

Major Research Project DM3107

The Transformative Impact of Mobile Health: Measuring the Life-Saving Potential of Mobile Health Applications.

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Abstract

This paper dives into the transformative impact of health applications and the potential life-saving impact of these applications and features. A range of life saving apps will be explored such as mental and physical health apps, as well as features such as crash detection and the utilisation of smart watches. By examining these applications and features, this paper will provide deep insights into the ways in which mobile technology can be developed to save lives and reshape healthcare.

The study will also investigate how mobile health applications have evolved to become fundamental elements of healthcare. The secondary research adopts an intricate approach, incorporating detailed analyses of existing literature such as case studies and articles. Discovering real life scenarios from instances in which health apps have served as crucial tools in responding to critical health situations, this case study aims to identify and understand how these health applications have the power to contribute to life-saving situations. Current health apps this year include a range of applications, from Talkspace Therapy and Counselling, a mental health app, to MyFitnessPal, a fitness app which has achieved one hundred million downloads.

For the second part of this project, an interface of a mobile health app will be designed. This app will aim to include a number of life saving features and to potentially design a smart watch interface of the same app. This is because the majority of current health apps link to a user's smartwatch to monitor health 24/7.

Introduction

Within the ever-evolving world of mobile technology, the effectiveness and importance of mobile applications has surged. These digital apps have found utility in almost every aspect of a human's life, from communication to entertainment, learning, and now health. As the dependence on mobile applications continues to grow, an important question emerges of whether these applications have the power to preserve life itself.

This topic is being analysed due to the significant interest in, and use of, mobile application design and development, as well as interest into how the world of mobile technology can help prolong and save the lives of its users. This aspect of mobile technology stands out as it shows the evolution of how far mobile application design and development has come.

The aim of this case study is to shed light on how the design and development of mobile apps and features can save a user's life. The objectives are to investigate the role of mobile applications in enhancing user safety and health outcomes, to explore other life saving features within mobile devices and to discover potential pitfalls of mobile health applications. This case study will be structured into multiple areas, starting with this introduction, followed by a substantial literature review, methodology and discussion, and finishing with a conclusion.

Research Thesis Statement

Through a clear analysis of the development of mobile health applications and mobile features, this case study aspires to establish the crucial role played by health applications in preventing and managing life-threatening conditions or situations. By investigating real-world instances of health apps contributing to life-saving circumstances, this research seeks to highlight the transformative impact of mobile technologies in healthcare, providing beneficial insights for users and developers.

The research question for this paper is, 'How Does the Design and Development of Mobile Apps and Mobile Features Have the Ability to Save a User's Life'? The research topic is, 'The Digital Lifeline: Investigating the Life-Saving Capabilities of Mobile Health Applications.'

