

# BMJ Open Quality evaluation of community pharmacy blood pressure (BP) screening services: an English cross-sectional survey with geospatial analysis

Ravina Barrett <sup>1,2</sup>, James Hodgkinson<sup>3</sup>

**To cite:** Barrett R, Hodgkinson J. Quality evaluation of community pharmacy blood pressure (BP) screening services: an English cross-sectional survey with geospatial analysis. *BMJ Open* 2019;**9**:e032342. doi:10.1136/bmjopen-2019-032342

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2019-032342>).

Received 16 June 2019  
Revised 01 November 2019  
Accepted 11 November 2019



© Author(s) (or their employer(s)) 2019. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

<sup>1</sup>School of Pharmacy and Biomolecular Sciences, University of Brighton, Brighton, UK

<sup>2</sup>Pharmacy Practice, School of Pharmacy and Biomedical Sciences, University of Portsmouth, Portsmouth, UK

<sup>3</sup>Institute of Applied Health Research, University of Birmingham, Birmingham, UK

## Correspondence to

Mrs Ravina Barrett;  
[ravina.barrett@port.ac.uk](mailto:ravina.barrett@port.ac.uk)

## ABSTRACT

**Objectives** The primary objective was to assess the accuracy (calibration and validation status) of digital blood pressure (BP) monitors used within community pharmacy in England and the secondary objectives were to assess the overall quality of the BP service by assessing service prevalence, service utilisation and other in-service considerations.

**Design** A cross-sectional survey.

**Setting** Primary-care retail-pharmacies.

**Participants** 500 pharmacies that contribute to government dispensing-data were invited by post to complete the survey. Private contractors were excluded.

**Interventions** We conducted a questionnaire survey with a follow-up (September 2018 to December 2018).

**Results** 109 responses were received. 61% (n=66) of responding pharmacies provided a free BP check to their patients. 40 (61%) pharmacies used recommended validated clinical metres, 6 (9%) had failed validation and 20 (30%) provided too little information to enable us to determine their monitor's status.

**Conclusions** Responding pharmacies were able to provide useful BP monitoring services to their patients, though quality enhancements need to be implemented. Majority of pharmacies use validated BP monitors, however, there was a lack of range of cuff sizes, variation in replacement and calibration of monitors and apparent absence of such practice in a minority of pharmacies alongside variation in training standards. We noted higher frequency of BP screening in the most deprived postcodes.

We recommend in-service redesign and delivery improvements, and suggest professional bodies and researchers work together to create clearer frameworks for front-line practitioners, creating appropriate incentives to facilitate this service redesign.

Funders and policy setters should consider the value added to the National Health Service and other healthcare agencies of such screening by pharmacy providers both nationally and internationally. It has the potential to reduce complications of undiagnosed hypertension and the medicines burden that it creates. Future work should examine the impact of pharmacist-led BP screening on patients.

## Strengths and limitations of this study

- We invited pharmacists from 500 pharmacies across England to complete a survey.
- We mailed our survey with a single follow-up of non-responders (September 2018 to December 2018).
- Postcodes of pharmacies were linked with freely available data on Index of Multiple Deprivation scores, which provides an estimate of the socioeconomic deprivation of the practice population.
- The interactive application helps to visualise the data easily: <https://portuni.maps.arcgis.com/apps/webappviewer/index.html?id=a4ef6e48721649a-da4eec362507245f6> or <https://arcg.is/1jrevP>

## INTRODUCTION

Hypertension (high blood pressure (BP)) is the most important modifiable risk factor for cardiovascular, cerebrovascular and renal disease, and avoidable cause of premature morbidity and mortality.<sup>1-6</sup>

The Health Survey for England monitors trends in the nation's health, estimating the proportion of people in England who have specified health conditions, and the prevalence of risk factors and behaviours associated with these conditions.<sup>7</sup> According to the 2016 Survey, 28% of adults had hypertension, 10% had controlled hypertension and 12% had untreated hypertension. Thus, approximately 7.9 million people were suffering from undiagnosed hypertension in 2016, who are at risk of heart attack or stroke, leading to hospital admission and reduced quality-of-life.

