



Scale-Up BP Final Evaluation

*Extending the reach of remote blood pressure monitoring
across Scotland between April 2019 and September 2021*

Dr Helen Alexander,

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A big thank you also goes to the project team and everyone in Scottish Government who has contributed to Scale-Up BP at many different levels, especially those who provided information and answered questions in relation to this evaluation.

SUMMARY

Scale-Up BP has been more successful than originally hoped and contributed to increased condition control, in-person appointments saved, and better use of resources. People had overwhelmingly positive experiences of the technology and staff felt engaged and supported in its use. The pandemic may have contributed to giving Scotland a stronger foundation for Connect Me, but more citizens can still benefit

Scale-Up BP ran from April 2019 to September 2021 to increase the reach of remote blood pressure monitoring via SMS texts



30148 people benefited – 50% more than target

537 General Practices joined the programme – 8% more than target

In 2018 remote monitoring reached 1.6% of those with hypertension in Scotland. Scale-Up BP increased this to 5%

There are still more people who could benefit



Over **67,000 in-person appointments** were saved by 6 of the 13 partners



Scale-Up BP increased condition control

Median systolic and diastolic BPs were lower after 6 or more months of remote monitoring in two partner areas

Resources were used effectively & efficiently

An estimated £629,000 cost was avoided from people not needing in-person appointments, and the Net Present Value cost-effectiveness was at least £4.5m over the next 10 years

“It’s so easy to use ... it takes about two minutes”

***People had overwhelmingly positive experiences of the system.** They said it was easy to use, 85% found it helpful, it saved a lot of time and effort and did not impact on life too much. Although a few did not like it, 57% were more aware of health issues, most appreciated getting reminders to measure their BP and one found it encouraged them to exercise and eat more healthily*



“It saves on appointments” and “improved patients’ BP control”

***Staff felt engaged and supported**, saying remote monitoring was easy to use and helpful. Although a couple had encountered system issues and there was a little lack of buy-in early on, others found it helped them diagnose hypertension more quickly or reduce some of the workload. One noted it was not for everyone, but felt more patients who had used it seemed to be taking responsibility for their health and wellbeing*

It appears the **pandemic may have had a positive impact** on some issues identified at the outset as potentially detrimental to Scale-Up BP. Remote monitoring increased in value when working practices had to change radically and the emergency procurement of a new national system brought improved functionality. The pandemic also highlighted issues around digital inclusion

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1] INTRODUCTION

Our refreshed Digital Health and Care Strategy (Scottish Government, 2021) puts citizens at the centre of incorporating digital technologies into service design and delivery. Evaluation has shown that *Connect Me* (previously known as Home and Mobile Health Monitoring) contributes to a range of person-centred outcomes such as increased self-management, greater access to services, improved condition control, and optimised in-person contacts (Alexander, 2018). It also enables resources to be used efficiently (reinforced in Michael et al, 2019) and people who are remotely monitoring describe very positive experiences.

By 2018 our national Technology Enabled Care (TEC) programme had built a solid foundation for scaling up some of our *Connect Me* pathways. A focus on hypertension was agreed because it was the most frequently used pathway at the time and research in general practice suggested that telemonitoring could reduce blood pressure (BP) to a similar extent as seen in randomised controlled trials, with little detriment to workload (confirmed in Hammersley et al, 2020).

‘Scale-Up BP’ was to run from April 2019 to March 2021 and increase the reach of remote BP monitoring. Eight core partners were initially funded, one started later, and another four undertook tests of change. Some partners had previous experience with remote monitoring in general practice whilst others were new to the system i.e. Florence Short Message System (SMS). The funding period was extended to compensate for the impact of the pandemic in some areas, and this report shows how much progress had been made by the end of the programme in September 2021.

2] METHOD

The TEC evaluation options study (Scottish Government, 2018) recommended a theory-based approach to evaluation and defined the outcomes that *Connect Me* should aim to achieve. Further evidence on the impact of Scale-Up BP was sought using a Contribution Analysis approach (Mayne, 2012), with which many of the funded partners were already familiar. Mayne (2012) says that ‘*if one can verify or confirm a theory of change with empirical evidence, and account for major external influencing factors, then it is reasonable to conclude that the intervention in question has made a difference.*’ Table 1 shows the Contribution Analysis timeline for Scale-Up BP.

Table 1 – Timeline of the six steps of Contribution Analysis for Scale-Up BP

Step	Step description	When undertaken
1	Set out the issue to be addressed	Scale-Up BP launch in 2019
2	Develop the theory of change	Scottish Government (2018) logic model
3	Gather evidence about the theory of change	September 2019 to December 2020
4	Assemble and assess the contribution claim	Interim evaluation December 2020
5	Seek out additional evidence	January 2021 to January 2022
6	Revise and strengthen the contribution story	February 2022

The case for change was articulated in 2019 i.e. overall BP control in Scotland was poor and that over a million in-person appointments each year to measure it was an inefficient use of resources. For step 3 in Table 1, discussions were held with each of the partners to identify which of the logic model outcomes they would contribute to. The first *Connect Me* evaluation (Alexander, 2018) had presented considerable evidence for increased self-management and improved access to services, so Scale-Up BP focused on the ones described in Table 3.

The evaluation also included a baseline assessment of the potential for scale-up across the partners, undertaken using the short ‘**Non-adoption, Abandonment and challenges to Scale-up, Spread and Sustainability**’ (NASSS) **Complexity Assessment Tool** (Greenhalgh et al, 2020). This was to identify issues that might need to be addressed and was revisited later to assess the pandemic’s impact.

