

The role of app-based remote patient monitoring in reducing primary care clinician workload during the COVID pandemic: A prospective observational real world feasibility study.

Sachin Shailendra Shah (✉ sachsshah@gmail.com)

Huma Therapeutics

Afsana Safa

NHS Central London (Westminster) CCG

Kuldhir Johal

Eastbury Surgery

Dillon Obika

Huma Therapeutics

Sophie Valenine

Huma Therapeutics

Research Article

Keywords: Digital, Remote Patient Monitoring, Primary Care, App

Posted Date: March 23rd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-275976/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background COVID-19 has placed unprecedented strain on healthcare providers, in particular, primary care services. GP practices have to effectively manage patients remotely preserving social distancing. We aim to assess an app-based remote patient monitoring solution in reducing the workload of a clinician. Primary care COVID patients in West London deemed medium risk were recruited into the virtual ward. Patients were monitored for 14 days by telephone or by both the Huma app and telephone. Information on number of phone calls, duration of phone calls and duration of time spent reviewing the app data recorded.

Results The amount of time spent reviewing one patient on the telephone only arm of the study was 490 minutes, compared with 280 minutes spent reviewing one patient who was monitored via both the Huma app and telephone. Based on employed clinicians monitoring patients, this equates to a 0.04 reduction of full-time equivalent staffing i.e. for every 100 patients, it would require 4 less personal to remotely monitor them. There was no difference in mortality or adverse events between the two groups.

Conclusion App-based remote patient monitoring clearly holds large economic benefit to COVID-19 patients. In wake of further waves or future pandemics, and even in routine care, app-based remote monitoring patients could free up vital resources in terms of clinical team's time, allowing a better reallocation of services.

How This Fits In

- Digital tools are slowly being utilised by NHS services
- There is good but little evidence showing the economic and clinical benefit of app-based solutions
- Primary care infrastructure needs drastic changes to meet demand
- This study aims to show the economic benefit of an app during testing times

Background/ Introduction

In December 2019 the novel coronavirus disease (COVID-19) was first identified. By early 2020, the COVID-19 pandemic presented a public health crisis unprecedented in modern times. Since then, nearly 20 million people have been infected with just over 700,000 deaths [1]. In the UK alone, over 300,000 confirmed cases have resulted in over 40,000 deaths [2] and an unattainable strain on NHS resources. [3] With an already increasing demand for primary care appointments, [4] GPs practices were faced with an unprecedented rise in patient caseloads. [5] Primary care providers act as the gateway to overstretched secondary care resources, quickly resulting in primary care providers becoming overburdened with patients not receiving the appropriate care. The role of GPs in the COVID crisis revolved around effective identification and triaging of suspected patients followed up with an appropriate monitoring system. Many practices adopted telephone consultations as a means of reviewing patients, where previously, telephone calls were only used as a tool for triaging patients. However, for continuous monitoring of

patients with little information, many practices did not have an adequate infrastructure in place. A survey undertaken before the pandemic of 318 GP practices found that 86% had no intention of utilising video consultations prior to the COVID-19 pandemic [6]. With a need for social distancing to minimise new infection rates, commissioning care groups (CCG) quickly had to overhaul their typically archaic infrastructure to conduct patient reviews and consultations virtually.

The role of remote patient monitoring in primary care

Remote patient monitoring (RPM) varies in definition, from simple telephone calls, to video-conferencing calls, to the utilisation of smartphone apps to transmit patient data directly to clinical teams [reference]. GP practices have often resisted implementing remote care, with most adopting telephone triage as their only remote functionality. However over recent years, encouraged by the explosion of digital health, extensive research has demonstrated the value of mobile health (mHealth) solutions in primary care and in the management of chronic conditions. [7] One study evaluating the implementation of a mobile app solution in primary stroke prevention showed that patients on the digital health pathway observed an improvement in their cardiovascular health by 0.36 (clinically significant) on the Life's Simple 7 questionnaire (a 0-14 scale with 14 indicating optimal cardiovascular health), indication compared to patients on the traditional care pathway, whose score improved by 0.01 [8]. Another study demonstrated that patients using an mHealth solution to promote increased physical activity on average took over 1000 more steps a day compared to those not using the app [9]. Furthermore, digital health solutions focusing on RPM yield large economic benefits; multiple studies have shown digital RPM reduces costs imposed on both patients and healthcare providers. Patients are able to minimise costs associated with travel and time out of work, which can be extensive for those with chronic conditions. Moreover, costs to individuals of time not working are reflected in the national economy; it is estimated that time taken off work to visit the GP costs the British economy around £5 billion yearly [10]. Meanwhile, health care providers benefit from a reduction in unplanned admissions and emergency appointments [11].

