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Designing an Artifact to Empower Chronic Patients for Monitoring Health During a Pandemic: A COVID-19 Screening App

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Abstract

Chronic diseases have been declared as an invisible epidemic by the World Health Organization (WHO, 2005). Over the past fifty years, the prevalence of chronic conditions has increased, leading to the disease burden caused by cancer, cardiovascular diseases, diabetes, musculoskeletal conditions, and mental and substance use disorders (DOH, 2021). Chronic patients need to reimagine how they will empower themselves to effectively manage and monitor their health and wellbeing in a COVID-19 era, when frequent in-person health care visits will no longer be feasible. In this study, we propose the features for the design of a mobile based application that will aid chronic patients and end-users to self-manage and monitor their health during the pandemic era. Based on an empirical investigation involving pharmacists and researchers, we designed and developed a prototype capable of empowering chronic patients. This study particularly focuses on how technological interventions can help chronic patients to self-manage and monitor their health and well-being related to COVID-19 where the user expectations are met with less attrition rates.

Keywords: Chronic patients, COVID-19, digital interventions, medical literacy, Self-management, Self-tracking, m-Health

1. Introduction

Health is a state of physical, mental, social, and cultural wellbeing for humans (DOH, 2021). Although medical systems are fundamentally focused on the treatment of illness and disease, COVID-19 pandemic has elevated the need for public health and prevention. Studies have evidenced that individuals with chronic conditions such as cardiovascular disease, cancer, diabetes, smoking, and obesity, were at greater risk of adverse outcomes associated with COVID-19 (Hamer et al., 2020; Almalki et al., 2020; Mirsky et al., 2020). Enhancing patients' ability to engage in self-managed and self-monitoring of their health and well-being through e-Health solutions has been increasingly a top health-care priority both nationally and globally.

eHealth solutions are defined as the use of digital interaction technologies to deliver medical services and enable self-management of health conditions (Keogh et al., 2010). In a study conducted by Australian Institute of Health and Welfare, modifiable lifestyle-related risk factors such as alcohol consumption, tobacco smoking, unhealthy diet, physical inactivity, and obesity accounted for 36% of the health burden in Australia in 2016 (AIHW, 2016) and 47% of Australians have chronic conditions, while 67% of adults are overweight or Obese in 2021 (DOH, 2021). Being well and preserving health throughout one's life path, from prenatal to old age, has enormous significance for all Australians. Coorey et al., (2018) illustrated that using m-Health apps to mitigate unhealthy behaviors appear to be feasible in the short term. These apps pledge to encourage motivated individuals to maintain a healthy lifestyle and replace regular high-cost and often limited in-clinic interactions with affordable remote healthcare services (Poole, 2013). So, it is very important that health sector makes use of digital intervention technologies to empower the community with proper tools and devices to provide affordable and accurate health services. This is even more significant in the case of empowering chronic patients during the COVID-19 pandemic.

Empowerment of patients is a term that has been widely used by health care researchers and people

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associated with the health sector (Castro et al., 2016). Patient empowerment is the process of enabling patients to achieve a state where they are actively engaged in their own health management by making them active with timely medications, having good knowledge about the medications that they are consuming, increased communications with the health care professionals and keeping track of their day-to-day activities. Empowerment leading to self-management refers to a management approach in which patients actively take responsibility for treating their health and involves self-regulation, active, uninterrupted, and interactive processes (Dadgar & Joshi, 2018). Hence, empowering chronic patients to efficiently self-manage their health and well-being can be made possible through e-Health solutions.

