**Institution:** University of Birmingham

**Unit of Assessment:** 2 – Public Health, Health Services and Primary Care

**Title of case study:** Improving the diagnosis and management of hypertension through self-measurement of blood pressure at home

**Period when the underpinning research was undertaken:** 2007–2017

**Details of staff conducting the underpinning research from the submitting unit:**

| Name(s): | Role(s) (e.g. job title): | Period(s) employed by submitting HEI: |
|---|---|---|
| Dr James Hodgkinson | Research Fellow | 2007-current |
| Prof. Sheila Greenfield | Professor of Medical Sociology | 1983-current |
| Prof. Una Martin | Professor of Clinical Pharmacology | 1996-current |
| Dr Sue Jowett | Health Economist | 1995-current |
| Prof. Richard McManus | Professor of Primary Care | 1998-2011 |

**Period when the claimed impact occurred:** 2014 – December 2020

**Is this case study continued from a case study submitted in 2014?** No

**1. Summary of the impact** (indicative maximum 100 words)

Studies led by the University of Birmingham have provided definitive evidence for the effectiveness of home blood pressure (BP) monitoring for diagnosis of hypertension and improving BP control. This has led to **improved patient experience** through a **reduction in unnecessary treatment** and also **reduced NHS costs**.
Specifically, we have:

- **Changed international guidelines** on the use of home BP monitoring for the diagnosis and management of hypertension.
- **Changed clinical practice** as GPs now widely adopt home monitoring for diagnosis and assessment of BP.

**2. Underpinning research** (indicative maximum 500 words)

High blood pressure (hypertension) is a major cause of stroke and other cardiovascular diseases and is one of the most important global preventable causes of morbidity and mortality. In 2020, hypertension affected 28% adults in England (around 15 million people) and contributed to more than 75,000 deaths. Clinical management of hypertension accounts for 12% of visits to primary care and up to £2.1 billion of healthcare expenditure including £1 billion on drugs alone.

Control of blood pressure (BP) is often difficult to achieve and until recently has been managed solely in the clinic by healthcare professionals. However, the stress of visiting the clinic increases the risk of an elevated BP reading, and clinic readings (CBPM) do not show how a patient's BP varies over time. Measuring the BP out of the clinic environment offers a better approach.

For this reason, **Ambulatory BP monitoring (ABPM)**, where a cuff connected to a portable monitor is worn continuously by the patient for a period of 24 hours, has become the gold standard method for diagnosing hypertension, but many people find it disruptive and there can be delays waiting for the appropriate equipment. **Home BP Monitoring (HBPM)**, where a patient measures their own BP, is an alternative option for measuring BP out of the clinic and has the added benefit of augmenting the role of the patient in their own healthcare.

Through a series of randomised controlled trials and systematic reviews, researchers from the University of Birmingham (UoB) have assessed the use of HBPM for the diagnosis and ongoing management of hypertension. In 2011, Hodgkinson led a systematic review to assess the relative effectiveness of HBPM, ABPM and CBPM for diagnosing hypertension [R1]. The results provided definitive evidence that (1) **both HBPM and ABPM are superior to CBPM for the diagnosis of hypertension** (KF1) and (2) **CBPM alone may result in substantial over-diagnosis** (KF2). Based on R1, McManus and Jowett led a cost-benefit analysis for the National Institute of Health and Care Excellence (NICE), which modelled the potential costs incurred by the NHS balanced against the health and quality of life outcomes for patients when diagnosing hypertension by the different methods to measure BP [R2]. This showed that **HBPM is cost-effective compared to clinic monitoring of BP** (KF3).

The team also studied the potential of HBPM for use in **management of hypertension**. Through a systematic review they identified that self-monitoring reduced BP in a range of international studies [R3]. Following this, through a series of randomised controlled trials (TASMINH2 [R4]; TASMIN-SR [R5] and TASMINH4 [R6]), they have shown that:

KF4. Self-management (involving self-monitoring of BP, self-adjustment of antihypertensive drug levels and telemonitoring of HBPM measurement, in which readings made at home are relayed to a health professional) results in better BP control and lower systolic BP compared with clinic readings in patients with poorly controlled hypertension [R4] and patients at high risk of cardiovascular disease [R5].

KF5. Drug adjustment by GPs, guided by HBPM readings, lowered BP better than adjustment guided by clinic readings in patients with poorly controlled BP. No additional benefit for telemonitoring alongside self-monitoring was seen over self-monitoring alone [R6].