Additionally, an increase in video consultations has been observed, with high growth health-tech companies reflecting the increasing demand for telemedicine on a national scale. [12] Qualitative feedback from patients has indicated a preference for virtual consultations when compared to the telephone. Outcomes from one study demonstrated that patients felt that telephone calls alone did not offer a sufficient platform to communicate their clinical concerns and expectations, and much preferred digital solutions that encompassed a variety of communication channels, including video consultations [13]. Furthermore, research has also demonstrated that even within patients who show no change in disease progression, greater patient satisfaction is achieved by mHealth solutions than by traditional monitoring. These studies observed a reduction in costs with no substantial change in service use. [14]

Digital RPM in COVID

Due to the highly infective nature of COVID-19, GP practices have been forced to employ methods of monitoring COVID-19 patients whilst maintaining social distancing measures and avoiding unnecessary visits. The NHS swiftly implemented guidelines suggesting that the majority of COVID-19 patients should be monitored remotely with advice on symptom management and self-isolation, given that information on safety netting was provided [15]. Since the pandemic, multiple scientific and political voices have praised the use of digital RPM as a means of combating the spreading outbreak. Digital RPM allows care teams to monitor patients' symptoms of COVID-19, allowing escalation to the relevant service if there are signs of deterioration. Vitally, RPM can keep stable patients at home away from overloaded hospitals, reducing overall infection rates. Moreover, these tools can provide a means to collect phenotypic information on large patient cohorts, to enable study of the natural history of COVID-19, a disease about which we know relatively little [16]. As a result of this demand, we have seen a surge in the number of health providers, resulting in improved product quality via market competition and helping digital health become an established part of everyday practice [17].

Methods

The aim of the present research was to determine the economic impact of an app-based RPM solution for monitoring COVID-19.

A London CCG's COVID-19 Hub, in partnership with NHSX, set up a virtual ward to monitor COVID-19 patients presenting via phone calls to 111, or directly to GPs in the CCG catchment area. Patients whose health status was classified as moderate COVID-19 severity (as per NHS guidelines) and milder category patients (those with relevant co-morbidities or as determined by their GP) were consented to join the virtual ward by their GP and on-boarded to the platform the same day by the practice's clinical team. Patients had the option of choosing between being monitored solely by phone calls or a combination of phone calls and a mobile app (provided by Medopad (Huma Therapeutics)) and were observed for 14 days. The total duration of phone calls was the primary outcome measure, with a view to identify if the addition of an app reduces the burden on inefficient phone-based monitoring. Patients using the app (Figure 1) were instructed to submit data daily regarding their heart rate (obtained via PPG technology embedded in the app), their oxygen saturation (obtained via a pulse oximeter wirelessly connected to the app or via manual entry), their temperature (obtained via a digital thermometer connected to the app or manual entry), any symptoms (Table 1) they were experiencing and finally their breathlessness, obtained via a single-question questionnaire, scored from 1 to 5 (1 being the least and 5 being the worst) created by the clinicians belonging to the West London CCG; "How breathless are you when walking around or walking upstairs?". This data was manually transcribed to a variety of electronic health records via populating a premade template.

Table 1 – A list of symptoms patients can choose from on the app to submit to their care team

Fever
Cough
Shortness of breath
Nausea
Loss of taste
Loss of smell
Vomiting
Chest pain/tightness
Headache
Heart palpitations
Dizziness
Loss of consciousness

Results

35 patients were recruited into the virtual ward for one month. 23 were enrolled on the app with telephone calls, whilst 12 were monitored by telephone calls. A breakdown of ethnicity and age by enrolment group can be seen in figures 2 and 3, respectively. The virtual ward was staffed by a combination of two GPs and 1 nurse working a total of 154 hours a week, who were responsible for reviewing the app data and calling patients.

Patients on the telephone virtual ward received calls from both their assigned GP and nurse. Each patient received a phone call from their nurse three times a day on each day of the 14-day observation period, resulting in a total of 42 phone calls per patient. The mean duration of a nurse phone call was 7.5 minutes. A GP would contact the patient once a day via telephone resulting in 14 phone calls over the 14-day observation period. The mean GP phone call duration was 12.5 minutes. As a result, a mean total of 490 minutes (8 hours and 10 minutes) over 14 days was spent monitoring each patient in this cohort.

