





BMJ Open Exploring the patient experience of remote hypertension management in Scotland during COVID-19: a qualitative study

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ABSTRACT

Objectives The aim of this study was to understand how patients experienced hypertension management, with or without blood pressure (BP) telemonitoring, during the COVID-19 pandemic.

Design, methods, participants and setting This qualitative study conducted between April and November 2022 consisted of 43 semistructured telephone interviews (23 men and 20 women) from 6 primary care practices in one area of Scotland.

Results From the views of 25 participants with experience of using the Connect Me telemonitoring service and 18 participants without such experience, 5 themes were developed. These were: (1) navigating access to services. There were challenges to gaining timely and/or in-person access to services and a reluctance to attend clinical settings because participants were aware of their increased risk of contracting the COVID-19 virus. (2) Adapting National Health Service services. All six practices had adapted care provision in response to potential COVID-19 transmission; however, these adaptations disrupted routine management of in-person primary care hypertension, diabetes and/or asthma checks. (3) Telemonitoring feedback.

Telemonitoring reduced the need to attend in-person primary care practices and supported access to remote healthcare monitoring and feedback. (4) Self-management. Many non-telemonitoring participants were motivated to use self-management strategies to track their BP using home monitoring equipment. Also, participants were empowered to self-manage lifestyle and hypertension medication. (5) Experience of having COVID-19. Some participants contracting the COVID-19 virus experienced an immediate increase in their BP while a few experienced ongoing increased BP readings.

Conclusions The COVID-19 pandemic disrupted routine in-person care for patients with hypertension. Both telemonitoring and some non-telemonitoring patients were motivated to self-manage hypertension, including self-adjusting medication; however, only those with access to telemonitoring had increased access to hypertension monitoring and feedback. BP telemonitoring permitted routine care to continue for participants in this study and may offer a service useful in pandemic proofing hypertension healthcare in the future.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study examines an under researched area, exploring patients with and without experience of remote blood pressure telemonitoring in the context of the COVID-19 pandemic.
- ⇒ This study is limited to a sample of patients with and without experience of telemonitoring from one health service region of Scotland.
- ⇒ We included a qualitative sample of 43 patients from across 6 different primary care centres based in areas of mixed deprivation where telemonitoring is widespread but not routine.
- ⇒ To enhance the trustworthiness of our qualitative data analysis, three members of the research team reviewed the initial data coding frame.

INTRODUCTION

Hypertension is a leading preventable risk factor for cardiovascular disease (CVD) which affects approximately 1.28 billion people worldwide.¹ In Scotland, 30% of adults are known to have high blood pressure (BP),² with prevalence increasing with age. Uncontrolled hypertension is associated with worse cardiovascular outcomes.³ Hypertension is associated with an increased risk of COVID-19 related mortality,^{4,5} and those with untreated hypertension have significantly higher risk of COVID-19 mortality compared with those on antihypertensive treatment.⁵ Often with no discernible symptoms, many people are unaware of their consistently raised BP and associated risks.⁶ Therefore, robust diagnosis and effective management of hypertension are integral for both CVD risk factor reduction and reducing the risk of adverse outcomes in COVID-19, but hypertension monitoring and management were significantly impacted by the pandemic.⁷

Telemonitoring is an effective tool to help facilitate diagnosis and provide ongoing self-management of hypertension by offering

Box 1 The connect me telemonitoring intervention in Scotland.

Connect Me¹² (formerly known as Scale-Up BP which used the Florence telehealth system³⁸ with additional practice reporting mechanisms)¹⁴ involves patients checking their blood pressure (BP) at predefined frequencies determined by their healthcare team, using a British Hypertension Society approved electronic sphygmomanometer.³⁹ The patient is shown how to use the BP machine and to record results on a third-party website. An action plan is agreed, based on a standard template although thresholds and actions can be agreed to suit the individual. Automated reminders are sent to participating people to check their BP. Patients are sent an automated text message on receipt of their BP reading, confirming if the reading is within range or should be repeated if high. An essential element of the intervention is the understanding patients are expected to take an active role in their care and actions on high readings are the responsibility of the patient. BP readings are summarised into weekly, monthly, 3 or 6 monthly reports, the frequency determined by the frequency of BP readings requested in the protocol the patient is following and sent to the general practitioner (GP) practice for clinician review. The level of patient follow-up is determined by whether BP readings signal controlled or uncontrolled hypertension (figure 2). Any changes required after clinician review are communicated to the patient by telephone, email, letter or text at the clinician's discretion, with patients only invited to attend the surgery if blood tests or physical examination are required.

individually tailored support and clinician structured communication.^{8 9} Compared with traditional clinician monitoring, telemonitoring results in long-term

clinical significant reductions (an average of 4.3 mmHg) in daytime systolic and diastolic ambulatory pressures.¹⁰ There is an 89% probability that BP telemonitoring is cost-effective due to consequent reductions in cardiovascular morbidity and mortality.¹¹ Connect Me¹² (formerly known as Scale Up BP) (box 1)^{13 14} is the BP telemetric supported self-monitoring intervention being embedded across National Health Service (NHS) Scotland routine hypertension management within primary care. Initial implementation occurred pre-COVID-19, and supported effective hypertension care for users during COVID-19.^{12 15} However, it has not been clear how telemonitored patients' experience of BP management during the pandemic differed from those who were managed traditionally.

AIM

The aim of this study was to understand how patients experienced hypertension management, with or without BP telemonitoring, during the COVID-19 pandemic.