Sustainable Development Goal 4

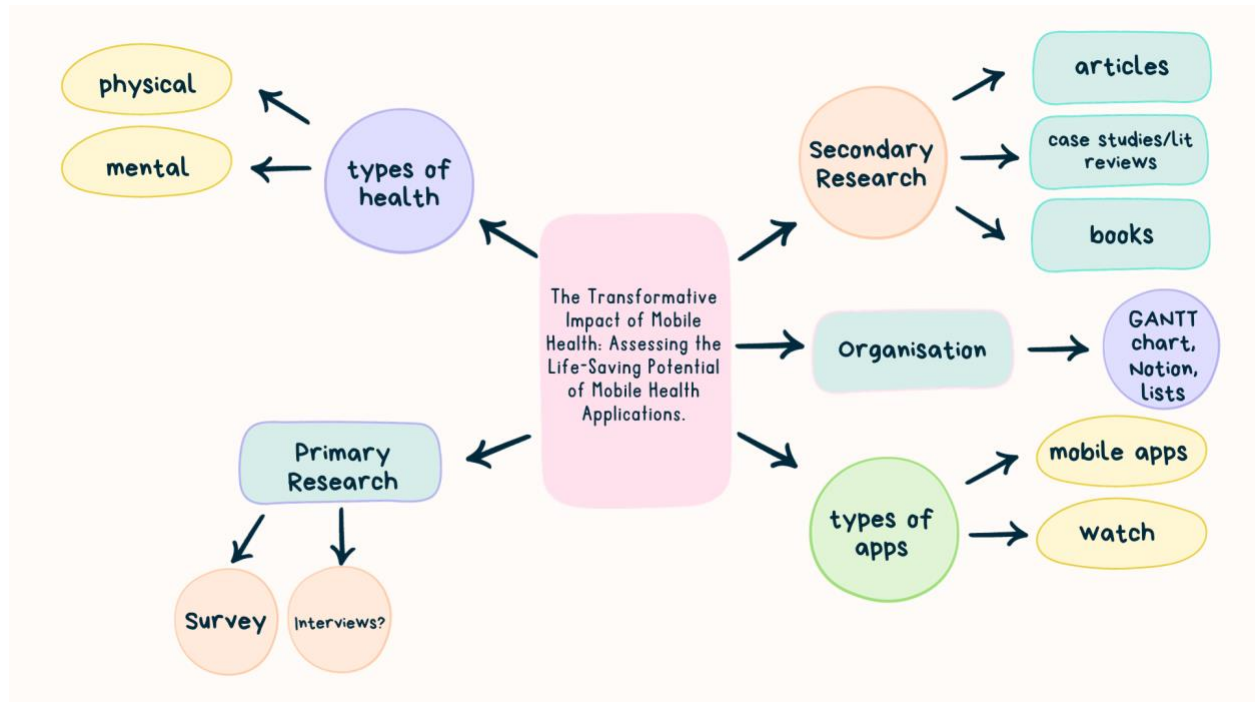
This case study links to sustainable development goal four in several ways. For example, the use of mobile health applications for life-saving purposes aligns with the promotion of health education and literacy. The paper may also contribute to improving individuals' knowledge of health-related issues as well. The research within this paper may emphasise the educational aspect of using mobile health apps for emergency responses and educate individuals on how to use these applications effectively in critical situations.

Figure 1 - UN Sustainable Goal 4

Title of Image: United Nations Sustainable Development Goal 4
Source: [(Online), United Nations General Assembly, 2023]



Figure 2 - Personal Research Map
 Title of Image: Research Map
 Source: [(Online), Imogen Buttimore, 2023]



This research map helped with visualising the desired research and planning the research further. The map also assisted with devising different forms of sources, as well as ideas for primary research regarding next semester's project.

Literature Review

In the rapidly evolving world of technology and healthcare, the design and development of mobile health applications and features has attracted worldwide attention for their innovative abilities.

This literature review will explore the evolving body of research into the roles that health applications play within user safety, the challenges within the design of health applications, as well as alternative life-saving mobile features. The purpose of this review is to analyse the existing literature on health applications, with a focus on how the design and development of these applications have the ability to secure user safety.

The Role of Physical Health Applications

An abundance of research has been conducted into the use of physical health applications and whether they have the ability to help user outcomes or possibly save a life. Physical health apps can be used to help users observe specific health needs or symptoms.

In a study based on patients with diabetes conducted by Ghose (2021), it was revealed that the use of an mHealth (mobile health) application showed an improvement in areas such as the reduction of blood glucose levels, leading to fewer hospital visits and medical expenses. The study highlights that patients who used the app maintained higher levels of exercise, achieved a healthier diet and improved sleep. The research conducted therefore supports the idea that a mobile app can save a user's life by allowing them to monitor their overall physical health and make a significant difference for those with a chronic illness.

However, Ghose (2021) also states in their research that a survey regarding the use of personalised notifications from the desired application was completed by participants **after** the experiment. This highlights a negative aspect as participants found the personalised messages to be intrusive and annoying. Some mentioned that they found themselves feeling constantly coerced to follow the app's wellness recommendations, which lead to demotivation and a lower level of wellness activity. This demonstrates that although the specific application had many positives, it also had drawbacks that may deter users from downloading it.

Research has also found that digital contact tracing is useful for user health and safety. Firstly, a mobile contact-tracing app can track who each user has been in proximity to and then alert all affected users when one confirms a positive result of infection (Farronato et al, 2020).