Patients on the app-based virtual ward had their data reviewed three times a day for 14 days, with a mean review duration of 2.5 minutes. This totalled a mean of 105 minutes (1 hour and 45 minutes) of review time for each patient over the 14 days. GPs only reviewed each patient's data when asked to do so by the nurse assigned to routinely monitor the patient's data. As with the telephone-based virtual ward group, app-based patients received one telephone call a day from their GP during the observation period, which entailed a mean call duration of 12.5 minutes. A mean total of 280 minutes (4 hours and 40 minutes) was spent monitoring each patient over the 14-day observation period.

This represents a saving of 210 minutes (3 hours and 30 minutes) per patient over 14 days, when compared to staffing of the telephone-based virtual ward described above (Figure 4).

Calculating full-time equivalents (FTE), defined as the number of full time staff needed to fulfil this operation, based on the hours contracted by the two GPs and one nurse, the introduction of an app-based virtual ward provided a saving of 0.04 FTE for each patient receiving care compared to the telephone only RPM pathway. As such, a GP practice employing an app-based virtual ward would theoretically be able to hire 4 less full-time staff (GPs and Nurses) to manage each 100 patients for whom they provide care, when compared to a practice utilising a telephone-based virtual ward.

Although clinical outcomes were not the primary endpoint of interest for the present research, no difference was observed in the number of patients requiring medical intervention over the 14 days between the groups respectively receiving telephone and app-based remote care. Informal qualitative feedback received by the care teams yielded positive comments from patients regarding the digital solution; "Access to the app, to me, was greatly appreciated." Clinicians additionally saw a benefit of patient reassurance and mental wellbeing; "I think it has helped patients and reassured them. Everyone I have discharged has been so grateful for the level of care we have given them. When they have been acutely unwell, knowing there are doctors and nurses monitoring them has made a big difference to them psychologically and this has probably helped them recover". In addition, clinicians claimed that once familiar with the template, the transcribing of app data to their electronic health record took a matter of minutes.

Discussion

Summary

COVID-19 has swept the globe causing ubiquitous and unprecedented strains on healthcare service providers. Within the UK, the problem only confounds pre-existing overstretching of services across both primary and secondary care. Healthcare providers have had to adapt to ensure they can meet the new levels of demand, all whilst endeavouring to uphold social distancing guidelines. With digital health technology poorly embedded into existing infrastructures, implementation of novel digital tools within NHS services must become a priority if we are to meet the increasing demand for patients in the event of further pandemics or spikes. Vulnerable patient groups at risk of developing severe complications from COVID-19 need to be monitored, whilst also self-isolation to prevent disease spread. Digital remote patient monitoring and virtual wards provide the optimal basis for this. The majority of non face-to-face consultations take the form of telephone triage, an infrastructure that is not set up to manage patients remotely. Whilst an increase in virtual consultations has been observed, adoption of these services is still slow and far from sufficiently widespread to manage the volume of patients impacted by COVID-19.

COVID-19 has presented a formidable challenge to clinical practices in the form of managing an increased burden of patients with reduced availability of face-to-face consultation, but through the ashes rises a new appreciation for digital health technology. Healthcare providers must learn from this pandemic and improve access to digital technologies while streamlining the effectiveness of mHealth solutions. This will ultimately allow greater access to higher quality healthcare going forward. By continuing to develop a digital health infrastructure within primary care, we may stand prepared for anticipated second and future waves of the COVID-19 global health pandemic.

Strengths and Limitations

Although a small pilot, this feasibility study discussed demonstrates potential large economic benefits of implementing such solutions. Larger scale investigations into the true economic benefit, as well as clinical benefits would further build the case of mHealth solutions in primary care. This study captures a broad range of ages and ethnicity's, as well as a good balance of biological sex, however it only represents one group of patients (COVID-19 sufferers). In order to show worth, digital solutions needs to demonstrate broader generalisability across disease groups.

Comparison with Existing Literature

There is limited research carried out assessing the role of mHealth solutions in general practice. The research present demonstrates the clinical benefit of apps, but as here, it is often on a small scale and rarely generalisable. Economic evidence of digital solutions in primary care in rare, indicating the significance of this paper to drive more research into the true economic benefit digital solutions can hold in general practice.

Implications for Research and/or Practice

Clinicians are able to monitor large groups of patients in significantly less time. Clinical teams' time is a valuable commodity and solutions able to reduce their workload burden should be maximised. In addition, demonstrating the ability to manage more patients with the same number of resources is paramount in future planning amidst discussions of second waves of COVID-19 or other potential pandemics. From this, pulling out the challenges of infection control, asymptomatic hypoxia, clinician and patient concern, and need for early identification of deterioration could have large impact in the future of primary care. Looking forward to the winter, this tool will be invaluable in terms of managing larger numbers of patients with moderate respiratory symptoms and has proven that remote monitoring in the community can work effectively for acute as well as chronic conditions Lastly, as economies have already begun to recede in response to COVID-19, efforts to reduce national healthcare costs via the implementation of simple digital tools must be employed to ensure basic healthcare needs are not denied to those who need them.