METHODS

Design

This was a qualitative study collecting data via telephone interviews using a semistructured question guide. The reporting of the study followed the Consolidated criteria for Reporting Qualitative research.¹⁶

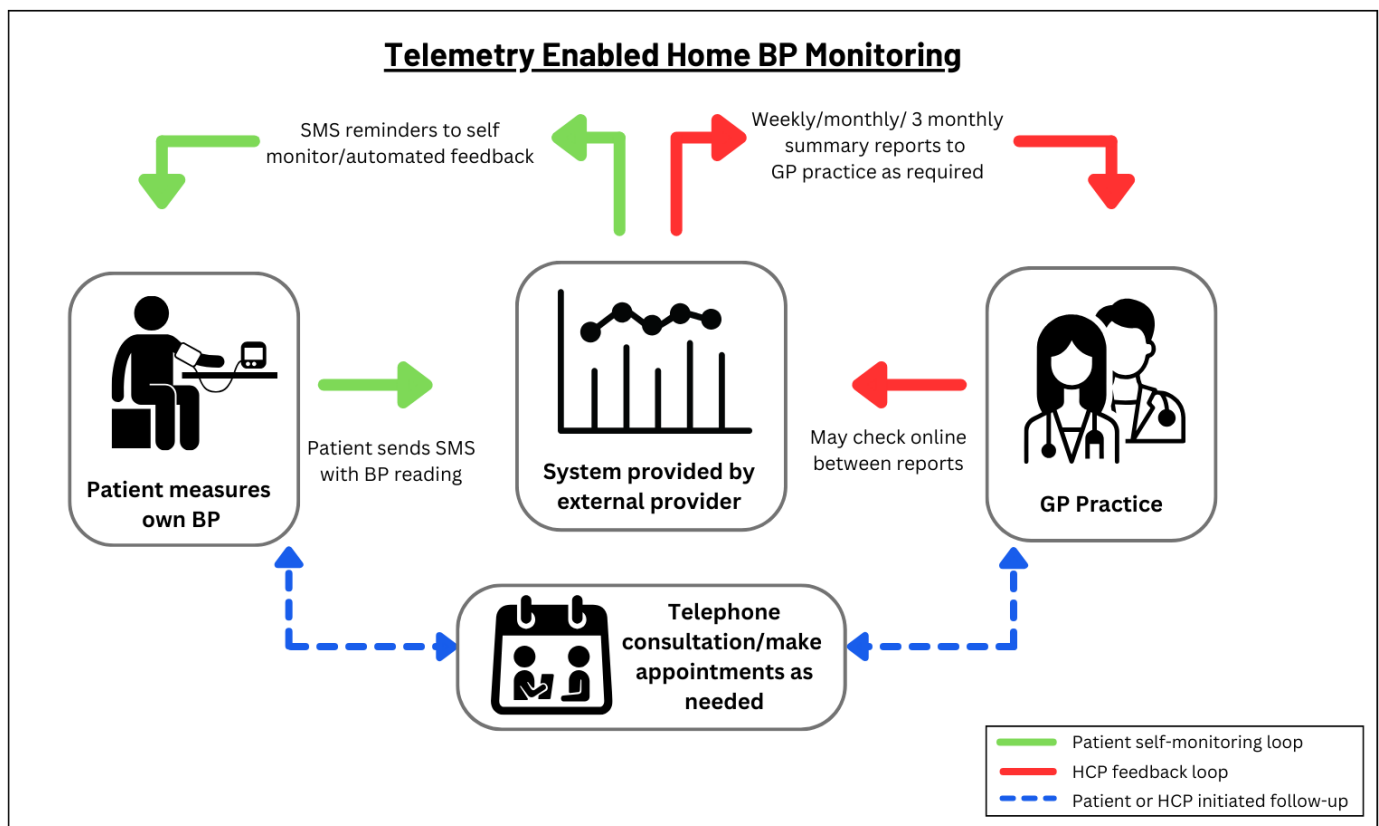


Figure 2 Telemonitoring enabled home blood pressure (BP) monitoring.

Participants

Participants were recruited via the National Research Scotland Primary Care Network. Eligible participants were people diagnosed with hypertension managed by NHS Lothian general practices. There were no specific exclusion criteria; however, general practitioners from participating primary care centres reviewed the list of potential invitees and removed any individuals where they considered that a study invitation would not be appropriate (eg, because of other illnesses at the time of recruitment). Participants were sampled from four practices which had, and two practices which had not implemented telemonitoring before or during COVID-19. Practices were chosen to represent a range of size, location and deprivation. Letters containing study information were posted to 573 eligible participants by The Scottish Health Research Register and Biobank network between March and November 2022. The intention was to recruit 40 participants (20 with and 20 without experience of using remote BP telemonitoring services). Participation was voluntary and individuals chose to register for the study by returning a consent form to the principal investigator.

Patient and public involvement

Neither the design, conduct, reporting, nor dissemination plans for this research involved any input from patients or the public.

Data collection

Data collection took place between April and November 2022 using telephone interviews. A semi-structured interview guide (online supplemental file 1) was developed and refined through discussion among researchers from Edinburgh Napier University to ensure clarity and suitability for the study's participants. The interview guide was consistently applied across all interviews by one qualitative researcher (SM). For both the telemonitoring and the non-telemonitoring participants, interviews were opened with broad questions that included views on self-management and telemonitoring, before exploring personal perspectives. Reflective notes were taken immediately after each interview and retained as contextual information. The telephone interviews were audio recorded using an encrypted audio device and transcribed verbatim by an external agency. Identifiable data were removed during transcription and participant's names replaced with study ID number. Each interview lasted between 16 and 84 minutes.

