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**REVIEWER COMMENTS ON BAM PAPER – AMENDS**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| It may be a good choice to select multiple hospitals for experimental comparison.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Many thanks for this suggestion. We have acknowledged this in the paper on page 12. It is not possible to include more than one hospital in this study, as it is a one-year MPhil and time and resources are limited. However, more than one hospital is interested in participating and we hope that the work will proceed to PhD to confirm the results. |
| The study may have certain limitations. As mentioned above, the accuracy of the sample will directly affect the results of the quantitative analysis. Therefore, the author needs to pay more attention to those potential development objects and ensure that the selected experimental objects are sufficiently representative. In my humble opinion, selecting multiple samples will provide more reference and guarantee for the accuracy of the empirical analysis, reduce the bias caused by the particularity of the sample, and the ultimate goal is to make the experimental results more convincing. | Thanks for these observations. As explained above, we cannot include more hospitals in this study. However, the time and motion study is supplemented by interviews with those using the app to improve the accuracy and robustness of the data. This is noted in the paper on page 12.                                                                    |
| Considering the different directions of research, perhaps the author can provide some attention to other fields, such as agile management and organizational behavior in digital transformation.                                                                                                                                                                                                                                                                                                                                                                                                               | Thank you for these comments. We have included a short discussion of these ideas in the literature review on pages 7 - 9.                                                                                                                                                                                                                                  |
| Sections on ethics, supervision etc needs to be included.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Section on ethics added on page 13.                                                                                                                                                                                                                                                                                                                        |
| Sources cited are recent, however, needs to include more publications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | We have included more publications on agile management and workers' response to digital transformation on pages 14 - 18.                                                                                                                                                                                                                                   |

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| Subheadings of the information should have been provided such as research design, strategy, philosophy, data collection and data analysis. | Subheadings have been added in the methodology section pages 12 and 13. |
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**TITLE:** To evaluate the impact of implementing the new digital communication platform in hospital workflow.

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## 1. INTRODUCTION

The Netherlands made the Internet available to everyone in 1994, and Amsterdam was dubbed "De Digitale Stad" (the digital city) (Nevejan and Badenoch, 2014). Following this, it was inevitable that the rest of the world would follow suit and enjoy the increased productivity offered by the Internet. So 1994 can be considered the start of the fourth industrial revolution, which is still reshaping our lives and providing limitless growth opportunities (Freund and Weinhold, 2004). The Internet is at the heart of today's digital infrastructure, and businesses are undergoing digital transformation to make their workflow more efficient and error-free (Aminah and Saksono, 2021). Like other industries, the healthcare industry has started implementing digital technologies to improve workflow efficiency and eliminate errors. With the advancement in medical sciences, the healthcare sector has become much more complex and frequently, digital technologies have been implemented in healthcare to make the system less complex and more efficient. Implementing digital technologies impacts the whole infrastructure of organizational workflow (Kraus *et al.*, 2021). Communication processes utilized in the hospital to delegate and conduct tasks within the sector are the backbone of the organizational workflow of the hospital. Digital technologies have also been implemented to improve these communication processes to make hospital workflow more efficient.

Establishing any communication is a process that typically requires a sender, a message and a receiver. By definition, the communication process is finished when the receiver understands the intention and the reason for the message (Velentzas and Broni, 2014). Typically, healthcare organizations have two communication processes: one between healthcare professionals and patients and the other between healthcare professionals collaborating during the hospital workflow. The latter is vital for the healthcare system to work and pervades the whole healthcare system. Healthcare professionals use this type of communication to collaborate and work within their healthcare setup (Weiner *et al.*, 2005). The delivery of services in a healthcare setup heavily depends on the communication processes established between HCPs. The breakdown of this communication process could result in medical errors and put lives in danger (Singh *et al.*, 2008). Literature defines an effective communication process in healthcare as effective interactions, collaboration and communication between HCPs during the workflow, which involves sharing information securely, reliably and timely (Sim *et al.*, 2020). Effective communication is the key to running a smooth and successful healthcare setup. In this human-centric industry, stakeholders must rely on more than just technology to keep it running effectively. Life-threatening decisions need to be made, and the human touch is necessary for making those decisions. So in this time-sensitive industry, effective workflow can only continue if the correct

information is delivered to the right person at the right time and correct decisions are taken at the right time (Ratna, 2019). Communication processes within a healthcare setup hold the workflow of the setup together. So the level of effective communication processes within a healthcare setup reflects directly on the quality of care that setup provides. Advancements in information and communication technologies (ICT) have significantly impacted hospitals' communication processes and greatly improved hospitals workflow. According to previous literature, ICT adoption can improve hospital workflow and communication in the healthcare setting. Literature suggests that this digital health transformation has completely changed the healthcare landscape. These ICTs provide new opportunities to develop a more effective, efficient communication infrastructure for hospitals. It enables HCPs to work together effectively, share their medical knowledge and provide a streamlined healthcare experience for patients (Aceto *et al.*, 2018).