References

1. Who.int. 2020. *Coronavirus Disease (COVID-19) Situation Reports*. [online] Available at: <<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>> [Accessed 10 September 2020].
2. Coronavirus (COVID-19) in the UK [Internet]. Coronavirus.data.gov.uk. 2020 [cited 10 September 2020]. Available from: <https://coronavirus.data.gov.uk/>
3. Tanne J, Hayasaki E, Zastrow M et al. Covid-19: how doctors and healthcare systems are tackling coronavirus worldwide. *BMJ*. 2020;;m1090.
4. Kaffash J. Average waiting time for GP appointment increases 30% in a year [Internet]. Pulse Today. 2020 [cited 10 September 2020]. Available from: <http://www.pulsetoday.co.uk/your-practice/access/average-waiting-time-for-gp-appointment-increases-30-in-a-year/20032025.article>
5. GPs need resources to tackle 'inevitable' surge in demand amid tumbling A&E visits | GPonline [Internet]. Gponline.com. 2020 [cited 10 September 2020]. Available from: <https://www.gponline.com/gps-need-resources-tackle-inevitable-surge-demand-amid-tumbling-a-e-visits/article/1683292>
6. Brant H, Atherton H, Ziebland S et al. Using alternatives to face-to-face consultations: a survey of prevalence and attitudes in general practice. *Br J Gen Pract*. 2016;66(648):e460-e466.
7. Noah B, Keller M, Mosadeghi S et al. Impact of remote patient monitoring on clinical outcomes: an updated meta-analysis of randomized controlled trials. *NPJ Digit Med*. 2018;1(1).
8. Krishnamurthi R, Hale L, Barker-Collo S et al. Mobile Technology for Primary Stroke Prevention. *J Am Heart Assoc Stroke*. 2019;50(1):196-198.
9. Glynn L, Hayes P, Casey M et al. Effectiveness of a smartphone application to promote physical activity in primary care: the SMART MOVE randomised controlled trial. *Br J Gen Pract*. 2014;64(624):e384-e391.
10. Chada B. Virtual consultations in general practice: embracing innovation, carefully. *Br J Gen Pract*. 2017;67(659):264-264.
11. PMC E. Europe PMC [Internet]. Europepmc.org. 2020 [cited 10 September 2020]. Available from: <http://europepmc.org/article/MED/12459044>
12. Intelligence P. Telemedicine Market to Witness Robust Growth Ahead: P&S Intelligence [Internet]. Prnewswire.co.uk. 2020 [cited 10 September 2020]. Available from: <https://www.prnewswire.co.uk/news-releases/telemedicine-market-to-witness-robust-growth-ahead-p-amp-s-intelligence-859284803.html>
13. Verhoeven V, Tsakitzidis G, Philips H, Van Royen P. Impact of the COVID-19 pandemic on the core functions of primary care: will the cure be worse than the disease? A qualitative interview study in Flemish GPs. *BMJ Open*. 2020;10(6):e039674.
14. Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. *BMJ*. 2020;;m998.
15. Greenhalgh T, Koh G, Car J. Covid-19: a remote assessment in primary care. *BMJ*. 2020;;m1182.

16. Fagherazzi G, Goetzinger C, Rashid MA, Aguayo GA, Huiart L: Digital Health Strategies to Fight COVID-19 Worldwide: Challenges, Recommendations, and a Call for Papers. *J Med Internet Res* 2020;22(6):e19284
17. Vokinger Kerstin N, Nittas Vasileios, Witt Claudia M, Fabrikant Sara Irina, von Wyl Viktor. Digital health and the COVID-19 epidemic: an assessment framework for apps from an epidemiological and legal perspective. *Swiss Med Wkly.* 2020;150:w20282

Novelty Statement

This study shows how use of mobile phone technology can help GP practices can manage their increasing workload. We demonstrate that by using an app as part of their monitoring service, they can reduce the amount of time they spend reviewing patients, without comprising on clinical safety. This means that GPs can either see more patients in the same amount of time or can spend more time on those that need it. It also provides patients a better platform to start understanding their condition and increases communication with their GPs.

Declarations

Ethics approval and consent to participate

The above-described solution was implemented as a quality improvement project regardless of this research paper. This paper merely highlights the effectiveness of implementing such solutions of clinician workload therefore traditional ethical approval for human subject research was not acquired as users were signing up as a part of their clinical care, **NOT** as a research study.