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3] TARGETS FOR SCALE-UP BP

Scale-Up BP aimed to extend the reach of remote BP monitoring to another 20,000 citizens by March 2021 as well as increasing the uptake to more than half of Scotland’s general practices. Figure 1 shows how many citizens had benefited by the programme’s revised end date (September, 2021).

Figure 1 - Cumulative no. citizens benefiting from remote BP monitoring

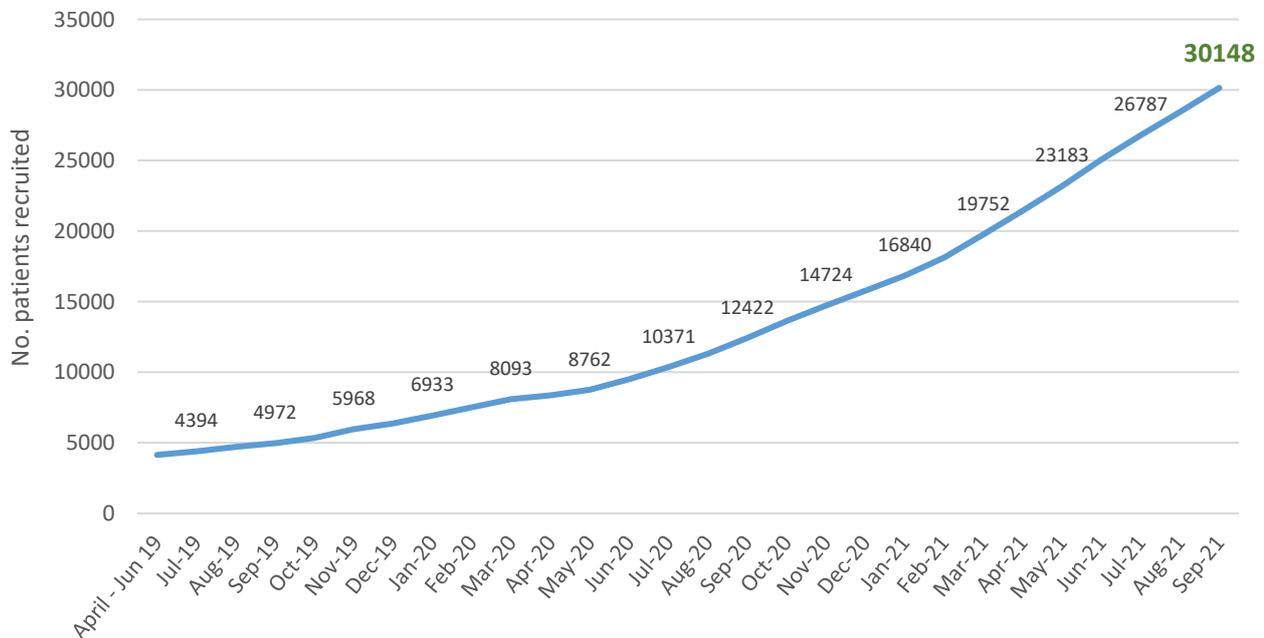


Figure 1 includes 3,277 people who were recruited by some partners in the overlap with a British Heart Foundation project (April to June 2019). However, by 30th September, 2021 the target had not only been met, but **surpassed by an additional 50%**, with **30,148 citizens** having remotely monitored their blood pressure. Although Scale-Up BP had been extended to compensate for any pandemic impact, the target was met just after the original target date, in April 2021.

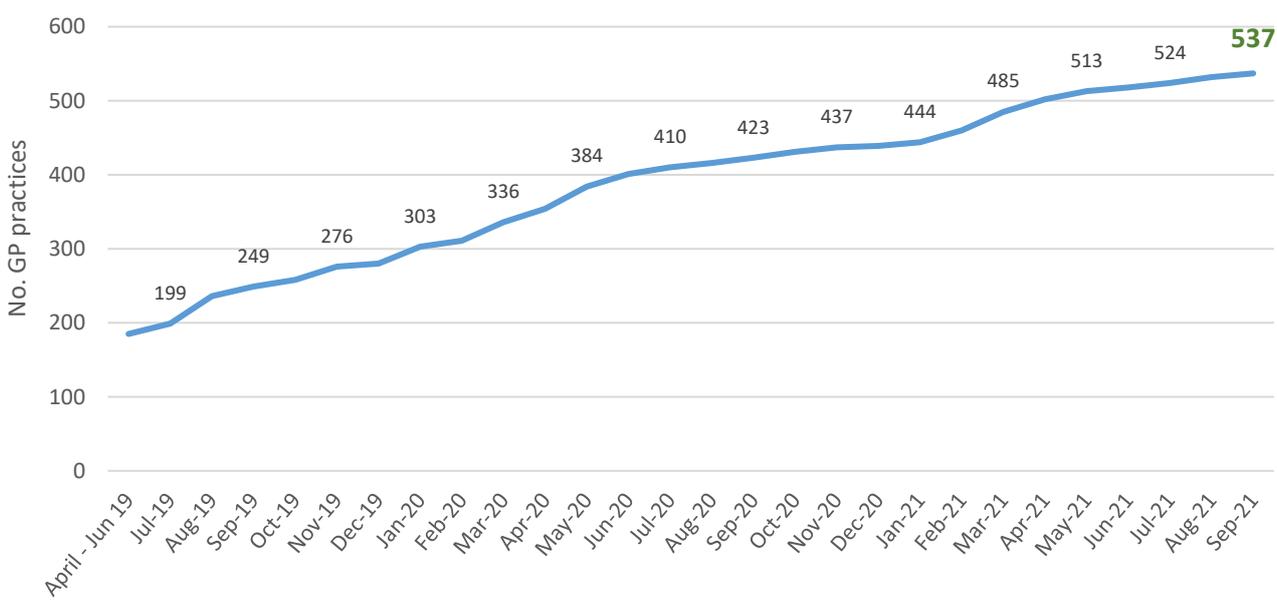
At the start of the pandemic there was an understandable slowing of recruitment in general practices, but it quickly began to pick up from May 2020 onwards. The month of October 2020 saw 1,204 new patients recruited, which was more than double the pre-pandemic number in February, 2020 (n=582). The rate of recruitment continued to increase, as shown by the steepening gradient in Figure 1, especially in the last seven months of the programme.