Despite technological advances in healthcare to improve care and reduce costs, attrition rates typically reach 60-80 per cent (Van der Mispel et al., 2017). Patients often avoid using them, mainly because patients are often ignored in their design (Dadgar & Joshi, 2018). To addon, COVID-19 pandemic has immensely changed the need and the purpose of use of e-Health solutions for self-management of their health by a diverse range of patients across the world. Today, there is a need to monitor and record a patient's COVID-19 test results for personal monitoring or work-related screening. In addition, the test results also facilitate the management of chronic conditions, medical literacy related to COVID-19, the health and well-being of users, along with effective decision-making. To add on, patients require effective communication with their health care workers or close family members and friends during remote or isolated stay during the pandemic lockdowns or preventive self-isolation. The development of e-health solutions with a focus on chronic patient-centered care to facilitate self-management of their health and wellbeing during the covid-19 pandemic is still in its infancy. Hence, the aim of this research is to design and develop a mobile application as a self-monitoring digital platform for chronic patients. The central focus of this study is to understand the needs of a chronic patient with an emphasis on the new requirements that evolved due to the COVID-19 remote and isolated living along with self-management of their health during the pandemic. We draw on the Design Science Research (DSR) Framework (Hevner et al. 2004) to design, develop and test a mobile application which focuses on self-management and monitoring of COVID-19 rapid antigen test (RAT) results for patients with chronic disease. The iterative design and development of the e-Health solution in four phases will aim towards developing an application to improve the health monitoring and medication literacy of chronic disease patients in the post COVID-19 era. This paper is the first step towards the comprehensive development of a mobile health hub.

2. Literature Review

This section will explore previous studies to know about the people involved, solutions suggested, how the application is designed and developed, how useful it was for the non-research and non-developer end user community. There is also a need to understand the drivers and barriers of using a e-health solution that empower chronic patients as well as toward building a prevention system for our future.

2.1. Patient Centric e-Health Solution

Numerous studies in healthcare describe the design process for e-Health solutions for chronic conditions such as diabetes (Glasgow et al., 2012), cardiovascular diseases (Coorey et al., 2018), Parkinson's disease (Barros et al., 2018), Ischemic Stroke (Katzan et al., 2021) and smoking (Gwaltney et al., 2009). E-Health solutions investigated in these studies range from websites, mobile applications to Internet of Things (IOT). However, the design processes presented in these studies compromise patients' perspectives. Patient centric design is an important need as we design e-Health solutions for the future due to the following reasons. First, any sector of the community is all about its people and their sentiments (Dadgar & Joshi, 2018). Whether it is a highly advanced urban community or an aboriginal community, providing proper supportive services and preventive mechanisms for their health is very important (Chinedu & Nilmini, 2021). Second challenge to patients and the community especially in Australia, is the high cost of health care services. So, this is where the use of digital interventions and e-health solutions comes into play (Wickramasinghe et al., 2019). According to the study conducted by (Gwaltney et al., 2009), the authors claim that the major factors that help in smoking cessation are medical literacy and self-confidence. But the main challenge to the use of these smart solutions is their high attrition rate (Van der Mispel et al., 2017). As the attrition rate of users during the development phase increase, it eventually results in the development team and the researchers lacking good and valuable feedback from the end-users before final deployment. Applications developed for research purpose never helps the public, whilst corporate initiatives offered outside of research are either unsubstantiated or have little or no evidence to back up their advantages

(Wright et al., 2019). This is also supported by a study done by the IQVIA Institute (2022) where only 26% of the top wellness and prevention apps and only 13% of the top condition management apps are practically adopted by the end-users. Hence, the important challenge to be addressed is the need for a promising patients centric design by actively involving patients and their community to understand their needs with a good intersection of the community, industry and researchers while designing and developing a patient centric e-health solution.

2.2. Self-Management of Medication and Health

Self-Management of medication and health is very crucial when considered from the perspective of chronic patients (Eiken et al., 2022; Chalmers et al., 2018; Ali et al., 2018). Eiken et al., (2022) conducted a feasibility study about the use of digital intervention solutions on patients with chronic pains by studying the impact of an app-based cognitive behavioral pain self-management system and its effectiveness, usage, and ease of use. They proposed a system called EPIO which was then passed to end-users with chronic pain. They proposed a blended care requirement for effective use of the application that gives the patients the awareness of the situation, feeling more valuable and increasing self-acceptance, self-assertion, and hope. Among the telehealth interventions, Chalmers et al., (2018) evaluated a psychological assessment via telemedicine. A telehealth assessment was more successful than a physical assessment, according to most participants. Medication management is another crucial venue in self-management. Most of the patients in most of the cases are taking medications without proper knowledge of what they are having and taking at times that they think is better for them to have. This can be properly managed using e-Health solutions. Huang et al., (2019), assessed 143 commercially accessible applications for diabetic medication management for patients diagnosed with diabetics. Half of the applications provided a medication alert option, but just 6% contained drug information. They tried to assess the feasibility, acceptance, and clinical results of employing an app to increase medication adherence in diabetic population of a multiethnic Asian community. Overall proportion of respondents (80%) thought that the app was simple to use and helped them stay on track with their prescription. Yet another study discovered that medication adherence applications lacked illness and/or drug information (Ali et al., 2018). Corden et al., (2016) used a MedLink smartphone app to evaluate the feasibility of a systemic digital intervention designed to address failure points and improve treatment of depression and found effective. Thus, based on the above studies, it is evident that self-management of medication and health is an important component that is required to empower chronic patients in the post pandemic world.