Ethical approval for the implementation of the digital solution as a quality improvement project was sought through the local West London CCG Information Governance body (not an official ethics committee) as well as passing information governance requirements set out by NHS-X (an official ethics/IG panel). This process was carried out by completing the NHS's Digital Assessment Questionnaire process which allowed this pilot to proceed. This research was carried out as a measure of effectiveness of this already implemented solution.

Informed consent (e-consent) was obtained digitally in the form of a digital signature of which a copy was emailed to participants. Participants had the option to use the app as part of their clinical care as well as allowing their anonymised (non-PI) data to be used for research purposes. All methods were performed in accordance with the relevant guidelines and regulations (Declaration of Helsinki/GCP), as dictated by NHS-X.

Consent for publication

Not Applicable

Availability of data and materials

The data that support the findings of this study are available from NHSX but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of NHSX.

Competing interests

Shah SS, Obika D and Valentine S were all employed by Huma Therapeutics, the vendor of the digital solution, during the pilot study. Their roles were clinical project management, tasked at implementing the clinical needs of the NHS primary care group lead by Safa A and Johal K.

Funding

This study was paid for at cost by NHSX. Huma made no profit from this project.

Authors' contributions

Shah SS, Obika D and Valentine S were clinical project management, tasked at implementing the clinical needs of the NHS primary care group lead by Safa A and Johal K.

Safa A and Johal K were clinical leads (GPs by vocation) for NHSX, tasked with implementing the digital solution within the care hubs.

Shah SS the main manuscript text and Obika D and Valentine S reviewed and iterated corrections. Safa A and Johal K collected, processed and analysed the data used for the findings. Shah SS calculated the findings based on the data presented by Safa A and Johal K.