For instance, Kendall et al (2023) highlights the phenomenon of the NHS covid application, and how the utilisation of digital contact tracing saved approximately ten thousand lives in its first

year. Research conducted by Kendall et al (2023) shows that the app played a crucial role in reducing transmissions of the virus, preventing around one million cases and forty-four thousand hospitalisations. This substantial evidence shows that the development of contact-tracing apps can prevent hospitalisations and potentially save lives.

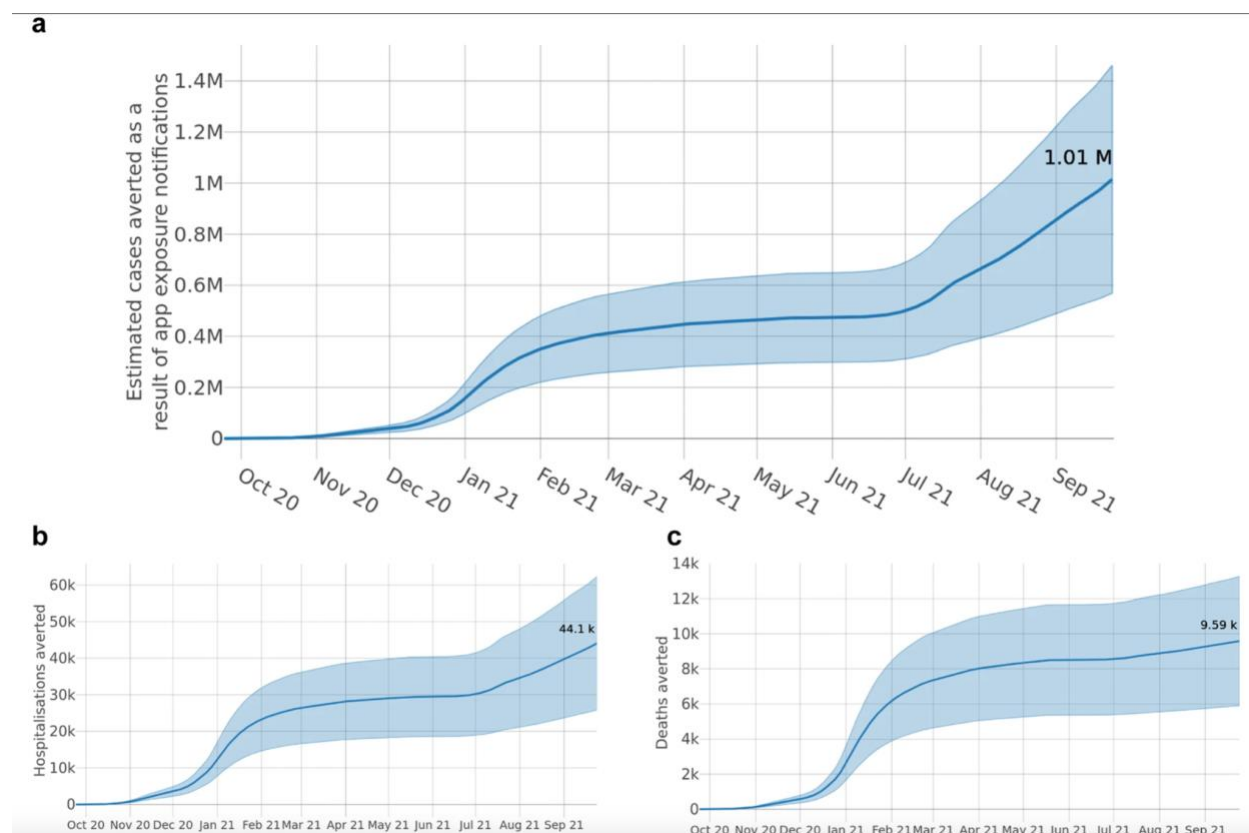


Figure 3 - a. Estimated number of cases, b. Hospitalisations, c. deaths averted by app exposure notifications between 24th September 2020 and 24th September 2021 (Kendall et al., 2023).

Title of Image: Epidemiological Impacts

Source: [(Online) Kendall et al., 2023]

However, contradicting research also reveals that the NHS covid app has failed in some respects. According to Burgess (2020), the app struggled to detect iPhones, only being able to detect four per cent of iPhones they encountered. Burgess (2020) further states that there has been a continuous number of concerns surrounding the app, with complaints about incorrect notifications, glitches, bugs and draining phone batteries. These issues caused many users to uninstall the app from their devices.