According to the literature, having an effective communication process with the hospital allows the hospital to benefit in four dimensions: (1) efficiency of resource utilisation, (2) effectiveness of core operations, (3) quality of work life (Staff) and (4) service quality (Agarwal, Daniel Z Sands, *et al.*, 2010). To ensure well-coordinated and effective healthcare, the National Health Service (NHS) in the UK plans to incorporate the latest ICT into its hospitals. The NHS plans to replace the fifty-year-old pager system that hospitals use to communicate and generate alerts as part of their communication network. Alertive Limited is a Derby-based digital health SME that has developed an ICT platform that allows HCPs to generate alerts, collaborate on various medical procedures, and share patient data in a secure communication environment. Alertive Limited is providing NHS with the alternative they seek to replace the pager system. The Alertive App was created to fill communication gaps in hospitals and make NHS hospitals more coordinated and efficient. This study will evaluate the benefits of Alertive App's adoption in NHS hospitals as they pertain to the following four dimensions; (1) Resource Utilization of hospital;(2) Core Operations of the hospital;(3) Quality of work life (staff);(4) Service quality provided. Previous literature suggests a time-motion study methodology to be used to evaluate the impact of this type of implementation (Menon and Rivett, 2019). However, this study will evaluate multiple variables using a time-motion study followed by surveys and interviews. Therefore a multiple-method study design will be followed to gather data. It will combine time motion, observation, interviews, and a case study. Healthcare professionals in one or two NHS hospitals will be recruited for this study.

## **2. LITERATURE REVIEW**

### **2.1 HOSPITAL ADAPTIBILITY TO CHANGE**

The workflow management practiced in hospitals significantly impacts the quality of service provided by the hospitals. The hospital working environment is a complex setting comprising numerous small business processes that, when combined, support and maintain the quality of service the hospital gives (Graeber, 1997). A typical hospital workflow has to bear the burden of constantly changing circumstances, sometimes due to medical emergencies, and cope with patient turnover greater than the hospital's capacity. The COVID-19 situation exemplifies the patient burden and the unpredictable circumstances that hospital workflow faces (Maruster *et al.*, 2001). During COVID-19, hospitals around the globe faced significant staff shortages, and patient flow was constantly increasing (Rasmussen *et al.*, 2020). There were reports of hospital staff acquiring COVID-19 infection from the hospital while providing

treatment to patients suffering from COVID-19 (Yang *et al.*, 2020). This resulted in a severe staff shortage at the hospital, and the remaining available staff was subjected to significant duty stress, with reports indicating severe staff burnout during the COVID-19 emergency days (Manzano García and Ayala Calvo, 2021). Circumstances like these could directly result in compromising the hospital's service quality, as patients face delays in seeking treatment, hospital staff must work overtime to cope with these unpredictable situations, and overutilization of hospital resources occurs in these circumstances, resulting in financial loss to the hospital (Messacar *et al.*, 2015). Typically a hospital work environment has to face these unexpected circumstances, and the flexibility of hospital workflow to adapt to change determines the standard of the service provided by the hospital. In this dynamic working environment, the quality of services can only be maintained with the constant availability of medical resources and required supporting staff (Yousefli *et al.*, 2020). To effectively withstand these constantly changing circumstances and unexpected medical emergencies, the hospital workflow management system needs to be flexible enough to adapt to these changing circumstances to maintain the level of care the hospital provides. Literature has identified two dimensions that can influence the preparedness of complex systems such as hospitals. One is robustness, which defines the extent of hospital function maintained under the pressure of these unforeseen circumstances. The second is the rapidity of the healthcare setup, which establishes the time the hospital takes to restore its function and provide the same standard of care as before unexpected circumstances. Together these two dimensions define the resilience of the healthcare setup to withstand the pressure that comes with these constantly changing circumstances (McDaniels *et al.*, 2008).

## **2.2 COMMUNICATION INFRASTRUCTURE AND PATIENT JOURNEY**

Hospitals throughout the globe are facing increasing workloads because of population growth, an ageing population and a lack of new infrastructure. A hospital can only withstand this pressure if it is resilient to the changing circumstance. This resilience strongly depends on the underlying infrastructure supporting the hospital's workflow. Therefore the healthcare infrastructure that supports the hospital's workflows must be flexible enough to sustain the same level of care without compromising the service quality (Norazam, 2018). Hospital adaptability to these unexpected challenges and withstand the work pressure that occurs due to these challenges strongly depend upon the efficiency of the core infrastructure established in the hospital (Meli *et al.*, 2014). Communication infrastructure within the hospital holds the most vital position in providing stability to the core infrastructure of the hospital. It supports the hospital from inefficiencies and hence supports the hospital to become more resilient in crisis (Coiera and Tombs, 1998). Furthermore, communication infrastructure within the hospital helps Healthcare professionals(HCPs) share information with their colleagues and delegate tasks. Across the globe, hospitals have adopted different technologies to upgrade their communication infrastructure, allowing the hospitals' staff to communicate and share information effectively (Hanada *et al.*, 2013).