Data analysis

Thematic analysis was performed using the framework approach.¹⁷ One researcher with 6 years' qualitative experience (SM) read and re-read all transcripts to familiarise themselves with the data. NVivo V.20 (QSR International, Melbourne, Australia) was used to freely code preliminary concepts for 10 transcripts. After discussion (between SM, JH, MP), initial codes were grouped together into

themes to identify a working analytical framework. One researcher (SM) applied the analytical framework across subsequent transcripts.

We used NVivo framework matrices to chart the data and generate a framework matrix. At the charting stage, we created descriptive statements to explain the data for each transcript. We then combined the statements to create explanatory themes and placed them within the columns of a matrix to illustrate the quotations for each theme against the rows containing the identification number of the telemonitoring and non-telemonitoring files. Explanatory summaries were developed by reading the content of each row and column within the matrix.

RESULTS

Sixty potential participants with hypertension registered with six general practices expressed interest in the study, and 43 agreed to be recruited and took part in a semi-structured telephone interview: 25 participants (12 men, 13 women) with experience of using the Connect Me telemonitoring service during COVID-19 and 18 participants (11 men, 7 women) without such experience. All general practices were based within quintiles 1–3 of the Scottish Index of Multiple Deprivation zones (1 representing the most deprived and 5 representing the least deprived).

Overarching themes

We identified five distinct themes across the two cohorts regarding patient experiences of hypertension service delivery during the COVID-19 pandemic. These were: (1) navigating access to services; (2) adapting NHS services; (3) telemonitoring feedback; (4) self-management and (5) experience of having COVID-19 (figure 1).

Navigating access to services during COVID-19

During COVID-19, participants had negative and frustrating experiences of navigating telephone and online appointment booking systems, and telephone consultations. Many had to re-dial their surgery numerous times only to be told they could not book an appointment, and to try again the following morning. A few participants gave up and instead chose to delay seeking support for their BP management:

'...the telephone system was bad really. You could maybe wait over an hour. By the time...maybe you wouldn't even have been able to see a doctor on that day because you had been too late in getting through.' (Telemonitoring 3)

Two participants reported challenges navigating an online appointment booking system. One felt he had no alternative but to access the local NHS emergency department. The other chose to manipulate the online questions to avoid being directed to the emergency department and instead gain access to a GP appointment to address high BP readings:

Hypertension service delivery during COVID-19

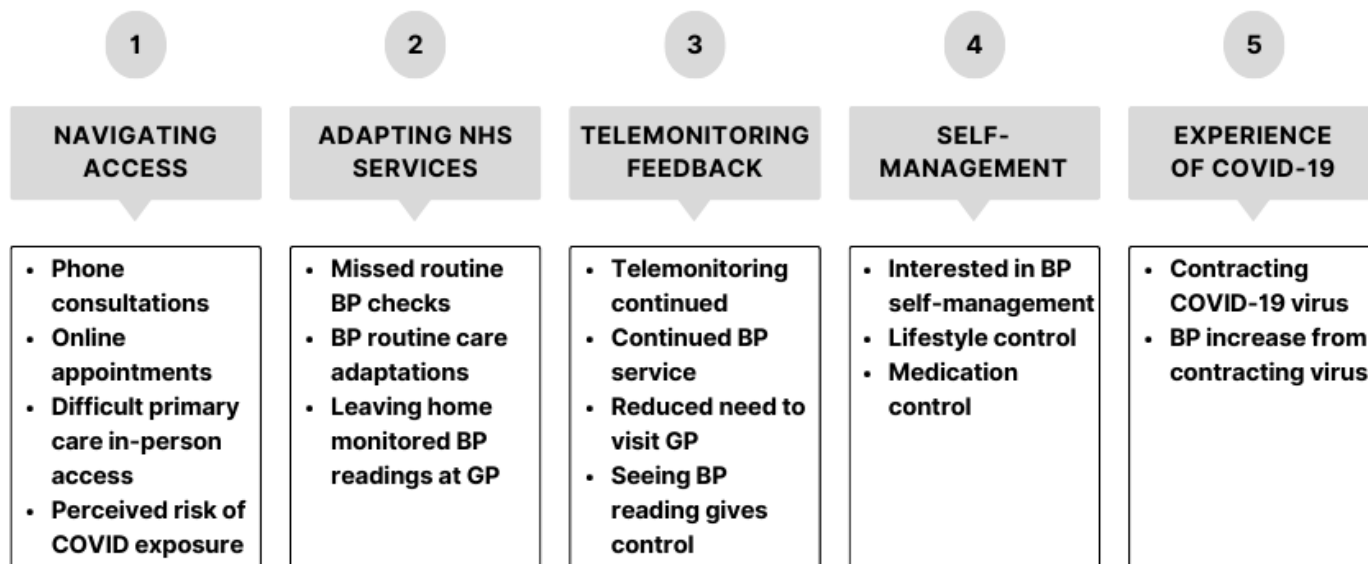


Figure 1 Themes representing hypertension service delivery during COVID-19. BP, blood pressure.

