: Participants did not specify*

## Discussion

The findings suggest that the hospital has a good chance to enhance its staff attendance during extreme events. Staff are well motivated and loyal to their hospitals, as demonstrated by the long experience they have in serving their hospital: 66% ( $n = 130$ ) of the staff have worked there for at least 11 years, and 19% ( $n = 39$ ) have served for more than 30 years. This is an opportunity for the hospital to build on in order to increase its staff attendance during extreme events.

The staff's day-to-day workload and work stress are among the factors staff have highlighted as issues with the potential to affect their capability to work effectively. Almost half the staff (44%,  $n = 86$ ) work under substantial stress, indicating that staff attendance might drop during extreme events as experienced in international experiences (e.g., Japan). This drop is not due to willingness but due to an inability to attend. Literature and experience have revealed that staff tend to suffer post-traumatic stress disorder (PTSD) due to the extra pressure they go through, not just because of the extra workload but also because of the shocking images they might see or even decisions they have to take (e.g., prioritizing care that can cause patients to die).

Living in proximity to the hospital and means of travel have also been highlighted by staff. Approximately 33% of the staff live within 10 miles, which means they have a higher chance to attend work during extreme events; however, this also means that 66% are at risk of being unable to work if roads and railway networks are affected. Only a few staff members considered road safety to be an issue for them; actually, this is a vulnerability for the hospital, which needs to plan for such a scenario by finding ways to increase staff attendance when things go wrong. Transportation networks are critical for hospital access, not just for staff but also for supplies, patients, and relatives (see Figure 1).

Another contributor to staff attendance is having dependents. Approximately 40% of staff ( $n = 77$ ) have dependents (e.g., children, parents), indicating another risk of being unable to get to work at the hospital during extreme events. Hospitals may have some ability to reduce such risk by setting childcare facilities for staff on their premises, just as some hospitals did during the 2016 Kumamoto Earthquake (Achour & Miyajima, 2020). During the COVID-19 pandemic, the UK Government kept schools and childcare facilities open for keyworkers' (e.g., hospital staff and food suppliers) children, which enhanced staff attendance. The challenge, however, is that doing this may be difficult for the Government for other extreme events. Hospitals therefore need to develop their own solution to mitigate this risk.

The study established the important role non-clinical staff have. Approximately 40% ( $n = 78$ ) of staff indicated that their absence would affect the operation of particular services such computer and IT networks (e.g., email, phone lines, patient record access), CTs, MRIs, ECGs, and ventilators. This links to the complexity of staffing, something that is often overseen during extreme events. Achour and Miyajima (2020) argued that these systems can have a major impact on hospital functionality.

### Conclusion

Healthcare services are one of the most intricate and vital services in the world. Their imperativeness lies in managing and maintaining the flow of an enormous volume of patients from admission to discharge. The influx of COVID-19 patients has drastically increased demand, overwhelming these services. This becomes a situation with a significantly higher demand than usual that needs to be matched with capacity and resources; staffing levels need to be increased, but this does not happen due to the complexity of disasters, which tends to affect patients and staff either directly through illness and injuries or indirectly due to having dependents or travel issues. The intricacy of healthcare facilities rises with the number of systems they host and the interdependency between the system and the staff using these systems. This study has established that vital equipment such as imaging scanners (MRIs, CTs, and x-rays) and key ventilators may cease operation if specialized staff are absent. The recent healthcare disruptions caused by COVID-19 highlight the need to globally address a current preparedness plan and staff safety such as providing PPE. This study highlights that staff attendance depends on many contributing factors such as workload, stress, motivation, proximity of work to home, transportation networks, and having dependents. The absence of any staff member regardless of their role, level, or background will have an impact on the functionality of the hospital. The more hospitals reduce the risks of staff absence, the higher the chance they have to function effectively.

This study presents the factors influencing staff attendance during an extreme event and the impact of staff attendance on the continuity of the healthcare service. Further research will need to be conducted in order to measure the capabilities provided by staff attendance. This will be set as the next research plan.

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