In a typical hospital setting, a clinical task begins with the patient's admission to the hospital and ends with discharge management. In the patient's eye-view, the patient journey is a horizontal journey across the hospital; during this journey, they are transferred from one department to another until they are discharged. During this journey, patients have to go through multiple interactive touchpoints, where they are treated and facilitated by multiple groups of HCPs (Gualandi *et al.*, 2019). Each group has its own well-defined responsibilities. The patient is the only one who experiences

this journey from the start to the end. At the back end, this whole journey is supported by clinical process design, and HCPs play their role throughout this process towards the completion of a patient's stay in a hospital. The fluidity of the patient journey is strongly dependent on the efficiency of clinical process design and the communication infrastructure used by the HCPs to delegate tasks and share information (Ben-Tovim *et al.*, 2008).

During the process mapping of the patient journey, the hospital staff is divided into multiple small units based on their clinical expertise. Throughout the patient journey, these small units work together in coordination with each other and fulfil their assigned role in the process map. Their coordination helps the hospital maintain the fluidity of the patient flow across the hospital. The coordination between the HCPs is managed through the communication infrastructure established within the hospital. Communication infrastructure within the hospital allows the hospital staff to establish communication processes within each hospital department and across different departments of the hospital. These communication processes made a network of channels through which hospital staff delegate tasks and transfer information within the hospital. These channels require human actors (Healthcare professionals) and non-human actors such as pager system, bleeps, social media, email and phones (Popovici *et al.*, 2015).

### **2.3 INEFFECTIVE COMMUNICATION AND ECONOMIC EFFICIENCIES**

A study was conducted in United States hospitals, during which the following four economic inefficiencies have been identified as the consequences of poor communication within the hospital; (1) efficiency of resource utilization; (2) effectiveness of resource utilization; (3) quality of work life and (4) service quality. The same research has defined efficiency in the hospital context as “optimal use of key and scarce resources in hospital”. In the study, the time of physicians and nurses has been considered a scarce resource (Agarwal, Daniel Z Sands, *et al.*, 2010b). However, hospital resources collectively include both human resources and non-human resources. Non-human resources in a hospital are the hospital armamentarium and hospital facilities. At the time of crisis, effective management of these resources is crucial to maintain the quality of care provided by the hospital (Barie *et al.*, 2020). The management of these resources also depends on the effective communication of information shared between the HCPs in the hospital (Fugok and Slamon, 2018). If information is delivered to the right person at the right time, these resources can better be managed hence more effective patient flow management.

Under unexpected circumstances, the workflow burden falls on the HCPs trying to manage hospital patient flow. In these circumstances, a minor hiccup in the communication processes of HCPs could result in medical errors and sometimes fatalities. This time-sensitive workflow requires an effective communication infrastructure that allows healthcare professionals to delegate tasks effectively so accurate information is delivered to the right person at the right time (Manias *et al.*, 2019). Therefore, to minimize medical errors, data has to be delivered effectively using reliable communication processes between the HCPs. This way, resources are utilized in the core operations of the hospital most effectively with minimal medical errors.

A staff member's work-life quality in a workflow is crucial to keep the workforce satisfied with their work and motivated for new challenges (Azeem and Akhtar, 2014). In this ever-changing industry where workloads fluctuate very often, it is essential for medical leadership to provide the staff with resources that can help them in easing out their workload. Agarwal mentioned that healthcare professionals want their time at

work to be utilized in professional expertise; it keeps them motivated and unproductive use of their expertise could lead to job dissatisfaction. Improving the communication network of the hospital will help the staff member save time per shift and make the workflow smooth for them (Agarwal, Daniel Z. Sands, *et al.*, 2010).

In a patient journey, the patient is the only individual who experiences the whole patient journey from start to finish. However, at the back end, multiple HCPs and communication networks coordinate effectively to make the hospital time of the patient as smooth as possible. The communication networks established at the back end of the patient journey determine the fluidity across the hospital. A minor hiccup in the communication network could disrupt the workflow in the hospital. These disruptions can cause unnecessary delays, which is a crucial issue in the time-sensitive work environment of the hospital. Therefore effective communication throughout the patient journey improves the staff's work life and the quality of care provided in the hospital (Anderson, 2019).