'I tried to make an appointment with the GP [...] you go online and if I put down that my blood pressure is really high. They'll tell me to go to the hospital. Go to A&E. So, you end up having to tell porkies to get an appointment. So, I'll have to go and either tell a different story or forget it basically.' (Non-telemonitoring 15)

After successfully booking a telephone consultation, many spoke positively about their experience, while others shared negative experiences. Negative experiences included time delays in receiving the booked GP telephone call back, the inability of GPs to physically observe or check symptoms such as breathlessness, or the lack of confidence in their ability to find the right words to express their health concerns to a GP over the telephone:

'To me, it had to be face-to-face. I'm not good on the phone and you try and explain things to a doctor over the phone, you're lost. That's a no-go to me.' (Non-telemonitoring 3)

In addition, participants reported being aware of their increased health risks of contracting the COVID-19 virus while attending in-person services:

'... the early stages of the COVID pandemic was literally like living through the zombie apocalypse for me. It was horrendous [...] I wouldn't leave the house for about three weeks at all. And I think because of that, my health definitely dipped [...] I went on the British Heart Foundation website, and it identified that people who have hypertension were in a high-risk group.' (Telemonitoring 1)

Participants reported that they only contacted the NHS during the pandemic if absolutely necessary:

'It made me very reticent [...] I've had two or three funny turns since... I did actually go down to A&E for them just because of [...] the significance of having a second or third stroke. But it would be fair to say that I avoid all contacts that I can, including hospital.' (Non-telemonitoring 1)

This resulted in participants avoiding or delaying help for high BP, dizziness and/or other illnesses. Despite GP advice, one telemonitoring patient refused to be admitted to the hospital while feeling unwell:

'I was determined, I was not going into hospital [...] it was for my high blood pressure [...] when my GP came out, he said, you know, we're not sure why it's like this, so I want you to go into hospital and I refused. I thought during the pandemic, 'cause I knew a lot of ill people in hospital.' (Telemonitoring 18)

Adapting NHS services during COVID-19

All six practices had adapted how they provided care in response to concerns about COVID-19 transmission, such as minimising in-person consultations. For many patients, these adaptations disrupted the routine management of in-person primary care hypertension, diabetes and/or asthma checks. Non-telemonitoring participants reported that in-person BP checks with healthcare professionals were infrequent or not at all:

'I used to (get an annual review), pre-COVID, but I don't think anyone's actually taken my blood pressure since COVID.' (Non-telemonitoring 10)

Non-telemonitoring participants became aware of the lengthy time lapse since their last BP review. Consequently, this prompted eight non-telemonitoring participants to initiate self-monitoring of their BP to provide insight and reassurance that their BP readings were in keeping with perceived satisfactory numbers. Others waited until their BP was checked by health professionals when attending hospital outpatient services for physical investigations for other medical conditions:

'I've not [...] seen my doctor. Probably, never [...] in the twoyears or the threeyears. I've never been called up [...] to [...] get a check-up or anything like that. I'm on a biochemical tablet as well. So, they [...] need my blood taken every month. And I've been getting that done but [...] I don't [...] get my blood pressure done until I go to the rheumatologist' (Non-telemonitoring 13)

Non-telemonitoring participants were invited by health professionals to submit home monitored readings using either their own BP monitors or BP monitors issued by NHS staff. Participants liked this, but some were concerned that they did not receive feedback. A dominant narrative within the non-telemonitoring interviews was that home-monitored BP readings could not be emailed, posted, or handed to an individual member of staff. Instead, participants were invited to leave their BP readings on a table or box at reception. Most participants did not know whether their BP readings reached the intended recipient:

'Because when I took it down, nobody even came to the door to take it, I had to put it in the box. I've not heard a word. I put my details on it, you know, or they wouldn't know who it's from. I mean, you can go into a pub, and the receptionist can't even open the door' (Non-telemonitoring 12)

Most participants accepted that they had received no feedback and presumed that 'no news was good news' (non-telemonitoring 5). Not all routine health checks had been disrupted or stopped. Routine monitoring related to certain medication or cancer markers continued and occasionally the opportunity to combine health checks for different conditions was used by healthcare professionals. Telemonitoring participants reported continuing to self-monitor and routinely report their BP, but still reported problems getting other kinds of hypertension care:

'But I haven't missed out on any because as I say, going in for my regular PSA [prostate cancer] blood tests, the nurse, I would say well, what's happened to the annual checks [annual BP and associated blood tests]? She looked back and said oh yeah, we could do the blood tests now.' (Telemonitoring 15)

Telemonitoring feedback

Telemonitoring reduced the need for participants to attend their primary care practice in-person to receive feedback related to their hypertension management during COVID-19. Many mentioned that the BP telemonitoring model of care minimised the risk of exposure to the virus and reduced the work burden of NHS staff. Participants felt that the telemonitoring model of care routinely experienced prior to the pandemic continued supporting access to healthcare monitoring and feedback without interruption:

'I haven't tried [to access BP care] I just felt that [...] before COVID, I was sending them in and it was just if it was too high or too low, it would have been flagged up and they would've been in touch. And that just carried on in the same way through COVID.' (Telemonitoring 4)

Participants felt reassured knowing telemonitored BP readings were regularly being checked from afar by healthcare professionals. Most felt supported by primary care services, trusting that if there were any BP problems, they would be contacted:

'It gives you peace of mind... There was, a professional that was looking at your blood pressure and you knew that you were being monitored remotely... You know somebody professional is looking at your readings every month. And then, if there was something really out of order, they would get in touch with you.' (Telemonitoring 18)

Most participants, but not all, felt confident in the telemonitoring model of care and were able to self-monitor their BP and detect signs of BP change. A frequently mentioned advantage of submitting a series of home BP readings was that participants and primary care health professionals were able to view and act on BP trends over time as opposed to single readings. The information gathered from ongoing BP readings was of benefit to many, but especially to those whose health anxiety was affected during the initial months of the pandemic. In one case, worries about perceived high BP readings taken at one point in time were alleviated when a GP was able to reassure the participant and provide feedback that average readings were 'considered normal':

'because I was very anxious. And that's where Flo [telemonitoring] comes into its own, because you've got a longer picture, and the doctor can also see the picture. And then they would talk to me about what they considered normal' (Telemonitoring 1)