Acknowledgements

Not Applicable

Figures

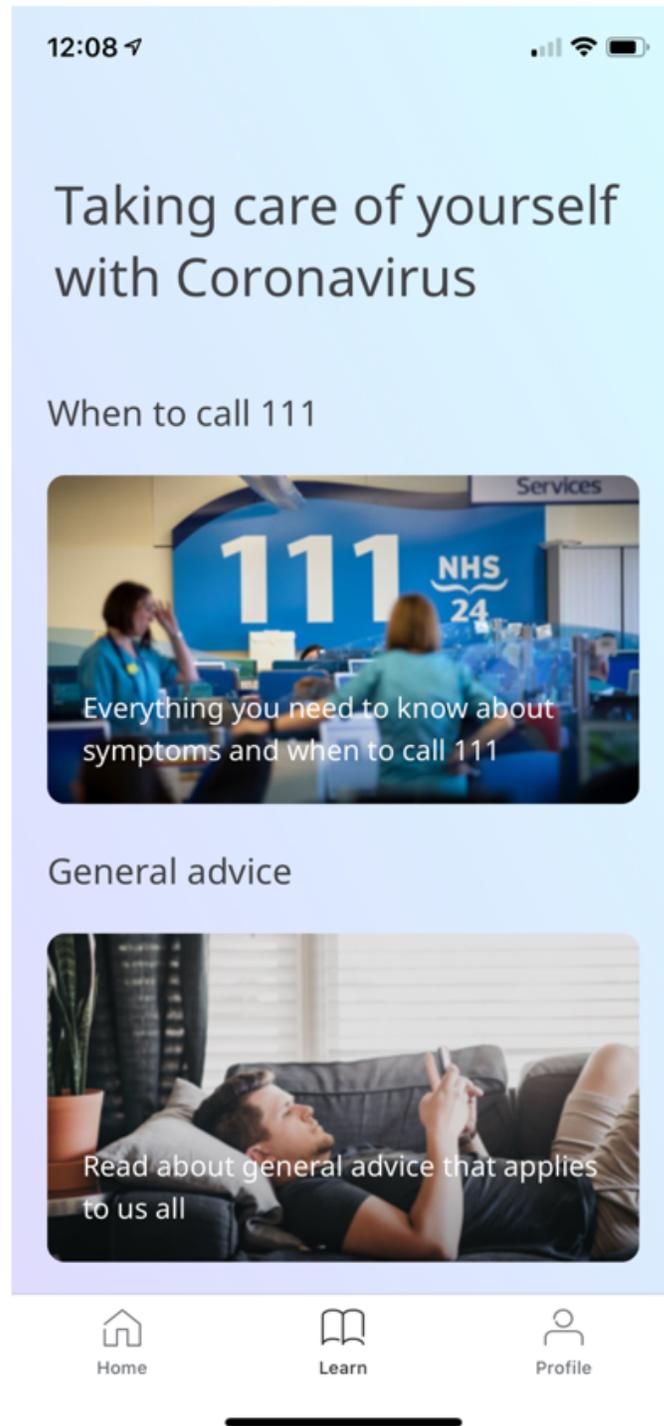
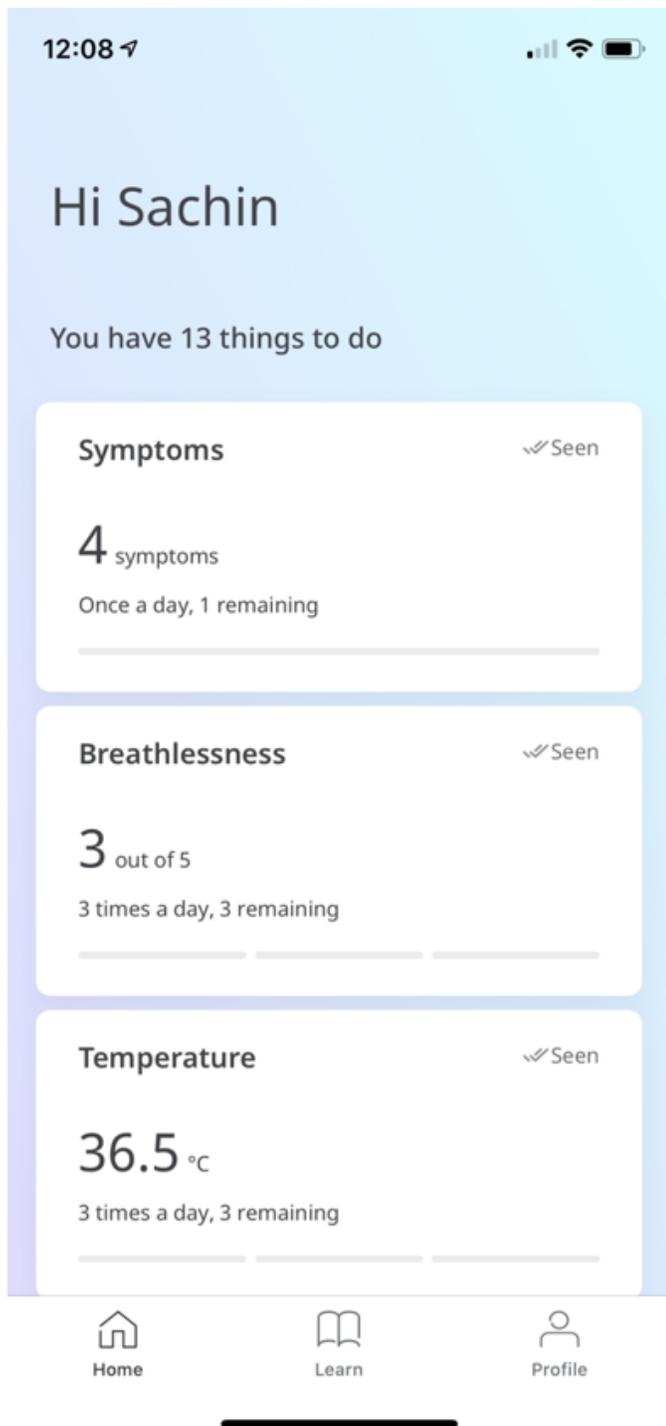


Figure 1

Screenshots of the app used by patients in the study.