Despite the fundamental research surrounding the NHS covid app, there is a notable gap regarding whether contact-tracing apps are the most effective way of reducing disease transmissions. Garousi and Cutting (2021) claim that more work is needed by the stakeholders

behind the app to improve quality. Overall, the varying research implies that many lives can be saved through the design of contact-tracing apps, but on the other hand, the technology has a number of setbacks due to unreliable development.

Lastly, research surrounding the potential of physical health apps conducted by Ruckenstein and Schüll (2017), claim that even though some areas of the health industry remain sceptical, individuals already have their own positive experiences which provide notable evidence that physical health apps can save lives. For instance, Whittaker's (2016) mother showed cold-like symptoms after a trip. After experiencing a tight chest, they used a heart rate app which measured changes in light by placing a finger over the camera. This led to a discovery of an abnormal heartbeat and prompted them to call an ambulance, resulting in an atrial fibrillation diagnosis. The doctors emphasised that the app's timely use likely prevented a heart attack or stroke. Whittaker's (2016) findings clearly provide evidence that the development of physical health applications have a significant positive effect on a user's health through their powerful technology.

The Role of Mental Health Applications

Research has also explored the use of mental health applications, and its effectiveness into user health and safety. Noughton (n.d.) points out that "there are many people who will respond better to a well-developed and clinically tested app, rather than face-to-face therapy". This finding suggests that mobile applications may play a bigger role in helping a user's mental health over in-person therapy. Lal and Adair (2014) are in agreement with Noughton (n.d.) because they also state in their review based on e-mental health treatments that digital mental health services allow users who are uncomfortable with in-person treatment to receive help digitally, thus allowing them to avoid the discomforts of social situations and interactions.

However, Noughton (n.d) further claims that apps are essentially a commercial enterprise, commonly developed by people thinking in business terms such as profit. This is a drawback for the design of mental health applications because apps are often developed by those without mental health expertise. This lack of expertise implies that potential mental health apps may not have the quality of research and knowledge needed to be able to help users to their fullest potential, therefore putting lives at risk.

Koh, Tng and Hartanto (2022) share a similar view with Noughton (n.d) discussing that mental health applications have a big potential, through offering timely support and cost effectiveness, to helping to combat the stigma in seeking help, as well as enhancing therapeutic outcomes. Koh, Tng and Hartanto's (2022) argument are powerful because it clearly shows that mental health apps can reach many individuals. On the other hand, Koh, Tng and Hartanto (2022) also

demonstrate a differing view. They state that although these apps can provide timely, cost effective and discreet support, it is important that users are aware of potential pitfalls. These pitfalls range from engagement challenges, safety issues and confidentiality breaches.