Participants who did not feel confident in the telemonitoring model felt concerned that the feedback received from the telemonitoring system after submitting monthly readings differed from the information that the GP acted and based treatment on. For example, one participant received feedback that a submitted BP reading was high, but when contacting the GP were told that

average readings were normal and in accordance with age-appropriate guidance. The same participant visited the GP on three occasions, seeking reassurance about the feedback received from the telemonitoring system. To improve feedback, a few telemonitoring participants suggest the BP trends captured in the monthly reports to clinicians should be shared with patients with hypertension and state that 'based on our algorithm, this is what you should do because the trend's been going for a couple of reporting periods.' (Telemonitoring 19)

Self-management

Due to the reduction in regular NHS BP checks, many non-telemonitoring participants were motivated to use self-management strategies to track their BP during COVID-19. Using either self-purchased, borrowed or NHS supplied BP monitoring devices, non-telemonitoring participants felt self-monitoring of BP at home was acceptable and reduced the burden on NHS staff time:

'I wanted to be able to, ...keep an eye on it myself. Rather than have to... run to the doctor every time... But I suppose it gives you an indication of how things are,' (Non-telemonitoring 15)

Being more conscious of the need to self-manage their health, some non-telemonitoring participants were seeking reassurance about their hypertension and performing self-checks to gain feedback and information about their BP health:

'I've got a little more understanding of the consequences of not managing it. But, without some monitoring, it was going to be impossible to tell.' (Non-telemonitoring 1)

Most participants understood that addressing lifestyle factors such as increasing walking and reducing salt, and regularly taking medication helped to reduce their BP to levels deemed appropriate to reduce hypertension risks. Home BP self-monitoring provided individuals with a mechanism to understand what the lifestyle factors (eg, reducing stress) and medication factors (eg, self-adjusting anti-hypertensives) increased or decreased BP levels during the pandemic. Self-checking BP readings empowered a few telemonitoring, and non-telemonitoring participants to self-manage their medication. In the absence of healthcare professional advice, one participant increased the dose of medication to improve BP readings to levels perceived to aid control of hypertension:

'I probably took extra tablets to try and bring it back under control. But because it was so difficult to get to see a doctor. It would have been almost impossible to get an appointment to see a doctor during those two years.' (Non-telemonitoring 15)

Based on information read online, two participants reported changing the time of day when they took medication to reduce their perceived risk of having a stroke. One participant read that 'most strokes happen

during the night' (Telemonitoring 17). This information resulted in the participant changing medication taking from morning to evening. Another believed that management of hypertension was a modifiable lifestyle issue. From self-monitored readings, this participant felt occasionally able to alter medication dosage when average BP readings fluctuated:

'If I halve the tablet [...] for two or three days the blood pressure doesn't go up, it remains fairly stable. I don't do it all the time. [...] Maybe for a week or so I will halve the tablet and then it evens itself out. Then it might start creeping up after ten days, so I just use the whole tablet again and it settles all back down. So, I just keep monitoring it.

Does your GP know that you mix up the medication? (Interviewer)

No, [...] I find it more a lifestyle scenario rather than a medical problem.' (Telemonitoring 14)

Experience of having COVID-19

Twelve telemonitoring and two non-telemonitoring participants reported contracting COVID-19. There was no difference in the experience of COVID-19 infection between participants who used telemonitoring and those who did not. Most had experienced flu-like symptoms, but a few had noticed an immediate increase in their BP readings while infected, and four reported ongoing increased BP readings post virus, and/or feelings of chest discomfort, breathlessness, coughing, and joint and muscle pain. According to one participant, a complication of contracting the COVID-19 virus was that BP readings were higher for at least 1 year afterwards, altering the effectiveness of routine hypertension medication:

'last September I took COVID and it's knocked all my tablets out. We're [...] struggling to get my blood pressure settled [...], trying to find medication to help with my blood pressure at the moment. Sometimes my head's a bit dizzy and I'm a bit sore, as [...] it feels like you're having a heart attack or a stroke' (Non-telemonitoring 17)

DISCUSSION

The COVID-19 pandemic disrupted hypertension in-person care for general practice patients in this study. Six participating general practices had adapted hypertension care services to minimise the risk for COVID-19 transmission, which from a patient perspective resulted in restrictions to hypertension checks and feedback, and difficulties accessing the practices for BP support. For some participants, routine monitoring for hypertension and other long-term conditions had not taken place. This is consistent with large datasets in the UK and US which show reduced numbers of BP measurements taken,⁷ reduced cardiovascular prescribing,¹⁸ and increased BP

levels at a population level¹⁹ during the pandemic which may lead to a future increase in cardiovascular events.

Overall, this study shows that BP telemonitoring participants were supported to access healthcare monitoring and feedback compared with non-telemonitoring individuals. The telemonitoring service allowed routine care to continue. Conversely, there was inconsistent seizing of opportunities to monitor hypertension care when patients did have to attend general practice. Patients were aware of this but only one participant in this study prompted their healthcare provider to carry out their hypertension monitoring while they were in the surgery. Integrating care pathways around individual patients is complex at a whole system level²⁰ but a level of coordination in primary care would prevent this happening in future global emergencies, may reduce the number of appointments needed and the frustrations felt by the participants of this study when navigating access to healthcare.