The Figure 1 totals are for all three protocols developed during Scale-Up BP; one each for hypertension diagnosis, medication titration and long-term monitoring. Before this programme, partners had created their own protocols in response to local need. However, it was agreed that standardising them across Scotland would be important for collating the results and ensuring that all citizens benefited from the same approach. New partners were able to begin with the standard national protocols, whilst the others transitioned onto them over time. Although not all partners submitted detailed protocol data, remote monitoring was mostly used for diagnosis and titration.

By September, 2021 a total of **537 GP practices** had joined the programme (Figure 2), which is **58%** of the 921 practices listed in Scotland on 1st January, 2022 (ISD, 2022) and 8% above the target. In terms of participation in the areas covered by the Scale-Up BP partners, these 537 represent 67% of the potential 796 practices that could have taken part.

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Figure 2 - Cumulative no. GP practices using remote BP monitoring



Whilst the numbers achieved during the Scale-Up BP programme have exceeded the targets set, they need to be considered in the wider context. The earlier *Connect Me* evaluation (Alexander, 2018) found that 1.6% of those with hypertension in the partner areas had remotely monitored their blood pressure. Table 2 shows the rate for each of the Scale-Up BP partners.

Table 2 – Percentage of people with hypertension who had remotely monitored their blood pressure

Partner (Test of Change) <i>New in green, experienced in blue</i>	No. who had remotely monitored by Sept '21	No. months enrolling patients	Mid-2020 population *	Estimated hypertension prevalence **	% hypertensive population who had remotely monitored
NHS Ayrshire & Arran	4,388	30	367,990	51,151	8.6%
NHS Highland	3,351	30	320,860	44,600	7.5%
NHS Lanarkshire	6,447	30	661,960	92,012	7.0%
NHS Western Isles	192	6	26,500	3,684	5.2%
NHS Lothian	6,525	23	912,490	126,836	5.1%
NHS Forth Valley	1,389	30	305,930	42,524	3.3%
Aberdeenshire HSCP	890	6	229,060	31,839	2.8%
Dumfries & Galloway HSCP (ToC)	547	24	148,290	20,612	2.7%
Scottish Borders HSCP (ToC)	339	9	115,240	16,018	2.1%
Glasgow City HSCP	1,701	30	635,640	88,354	1.9%
East Renfrewshire HSCP (ToC)	231	11	96,060	13,352	1.7%
NHS Tayside	699	26	416,550	57,900	1.2%
NHS Fife (ToC)	172	8	374,130	52,004	0.3%
British Heart Foundation overlap	3,277	N/A	N/A	N/A	N/A
TOTALS	30,148	N/A	4,309,970	640,886	5%

* National Records of Scotland: Population Estimates by Administrative Area. <https://www.nrsscotland.org.uk>

** Scottish Public Health Observatory: 2015/16 Quality & Outcomes Framework hypertension prevalence of 13.9%. <https://www.scotpho.org.uk/clinical-risk-factors/high-blood-pressure/data/prevalence/>

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Table 2 shows that most progress in scaling up was made by those partners who had previous experience with remotely monitoring blood pressure (highlighted in blue in Table 1). Many of the newer partners (highlighted in green) needed to establish the processes involved, leaving them less time to enrol patients. Three of the four test of change (ToC) partners left the programme long before the end, and only one of them continued to scale-up until September, 2021.

By the end of Scale-Up BP in September 2021, 5% of those with hypertension in the target areas had remotely monitored their blood pressure and 11 of the 13 partners exceeded the 1.6% reached in 2018. Whilst 5% is more than three times the previous programme level (2015-18), it means there are still many people who have not been offered remote monitoring. Most partners used remote monitoring for the diagnosis and/or medication titration of new patients, so a future focus on use of the long-term monitoring protocol for those with established hypertension should be considered. The outcomes that they might benefit from are discussed in section 4.

4] OUTCOMES FOR THE EVALUATION OF SCALE-UP BP

This evaluation is viewed as a progression of the 2015-18 work that generated considerable evidence of outcome achievement. Table 3 summarises the data gathered from 2019 to 2021.

Table 3 – Evidence available for Scale-Up BP outcome achievement

Outcome	Evidence to determine achievement (or not)
1 Increased condition control	Long-term BP monitoring data from Highland and Lanarkshire
2 Optimised in-person contacts, if needed e.g. in-person appointments avoided	Number of in-person appointments avoided in Ayrshire & Arran, Borders, Fife, Highland, Lanarkshire and Lothian
3 Resources used effectively and efficiently	Appointment costs avoided for Ayrshire & Arran, Lanarkshire and the Western Isles
4 People have positive experiences of services	Patient feedback survey from Highland, digital stories from Ayrshire & Arran and Lanarkshire
5 Staff feel engaged and supported	Staff feedback surveys from Lanarkshire, Highland & Tayside, Lanarkshire practice staff interviews

4.1] INCREASED CONDITION CONTROL

One of the Scale-Up BP partners (NHS Lothian) had previously run a hypertension telemonitoring study to test if randomised controlled trial findings could be replicated in routine clinical practice at scale (Hammersley et al, 2020). They showed that median blood pressure was lower (by 6mmHg for systolic, 4mmHg for diastolic) after people with hypertension had self-monitored for a year.