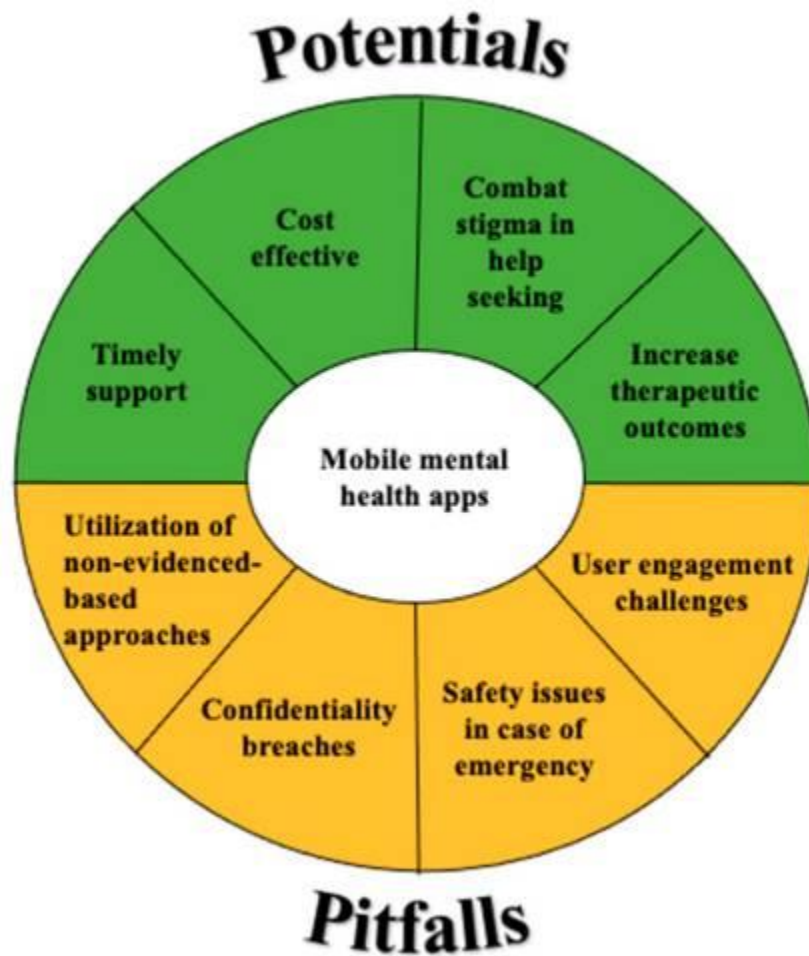


Figure 4 - Potentials and Pitfalls (Koh, Tng and Hartanto, 2022)

Title of Image: Potential and Pitfalls of Mobile Health Apps

Source [(Online) Koh, Tng and Hartanto, 2022]

Furthermore, a study undertaken by Petrovic and Gaggioli (2020) demonstrates that participants experienced reduced stress levels and improved coping skills after only three weeks of app usage. This evidence indicates that applications can increase the chances of treatment success and faster improvements in mental health. Hwang, Ha and Kim (2021) share a similar view to Petrovic and Gaggioli (2020) stating that mental health apps which can track users' emotional state and psychological stress were found to minimise levels of depression, stress and anxiety. Therefore, this piece of literature shows that providing constant documentation of users' mental well-being can tailor relevant treatment for the specific user, increasing the chances of improving, or even saving, a user's life.

Alternative Mobile Features

Research has also delved into the area of alternative mobile features such as Apple's crash detection feature or being able to monitor specific health aspects on an Apple watch.

Crash detection is a feature within Apple phones and watches that utilises the sensors which detect motion and speed (Mauran, 2022). The feature also includes GPS to infer high speeds, a barometer to detect pressure if the airbags are deployed, microphone activity to detect sounds of a crash, and even Bluetooth to inform the device that someone is in a car.

According to an article written by Vlamis (2022), it is stated that a couple was saved after their car tumbled three hundred feet into a California canyon. Although one of their phones was found smashed and with no service, it was still able to detect the crash and contact emergency services. Within thirty minutes, they were airlifted out of the canyon. This real-life story demonstrates the power of a mobile feature which has the technology to save a user's life even without the need of a mobile signal, making the feature even more crucial and useful.

However, research undertaken by Johnson (2023) illustrates that false alarms from the new feature are a growing problem for emergency responders, specifically people engaging in winter activities such as skiing. This is because these types of activities provide fast starts, stops, and jolts which can trick an iPhone into thinking there's been an accident. This demonstrates that the feature needs to be modified further to offer its full potential to users.



Figure 5 - Crash Detection, Apple (2023)

Title of Image: Crash Detection

Source: [(Online) Apple, 2023]

Lastly, research into Apple's smart watch shows the significance it has when it comes to user safety. Apple (n.d.) states that the watch has the ability to monitor heart rate which notifies its user if it is unusually high or low. The watch can monitor irregular heart rhythms and capture an ECG and record the symptoms. Crash and fall detection are also available which allows the user to easily call the emergency services when a hard fall or crash is detected.

A study by Eastzer (2022) demonstrates the features on an Apple watch which could save user's lives. For instance, Eastzer (2022) states that he has Type One Diabetes and uses the glucose monitor on his Apple watch. He claims that this feature saved his life when his watch notified him of a dangerously low blood sugar warning. The use of this feature allowed him to address the low blood sugar before it was too late.



Figure 6 - Apple's blood sugar measurement feature (Lovejoy, 2021).