Receiving feedback from BP readings was important for participants in this study. Those who were used to face-to-face monitoring missed the feedback from health care professionals (HCPs) even if they started home-monitoring BP and manually submitted readings to general practice. Prepandemic research suggested that lack of feedback may exacerbate existing health anxiety and prompt patients to seek additional healthcare interactions.^{21 22} In contrast, we found that most telemonitoring participants had reassurance that the feedback system for home-monitored BP readings worked. Similar to previous evidence, our results show automated text messaging in hypertension supported participants confidence to self-manage their hypertension²³ and those in the telemonitoring group felt remotely supported by primary care. BP telemonitoring has been shown, again outside a pandemic situation, to reduce the need for face-to-face appointments.¹³ Feedback remained important, although inconsistent feedback caused concern. The situation where automated feedback about a single reading has said BP is high, but the HCP says it is satisfactory has also been observed in our other studies,²³ and causes anxiety. Deciding whether to increase medication when average BP is close to a target can be complex, but it is important to ensure that the decision is well explained and target levels on the automated system are individually adjusted so that inconsistent feedback does not continue.

This study showed that the pandemic motivated people to extend the ways in which they self-managed their hypertension including starting to use a BP monitor at home for the first time to independently adjusting dose and/or timing of their anti-hypertensive medication. Self-adjustment of medication at home and in response to self-monitoring of a medical condition is commonplace in patients diagnosed with diabetes^{24 25} but not currently routine in patients diagnosed with hypertension. However, trials of BP self-monitoring and telemonitoring, plus self-titration of medication have shown it to be an effective strategy to manage hypertension.^{26–29} The patients in our study did not receive HCP-guided medication titration

coaching or support and had self-adjusted their medication in response to home BP readings and knowledge gained from online reading of CVD risk reduction. A pre-defined algorithm for how and when patients should titrate their medication is seen as essential to prevent adverse events.²⁹ It may also overcome patient reluctance to change medication for borderline readings.³⁰ Physicians have previously reported feeling comfortable with the idea of anti-hypertensive self-titration and do not consider it dissimilar to diabetes management as long as decisions were personalised to patients to improve acceptability.³¹

The participants in this study all had hypertension. Many saw themselves as high risk of severe COVID-19 and avoided crowded situations and were reluctant to attend hospitals and GP surgeries. Although at the time scientific opinion on the level of risk of severe COVID-19 posed by hypertension was mixed,³² a recent analysis suggests that it is a significant risk factor.³³ Our results highlight that a number of participants contracted COVID-19 and while none were hospitalised by the virus, suggesting that their caution in the early stages of the pandemic was an effective strategy, a small number reported ongoing symptoms or an adverse effect on BP control. Uncontrolled hypertension is a possible risk factor for long COVID-19.³⁴ Also, cardiovascular risk increases following COVID-19 infection³⁵ and in hospital patients there is an increase in BP following COVID-19.^{36 37} Research addressing the effect of COVID-19 on BP in people who were not previously hypertensive is ongoing¹⁸ but the effect of COVID-19 on BP control in treated patients with hypertension who were not hospitalised is unclear.

Finally, we acknowledge that the findings from this study are based on a group of patients from one health service region of Scotland; however, we carefully sampled people with and without experience of telemonitoring in a region where telemonitoring is widespread but not routine. We are not aware of any sampling bias. The sample comprised patients from across six different primary care centres based in areas of mixed deprivation. Our data analysis found viewpoints were similar across all themes identified from the participants in this study.

CONCLUSIONS

The COVID-19 pandemic disrupted routine in-person healthcare services for patients with hypertension of six general practices within one area of Scotland. The pandemic motivated participants to self-manage hypertension, including finding new ways to navigate access to healthcare, initiating self-monitoring and self-adjusting their own medication guided by BP measurements. BP telemonitoring permitted routine care to continue for participants in this study and may provide support for future antihypertensive patient self-titration care pathways and pandemic proofing hypertension healthcare in the future. Overall, remote BP monitoring was well received and offers an opportunity for greater adoption

of self-management of hypertension beyond current recommendations.

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Contributors SM made substantial contributions to the design and content of the work. SM, AP, JH and MP made substantial contributions to the analysis, interpretation, drafting and revising of the work. All authors contributed to the final revision of the work and the final version to be published.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by NHS Health Research Authority (IRAS ID No. 299323) and Research Ethics Committee (REC No. 21/EM/0148), and Edinburgh Napier University School of Health and Social Care research and integrity committee (Ref: SHSC 2762423). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data are deidentified participant data, available from CardiovascularHealth@napier.ac.uk upon receipt of a reasonable request for access. In this case, the Principal Investigator will decide about whether to supply data to a potential new user. Before data is shared, a data-sharing agreement will be issued and signed by appropriate authorities.