## **2.4 DIGITLIZATION AND DIGITAL TRANSFORMATION**

Organizations established throughout the globe welcomed the advent of the Internet age as an opportunity to make their operations more efficient and error-free. Over time, new digital technologies have been developed and are made common for the general public to acquire. Now adoption of technology within the work culture is no longer a luxury for organizations; technology adoption is necessary for organizations if they intend to maintain their competitive advantage. Customers and clients are becoming more digitally literate every year, and now they prefer to interact with the organization using digital touch points. So if some organization lacks a digital platform for its clients to reach them, it will automatically cause the organization to lose its competitive advantage (Porter, 1985). So to maintain their competitive advantage, organizations must adopt digital technologies and use them as an opportunity for value creation (Reddy and Reinartz, 2017). This adoption of digital technology into the organization's business model and organizational culture is called Digitalization (Brennen and Kreiss, 2016). However, the digitalization process has a massive impact on the organization's internal and external stakeholders. The adoption of technology into the organization's work culture requires thorough planning before the organization decides to follow through with the process. To adapt to the new technology, an organization's work culture must undergo complete cultural change. This cultural shift an organization goes through due to Digitalization is known as Digital Transformation (Iyamu *et al.*, 2021).

### **2.4.1 DIGITAL TRANSFORMATION – A COMPLEX CHANGE MANAGEMENT**

Organizations conduct their day-to-day activities in a particular manner; staff manage their task as assigned by the rules implemented by the management, and customers or clients interact with the organizations in a manner defined by them. This management way of doing things and interacting with clients collectively forms the organization's work culture. This culture inspires loyalty among the staff for the leadership and the company and determines the experience that clients or customers feel while interacting with the organization for their needs (Yusof and Ali, 2000). This organizational culture is present within every organization, whether healthcare, retail stores, fashion industry, sports or any other business organization. This culture holds the organization together and provides the foundation to function (Lincoln and Kalleberg, 1992). Organizational culture is the ecosystem where all the organization's

stakeholders interact following the rules defined by the organization (Pratono and Sutanti, 2016). In any organization, there are two types of stakeholders, internal stakeholders and external holders; internal are the ones who manage the organization's daily activities, and external stakeholders are the ones who interact with the organization for their needs. In healthcare, internal stakeholders include HCPs, clinical leadership and operations managers while external stakeholders are patients, government officials, trusts and investors. So the like any organization the work culture of hospitals directly affects every stakeholder in some way (de Chernatony and Harris, 2000). Hospital leadership has a very strong role in the successful implementation of digital technologies in hospital workflow. They are responsible for managing staff training and make sure that adopted technology is helping hospital staff manage workload. They keep the staff motivated for the change and makes sure that transition phase remains as smooth as possible (Laukka *et al.*, 2022).

Before going into the change, the organization needs to assess its internal stakeholder's attitude towards the change, and organizations can do that by evaluating the two determinants of change, change commitment and change efficacy. "Organizational Readiness for Implementing Change", also known as "ORIC", is a valuable tool to assess these determinants of change (Shea *et al.*, 2014). However, digital transformation is a much more complex process than simple change management, so to use digital transformation as an opportunity for value creation, an organization needs to consider the people who work within the organization as well as the people who interact with the organization from outside for their needs (Mushore and Kyobe, 2019). Furthermore, external macroenvironmental factors should be considered before planning the organization's digital transformation. Macroenvironmental factors such as the country's political stability, economic stability, social acceptance of the technology and technological advancement can significantly influence the outcome of digital transformation (Lin *et al.*, 2019). It is critical to assess that the political leadership of the society is in favor of developing infrastructure for the digital economy, and the political leadership of the community can only make these policies if the country is economically stable enough. The community's legislation must be addressed while devising the digital transformation strategy for the organization. Developing legislation is a slow process; often, technology advancement outpaces the legislation development process. So this legislative lag can prevent the organization from making certain decisions which can directly influence the digital transformation strategy of the organization (Glinskii and Glinsky, 2008). The country's technological potential is the backbone of successful digital transformation implementation because organizations require technical and human resources in this transition. So ICT infrastructure of the country and the available digital literate workforce in the country are both necessary components for conducting this volatile change and sustaining it (Hanna, 2016). Organizations must show extraordinary entrepreneurial potential to design a strategy addressing these barriers before going into this volatile change.

As mentioned earlier, all stakeholders are crucial when implementing digital transformation, so stakeholders' behaviour regarding technology acceptance is integral in this volatile change. Assessment of external stakeholders, especially clients and customers, is crucially essential for value creation from the digital transformation of the organizations. Organizations need to assess their target population for their digital awareness, digital usage, language for communication and attitude towards technology acceptance. In his "innovation adoption life cycle" model, Everett Rogers highlighted five categories of innovation adopters. This cycle can help assess the social acceptance of technology within a society (Rogers, 2010). Communities with

more innovators, early adopters and early majority generally adopt the technology quickly, while it is vice versa for the communities with more late majority and laggards.