2.3. Medical Literacy

According to Ratzan et al., (2000), health literacy is defined as *"The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."* Medical literacy is more focused and related to patients within health care settings. Medical literacy offered through mobile application intervention with dose reminders, detail information about diseases and related medication and surveys of symptoms and side effects were found to be effective to self-manage chronic pain (Eiken et al., 2022). Patients with gestational diabetes mellitus also found medical literacy offered by a diabetes monitoring device solution they used to be the most effective feature in their evaluation (Wickramasinghe et al., 2019). Mörelius et al., (2021) investigated the effect of digital intervention among parents of children aged 0-12 years old taking into consideration the engagement, use and satisfaction factor, their effect on parental knowledge about health and its effect on children. They reported high satisfactions and post intervention improvement in parental health literacy as either an increase in illness knowledge or improvements in health behavior. Currently existing digital interventions that are evaluated and tested for the young population are very less in terms of number. To add on Webb et al., (2020) developed a mobile app called quit genius that delivers behavioral therapy content to end-users to help them stop smoking and compared with equal numbers of users who were treated without the app. They found that the digitized therapy treatment studied here is a viable choice for the cessation of smoking in the near term. Thus, medical literacy is an important factor that needs to be the backbone of any e-Health solution to empower patients with intervention and self-management with confidence.

2.4. Patient-generated Data for Decision Making

e-Health solutions can improve decision making by integrating real-time data and information from multiple sources. Singh et al., (2022) developed a framework to study the quality and timeliness of digital interventions to support quality decision making taking into consideration patient-generated

health data. They have conceptualized that the primary source of data is from end-users in the form of healthcare apps and smart devices. The confluence of patient-generated health data and health care professional generated data can facilitate faster remote choices and improve patient care (El-Sappagh et al., 2019; Mandl et al., 2012; Warner et al., 2016). Remote decisions can improve the ability to intervene quickly, resulting in better clinical outcomes. Furthermore, the availability of detailed and usable patient-generated health data can help with decision making. Monitoring a patient's medication compliance of the dosage on a daily, weekly, and monthly levels is one such scenario (Wickramasinghe et al., 2019). This can result in missed doses owing to "medication holidays" and decision-making can lead to appropriate treatments to resolve such issues (Khalemsky & Schwartz, 2017). On the other hand, patient-generated health might be unreliable, creative, unconstrained, and unsecure. Also, there can be legal complications that might arise because of the poor quality of information from the end-user affecting the decision-making process. Thus, good quality patient-generated health data can aid in optimal decision making specially in the case of chronic disease monitoring during the pandemic era.

2.5. Health Data Analytics and Management

Data Analytics, visualization and management is always a key component in e-Health solutions (Katzan et al., 2021; Feehan et al., 2018). A practical example of studying the correlation between Fitbit parameters and medical condition is presented by Katzan et al., (2021). The study also highlights that the margin of error for Fitbit is acceptable. The same is supported by another study by Feehan et al., (2018) by considering in-depth Fitbit health parameters. These cases can be considered to support other health care smart devices in a generalized manner as the parameters under consideration in all major smart bands are of the same kind. Hence, monitoring timely and accurate real time patient data could be very beneficial for health care professionals and it can also help them identify the triggering parameters that can lead to a certain medical condition. Patient-generated health data captured using IOT or mobile devices will help patients in decision making based on efficient analytics and visualization. m-Health 2.0 represent the evolution of mobile health in big data analytics and machine learning innovations for post pandemic era (Istepanian, 2018). Hence effective data capture, management and visualization is a key component required for m-health solutions.