Public Health England (PHE) exists to protect and improve the nation's health and well-being, and reduce health inequalities. PHE is an operationally autonomous executive agency of the Department of Health.<sup>8</sup> The 2014 PHE figures reveal that diseases caused by high BP are estimated to cost over £2 billion annually.<sup>9</sup> National Health Service (NHS) and social care spend of £850 million



could be avoided over 10 years by reducing the BP of the nation. If just 15% more people (1.185 million people), unaware they have high BP, are diagnosed, £120 million of NHS and social care spend could be avoided over 10 years.<sup>9</sup>

Community pharmacists and their teams make an important contribution to the prevention, detection and management of high BP via routine public health promotion, medicines optimisation services and through a wide range of targeted services and interventions specifically designed to detect, diagnose and manage hypertension as recommended by research, in national guidance from PHE and NHS England.<sup>10–13</sup> Community pharmacy BP monitoring is readily available and recommended by Canadian hypertension guidelines.<sup>14</sup>

The digital BP monitors used within the services need to be of good quality (validated for clinical use<sup>15–18</sup>) and need regular maintenance (calibration) for accurate functioning. This phenomenon has been well studied in physicians' offices,<sup>19–21</sup> but less so in pharmacy settings.<sup>22–24</sup>

With increasing general practitioner (GP) shortages, pharmacy providers are more valued.<sup>25 26</sup> They often have extended opening hours during evenings and weekends and are frequently located in comfortable and attractive retail spaces accessible within 20 min' walk.<sup>27</sup> Thus, they provide a less clinical space, more convenient for people with less access to healthcare.

Current standards for initial education and training on BP monitoring delivered to pharmacy undergraduate students lack sufficient detail to be incorporated into a service specification. The independent pharmacist prescribers course<sup>28</sup> specifies that students are able to use diagnostic aids relevant to the condition for which the pharmacist intends to prescribe.

Consequently, there is no certification or credentialing for providing a high-quality BP service via pharmacy in the UK. As there are no standard specifications integrated into the pharmacy contract, there is possibly quality variability across postcodes. Finally, there is no consensus on how or when referrals are made to medical doctors, though patients would be expected to be signposted to their GP.

This study seeks to understand the challenges faced by under pressure models of care in the Western world (growing patient demand, insufficient funding in primary care, changing patterns of demand, reduced access to GPs and addressing national health inequalities). This study aligns with the United Nations (UN)'s agenda for Sustainable Development Goals 3: to reduce by one-third premature mortality from cardiovascular disease by 2030.<sup>29 30</sup>

## Objectives

The primary objective of this study was to assess the accuracy (calibration and validation status) of digital BP monitors used within community pharmacy in England and the secondary objectives were to assess the overall quality of the BP service. Secondary objectives were assessed by ascertaining prevalence of service provision,

level of service utilisation, quality of service (how the monitor make and model was chosen, length of time in service, care and maintenance including calibration history, visual or physical checks before each use, instructions provided to patients before taking measurements, available cuff sizes, relevant staff training) and estimated number of patients newly detected with hypertension. We also aimed to use this data to examine its association with geospatial location, dispensing data and Index of Multiple Deprivation (IMD) score which provides statistics on relative deprivation in small areas in England.<sup>31</sup>

## METHODS

### Participants and recruitment

We invited 500 pharmacies across England to complete a survey about their BP screening service.

**Inclusion criteria:** Community pharmacies that contribute to the NHS Business Services Authority (BSA) dispensing data (pharmacy-contractor reimbursement agency).

**Exclusion criteria:** Community pharmacies that are not NHS contractors, other settings that offer BP monitoring (eg, hospitals, GP surgeries, walk-in centres).

Addresses were taken from publicly available NHS BSA website (March 2018) to gain a nationally representative sample. We selected the first 500 pharmacies by Contractor Code (FA002 to FAQ67), ensuring they were nationally representative with respect to the number of prescription forms (invited sample mean 3633, SD 2053 vs England population mean 3564, SD 2692) and number of prescription items dispensed (invited sample mean 7366, SD 4296 vs England population mean 7132, SD 5167). This permitted comparison with like for like businesses (approximately equal burden of work, similar team size and similar business complexity) across the country, therefore allowing fair comparison between pharmacies that provide the service and those that do not.

We mailed the survey with a single follow-up of non-responders from September 2018 to December 2018. Respondents were invited to provide self-reported answers. A prepaid self-addressed envelope was provided. The participants could include registered pharmacists or pharmacy support staff working in community pharmacy.