The evaluation of Scale-Up BP was not a research study, rather it explored the use of remote monitoring with local GP practices who were willing to take part, and condition control data from routinely reported BP. Data availability was limited by all the day-to-day issues encountered by the partners and the fact that they mostly used the diagnosis and medication titration protocols. Only NHS Highland and NHS Lanarkshire had enough long-term monitoring data to analyse, and the monitoring period had to be reduced from a year to six months to maximise the numbers.

Anonymised data was extracted by the TEC teams in Highland and Lanarkshire for any patient who had at least six months of readings between 29th August 2019 and 31st October, 2021. It was transferred securely for the evaluation and a single dataset was created for analysis, applying the parameters used by Hammersley et al (2020) e.g. comparing second and last BP readings. A summary of the results is shown in Table 4.

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Table 4 – Comparison of Scale-Up BP data and Hammersley et al (2020) results

NHS Highland + NHS Lanarkshire data (SD)		
Difference between 2 nd and last recorded BP reading (mmHg) (n=138)		
Average 2 nd systolic BP reading	138 (16.6)	
Average last systolic BP reading	133 (13.6)	
Average 2 nd diastolic BP reading	79 (10.7)	
Average last diastolic BP reading	77 (10.8)	
	NHS Highland + NHS Lanarkshire data (SD) *	Hammersley et al (2020) results (IQR)
Median difference in 2nd and last systolic BP	5 (16.6)	6 (-3 to 15)
Median difference in 2nd and last diastolic BP	2.5 (9.8)	4 (-1 to 10)
People with uncontrolled hypertension at the start (home systolic BP \geq 135 mmHg)		
Median difference in 2nd and last systolic BP	12 (17.3), n=79	13 (6 to 23)
Percentage of people with uncontrolled hypertension at baseline and end of monitoring		
Uncontrolled hypertension at baseline	79 (57%)	48%
Uncontrolled hypertension at end of monitoring	59 (43%)	24%

* All 138 Highland (n=96) and Lanarkshire (n=42) patients were included as only 19 had \geq 12 months monitoring data, excepting the subset (n=79) with uncontrolled hypertension at the start. Average length of monitoring in Highland and Lanarkshire was 9 months (SD 3.4), and the average no. readings submitted was 32 (SD 41.9)

Table 4 shows that **median systolic and diastolic blood pressures were lower** after people with hypertension in Highland and Lanarkshire had self-monitored for six months or more. The magnitude of this reduction (5 mmHg) was slightly lower than found by Hammersley et al (2020), but the monitoring period was shorter (an average of 9 months compared to one year). However, a recent meta-analysis of 48 randomised trials found that ‘a 5 mmHg reduction of systolic blood pressure reduced the risk of major cardiovascular events by about 10%, irrespective of previous diagnoses of cardiovascular disease, and even at normal or high-normal blood pressure values’ (Blood Pressure Lowering Treatment Trialists’ Collaboration, 2021).

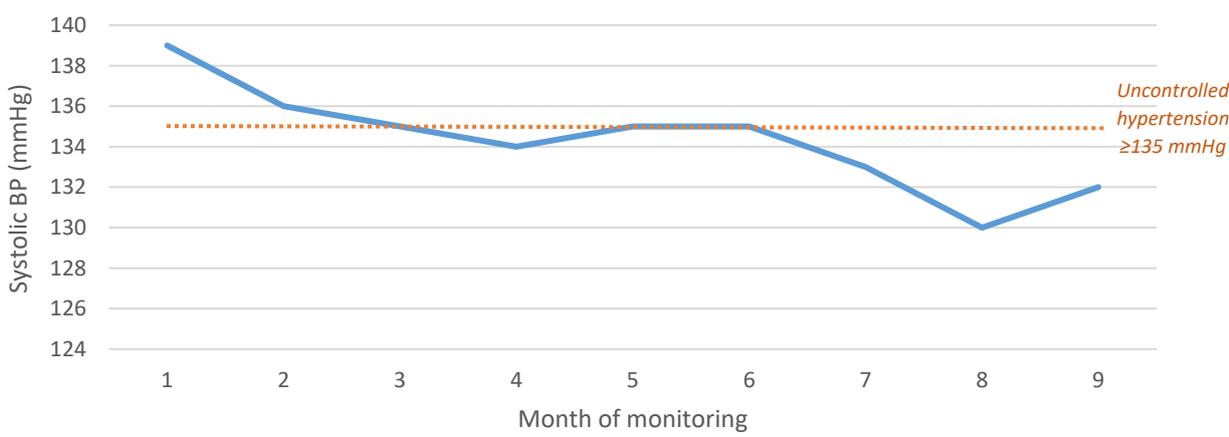
The median difference for those who started with uncontrolled hypertension (home systolic BP \geq 135 mmHg) was similar between the Scale-Up BP partners (12 mmHg lower) and Lothian results (13 mmHg lower), although the reduction in the percentage with uncontrolled hypertension at the end of monitoring was less. Again this is likely to have been affected by the shorter Scale-Up BP monitoring period.

It should be noted that there was considerable variation in these results, as shown by the relatively high standard deviations (SDs) in Table 4. However, this will have been affected by the relatively small sample size, and Hammersley et al (2020) also reported variation around the medians (shown in their interquartile ranges).