2.6. Social Connectedness and Wellness

Social connectedness and wellness are the top priority principles in National Health Strategy 2030 (DOH, 2021). A bidirectional study on social connectedness and mental health by Saeri et al., (2017) investigated if *lack* of social connectedness could cause poor mental health and also if poor mental health leads to lack of social connectedness. The study found that social connectedness and mental health was related to each other in both directions. Similarly, Pandey et al., (2021) found that the strength supplied by social ties to patients and carers was highlighted in this study as a beneficial factor. According to Quan et al., (2014) loneliness is a very crucial negative indicator of peoples coping mechanisms. Individuals who scored the highest on isolation attempted less healthy habits such as eating healthily and exercising, as well as keeping engaged by completing household duties and enjoyable hobbies. A study conducted during the phase of COVID when face-to-face encounters were not feasible, they highlighted the beneficial impact of using the internet and other media to communicate with others (Moore & March, 2022). They have found that these online social ties indicated the usage of healthy coping practices while also moderating the association amongst loneliness and healthy coping practices.

2.7. Self-Tracking

Self-tracking using wearables was initially supported by the launches of smart watches by Apple, Fitbit, and Samsung. Heart rate, sleep, respiration, perspiration, and temperature can all be measured and quantified (Dias et al., 2018). Therefore, they have been transformed as physical challenges and accomplishments where goals can be set, and results can be seen. They are also sources of performance matrices of how the body is reacting to changes that we make in our day-to-day life set of the same self-tracking by insurance companies where these innovations establish a significant power imbalance between insurance companies and consumers. Insurance companies can choose their clients, intervene in their behavior, and decide their worth. Jaana & Paré, (2020) studied the differences of use of mobile apps by older and younger generations. The study found that most of the healthcare apps downloaded by older adults are healthcare and wellness related. Also, about 62% of the old population reported the tracing of their health parameters but majority of them did manual tracking. The older population diagnosed with multiple chronic disorders were not using any tracking methods

irrespective if it's traditional or digital. Recently, to combat the COVID-19 pandemic, many countries have developed a public health strategy involving the use of digital contact tracing applications to improve timely tracking and contact tracing of COVID-19 cases (Albouney, 2021), while studies have also revealed the reluctance of contact tracing among young adults (Maytin et al., 2021). To conclude, self-tracking of vitals is an important measure specially for self-management of health in an isolated pandemic era.

From the detailed literature review it is evident that patient generated health data from a m-Health app could be a complementary tool for screening and monitoring COVID-19 symptoms. Possibilities of achieving social connectedness and wellbeing along with essential medical literacy using a m-Health app are promising directions towards empowering patients with chronic conditions during the pandemic era.

3. Research Methodology

The aim of this research is to design and develop a mobile application as a self-monitoring digital platform for chronic patients. The focus of this paper is on the new requirements *that* evolved due to the COVID-19 remote and isolated living for chronic patients while self-managing their health during the pandemic. The focus of the first phase of the project was to design and develop an initial prototype of COVID-19 rapid antigen test monitoring system for high-risk patients as a case in point to develop mobile health hub. Rational behind the need for a COVID-19 rapid antigen test monitoring system for chronic patients in the mobile health hub is threefold. First, studies have evidenced that individuals with chronic conditions were at greater risk of adverse outcomes associated with COVID-1919 (Hamer et al., 2020; Almalki et al., 2020; Mirsky et al., 2020). Second, as case numbers increase, the effectiveness of test, trace, isolate and quarantine declines and public health efforts are required to focus on highest risk and rely on individuals and workplaces to manage their own risk. Third, in addition to the vaccination efforts, it is highly important that community take effective approaches including social measures in monitoring and preventing transmission. To add on, in Jan 2022 Therapeutic Goods Administration (TGA) has identified the need for complimentary, smartphone-based apps/software's for recording and transmitting patients' RAT results. Hence, there is a critical need to develop an effective method to self-monitor COVID-19 using rapid antigen test kits, record and maintain test results digitally in a systematic way and inform the community regarding the test status to visit loved ones, to attend school, office, or social events and to travel national and international borders.