We sought and received favourable institutional ethical approval. No financial (or similar) benefits were offered to minimise biased responses.<sup>32</sup>

### Sample size

There are 11 619 community pharmacies in England in 2017 to 2018.<sup>33</sup> Assuming confidence level of 95%, CI of 9.5%, relative SE of 9.69% a sample size of 106 is calculated. To achieve this, we invited 500 pharmacies as research and previous experience indicates a response range between 15% to 25% in similar studies.<sup>34–39</sup>

## Questionnaire

The questionnaire was composed of items relating to demographics, BP service provision and how it is delivered, blood pressure monitor details, associated training, visual or manual checks performed on monitors and instructions given to patients. The survey is detailed in online supplementary appendix A. We had previously iteratively tested the survey in a local pilot study.<sup>34</sup>

We piloted the questionnaire via six steps. Questionnaire validation (pretesting) was achieved by researchers critically appraising the scale in a research-team focus-group. This comprised two external practicing community pharmacists, other academics with recent community and hospital practice experience and student researchers. This allowed for detection and deletion of ambiguous words, misinterpretation of questions, poor questions and sensitive questions. Amendments and improvements were made to the format, structure and content. To improve internal validity and reliability, the survey instrument was piloted with another external community pharmacist, and cognitive testing (read-aloud) was conducted. Further refinement was achieved with a research-team focus-group with contribution from experts at the research design service provided by the National Institute for Health Research. It took less than 10 minutes to complete the final survey.

## Data analysis

Analyses were undertaken using SPSS.<sup>40</sup> The results presented are descriptive, presented as proportions, correlational analysis and independent sample tests. Missing data are presented. For correlation coefficients, it is generally recognised that a reliability estimate needs to be above 0.70 and a validity estimate needs to be above 0.60 to be at an acceptable level.<sup>41</sup> All values above 0.6 were examined. We used Levene's test to assess statistical significance. Levene's test is an inferential statistic used to assess the equality of variances for a variable calculated for two groups (service providers vs non-providers). Some common statistical procedures assume that variances of the populations from which different samples are drawn are equal. Levene's test assesses this assumption.

Postcodes of pharmacies were linked with freely available data on IMD score, an estimate of the socioeconomic deprivation of the practice population<sup>31</sup> and NHS dispensing data.

We mapped our results using ArcGIS online and we created an interactive application to visualise the data easily: <https://portuni.maps.arcgis.com/apps/webappviewer/index.html?id=a4ef6e48721649ada4eec362507245f6>. It is freely and publicly accessible.

We mapped our responses alongside the IMD 2015 data (Ranks: every postcode has a rank from 1 which is the most deprived area up to 32 844 which is the least deprived area. Deciles are published alongside ranks to assess relative deprivation) to assess any relationship between deprivation and screening quality.

## Ethics

We used the Strengthening the Reporting of Observational Studies in Epidemiology cross-sectional reporting guidelines.<sup>42</sup>

## No patient and public involvement

We did not involve patients or the public in our work. This is likely to be done in the future.

## RESULTS

In total, 109 responses (21.8% response rate) were received, satisfying sample calculation needs. (74 responses on first approach, 35 additional responses on follow-up, six closures and abatements, three spoiled/defaced responses).

Sixty-one per cent (n=66) of responding pharmacies provided a free BP check to their patients.

Characteristics of service providers versus non-service providers on demographics are shown in [table 1](#).

Service providers employed more full-time pharmacists and were less likely to be co-located in GP practices. We found of the 66 service providers, 57 worked full-time.

[Table 2](#) demonstrates that pharmacists tended to lead the service delivery and tended to be more experienced. Employees involved in providing the BP check in the pharmacy included the whole team: 55 were pharmacists, two pharmacy technicians, seven dispensing assistants and one medicines counter assistant.

Pharmacies had provided the service for varying lengths of time: nine over 0 to 2 years, 12 over 3 to 6 years, 11 over 7 to 9 years and 24 over 9 years (eight did not know, with two missing).

## Service utilisation

All but one respondent provided monitoring solely within the pharmacy. One lent their BP monitor to patients for self-monitoring at home.

We enquired about monthly and annual screening figures because there may be distortions in some months when national or local health promotion campaigns are promoted (eg, 'Know your Numbers!', NHS Health Check, etc). In the last month, pharmacies reported providing BP screening as per [table 3](#).

Over the last year, the people screened in each pharmacy ranged from 10 to 2000 (mean 106.3, SD 295.2, 21 missing), with 10 pharmacies serving 100 or more people. Only one respondent said 2000 patients screened, which could be an outlier but this pharmacy is associated with higher business volumes (prescription forms and items dispensed were 5613 and 10 144, respectively, IMD decile 10-affluent).