Change in the overall average systolic BP over time for Highland and Lanarkshire (Figure 3) shows that the **average systolic BP reduced over the first nine months of self-monitoring** for this group of patients, from within the uncontrolled range (\geq 135 mmHg) to controlled. Although the definition of average means that not everyone had controlled hypertension after nine months, the downward systolic BP trend in Figure 3 is clear. The number of people self-monitoring for more than nine months was too small to extend the horizontal axis at this stage, but it is hoped that as more people use the long-term monitoring protocol, many others will benefit from a similar reduction, and whether or not it is sustained can be explored.

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Figure 3 - Average systolic BP for Highland and Lanarkshire long-term monitoring patients (n=138)



4.2] IN-PERSON APPOINTMENTS SAVED BY SCALE-UP BP

Six Scale-Up BP partners were able to provide data on the number of in-person appointments that were saved by remote monitoring (Table 5) i.e. when patients did not need to attend the practice to have their blood pressure checked by a GP or nurse.

Table 5 – No. in-person appointments saved between April 2019 and September 2021

Partner	No. in-person appointments saved per person	No. patients	Total saved
Ayrshire and Arran	Practice data showed an average of 2.4 appointments saved for diagnosis, 3.3 for medication titration. <i>Assume 1 per long-term monitoring patient (see Lothian below)</i>	2,961 + 3,786 + 53	7,106 12,494 53
Borders	Practices estimated an average of 2 appointments saved for diagnosis	339	678
Fife	122 face-to-face appointments saved for 145 patients in six practices over a six month period for diagnosis	172	145
Highland	Practice survey responses showed an average of 1.5 appointments saved for diagnosis, 1.1 for medication titration. <i>Assume 1 per long-term monitoring patient (see Lothian below)</i>	3950 + 3049 + 5154	5,925 3,354 5,154
Lanarkshire	Practices estimated an average of 4 appointments saved for diagnosis/medication titration	6,447	25,788
Lothian	Median in-person appointments reduced by 1 per patient with established hypertension (Hammersley et al, 2020)	6,525*	6,525
TOTAL FOR ALL SIX PARTNERS		20,283	67,222

* Assumes all were long-term monitoring. This number will be an underestimate if not

The number of in-person appointments saved by remote BP monitoring varies across Scotland, depending on how this was done before. In some areas GPs had already deployed self-monitoring, while others relied on in-person appointments to diagnose and treat hypertension. It is also affected by which protocols were used i.e. most areas focused on diagnosis and medication titration, which avoided more appointments than long-term monitoring.

To put the total number of in-person appointments saved into context, 275 GP practices used remote monitoring in these six partner areas, which is an average of 244 appointments per practice. In most cases it will have been nurses measuring blood pressure, so if each one takes around 10 minutes (Michael et al, 2019) the total saved would equate to 41 hours per practice.

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Of the 1.2 million appointments in Scotland each year for hypertension checks cited in Hammersley et al (2020), the 67,222 saved by these six Scale-Up BP partners over 2.5 years equates to 26,889 per year or 2.2% of all hypertension checks. If *Connect Me* for blood pressure monitoring was scaled up to the rest of Scotland and most of the eligible patients, the saving could be considerably more.

4.3] RESOURCES USED EFFECTIVELY AND EFFICIENTLY

Table 6 shows the minimum equivalent cost of appointment time saved for the three partners who were included in the *Connect Me* economic case study report (Michael et al, 2019). Although the calculations showed a range of costs based on different financial assumptions, only the lowest point is included in Table 6.

Table 6 – Minimum appointment costs avoided for three partners	Ayrshire and Arran	Lanarkshire	Western Isles
Minimum equivalent cost of appointment time saved per 100 patients *	£2,528	£2,018	£1,096
No. patients remotely monitoring BP by 30th September, 2021	4,388	6,447	192
Total minimum cost of avoided appointments	£110,929	£130,100	£2,104

* Economic case studies were based on 2017/18 costs, which will be higher now

The minimum cost avoided by these three partners was **£243,133**, although this is an underestimate as the economic case studies were based on 2017/18 costs. It is possible to extrapolate this for the other 10 partners by assuming that their costs were similar to those of Lanarkshire. These costs may be more typical since Ayrshire and Arran were the only NHS Board to have a dedicated TEC Hub at the time (e.g. their administration costs were centralised) and GPs in the Western Isles had already deployed remote blood pressure monitoring for their more rural practice populations (but not text messaging for results submission). Assuming the costs for other partners were similar to Lanarkshire would mean a total appointment cost avoided by Scale-Up BP as follows:

$$(\text{£}130,100 \div 6,447) \times 25,568 \text{ (11 partners)} + \text{£}110,929 \text{ (Ayrshire \& Arran)} + \text{£}2,104 \text{ (Western Isles)} \\ = \text{£}628,993$$

The economic case studies (Michael et al, 2019) calculated overall hypertension remote monitoring cost effectiveness via Net Present Value, and all the scenarios modelled were net positive. Net Present Value (NPV) is the sum of all future benefits (but in the present) minus the value of future costs, and it balances the overall cost of remote monitoring against the monetary equivalent of the benefits realised. The minimum NPVs calculated for the three partners in Table 6 were between £15k and £85k over 10 years for every 100 patients self-monitoring their BP. Using the lowest point (£15k) would mean that over the next 10 years the Net Present Value of these 30,148 patients self-monitoring would be more than **£4.5 million**.

NPV is not cash-releasing, but savings could be quantified if the diagnosis protocol stopped some people with white coat hypertension (WCH) being prescribed medication. Nuredini et al (2020) reported that 35% of people with elevated clinic BP that was untreated had WCH. More detail for patients using the diagnostic protocol would be needed, but the savings are likely to be fairly small.