DSR framework define three important keystones to *consider* when developing a new IT artifact: Knowledge Base, Environment, and IS Research. The environment is defined by identifying current challenges in chronic patients' health and social measures in monitoring and preventing transmission. An in-depth literature review presented in section 2 gives a need for patient centric design for monitoring and management of health and well-being. A detailed review of national and global priorities revealed six factors that influence the use, feasibility and compliance of a health based mobile application. They are listed as follow:

1) Easy management of recording desirable health data
2) Improve medical literacy and well-being as required
3) Use data collected for important decision making
4) Demonstrate understandable and accessible visualization of the data collected for effective monitoring
5) Enhance social connectedness and motivation towards physical and mental wellbeing
6) Enable self-tracking of measurable vitals and parameters

The six themes revealed in the literature review aligns with the six factors for a good design highlighted in the national and global priorities. The empirical setting of this project involves an Australian based, international pharmaceutical company (Eczanes Pharmaceuticals), who has indigenously developed the TGA approved (ARTG 336146) COVID-19 Rapid Antigen Self-Test Kit - Innoscreen®. Currently, Innoscreen® is the only Australian made Rapid Antigen Test (RAT) kit available in the market in Australia. The research team involving healthcare professionals, pharmacists and researchers conducted a need analysis of the proposed application. The team designed the application based on the following requirements as illustrated in Figure 1, considering the six influencing factors listed above.

As detailed in figure 1, the m-Health application is designed to guide end users with taking covid rapid antigen tests and to let them share it with the others easily. The application will also let users track their location for the past days so when the government or other agencies share covid hotspots, users can cross check it with their location. A quick view of the features available in the designed and developed app can be found in the following section.

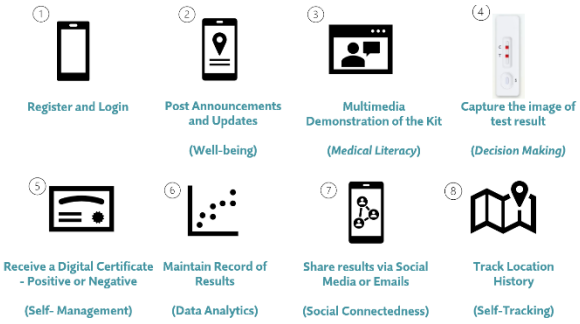

Figure 1. Design Features for COVID-19 Self-Monitoring

4. Results

The mobile app was designed to work in both the mobile operating systems - iOS and Android. Flutter was used to develop as it supports both iOS and android development with very less overhead. Flutter is a programming language that supports cross platform development. Firebase was used as the backend especially because of the easy interaction and setup of firebase in flutter projects. Firebase also supports real time database for real time location tracking of end users. The app after development is shared with the research team and internal users and stakeholders in the form of IPA and APK files depending on the type of OS. The product is not yet made available to end users especially because more research is needed before the final launch. The app is designed to work for iOS 9 and above and android 10 and above. Functions of the application designed is presented with sample screen shots below.

Login/Signup: The app starts with a basic login/ signup screen that will fetch the required details from the end users like name, date of birth, mobile number etc (Figure 2). These details are solely collected for the purpose of covid test certificate creation which can be shared with the end users. The app also requires permissions to always run location services.

Announcement and updates: Once the user login, the home page will display announcement and updates required based on the user needs and customization. This feature will act as an intervention to educate patients to increase their awareness as well as to recommend towards their well-being.

Covid Test Support: Successful signup and login takes the users to a Take Test screen where they are taken through a set of guided multi-media that will let them successfully guide them to take a RAT test (Figure 3). The guided test is designed only to work with a specific kind of RAT kit and the type of the kit is decided by scanning a QR code associated with the kit (Figure 2). The following screen in Figure 3 gives an example of how this feature works.

RAT Result Image Capture: Users can capture the test result image in the mobile app and save the result. The application will ask the user to answer the question regarding if the test result was positive or negative so that the user can enter the result evident in the test kit. This will help to self-manage the test results captured in the application. The result will be recorded for generation of a certificate along with the user details, the image captured along with a date and time stamp. The results recorded will also be used for visualizing the history of tests taken and the results over previous days, months, and years. This patient-generated data is managed, monitored, and analyzed for effective use.