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REFERENCES

- World Health Organization. Hypertension key facts WHO. 2022. Available: <https://www.who.int/news-room/fact-sheets/detail/hypertension>
- Chest HaSS. Beating high blood pressure: Scotland's silent killer. A report by the cross-party group on heart disease and stroke. 2019.
- Zhou D, Xi B, Zhao M, *et al*. Uncontrolled hypertension increases risk of all-cause and cardiovascular disease mortality in US adults: the NHANES III linked mortality study. *Sci Rep* 2018;8:9418.
- Zhou F, Yu T, Du R, *et al*. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020;395:1054–62.
- Gao C, Cai Y, Zhang K, *et al*. Association of hypertension and antihypertensive treatment with COVID-19 mortality: a retrospective observational study. *Eur Heart J* 2020;41:2058–66.
- Scottish Government. Scottish health survey 2019. gov.scot; 2020. Available: <https://www.gov.scot/publications/scottish-health-survey-2019-volume-1-main-report/pages/4/>
- Gotanda H, Liyanage-Don N, Moran AE, *et al*. Changes in blood pressure outcomes among hypertensive individuals during the COVID-19 pandemic: a time series analysis in three US healthcare organizations. *Hypertension* 2022;79:2733–42.
- Hanlon P, Daines L, Campbell C, *et al*. Telehealth interventions to support self-management of long-term conditions: a systematic meta-review of diabetes, heart failure, asthma. *J Med Internet Res* 2017;19:e172.
- Tucker KL, Sheppard JP, Stevens R, *et al*. Self-monitoring of blood pressure in hypertension: a systematic review and individual patient data meta-analysis. *PLoS Med* 2017;14:e1002389.
- McKinstry B, Hanley J, Wild S, *et al*. Telemonitoring based service redesign for the management of uncontrolled hypertension: Multicentre randomised controlled trial. *BMJ* 2013;346:f3030.
- Monahan M, Jowett S, Nickless A, *et al*. Cost-effectiveness of Telemonitoring and self-monitoring of blood pressure for antihypertensive titration in primary care (Tasminh4). *Hypertension* 2019;73:1231–9.
- Technology Enabled Care (TEC). Connect me for Clinicians: Digital health & care Scotland. 2022. Available: <https://tec.scot/programme-areas/connect-me/connect-me-clinicians>
- Hammersley V, Parker R, Paterson M, *et al*. Telemonitoring at scale for hypertension in primary care: an implementation study. *PLoS Med* 2020;17:e1003124.
- Scottish Government. Home blood pressure monitoring. gov.scot; 2019. Available: <https://www.gov.scot/news/home-blood-pressure-monitoring/>.
- Calton B, Abedini N, Fratkin M. Telemedicine in the time of Coronavirus. *J Pain Symptom Manage* 2020;60:e12–4.
- Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007;19:349–57.
- Ritchie J, Spencer L, O'Connor W. Carrying out qualitative analysis. qualitative research practice: a guide for social science students and researchers. 2003;2003:219–62.
- Dale CE, Takhar R, Carragher R, *et al*. The impact of the COVID-19 pandemic on cardiovascular disease prevention and management. *Nat Med* 2023;29:219–25.
- Laffin LJ, Kaufman HW, Chen Z, *et al*. Rise in blood pressure observed among US adults during the COVID-19 pandemic. *Circulation* 2022;145:235–7.
- Gartner J-B, Abasse KS, Bergeron F, *et al*. Definition and conceptualization of the patient-centered care pathway, a proposed integrative framework for consensus: a concept analysis and systematic review. *BMC Health Serv Res* 2022;22:558.
- Grant RW, Pandiscio JC, Pajolek H, *et al*. Implementation of a web-based tool for patient medication self-management: the medication self-titration evaluation programme (MED-STEP) for blood pressure control. *Inform Prim Care* 2012;20:57–67.
- Grant S, Hodgkinson JA, Milner SL, *et al*. Patients' and Clinicians' views on the optimum schedules for self-monitoring of blood pressure: a qualitative focus group and interview study. *Br J Gen Pract* 2016;66:e819–30.
- Hanley J, Ure J, Pagliari C, *et al*. Experiences of patients and professionals participating in the HITS home blood pressure telemonitoring trial: a qualitative study. *BMJ Open* 2013;3:e002671.
- Group DS. Training in flexible, intensive insulin management to enable dietary freedom in people with type 1 diabetes: dose adjustment for normal eating (DAFNE) randomised controlled trial. *BMJ* 2002;325:746.
- Greenwood DA, Gee PM, Fatkin KJ, *et al*. A systematic review of reviews evaluating technology-enabled diabetes self-management education and support. *J Diabetes Sci Technol* 2017;11:1015–27.
- McManus RJ, Mant J, Haque MS, *et al*. Effect of self-monitoring and medication self-titration on systolic blood pressure in hypertensive patients at high risk of cardiovascular disease: the TASMIN-SR randomized clinical trial. *JAMA* 2014;312:799.
- Chen T-Y, Kao C-W, Cheng S-M, *et al*. Effect of home medication titration on blood pressure control in patients with hypertension: a meta-analysis of randomized controlled trials. *Med Care* 2019;57:230–6.
- McManus RJ, Mant J, Bray EP, *et al*. Telemonitoring and self-management in the control of hypertension (Tasminh2): a randomised controlled trial. *The Lancet* 2010;376:163–72.
- Martínez-Ibáñez P, Marco-Moreno I, Peiró S, *et al*. Home blood pressure self-monitoring plus self-titration of antihypertensive medication for poorly controlled hypertension in primary care: the ADAMPA randomized clinical trial. *J Gen Intern Med* 2023;38:81–9.

- 30 Jones MI, Greenfield SM, Bray EP, *et al.* Patients' experiences of self-monitoring blood pressure and self-titration of medication: the Tasminh2 trial qualitative study. *Br J Gen Pract* 2012;62:e135–42.
- 31 Marco-Moreno I, Martínez-Ibañez P, Avelino-Hidalgo E, *et al.* Primary care doctors' views on self-monitoring of blood pressure and self-titration among patients with uncontrolled hypertension in Spain. The ADAMPA trial focus group study. *BJGP Open* 2020;4.
- 32 Clark CE, McDonagh STJ, McManus RJ, *et al.* COVID-19 and hypertension: risks and management. a scientific statement on behalf of the British and Irish hypertension society. *J Hum Hypertens* 2021;35:304–7.
- 33 Pavey H, Kulkarni S, Wood A, *et al.* Primary hypertension, anti-hypertensive medications and the risk of severe COVID-19 in UK Biobank. *PLoS One* 2022;17:e0276781.
- 34 Matsumoto C, Shibata S, Kishi T, *et al.* Long COVID and hypertension-related disorders: a report from the Japanese society of hypertension project team on COVID-19. *Hypertens Res* 2023;46:601–19.
- 35 Xie Y, Xu E, Bowe B, *et al.* Long-term cardiovascular outcomes of COVID-19. *Nat Med* 2022;28:583–90.
- 36 Akpek M. Does COVID-19 cause hypertension *Angiology* 2022;73:682–7.
- 37 Chen G, Li X, Gong Z, *et al.* Hypertension as a sequela in patients of SARS-Cov-2 infection. *PLoS One* 2021;16:e0250815.
- 38 Simple Shared Healthcare. Florence intelligent health Messaging London. 2023. Available: <https://www.simple.uk.net/>
- 39 BIHS. The British and Irish hypertension society, blood pressure monitors. 2023. Available: <https://bihsoc.org/bp-monitors/>