Long-term BP telemonitoring leads to approximately a 20% increase in anti-hypertensive therapy, although this does not result in significantly greater costs (Hammersley et al, 2020). This is partly because of the low cost of anti-hypertensive medication generally and the flat pricing structure for commonly used medications i.e. higher and lower strength tablets are similarly priced.

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4.4] PEOPLE HAVE POSITIVE EXPERIENCES OF SERVICES

How people experienced remote blood pressure monitoring was captured by NHS Highland in an extensive on-line survey, and by Ayrshire and Arran and Lanarkshire in digital stories.

Between 27th June, 2020 and 30th September, 2021 a total of 1,215 patients in Highland responded to an on-line survey asking how they found using the system (which they knew as Florence or Flo) and what difference, if any, it had made for them. The results were overwhelmingly positive, although a few said they would *'rather deal with people'* or felt Flo was *'a slow, drawn-out method'*.

- The average rating for overall experience of using Florence was 8.4 out of 10
 - 76% rated it 8, 9 or 10 and only 2.6% rated it less than 5 (4 gave it a 0)
- 85% said they found Florence helpful, 30% supportive and 29% motivating
- 57% said it had helped them become more aware of health issues, 50% to take personal responsibility
- 59% said Florence had reduced their need to attend GP appointments, 53% that it had enhanced their experience of healthcare
 - When asked to quantify how many visits to the GP practice had been avoided by using Florence, the average was 4.5 (SD 9.3)
 - 74% said they travelled to their GP practice by car, 20% walked
 - 57% lived less than 5 miles from their GP practice, 4% more than 10 miles

When given space to comment on what difference Florence had made to them or their health, many people reinforced the results above, but others added that it *'encouraged exercise and healthier eating'* and *'Flo is totally irritating but she makes me take my BP, which I would not do otherwise'*.

In terms of what people liked most about Florence there were a range of different responses. The most common wording was that it was easy/quick to use (11%), they appreciated the reminders to take their BP (11%), liked knowing what their BP was (6%) and the convenience of being able to check it at home/at any time (6%). While one person said I *'can't wait to get rid of it'*, another said they had *'ordered a monitor so I can continue'* after it was returned to the GP practice.

People were also asked what they disliked most about Florence and 45% said there was nothing they didn't like, 21% left the question blank. 7% mentioned the timing of text messages/taking readings, mostly that it was difficult to fit around work e.g. *'you don't get a chance to pick timing, especially if you do shift work'* or that it was too early or late in the day e.g. *'at the weekend it's 8 in the morning'*. (It is worth noting that the timing can be tailored.) 2% found the BP cuff painful/uncomfortable, others weren't sure they were doing it right (1%) and 1% commented on lack of mobile signal or being told by their provider they'd be charged for the texts, which they were not.

These survey results are also reflected in digital stories. One Ayrshire patient who was offered remote monitoring after being diagnosed with high blood pressure described how he benefited from *"not having to go and sit in a doctor's waiting room to get my blood pressure taken"*, saving him *"a lot of time and effort."* He would *"recommend Flo to anybody, it's very easy to use and very useful."* Find the full digital story at: [Remote monitoring and diagnosis - Digital \(alliance-scotland.org.uk\)](https://alliance-scotland.org.uk/digital-stories/remotemonitoringanddiagnosis).

A Lanarkshire patient who had high blood pressure also commented that *"the system in itself is so easy to use it doesn't impact on your life at all ... it takes about two minutes."* He was keen to stress how it fitted with his lifestyle, saying, *"A man of my age, you become quite independent and you don't want to rely on going to doctors ... now that I'm on the system I'm quite happy and it allows me to continue doing everything that I need to do and want to do."* Find the full digital story at <https://tec.scot/programme-areas/remote-health-pathways/blood-pressure>.

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4.5] STAFF FEEL ENGAGED AND SUPPORTED

The views of staff using *Connect Me* for blood pressure monitoring were gathered in Lanarkshire, Highland, and Tayside via on-line staff surveys and some individual interviews with Lanarkshire practice staff. Slightly different questions were used in each and one survey was conducted before the pandemic, the second a year later and the third at the end of Scale-Up BP.

NHS Lanarkshire asked for feedback on remote BP monitoring a few months before the start of the pandemic (December, 2019 to January 2020) and received responses from 13 practices covering 9 of the 10 main geographies. Nine were from nurses, three from GPs and one respondent was a healthcare assistant. They had recently started using the national protocols and many found them easy to use, said they were *'extremely helpful towards the running of my clinics'* or *'definitely working for our practice'*. Feedback about the Florence results now uploading to Docman was mainly seen as beneficial, although one or two respondents mentioned a delay before they could be viewed there, and one of the practices that linked with both Lanarkshire and Glasgow had not yet received anything via Docman. In the additional comments section, one GP said, *'this really is a fantastic service that is offered to patients and it also has made my work life much easier'*. A practice nurse said that in addition to Florence saving time, it *'involves the patient in the process, it actually makes them more aware of their blood pressure'*.

NHS Lanarkshire was also keen to explore the reasons why some practices used the system while others did not. Interviews were conducted with GPs and practice staff in November 2019, when two of them had stopped using Florence. Those who had continued to use it were clear about the benefits for their patients and themselves and had made remote BP monitoring business as usual, some noting their surprise at the high uptake by their older patients. Lack of buy-in from practice colleagues and a perception that remote monitoring was more complicated than in-person consultations had led to disengagement. However, those not using Florence at the time were receptive to re-engaging since system integration had been resolved, and the local TEC team were working with them.