**3. References to the research** (indicative maximum of six references)

**R1. Hodgkinson J**, Mant J, **Martin U**, **Guo B, Hobbs FDR**, **Deeks JJ**, Heneghan C, Roberts N, **McManus RJ**. Relative effectiveness of clinic and home blood pressure monitoring compared to ambulatory blood pressure monitoring in the diagnosis of hypertension: a systematic review. BMJ 2011; 342: d3621. doi: 10.1136/bmj.d3621

**R2.** Lovibond K, **Jowett S, Barton P**, Caulfield M, Heneghan C, **Hobbs FDR**, **Hodgkinson J**, Mant J, **Martin U**, Williams B, Wonderling D, **McManus RJ**. Cost-effectiveness of options for the diagnosis of high blood pressure in primary care: a modelling study. The Lancet 2011; 378(9798): 1219-1230. doi: 10.1016/S0140-6736(11)61184-7

**R3. Bray EP, Holder R, Mant J, McManus RJ**. Does self-monitoring reduce blood pressure? Meta-analysis with meta regression of randomised controlled trials. Ann Med. 2010;42(5):371-86.

**R4. McManus RJ**, **Mant J**, **Bray EP, Holder R, Jones MI, Greenfield S**, **Kaambwa B, Banting M,** Bryan S, Little P, Williams B, **Hobbs FDR**. Telemonitoring and self-management in the control of hypertension (TASMINH2): a randomised controlled trial. The Lancet 2010; 376(9736): 163-72. doi: 10.1016/S0140-6736(10)60964-6.

**R5.** McManus RJ, Mant J, **Haque MS**, Bray EP, Bryan S, **Greenfield SM**, **Jones MI**, **Jowett S**, Little P, **Penaloza C**, **Schwartz C**, **Shovelton C**, **Varghese J**, Williams B, Hobbs FDR. 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(8): 799-808. doi:10.1001/jama.2014.10057.

**R6.** McManus RJ, Mant J, Franssen M, Nickless A, Schwartz C, **Hodgkinson J, Bradburn P**, Farmer A, Grant S, **Greenfield SM**, Heneghan C, **Jowett S, Martin U**, **Milner S, Monahan M**, Mort S, Ogburn E, Perera-Salazar R, Shah SA, Yu LM, Tarassenko L, Hobbs FDR; TASMINH4 investigators. Efficacy of self-monitored blood pressure, with or without telemonitoring, for

titration of antihypertensive medication (TASMINH4): an unmasked randomised controlled trial. The Lancet 2018; 391(10124): 949-959. doi: 10.1016/S0140-6736(18)30309-X.

**4. Details of the impact** (indicative maximum 750 words)

Research from UoB has **improved clinical care and outcomes** for people with hypertension by increasing the use of home blood pressure monitoring. This **improves BP control** and therefore: i) **reduces the risk of stroke, cardiovascular disease and death** through improved treatment management, ii) **reduces unnecessary treatment** by misdiagnosis and (iii) **increases engagement of patients in their own care**. This has been achieved through:

- changing UK and international guidelines on hypertension;
- changing international care practices for the diagnosis and management of hypertension.

**1. <u>Healthcare guidelines for the diagnosis and management of hypertension have changed in the UK and internationally</u>**

We have had **world-wide influence on clinical guidelines** for the management of hypertension as **Canadian** (2015) [S1i, ii], **European** (2018) [S1iii], **Asian** (2018) [S1iv] and **American** (2018) [S1v] guidelines all now recommend HBPM as an alternative to ABPM, to confirm a diagnosis of hypertension [R1]. This brings them in line with **UK National Institute for Health and Care Excellence (NICE)** guidance which changed in 2011 based on our research [R1 and R2] to recommend "if a person is unable to tolerate ABPM, HBPM is a suitable alternative to confirm the diagnosis of hypertension." [recommendation 7.6.10, S1vii]

UK and international guidelines have also changed to support HBPM for ongoing monitoring of hypertension:

- **In the UK, new NICE guidance introduced in 2019** recommends clinicians to "Advise people with hypertension who choose to self-monitor their blood pressure to use HBPM" [recommendation 1.4.17, S1viiia, p. 12; R4, R6]. They also highlight that telemonitoring may not improve blood pressure control compared to self-monitoring, stating, "the evidence was not sufficient to support a clear benefit of this technique." [S1viiib, p. 33; R4, R6].
- **European guidelines** now state HBPM is "increasingly used by patients to monitor their BP control," and identify the benefit this brings to patients in that it "increases their engagement and may improve their adherence to treatment and BP control." [S1iii, p. 3038, ref 61,102; R5, R6].
- **Asian guidelines** now recommend, "Self-monitoring and self-titration may be feasible if carefully monitored by healthcare professionals and help improve BP control (Recommendation 5b)." [S1iv; R5].
- **American guidelines** now advise "Out-of-office BP measurements to confirm the diagnosis of hypertension and for titration of BP-lowering medication, in conjunction with telehealth counselling or clinical interventions." [Recommendation S4.2-3, Class 1 Level A; S1v, p. e24; R5]. During the COVID-19 pandemic, **a policy statement urging broader adoption of self-measured blood pressure monitoring** (SMBP) was also released by the American Heart Association and American Medical Association based on national guidelines. Its lead author stated "with fewer patients visiting medical offices during the COVID-19 pandemic, SMBP monitoring is more important than ever for people at risk for hypertension and uncontrolled BP" [S1vi].

**2. <u>GPs have changed care practices for the diagnosis and monitoring of patients with hypertension</u>**

**Use of HBPM to confirm a diagnosis of hypertension has more than doubled during this REF period** according to Clinical Practice Research Datalink (CPRD) data between 2006 and 2017 [S2] and a national survey of GPs which indicated a rise in use of HBPM for diagnosis from 37% in 2011 to 58% in 2015 [S3]. A survey in 2020 further shows that **nearly all GPs (88%) are now using HBPM to diagnose hypertension** with 50% using it as their preferred method. **Most**

**GPs (96%) are also using HBPM for ongoing management of hypertension** and 80% confirm they are more likely to use HBPM now than 10 years ago [S4].

We have contributed to this change in clinical practice, not only through influencing clinical guidelines, but also through **raising awareness of HBPM** directly with clinicians via an in-depth online learning module that provides practical guidance on blood pressure measurement [S5i]. This was published by the BMJ in 2011 and updated in January 2020. The module is now accredited by over 20 international organisations [S5i]. It has been completed by 12,846 clinicians; 623 feedback reviews have been left, nearly all of which are positive [S5ii].

We have also supported clinician training in HBPM through Martin's work with the **British and Irish Hypertension Society (BHIS)**, the main UK society for clinicians in hypertension. As a member of the Executive team and now President, Martin has promoted HBPM through **annual meetings, courses, workshops and online materials** [S6i-ii]. For example, Martin led an MSc-accredited course on management of hypertension in primary care. In 2016, 90% rated the session on measurement of BP as "excellent" and attendees stated the course "provided them with the clinical knowledge needed to help them to monitor hypertension in primary care." [S6ii] As incoming president in 2019, Martin also hosted the Annual Scientific Meeting where she chaired a session on the new NICE guidelines during which the evidence around HBPM was debated. Attendees considered the session "excellent" and the "best discussion." [S6ii]. The BHIS, supported by Martin through the Blood Pressure Monitoring Working Party, also **assists the public, GPs, surgeries and pharmacies in the choice of monitor for HBPM and raises their confidence in use of HBPM** by maintaining a **peer-reviewed list of blood pressure monitors** [S6iii]. NICE and the NHS provide a direct link to this list in recognition of its importance [S6iv].

These changes in clinical practice will have translated to **reduced NHS costs for the management of patients with hypertension** with savings coming from both a reduction in unnecessary treatment and in GP workload [R2; S7]. This is further supported by a 2020 survey of GPs which showed that 68% believed HBPM shortens consultation times [S4].