Title of Image: Blood Sugar Feature

Source: [(Online) Lovejoy, 2021]

Methodology

This report will be built with the use of qualitative and quantitative data. Qualitative data will be used to discover deeper meanings behind the research, along with discovering more in-depth insights into the roles of health applications and how they can potentially save lives.

Quantitative data such as statistics from the Office of National Statistics, will also be utilised as this type of data is able to find certain trends, gaps and results in the research which can then be analysed. This is because quantitative data includes the process of collecting and analysing numerical data.

Secondary research will be collected to give a large range of results and more data will be able to be analysed and discussed due to the large range of literature and sources available. Data can be compiled from a variety of sources including government statistics and the internet, and can be in a range of forms such as reports and sources gathered from libraries or the internet (Qualtrics, 2022). Secondary research will be conducted using the internet to find data and literature online. This will be supported by further quantitative research, as well as discovering articles, papers and books online.

For the second part of this project for next semester, a survey will be created for primary research. This will be an online survey in which participants will answer several questions relating to the research topic. Conducting a survey is the most suitable approach for primary data collection because it can be done remotely and within a matter of minutes, making it suitable for many participants. The survey will be accessible on platforms such as Facebook and LinkedIn because these will reach many individuals. As the survey will be both quantitative and qualitative, including open and closed ended questions, the data will be analysed for any trends or patterns, as well as any deeper results from the open-ended questions. It is important to include open ended questions for this project because it will provide significant evidence that can help to achieve the best project outcome.

Time Management

To stay on track with this project, Gantt charts have been produced to help keep on task and submit on time. A Gantt chart is one of the most popular and useful ways of showing activities displayed against time. On the left is a list of the desired activities or goals, and along the top is a suitable time scale. Each activity is represented by a bar and the position and length of the bar determines the start date, duration and end date (Duke, 2019).

The use of a planner and an online organisation platform called Notion, has also been used throughout the semester. These forms of time management and organisation allow us to see what tasks need to be completed each day, and how long each task must be achieved. The use of Google Calendar has also been utilised, giving the chance to see how far away each submission date is, which helps to plan each day alongside working part time.

Figure 7 - Gantt Chart for Research Report, Semester One

Title of Table: Research Report Gantt Chart

Source: [(Online) Imogen Buttimore, 2023]

Research Report	September 2023	October 2023	November 2023	December 2023
Research topic ideas				
Finalise research question				
Plan research				
Plan essay				
Finalise aims & objectives				
Undertake research				
Start and finish essay				
Receive feedback on essay				
Make final edits				
Submit essay (21st Dec)				

These activities were given this specific time scale because it is believed that this will be the most manageable way to complete the essay and submit on time. If any of these activities are missed, then a re-evaluation will take place on how these missed activities will fit within the given time frame. It is crucial that no activities will be missed regardless.