NHS Highland's staff feedback was gathered a year later, between December 2020 and February 2021. Responses were received from 7 GPs, 2 nurses and 2 healthcare assistants and they gave their overall experience an average rating of 7.7 out of 10 (SD 2.0). When estimating the time spent on each blood pressure appointment, there was an average saving of 5.5 minutes using Florence. Eight of the practices were already using the long-term monitoring protocol for its *'ease of use'*, because they obtained *'more reliable home BP levels'*, and it *'saves on appointments'*. They said it *'saves patients coming in every 6 months for a BP check'*, it *'empowers patients'* and *'patients seem to like it'*. One of those who had not yet used the long-term monitoring protocol said they found it easier to do an initial follow-up with the nurse then decide if Florence was required, another had not yet discussed using it, and the third had stopped using Florence until the results went directly into Docman (which they now do). Staff in Highland were asked to estimate what proportion of their patients currently purchased their own BP monitor instead of being supplied with one and the average was 29% (range 8 to 57%). In terms of the impact on patients' health and wellbeing, respondents felt it was *'good for patients to take control'* and that Florence had *'improved patients' BP control'*. Some of the practices said their processes were now *'more efficient'* e.g. *'huge reduction in appointments required'* and *'Florence allows us to diagnose hypertension quicker'* but another felt it hadn't changed their processes. When asked about any impact on workload, one respondent felt *'less harassed'* and another said there had been an initial increase but they were now *'starting to see a reduction in nurses' workload'*. Although some found it a *'very slow system'*, others highlighted *'patient responsibility'* and *'avoiding overmedicating'* as clear benefits.

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The most recent staff survey was undertaken in Tayside in December 2021 and 13 responses were received. When asked how they felt about using remote BP monitoring, all 13 comments were positive, e.g. that it was *'a good idea'*, a *'very useful tool'*, and *'easy to use'*. While one said it was *'user friendly for patients'*, another recognised that it was *'not for everybody'*. 12 of the 13 said they had enough support to use remote BP monitoring, singling out the project manager as being the most helpful source of this. In relation to clinical outcomes for patients, many respondents cited how the system helped them diagnose and manage hypertension remotely, saving *'a number of appointments'* for patients, while others noted some patients had had their medication increased or decreased. Two highlighted patients who had been diagnosed with white coat hypertension where *'their readings were much better at home and medication [was] not required'*. One felt with Florence that *'more patients are taking responsibility for their own health and wellbeing'* and had *'better compliance with medication when they see how it improves their readings'*. What they heard from their patients included that Florence was *'easy to use'*, *'very reassuring'* and they *'like the twice daily reminders'*. It saved their patients time and *'many have gone on to purchase their own machines to continue to monitor their BP regularly'*.

4.6] ALTERNATIVE EXPLANATIONS FOR THE RESULTS OBSERVED

Contribution Analysis acknowledges that there are likely to be a number of influencing factors at work, in addition to the intervention of interest. This means that to increase confidence in the claims being made, rival explanations for the results observed should be identified and their influence acknowledged or discounted. Table 7 is not intended to be comprehensive, but illustrates the most obvious rival explanations, with a summary of the basis for supporting or rejecting them.

Table 7 – Rival explanations for the observed Scale-Up BP results

Claim being made	Rival explanation	Rival explanation supported/rejected
Scale-Up BP increased condition control	Changes to medication regimes were responsible for reduced BP	Rejected – any changes at individual level are unlikely to be widespread
	Data from the small sample analysed was not representative	Possible – more data would increase confidence in the claim
	Improvements are due to people recording their BP wrongly	Rejected – similar errors across the whole sample are unlikely
Scale-Up BP saved 67,222 in-person appointments	Staff over-estimated the number of appointments avoided	Rejected – appointment data obtained directly from practices was similar to practice-informed & patient estimates
Resources were used more effectively and efficiently	Calculations may have overestimated the costs avoided	Rejected – a Health Economist did the original modelling and 2017/18 costs are more likely to be an underestimate
Most people had a positive experience of Scale-Up BP	Feedback may not have been obtained from a representative sample of users	Rejected – large sample size for one survey & not 100% positive, similar themes emerged from different areas
	The views of people not using the system were not included	Possible – we do not know what non-users thought about Scale-Up BP
Most staff using Scale-Up BP felt engaged and supported	The small sample may not be representative	Possible – more responses would increase confidence in the claim
	Staff don't feel able to be fully honest about any problems	Rejected – fairly consistent responses over time, some problems mentioned

Table 7 shows that most rival explanations were rejected, strengthening the claims that Scale-Up BP contributed to these outcomes. Although there was some support for three, they were based on insufficient or missing data rather than evidence directly calling them into question.

5] SCALE-UP, SPREAD AND SUSTAINABILITY

A baseline assessment of the potential for scale-up was undertaken between November 2019 and February 2020. Each partner was asked to complete short ‘Non-adoption, Abandonment and challenges to Scale-up, Spread and Sustainability’ (NASSS) Complexity Assessment Tool (Greenhalgh et al, 2020). This assumes that the level of complexity associated with technological innovations affects their implementation i.e. the more complex something is the less likely its chance of success. This is explored across six dimensions; the illness/condition, the technology, the value proposition, the intended adopters, the organisation, and the external context for the innovation.