**5. Sources to corroborate the impact** (indicative maximum of 10 references)

**S1.** Hypertension Guidelines.

**S1i.** BCGuidelines.ca: Hypertension – Diagnosis and Management, March 1 2015.

**S1ii.** 2015 Canadian Hypertension Education Program recommendations for blood pressure measurement, diagnosis, assessment of risk, prevention, and treatment of hypertension. doi: 10.1016/j.cjca.2015.02.016. Published: 6 February 2015

**S1iii.** 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. doi:10.1097/hjh.0000000000001940. Published: October 2018

**S1iv.** Expert panel consensus recommendations for home blood pressure monitoring in Asia: the Hope Asia Network. doi: 10.1038/s41371-017-0025-y. Published: 31 January 2018

**S1v.** ACC/AHA/AAPA/ABC/ACPM/AGS/APHA/ASH/ASPC/NMA /PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College Of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Published: 23 October 2018

**S1vi.** Shimbo D, Artinian NT, Basile JN, Krakoff LR, Margolis KL, Rakotz MK, Wozniak G; American Heart Association and the American Medical Association. Self-Measured Blood Pressure Monitoring at Home: A Joint Policy Statement From the American Heart Association and American Medical Association. Circulation. 2020 Jul 28;142(4):e42-e63. doi: 10.1161/CIR.0000000000000803.

**S1vii.** National Clinical Guideline Centre. Hypertension: management of hypertension in adults in primary care. Clinical Guideline 127. Issue date: 2011.

**S1viiia.** Hypertension in adults: diagnosis and management; NICE Guideline [NG136]. Published: 28 August 2019

**S1viiib.** National Institute for Health and Care Excellence. Hypertension in adults: diagnosis and management. [B] Evidence review for monitoring. NICE Guideline NG136. Intervention evidence review underpinning recommendations 1.4.15 and 1.4.17 to 1.4.19 in the guideline. August 2019

**S2.** Lay-Flurrie SL, Sheppard JP, Stevens RJ, Mallen C, Heneghan C, Hobbs FDR, Williams B, Mant J, McManus RJ. Impact of Changes to National Hypertension Guidelines on Hypertension Management and Outcomes in the United Kingdom. Hypertension. 2020 Feb;75(2):356-364. doi: 10.1161/HYPERTENSIONAHA.119.13926.

**S3.** Fletcher BR, Hinton L, Bray EP, Hayen A, Hobbs FR, Mant J, Potter JF, McManus RJ. Self-monitoring blood pressure in patients with hypertension: an internet-based survey of UK GPs. Br J Gen Pract. 2016 Nov;66(652):e831-e837. doi: 10.3399/bjgp16X687037.

**S4.** Results from 2020 survey of UK GPs.

**S5.** BMJlearning online module on BP measurement including HBPM.

**S5i.** Weblinks, front pages and acrediting organisations for versions released in 2011 and 2020.

**S5ii.** Feedback reviews by module users

**S6.** British and Irish Hypertension Society (BIHS) resources and programmes to support clinician and patient awareness and understanding of HBPM.

**S6i.** Downloadable resources on home blood pressure monitoring for healthcare professionals and patients.

**S6ii.** Examples of workshops, seminars and meetings delivered to assist clinicians in their understanding and provision of HBPM.

**S6iii.** British and Irish Hypertension Society list of peer reviewed BP monitors for HBPM.

**S6iv.** NICE and NHS webpages that link to the British and Irish Hypertension Society list of peer reviewed BP monitors for HBPM.

**S7.** Cost-effectiveness studies

**S7i.** Kaambwa B, Bryan S, Jowett S, Mant J, Bray EP, Hobbs FD, Holder R, Jones MI, Little P, Williams B, McManus RJ. Telemonitoring and self-management in the control of hypertension (TASMINH2): a cost-effectiveness analysis. Eur J Prev Cardiol. 2014 Dec;21(12):1517-30. doi: 10.1177/2047487313501886.

**S7ii.** Penaloza-Ramos MC, Jowett S, Mant J, Schwartz C, Bray EP, Sayeed Haque M, Richard Hobbs FD, Little P, Bryan S, Williams B, McManus RJ. Cost-effectiveness of self-management of blood pressure in hypertensive patients over 70 years with suboptimal control and established cardiovascular disease or additional cardiovascular risk diseases (TASMIN-SR). Eur J Prev Cardiol. 2016 Jun;23(9):902-12. doi: 10.1177/2047487315618784.

**S7iii.** Monahan M, Jowett S, Nickless A, Franssen M, Grant S, Greenfield S, Hobbs FDR, Hodgkinson J, Mant J, McManus RJ. Cost-Effectiveness of Telemonitoring and Self-Monitoring of Blood Pressure for Antihypertensive Titration in Primary Care (TASMINH4). Hypertension. 2019 Jun;73(6):1231-1239. doi: 10.1161/HYPERTENSIONAHA.118.12415.