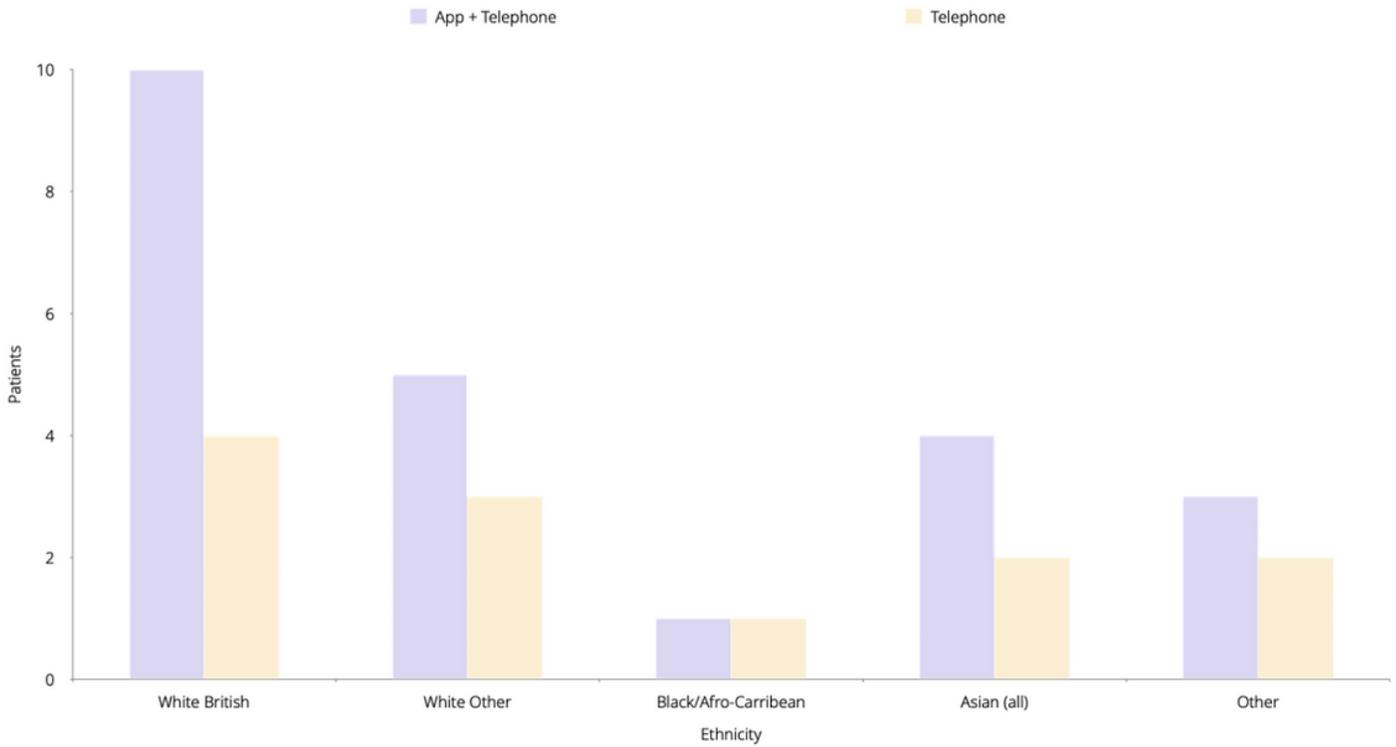


Figure 2

Ethnicity breakdown of all participants in the study

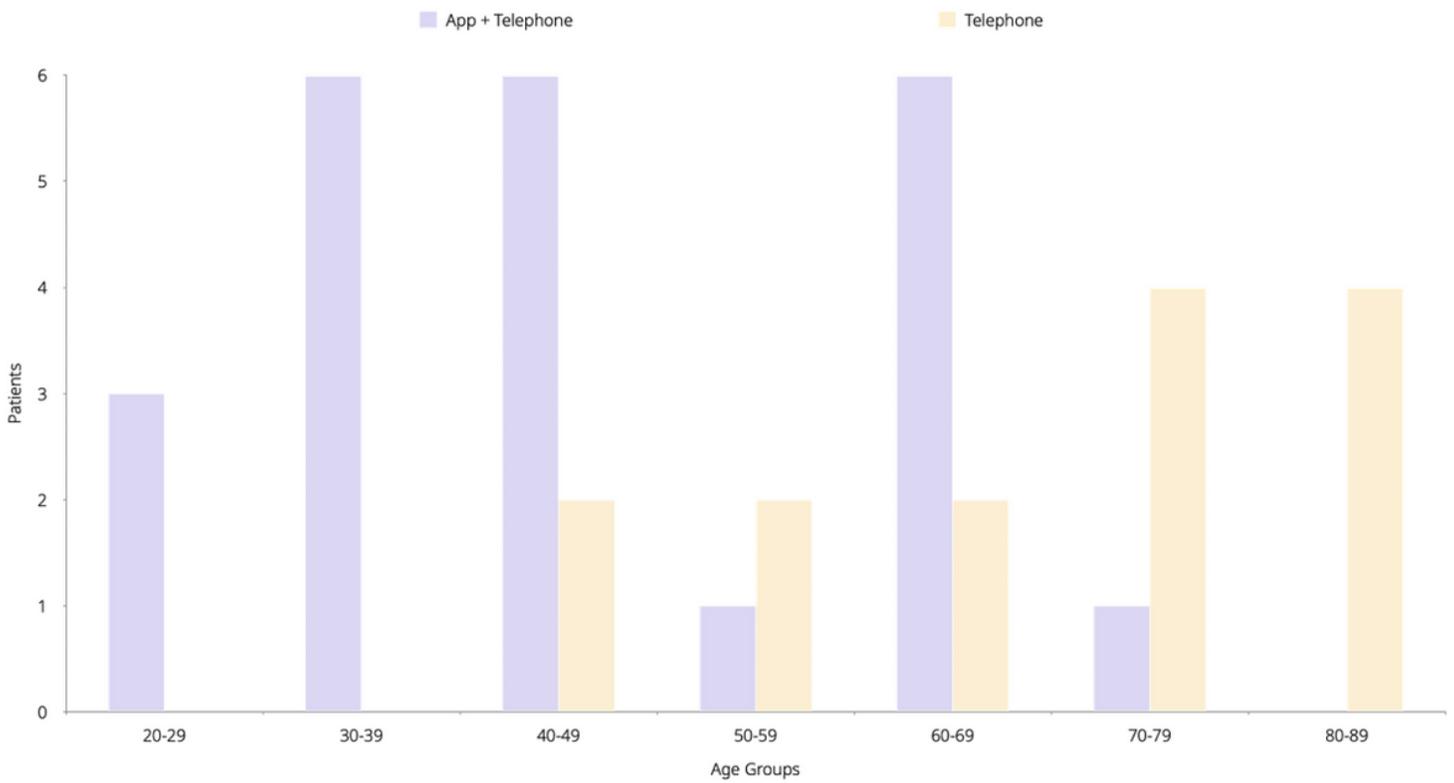


Figure 3