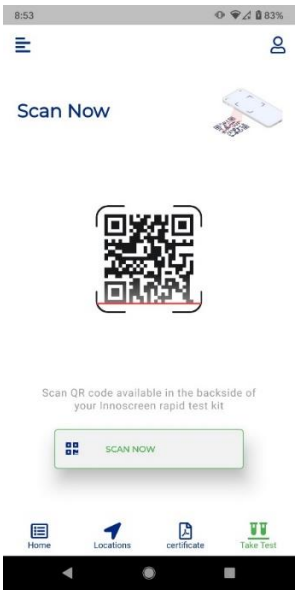

Figure 2. QR Verification

RAT Result Sharing: The results of the RAT tests can be shared easily with others using this app. After the tests are taken, there is an option to generate a pdf with the test which can easily be shared with family and friends. The medium through which it can be shared depends on users' choice. This will let the user communicate easily with their superiors or managers and also with their colleagues and friends easily. A practical example of daily use of this feature is for employees where they need to submit proof of covid tests to their office daily. Thus, the app lets the

users to also keep track of how many tests they have taken, what's the result for each test, the test was taken at what time (Figure 4).

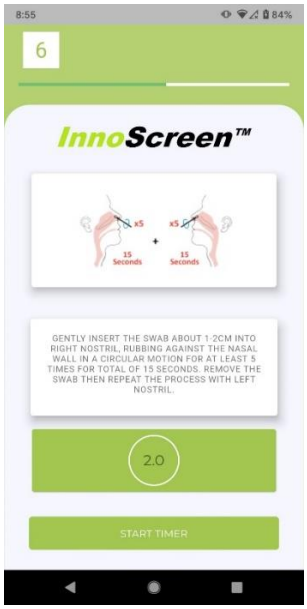

Figure 3. Test Support

Figure 4. Self-Management of Test Results

Location Tracking: Location tracking will help users to track their visited location with their consent (Figure 5). The application is having the option to let the end users share their location history so their close contacts and friends and public in social media platforms can know if they need to be alert for covid screening. This is also a very important feature for the users that let them share to their close ones instead of waiting for the government officials to share the results.

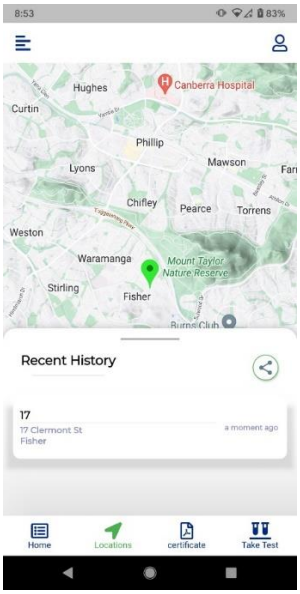

Figure 5. Location Tracking

5. Design Science Research Framework

DSR is an important and well-established paradigm in IS research (Gregor & Hevner, 2013). DSR refers to the construction of socio-technical artifacts to solve problems and derive prescriptive design knowledge (Gregor & Jones, 2007). DSR comprises both practical relevance through the construction of useful artifacts and the scientific rigor through the formulation of design theories (Baskerville et al., 2018). To achieve the scientific rigor in DSR, as illustrated in Figure 6, after an in-depth review of the design, development, and use of ICTs on patient-centered care for chronic conditions, an initial prototype of a Mobile Health Hub for chronic patients was designed and developed in the first phase of the project (Hevner et al. 2004).

The six themes identified in the literature review aligns with the six factors for a good design revealed in the national and global priorities that resulted in the six design features identified in Figure 1. The identified design features in Figure 1 are implemented in the development phase of the application as illustrated in Table 1. The design features will result in a comprehensive patient-centered design principles at the end the evaluation phase.