## **2.5 AGILE MANAGEMENT AND DIGITAL TRANSFORMATION**

Like NHS hospitals, healthcare setups across the globe are investing in digital technologies and implementing them in their workflow to obtain operational efficiency. Trust hospitals acquire the technology to manage the workload and prevent the staff from getting burned out. Private care settings adopt digital technologies to improve the patient journey and experience; adopting technology allows them to gain a competitive advantage over their counterparts (Dal Mas *et al.*, 2023). In this ever-changing world, hospitals tend to face many complicated challenges, so a holistic approach is required to face these challenges. Traditional change management is generally a slow process. However, to test a new implementation in this constantly changing workflow of the healthcare industry, organizations need a sprint methodology commonly known as agile transformation management (Al-Ali and Phaal, 2019). This process requires prototyping the new strategy and quick implementation; this way, organizations can quickly test their alterations and design their change management based on the narrowed-down successful strategies (Le Grand and Deneckere, 2019).

As mentioned earlier, leadership is crucial in successfully implementing digital transformation. Leaders of organizations should be flexible to change and able to test the different strategies with agility during the transition. The healthcare system has a complex and ever-changing workflow and has been scrutinized as a complex adaptive system in the literature. This means the healthcare setup should be flexible enough to adapt to change, self-organize to the changing circumstance and learn from the experiences (Paina and Peters, 2012). This kind of setup requires constant interventions to adapt, and even after going through change, healthcare setups require constant effort to update their adopted technologies and systems. Hence for complex adaptive systems, agile leadership is required who is flexible enough to test new ideas and implement new strategies in order to keep these systems going (Al Fannah *et al.*, 2020).

Digital transformation is a volatile change that an organization undergoes and requires an agile approach to manage successfully. Literature supports the sprint agile approach for change management during digital transformation (Gurusamy *et al.*, 2016). This agile approach requires leadership to be vigilant at all times; leaders should focus on all the internal and external factors that could affect the organization during the transformational phase of digitalization (Salvetti and Bertagni, 2020). Adopting digital technology in the hospital workflow completely changes the previously established business processes that hold a healthcare setup's operations (Faddis, 2018). Agile management is most suitable for this kind of volatile change and the healthcare industry, which is prone to changing circumstances and increasing workload; agile management is required while performing digital transformation in hospitals. As the literature defines, an agile system is flexible to changing circumstances. It can respond quickly to customer demand while optimizing costs and quality by adopting upgraded tools, processes, and training. By this definition, a healthcare setup as a complex adaptive system checks all the criteria of an agile system (Sindhvani *et al.*, 2019).

## **3. RATIONALE**

According to the literature, effective communication processes inside the hospital allow for effective coordination, resulting in better utilization of hospital resources and higher quality of treatment. The NHS aims to replace the existing pager system with more advanced ICT based on the evidence. The Alertive app is a more sophisticated and efficient replacement for the present communication platform. The Alertive App has already been implemented in Princess Alexandra Hospital's communication processes and has been used for some time. The hospital conducted its study to examine the impact of digital health implementation on hospital workflow. According to their data, their reaction time has decreased by 49% after adopting the Alertive App into their healthcare. The number of steps in the patient journey has been significantly reduced. Furthermore, approximately 38% of employees reported saving at least one hour per shift (Agarwal, Daniel Z Sands and Schneider, 2010).

Traditional bleeps and pagers are not an effective means of communication. When a pager sends out an alert, it is a receive-only device, and the sender cannot know whether or not the message was received. The receiver must then rely on another device to validate message receipt, and so forth. Thus, information transmission and confirmation through a pager is a multi-step procedure that requires the participation of multiple middle actors (human and non-human) to complete the task. The Alertive App is designed to simplify information delivery while allowing for two-way information sharing and collaboration within hospitals. It reduces reaction times, removes stages from essential hospital workflow, and helps personnel save time during shifts.