Ten of the 12 partners funded at the start of Scale-Up BP completed the short NASSS-CAT, identifying the level of complexity associated with remote BP monitoring in their areas. Four of them felt they had no major complexity impacting on their ability to scale-up, although some of their responses mentioned lack of clarity around future funding. The two domains most often considered to have complexity likely to affect success were the value proposition and intended adopters. Partners felt decision-makers did not sufficiently value the technology and they were not convinced that GPs would adopt it in large enough numbers, some appearing resistant to changing their current practice. In the organisation domain, partners felt the pressures on GPs and changes associated with the new General Medical Services (GMS) contract might affect success, and they explained that there was limited time for staff from different organisations to work together to implement Scale-Up BP. In terms of the technology itself, the inherent restrictions of the Florence software were not felt to be conducive to scale-up and it was noted that there are large parts of Scotland with little or no mobile signal to support text messaging.

When this baseline data was captured, none of the issues that emerged as likely to affect scale-up were new, but they were revisited 10 months’ later to determine if the COVID-19 pandemic had had any impact. Table 8 compares the issues identified at baseline with what was observed in the Scale-Up BP data, *Connect Me* policy and processes and the pandemic response, all of which appeared to have changed the position on a few of the NASSS-CAT domains.

Table 8 – Baseline issues affecting scale-up and observations on changes during the pandemic

BASELINE ISSUES (captured Nov '19 to Feb '20)	OBSERVATIONS ON CHANGES (Dec '20)
Those who will make decisions on continuation beyond Scale-Up BP funding do not appear to value remote monitoring highly enough	The increased rate of recruitment suggested the value of remote BP monitoring had increased during the pandemic
Some people are resistant to the required change to BP monitoring	The increased number of GPs participating appeared to indicate that the perception of remote BP monitoring had changed and it may have helped to relieve some pressure
GP adopters are under considerable pressure and primary care is experiencing a lot of change	
Staff across the different organisations coming together for Scale-Up BP have limited time to introduce the new ways of working	The necessity of working differently during the pandemic seemed to require people to make time for remote BP monitoring
The inherent restrictions of Florence software are not conducive to scale-up	Emergency procurement of a new platform allowed alternative software to be explored
Large parts of Scotland have little or no mobile signal to support text messaging	Digital inclusion became widely recognised, with a series of actions identified to address it

Table 8 suggests that the COVID-19 pandemic changed the proposition for Scale-Up BP in a number of ways; increasing its perceived value for allowing some clinical work to continue, possibly helping to relieve a little of the pressure experienced in primary care, and having to make time for it because of the new ways of working. The emergency procurement of a new platform would bring improved functionality and the greater recognition of digital inclusion required action in response.

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6] CONCLUSIONS FROM THE SCALE-UP BP EVALUATION

The recruitment of patients to remotely monitor their blood pressure **exceeded the target set** by an extra 50%, helping **30,148 citizens** to engage. This represents a threefold increase (5%) on the percentage of those with hypertension remotely monitoring their BP in 2018 (1.6%). Almost all of the partners exceeded the 2018 level and more GP practices participated than was originally hoped (58% instead of the 50% target). These are considerable achievements for Scale-Up BP, especially since most of them happened during a pandemic.

Scale-Up BP **increased condition control**, with both the median systolic and diastolic blood pressures being lower (by 5 and 2.5mmHg respectively) after people with hypertension in Highland and Lanarkshire had self-monitored for six months or more. The median difference in systolic BP was greater (12 mmHg lower) for those who started with uncontrolled hypertension (home systolic BP \geq 135 mmHg) and the median 5 mmHg reduction is clinically significant for reducing the risk of major cardiovascular events. Average systolic BP reduced over time and all of the Scale-Up BP results are similar to a recently published Lothian study (Hammersley et al, 2020).

Scale-Up BP **saved 67,222 in-person appointments** for six of the 13 partners, mainly for diagnosis and medication titration. This is equivalent to 244 appointments for each of the participating GP practices, or 2.2% of the 1.2 million hypertension checks each year in Scotland.

With Scale-Up BP, **resources were used more effectively and efficiently**, saving a minimum of **£628,993** in appointments avoided and an overall Net Present Value **cost-effectiveness of £4.5 million** over the next 10 years. Although this is not cash-releasing, some savings could be realised from not prescribing medications when white coat hypertension is diagnosed remotely.

Most **people had positive experiences** of remotely monitoring their blood pressure. 1,215 people surveyed gave the system an average rating of 8.4 out of 10, and 85% said they found it helpful. They liked its ease and convenience, receiving reminders to check their BP and how not having to go to their GP for this fitted in with the other things in their lives. One person said the system *'encouraged exercise and healthier eating'* and another that *'Flo is totally irritating but she makes me take my BP, which I would not do otherwise'*.

Staff felt engaged and supported. At the start of Scale-Up BP one GP said the national protocols were *'extremely helpful towards the running of my clinics'* and another that the system had *'made my work life much easier'*. Towards the end of Year 2, staff gave the system an overall rating of 7.7 out of 10 and felt they obtained *'more reliable home BP levels'*. One said *'Florence allows us to diagnose hypertension quicker'* and another was *'starting to see a reduction in nurses' workload'*. A more recent staff survey at the end of Scale-Up BP found the system was a *'very useful tool'*, although *'not for everybody'*. Most staff felt supported with remote BP monitoring and one noted *'more patients are taking responsibility for their own health and wellbeing'*.

Comparing the potential for scale-up at the start to observations in Year 2 suggested that the **pandemic may have had a positive impact** on some of the early issues raised. The increased use of remote BP monitoring may partly have been born of necessity, allowing clinical work to continue and possibly relieving a little of the pressure being experienced. The emergency procurement of a new system would increase the functionality compared to the previous one and the need to conduct more business on-line had brought issues around digital inclusion into sharper focus.

In summary, Scale-Up BP has been more successful than originally hoped, and it has contributed to the achievement of a number of outcomes. But when the results are put into the wider context, there are more citizens who can still benefit.

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7] REFERENCES

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