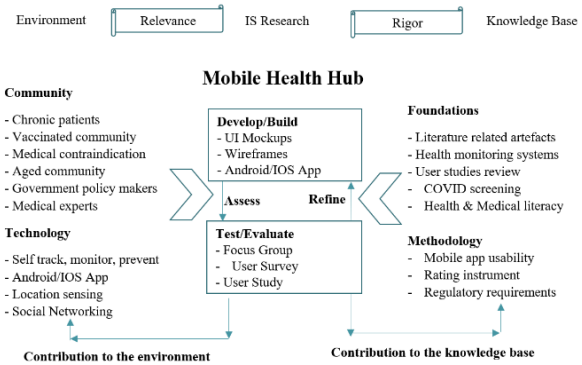

Figure 6. DSR Framework for Mobile Health Hub

Themes/Priorities	Design Features
Self-management: Easy management of recording desirable health data	**Login/Signup:** The user should be able to create and maintain a dedicated account with secure sing-in options that is easy to use.
Medical Literacy and Well-being: Improve medical literacy and well-being as required	**Announcement and Updates:** The user should be able receive announcements in the form of recommendations as well as multimedia support and updates to enhance their medical literacy and well-being.
	Covid Test Support: The user should be able to make COVID self-test using RAT kit and record their results.
Decision Making: Use data collected for important decision making	**RAT Result Image Capture:** The user should be able to systematically capture their result for decision making.
Data Analytics: Demonstrate understandable and accessible visualization of the data collected for effective monitoring	**RAT Result Image Capture:** The users should be able to keep track of a history of their test results.
Social Connectedness: Enhance social connectedness and motivation towards physical and mental wellbeing	**RAT Result Sharing:** The user should be able to share their updates with their closed network via social media or messages.
Self-tracking: Enable self-tracking of measurable vitals and parameters	**Location Tracking:** The user should be able to self-track their location to self-monitor.

Table 1. Design Features Identified

The developed Mobile Health Hub was based on the need analysis by the research team and stakeholders by following the proposed design features. Thus, phase one of the project covers, awareness of the problem, suggestions of the design features and development of the artifact (Kuechler and Vaishnavi, 2008). Phase two of this project will conduct a focus group involving stakeholders representing three different groups, chronic patients, interface designers and health care professionals, to evaluate the application with respect to ease of use, usability, accessibility, and security aspects. This phase is the evaluation phase of the design science research framework and will focus on the needs of chronic disease related health data, such as heart rate and blood sugar level, that is required to aid patients as they self-monitor in the pandemic era. The evaluation phase will also focus on the usability of the app and the security and protection requirements of the self-tracking data. By understanding the needs of patients with chronic health conditions, the design features will be refined to patient-centered design principles, thus enhancing the practical relevance of the designed artifact (Gregor & Jones, 2007).

Based on the findings of the phase two, third phase of this project will enhance the design and development of the Mobile Health Hub to incorporate patient-centric feedback before sending out to large group real-time evaluation. Fourth phase of this project will involve evaluation of the application by chronic patients in a naturalistic environment to improve the design and effectiveness of the application. The evaluation of the collected data based on user experience will help towards recommendations about the acceptability, usability, and fidelity of the initial proof of concept of the solution. We aim to finally release the application as well as derive formalised set of design principles based on our iterative design and development of the application for self-management of health and well-being of chronic patients during the post-pandemic era.

5. Conclusion

COVID-19 and its complications incur significant costs for the health system globally. The impact of COVID-19 for chronic patients are even more significant with greater risk of adverse outcomes associated with COVID-19. Hence, we present the design and development of a mobile application for chronic patients for COVID-19 screening and self-monitoring. The application emphasis on self-recording of test results, managing history of results, gaining text and multimedia resource for awareness, sharing the results as required to close contacts and tracking location history for awareness and prevention. COVID-19 RAT monitoring system will enable users to share images of the rapid antigen test result as a certificate to their family or colleagues whom they would like to inform in a timely manner so that they can avoid community transmission. Sharing negative results will help to make sure that the users take necessary steps towards meeting their close

family and friends to celebrate events or to work together. Sharing positive results will help to keep closed community informed about the updates after a rapid antigen test and avoid community transmission specially for patients with chronic conditions. Maintaining a history of regular RAT test (daily or weekly based on the requirements) will also help users to independently manage their checkups and evidence as required. This is a first step towards a patient centric design of a Mobile Health Hub for chronic patients following design science research framework.

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