Age Breakdown of all participants in the study

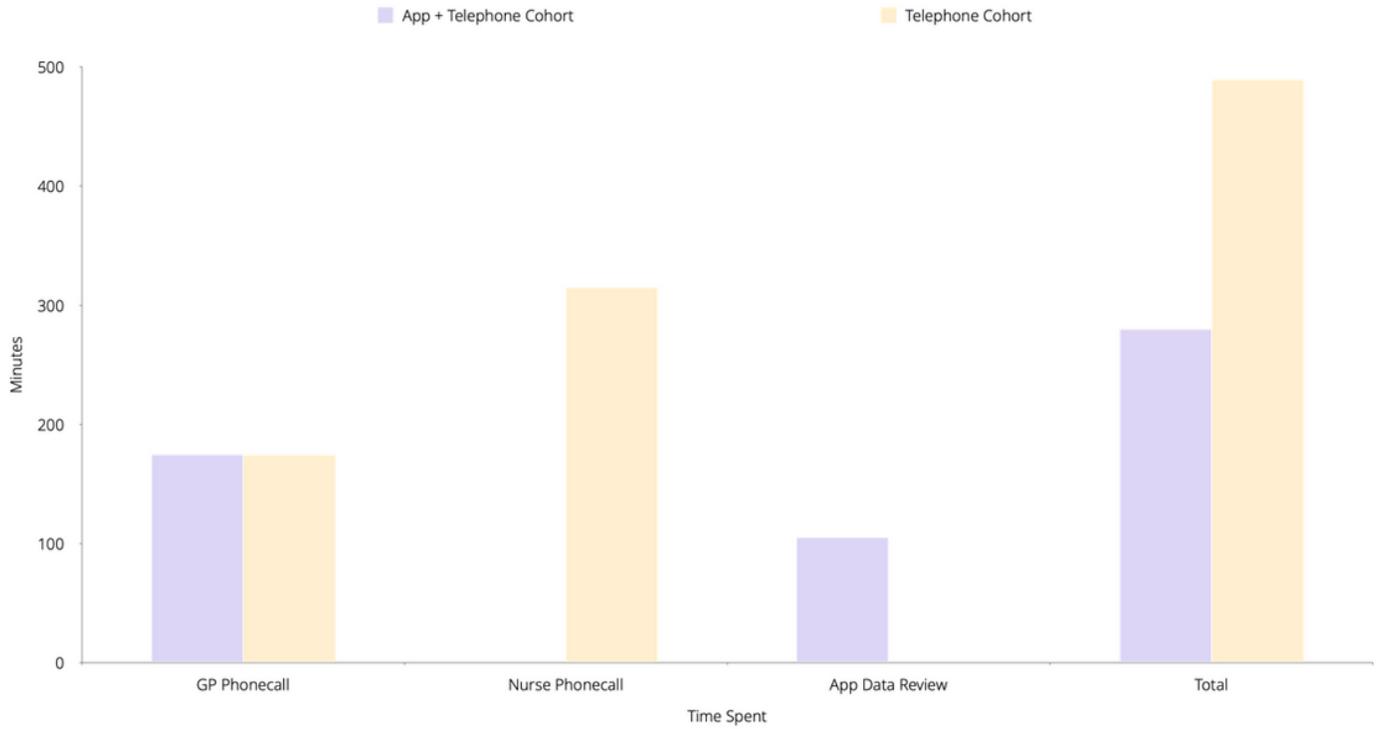


Figure 4

Graph illustrating the difference in time spent monitoring patients between the two cohorts