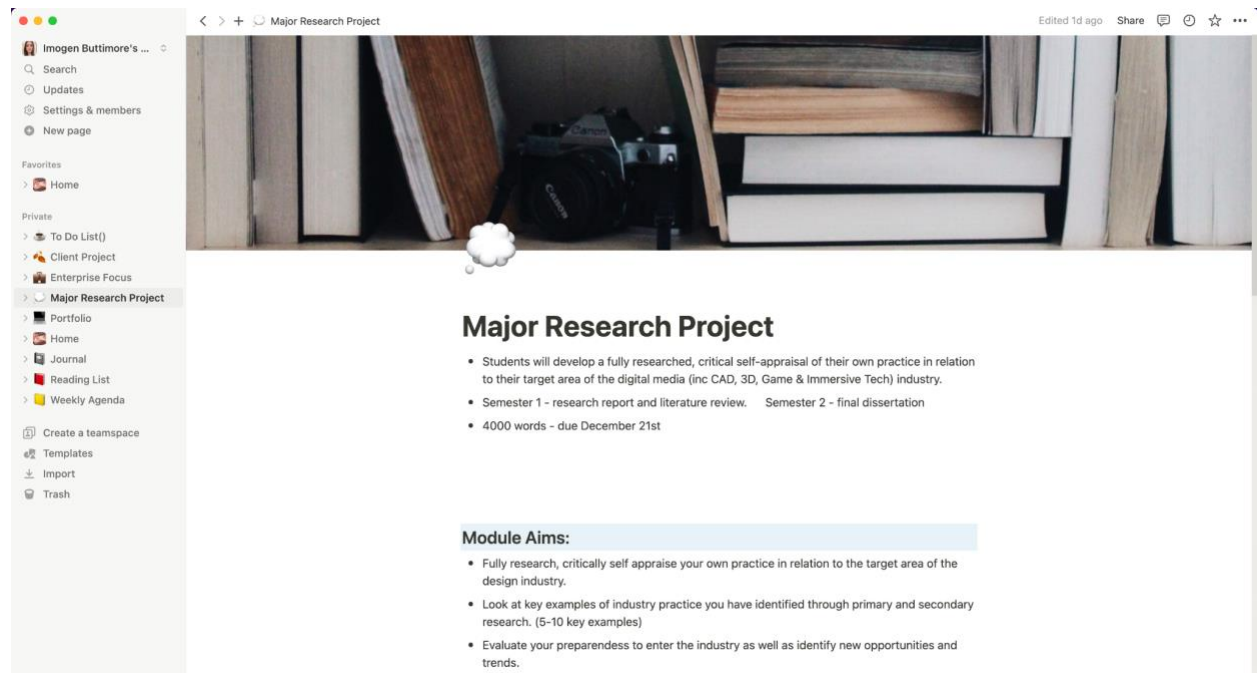


Figure 8 - Screenshot of Notion
 Title of Image: Notion Page
 Source: [(Online) Imogen Buttimore, 2023]

Above shows a visual representation of one form of time management that was used throughout the semester using Notion. Notion is a single space where you can think, write and plan (Notion, n.d.). It allows you to create multiple pages for different projects and offers a large range of templates such as to-do lists.

Figure 9 - Gantt Chart for Individual Project, Semester 2
 Title of Table: Individual Project Gantt Chart
 Source: [(Online) Imogen Buttimore, 2023]

Project	January 2024	February 2024	March 2024	April 2024	May 2024
Research into project					
Finalise idea					
Make a plan/brief					
Send out primary research - survey					
Research					
Branding design					
Site map					
Lo-fi wireframes					
Create user personas					
Start hi-fi wireframes in Figma					
Gain feedback on initial designs					
Prototype designs					
User testing					
Final changes					
Submit					

This Gantt chart above briefly shows how time will be managed next semester. This was more complicated to plan out due to not knowing what other projects will need to be completed alongside. For the second part of this research project, a health and medical app interface will be designed that will offer users a space in which they can track their physical and mental health in one app. Alongside this, the aim is to also design a smartwatch version of the health tracking aspects within the app, such as heartbeat.

Discussion

Having analysed the findings considering the research topic and question, it is noticeable that this study has uncovered comprehensive insights into the potential of live saving mobile applications. The findings contribute to the existing body of literature on whether mobile applications have the ability to save a life, and also shed light on how other mobile features contribute to user safety.

The results show a range of discoveries, with Ghose's (2021) study highlighting that the utilisation of a health application leads to the reduction of blood glucose levels in its diabetic participants. This finding clearly shows the achievement of the research aim because an increase in blood glucose levels is life threatening for those with diabetes, therefore, being able to monitor this can lead to the potential of saving a user's life. On the contrary, it was discovered that health applications can have a negative impact on users, with Ghose (2021) stating that users found personalised messages from a health application to be intrusive and annoying. This demonstrates a potential pitfall when it comes to developing a health app, and therefore successfully addressing the objective of discovering potential pitfalls.

The findings also reflect the success of digital contact tracing applications with the NHS covid app saving an estimated ten thousand lives in its first year. This application provides substantial evidence that the development of this type of health application has the ability to save user's lives, giving a clear answer to the overall research question. However, an unexpected result was found with the NHS app. The app was only able to detect 4% of iPhones that users encountered. This abrupt result highlights that although the app saved many lives, it may not be reliable enough to use.