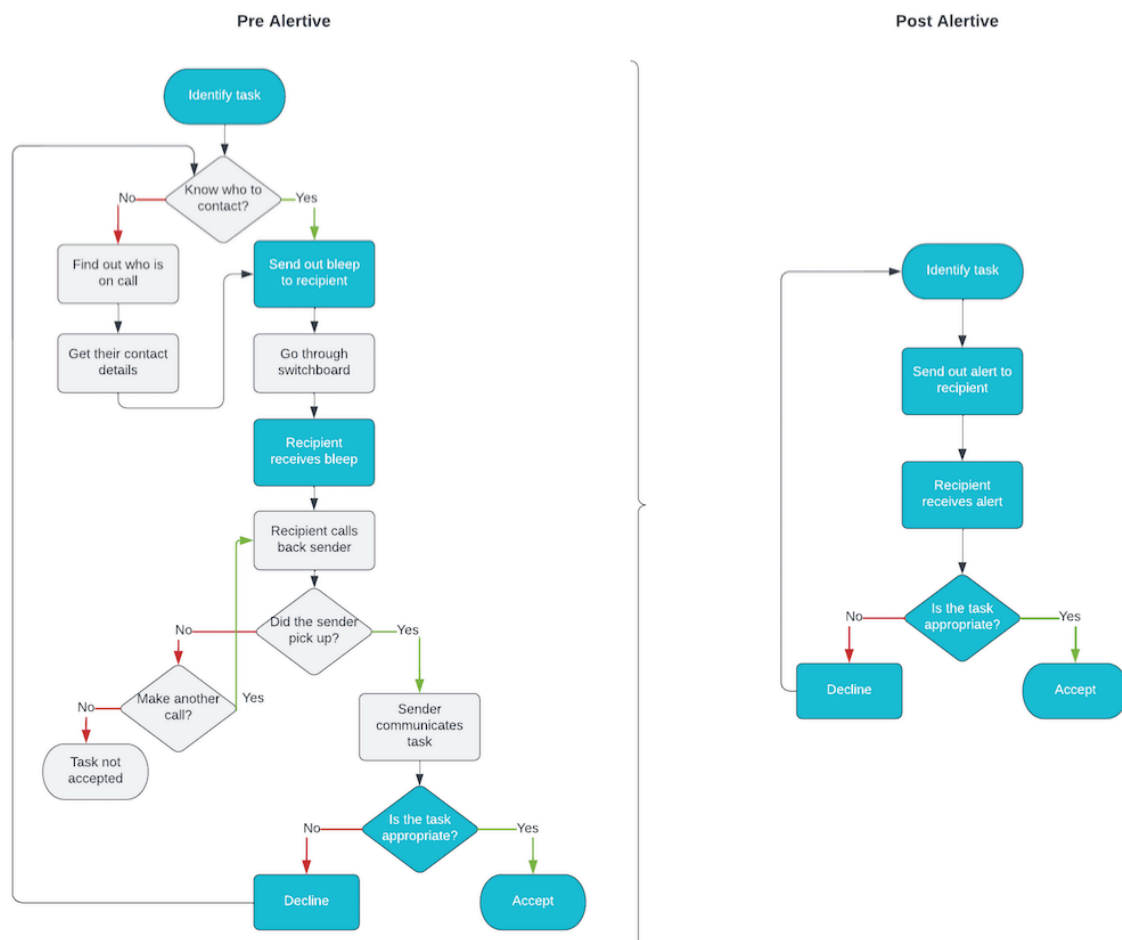


Figure 1. General comparison flow-map of steps involved in a hospital task generation pre and post implementation of Alertive App.

This study is based on preliminary data from Princess Alexandra Hospital, and Alertive Limited intends to investigate the product's performance in hospital workflows. According to the study objectives, the company intends to investigate and analyze the tradeoffs a hospital may face due to implementation. It will also provide answers to the following questions. Is the benefit of implementing the App greater than its cost? Is the staff satisfied with the upgraded system? What impact has this system had on patient care? What impact has this system had on staff life? Is the product user-friendly? Figure 1 depicts an overview comparison of two communication platforms. As a result, task delegation is expected to become less complicated and more streamlined following the implementation of the Alertive App within the hospital's workflow.

#### 4. CONCEPTUAL FRAMEWORK

This research examines four economic inefficiencies in a healthcare setting due to ineffective communication. These findings were supported by research conducted in US hospitals, and a conceptual framework was created to reduce the economic inefficiencies associated with ineffective communication processes (Agarwal et al., 2010). Alertive App was created to improve healthcare workflow and communication processes in the healthcare industry. Therefore, multiple variables will be used to evaluate the effects of the Alertive App on each of the four economic inefficiencies outcomes suggested by the study.