Appendix 8: Version 2 21/06/2021

Patient Interview Guide- Telemonitoring and non-Telemonitoring Groups



Prior to the start of each recorded interview the interviewer(s) will introduce themselves and inform the participant about use of audio recording device before reconfirming consent.

Section	Question/Content	Prompt
Basic Introduction: History of hypertension diagnosis and management.	<ol style="list-style-type: none"> 1. Can you tell us a little bit about how and when you were first diagnosed with hypertension (high blood pressure)? 2. How was your high blood pressure first managed and how do you manage it currently? 3. How do you feel living with hypertension? Do you feel hypertension impacts on your life? If yes, how so? 	Qu 1: <i>Do you have any additional health conditions?</i> Qu 2: <i>Lifestyle changes, medication?</i> Qu 3: <i>Does it cause you any worry or concern? Do you experience any other health conditions as a result of your high blood pressure e.g. headaches</i>
Telemonitoring Group: Experience of managing BP with monitor	<ol style="list-style-type: none"> 1. At what point during your management for high blood pressure were you introduced to remote monitoring technology to manage your condition? 2. What were your initial thoughts/feelings when first introduced to the remote monitoring technology? 3. What has your experience been of using remote monitoring technology to manage your blood pressure? 4. Has the use of remote monitoring technology changed the way you see/manage your condition? If so, how 5. Do you feel your blood pressure is under control? 	Qu 1: <i>i.e First diagnosed vs long term hypertension patients</i> Qu 3: <i>Technical/Clinical/Organisational</i> Qu 3: <i>Personal (anxiety/reassurance)</i> Qu 5: <i>If yes-</i> <i>What do you think has contributed to this? If no- In what way/what if anything do you think will help?</i>
Telemonitoring Group: COVID-19	<ol style="list-style-type: none"> 1. During the covid-19 pandemic if you felt unwell would you be more or less likely than usual to contact the NHS? 2. Have you managed to access health services to help you manage your hypertension during COVID-19? 3. How do you feel having access to the remote monitoring technology has impacted (if at all) on your blood pressure management during the pandemic? 4. If you had high blood pressure readings, what route did you use to follow this up during the pandemic? Has this changed as a result of the pandemic? 	Qu 2: <i>If so, how and why? If not, have you needed to? Been unable to?</i> Qu 3: <i>Personally- Has it helped you feel supported? left to own devices? In control? Safer- not having to travel to surgery for check ups?</i> Qu 4: <i>Phone call, email, letter for telephone appointment</i>

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Patient Interview Guide- Telemonitoring and non-Telemonitoring Groups




	<ol style="list-style-type: none"> 5. Have you had confirmed COVID-19? Did you require hospital treatment? Did you experience any challenges managing your hypertension during this time? 6. Have you required hospital treatment due to any other cause over the last 12-18 months? 7. Did you experience any challenges using the telemonitoring service during COVID-19? 8. What improvements, if any would you like to see with the telemonitoring service? 	<p><i>Qu 5: Any emergency admissions, cardiac (Heart) or thrombus (bleeding/clot) events i.e Stroke</i></p>
<p>Non-Telemonitoring Group: Experience of managing BP</p>	<ol style="list-style-type: none"> 1. Do you currently monitor your blood pressure? If yes, how? If no, would you like to have the opportunity to be able to monitor your own blood pressure? 2. What advice, if any have you been given to help manage your hypertension? 3. Do you feel your blood pressure is under control? If yes, what contributing factors do you think help you to control your blood pressure? If no, why do you think this is? what additional help/support/thing do you think would help you get your blood pressure under control 	<p>Qu 1: Were you advised to monitor your own blood pressure by a healthcare professional? or self-monitored by choice?</p> <p>Qu 3: e.g. lifestyle advice/changes? More medication? More or less healthcare professional support?</p>
<p>Non- Telemonitoring Group: COVID-19</p>	<ol style="list-style-type: none"> 1. During the covid-19 pandemic if you felt unwell would you be more or less likely than usual to contact the NHS? 2. Have you been able to access health services to manage your hypertension during COVID-19 3. If you monitor your blood pressure and had high readings, what route did you use to follow this up during the pandemic? Has this changed as a result of the pandemic? 	<p><i>Qu 2: If so, how and why? If not, have you needed to? Been unable to?</i></p>

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Patient Interview Guide- Telemonitoring and non-Telemonitoring Groups

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	<ol style="list-style-type: none">4. Have you had confirmed COVID-19? Did you require hospital treatment? Did you experience any challenges managing your hypertension during this time?5. Have you required hospital treatment due to any other cause over the last 12-18 months?6. What, if any challenges have you experience managing your hypertension during the COVID-19 pandemic?7. What improvements, if any would you like to see for managing hypertension?	<p><i>Qu 4: Any emergency admissions, cardiac or thrombus events i.e TIA/Stroke</i></p>
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