A common theme was discovered among mental health applications, with multiple findings by Noughton (n.d.) and Lal and Adair (2014) stating that these applications will receive a better response than in-person therapy as it allows users who are uncomfortable with in-person treatment to receive treatment digitally. These results imply that users may respond better with app-based therapy over in-person because they will be able to take part in treatment from the comfort of their home and will be more likely to demonstrate a higher improvement in mental health. Furthermore, results found by Petrovic and Gaggioli (2020) demonstrate that the use of a mental health app helped to improve its user's mental state within a matter of weeks. This finding highlights that the use of a mental health application can increase treatment success and provide vast improvement for the user's health.

Overall, the results uncovered on mental health applications distinctly achieve the paper's objective of investigating the role of mobile applications in enhancing user safety by showing that

the use of a mobile mental health app can actively help a user's mental health and therefore, potentially save a life with digital treatment. Differing results were also discovered based on mental health applications. For example, pitfalls were found ranging from safety issues to confidentiality breaches. A high level of pitfalls may imply that mental health applications have yet to be polished before engaging with its users, to prevent as few challenges as possible.

Regarding alternative mobile features, a range of beneficial findings were discovered. For instance, findings based on a real-life scenario unveiled that Apple's crash detection feature has the power to prevent the loss of life, even without the need for phone signal. This scenario reveals the success of the feature, with a couple's lives being saved after suffering a potentially fatal crash, leaving them unable to contact emergency services, but the development of crash detection gave them the opportunity for their lives to be saved. A second finding was also revealed, with another feature on an Apple smartwatch, a glucose monitor. The study completed by Eastzer (2022) proves that this alternative feature has the technology to save a life, with his own personal experience with Diabetes. It is claimed that his life was saved when his watch notified him of his dangerously low blood sugar level. If he did not have the smartwatch, this situation could have developed into a fatal story.

These findings clearly show the achievement of the second research objective, exploring other life saving features within mobile devices.

Conclusion

By closely researching the transformative world of mobile health, this case study has explored areas of technology and healthcare that have a focus on the life-saving potential of mobile health applications. As this paper comes to a close, the significance of the research becomes clear by revealing the impact and importance of these digital tools and how they can help to preserve a human's life. The intention of this study was to unravel the core functionalities of mobile health applications and to dive deeply into their capability as a lifeline in critical situations. The exploration unveiled diverse observations such as their pitfalls in preventing life threatening situations, to their responsiveness in emergency scenarios.

The findings of this research reveal the critical role that mobile health applications and features can play in the world of healthcare, confirming that they go beyond being a tool for just tracking health metrics. For example, Petrovic and Gaggiolis' (2020) study proved that a user's mental health showed signs of improvement after just three weeks of app usage. The evidence provided clearly illustrates the potential to detect issues such as Whittaker's (2016) real life scenario regarding their mother's irregular heartbeat, as well as prompt timely notifications. In this case, Eastzer's (2022) situation in which his life was saved by his smartwatch notifying him of his low blood sugar. However, the research has also provided insights into the downfalls of mobile health apps and features. For instance, Johnson's (2023) research into Apple's crash detection feature sending out false alarms as well as possible pitfalls of engagement challenges, safety issues and confidentiality breaches.

By reflecting on the transformative impact that has been discovered within this paper, it becomes obvious that the technology behind mobile health is a significant innovation within the healthcare world. The narratives shared above by individuals whose lives were impacted by the timely use of these applications and features serve as powerful examples of the life-saving potential that is embedded within digital devices, as well as a clear reminder for further research and development.

In relation to the future of the world of mobile health applications and features, there are several recommendations that can be made to further enhance their life-saving abilities. For instance, encouraging ongoing research and development to integrate fresh technological advancements into these apps and features. This could include improvements in artificial intelligence, or data analytics for more accurate diagnostics, or personalised health notifications. Secondly, improving the ability of various health apps to be able to seamlessly communicate and share data. This integration could enhance the overall effectiveness of health apps, specifically in emergency situations in which real-time information is crucial. Therefore, the rapid evolution of mobile

technology demands continuous exploration and refinement to secure its full potential for the benefit of humanity.

In closing, the exploration into “The Transformative Impact of Mobile Health: Assessing the Life-Saving Capabilities of Mobile Health Applications”, has highlighted not just present capabilities, but the endless future possibilities that lie on the horizon of digital and mobile health. The research undertaken in this case study has uncovered the innovation and empowerment that these intelligent technologies have in safeguarding human life.

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