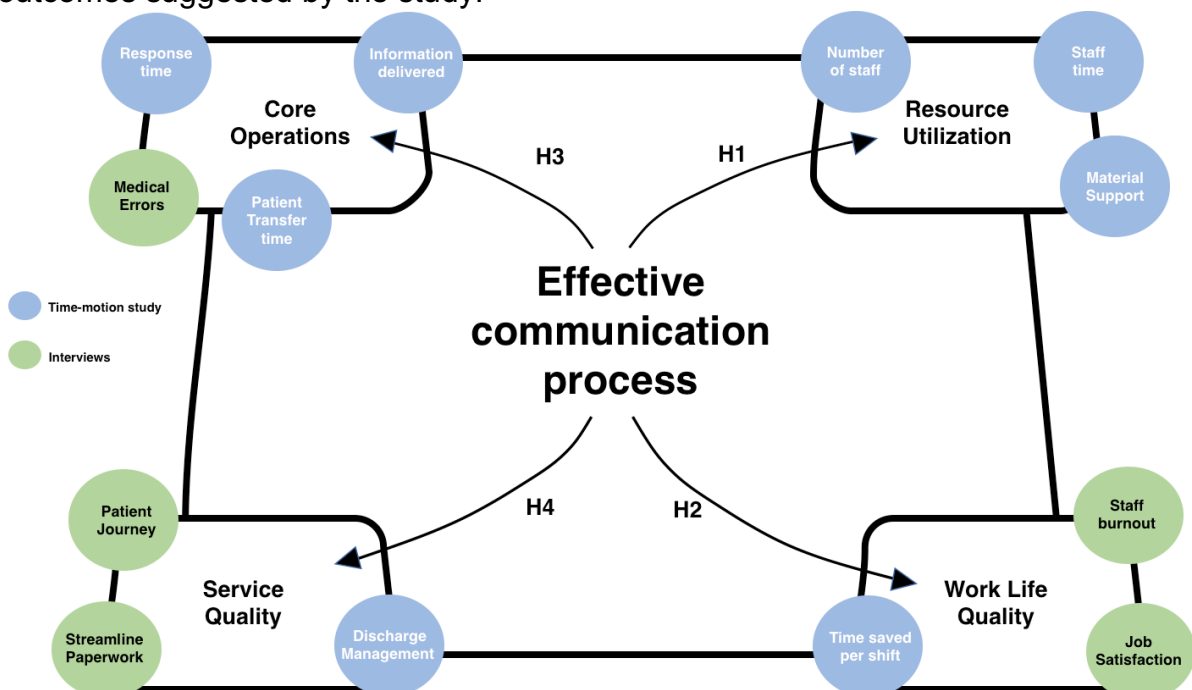


Figure 2. Impact of Alertive App on four economic inefficiencies outcome (Agarwal et al., 2010).

A time-motion research design has already been cited in the literature to monitor hospital workflow. The time-motion study design will be used in this project's research. Two cohorts will participate in the time-motion study, one utilizing a traditional pager platform and the other using the Alertive app. A time-motion research will be conducted to determine the impact of the Alertive App on hospital resource utilizations. The number of personnel involved in each standardized task will be determined, and the material support (communication gadgets, IT support) required to support communication processes will be analyzed. By resolving this economic inefficiency, pre- and post-implementation trade-offs can be examined.

Assessment of operational activities is carried out by monitoring the communication processes involved in each task. This includes information delivery (the number of messages the sender sends to complete a task), the number of medical errors reported in response time, and streamlining the patient mobility process from one department to another. A multi-method approach will be used to assess the effects on core operational activities, including time-motion studies and interviews. Staff burnout, time saved per shift, and workflow efficiency will be used as variables to assess the hospital's work-life balance. The impact of the Alertive App on work-life quality will be evaluated using a multi-method approach. Implementation in healthcare settings occurs for two reasons: to streamline workflow and to improve service quality. A mixed-method approach will be used to assess the impact of Alertive App implementation on service quality. Because no patients are involved in this investigation, this evaluation will be carried out through interviews with healthcare professionals. Their feedback on the impact of Alertive App on patient care will be noted. The time and motion study will also be used to monitor the patient discharge management process.

## **5. METHODOLOGY**

It is a comparison study between the current communication platform and the Alertive App. As the comparison will be made against multiple economic efficiencies associated with poor communication processes, a multi-method prospective study design will be used in this research. Research tools from different scientific disciplines will be used in this study to address the research objectives. This study will have two phases, the first is the pre-implementation protocol, and the second is the research phase. In the pre-implementation stage, the product managers of Alertive Limited will initiate this project by providing training to the HCPs. In the second stage, a time-motion study will be used to monitor the live performance of the implementation. Questionnaires and interviews will also be used to gather data.

### **5.1 PRE-IMPLEMENTATION**

In the pre-implementation stage of this project, IT teams and hospital management of the respective hospitals will be contacted, and with their help, an implementation strategy will be formulated. This stage will begin with identifying the appropriate departments; the research team will narrow down those departments with distinct hierarchies and well-defined roles for healthcare professionals (HCPs) in the workflow. The selected departments should be a microcosm of the hospital's communication networks. During this stage, Product managers will conduct multiple training sessions for HCPs, where they will be trained on the usability of the Alertive App. The researcher will also conduct a pilot study during the pre-implementation phase. The pilot study will use an observational study design during which human actors (HCPs) and non-human actors (communication platforms) involved in communication processes will be identified. The pilot will identify departments' general communication patterns, task distribution and interaction points.

### **5.2 THE RESEARCH STAGE**

The second stage is the research stage of this project. During this stage, a time-motion study will be performed to evaluate the impact of Alertive App implementation on economic inefficiencies associated with poor communication processes. Two cohorts will be selected from each hospital department. One cohort will use a conventional communication platform within the hospital. Likewise, the Alertive App will conduct the

same clinical process in the other cohort. The time saved per shift or task, the response time, the number of communication channels used per task and the number of messages exchanged throughout the task delegation will be the principal performance indicators. After the Time-motion study, interviews and questionnaire surveys will be conducted to gather feedback on the implementation, usability and impact of the Alertive App on the hospital's workflow.

### **5.3 PARTICIPATION SELECTION**

The Queen Elizabeth Hospital King's Lynn and Royal Marsden Hospital London are the two research sites identified for implementing Alertive App. Both hospitals are tertiary care setups with established complex communication processes, making them suitable for this study. Only one of these hospitals will be used as research site in this study. Three departments reflecting three different primary medical specialities (surgery, medicine and community) will be selected from the hospital. The study will occur on the trauma and orthopaedic wards in surgery, the maternity ward in medicine, and the community maternity day assessment unit. These three clinical environments are selected because they have distinct staff hierarchies. This allows observing the microcosm of communication networks established in a typical hospital. HCPs working in these three departments will be provided with research briefs. Consent will be taken from staff who have volunteered to participate in this research. Two doctors and nurses from each department will be selected using a random number generator and divided into two cohorts.

### **5.4 DATA COLLECTION**

A time-motion study will be conducted to gather data on the live performance of both communication platforms used in the study. In the post-implementation phase, a self-derived questionnaire will be given to the HCPs to gather their feedback on the Alertive App's usability and compare the Alertive App and the previously used communication platform. Interviews with research participants will also be conducted.

### **5.5 STATISTICAL ANALYSIS**

The Shapiro-Wilk test will be used to assess the normality of the Time-motion study data. An unpaired t-test will then be applied to generate the study results based on normally distributed data. 95% confidence intervals will be used to calculate statistical significance. Qualitative data collection will be conducted through interviews, which will be transcribed later. Inductive and deductive coding methods will be employed to interpret interview data. The results of interviews and questionnaires will be analyzed using descriptive statistics. Data analysis will be conducted using SPSS and GraphPad Prism.

## **6. ETHICS**

This study will recruit hospital staff such as doctors, nurses, paramedics, ward staff, and healthcare management staff for data collection. This study will raise ethical, legal, and management issues. Healthcare management staff at these hospitals have been approached to address management issues. Alertive Limited project managers collaborate closely with NHS leads assigned by the hospitals to make the necessary pre-implementation arrangements. In addition, the researcher will follow all hospital policies. In a hospital emergency, the data collection process will be halted and rescheduled immediately to avoid disruptions to patient care. Consent will be obtained from all study participants to address ethical and legal concerns about hospital staff

observation. Before data collection, HCPs will be briefed about all study aspects. Data breaches are another potential risk. To reduce this, participants will be kept completely anonymous. Only pertinent data will be collected for research purposes. The findings will be presented in a report. The researcher will use a copy of the report as part of his MPhil thesis. Following GDPR, all data will be stored at the University of Derby. Only study findings will be shared with Alertive Limited. For this study Ethics approval from NHS is not required as there are no patient involved in this research. However approval from HRA has been acquired. Furthermore, ethics approval has been acquired from University of Derby Ethics committee.

## 7. OUTCOME

The streamlined patient journey across a healthcare setting results from effective communication between healthcare professionals (HCPs) within that setting. Medical errors, staff burnout, inefficient use of hospital resources, and disruptions in the smooth patient journey can all result from communication breakdowns (Agarwal et al., 2010). Current technologies like hospital pagers take longer to deliver accurate information. Often, a message must be given, and the sender is unaware of the outcome. In a hospital setting, information cannot be left at this level of uncertainty because lives are at stake.

Furthermore, a pager system can only send limited information. Data compromise is always possible because other mobile communication apps do not offer safe information transfer. Preliminary data from the previous hospital suggests that the Alertive App increases workflow efficiency and solves data security breaches. The purpose of the current study is to evaluate how the Alertive app has created an impact in the following four categories: 1) Efficiency of resource utilization; 2) Effectiveness of core operations; 3) Quality of work life (staff); 4) Quality of service provided in the hospital. These four areas will highlight the Alertive App's impact on the hospital's economic inefficiencies, which were caused by the ineffective communication processes within the hospital.

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