When asked: 'What is the number of patients newly detected with high BP (BP>140/90 mm Hg) in the last month?' many could not give a clear answer, but estimates ranged from 0 to 25 with a high-frequency of ones and twos (mean 2.3, SD 4.0, 17 missing).

**Table 1** Response frequency

Variables	Respondent frequencies (Percentage) (n=109)	Service providers frequencies (Percentage) (n=66)	Levene's test for equality of variances at 95%, where equal variances assumed
Role	(two missing)	(zero missing)	F=0.706, p=0.403
Pharmacist	90 (84%)	55 (83%)	
Pharmacy technician	7 (7 %)	3 (4.5%)	
Dispensing assistant	7 (7 %)	7 (11%)	
Medicines counter assistant	3 (3 %)	1 (1.5%)	
Gender	(three missing)	(two missing)	F=0.203, p=0.653
Male	57 (54 %)	32 (50 %)	
Female	48 (45 %)	32 (50 %)	
Preferred not to say	1 (1 %)		
Years of registration experience	(nine missing)	(seven missing)	F=0.730, p=0.395
0–2	9 (8 %)	5 (8 %)	
3–5	16 (15 %)	9 (15 %)	
6–8	12 (11 %)	8 (14 %)	
9–11	11 (10 %)	8 (14 %)	
12–14	5 (5 %)	1 (2 %)	
15–17	7 (7 %)	7 (12 %)	
18–20	2 (2 %)	1 (2 %)	
>20 years	38 (36 %)	20 (34 %)	
Employer type	(two missing)	(one missing)	F=0.245, p=0.621
National chain pharmacy	51 (48 %)	35 (54 %)	
Independent pharmacy	56 (53 %)	30 (46 %)	
Work contract type	(three missing)	(one missing)	F=8.904, p=0.004
Full-time	90 (85 %)	57 (88 %)	
Part-time	12 (11 %)	7 (11 %)	
Locum	3 (3 %)	1 (2 %)	
Other	1 (1 %)	0	
Location of community pharmacy	(two missing)	(one missing)	F=0.471, p=0.494
Urban	47 (44 %)	32 (49 %)	
Suburban	47 (44 %)	26 (40 %)	
Rural	13 (12 %)	7 (11 %)	
Co-located within GP practice	(four missing)	(two missing)	F=4.766, p=0.031
Yes	20 (19 %)	10 (16 %)	
No	85 (81 %)	54 (84 %)	
Provide a BP monitoring service			
Yes	66 (61 %)		
No	43 (39 %)		

BP, blood pressure; GP, general practitioner.

### Calibration, validation, cuff sizes, maintenance intervals

Overwhelmingly pharmacies (97%; n=61) reported using an automatic BP monitor during BP screening (where cuff inflation, deflation and BP determination are fully performed by the device automatically). Two respondents (3%) said they used a semi-automatic device (BP determination is performed automatically but cuff inflation and/

or deflation needs manual operation). None used manual sphygmomanometers (three missing). All measured BP at the upper arm.

We then explored the rationale behind choosing their particular monitor. Fifty-eight responses were received: 25 (43%) respondents were given their monitor by head office (refers to any central office under the control of the

**Table 2** Pharmacist and non-pharmacist respondents stratified by years of registration experience (small numbers may not add up to 100%)

Years of registration experience of service providers	Pharmacists (n=55)	Non-pharmacist (n=11)
0–2	5 (9%)	0
3–5	7 (13%)	2 (18%)
6–8	6 (11%)	2 (18%)
9–11	7 (13%)	1 (9%)
12–14	1 (2%)	0
15–17	7 (13%)	0
18–20	1 (2%)	0
>20 years	20 (36%)	0
Missing data	0	6 (55%)

superintendent pharmacist, who takes legal responsibility for all business operations), 16 (28%) used a monitor that was convenient for them (often present in their own store for sale), seven (12%) had done some brand research, five (9%) participants identified their monitor as being ‘accredited’ and five (9%) were influenced by advertisement.

Further to this, 61 respondents provided a monitor’s brand, 50 provided a model number and 53 provided a batch number. We used the dablEducational Trust<sup>43</sup> and the British and Irish Hypertension Society (BIHS)<sup>44</sup> website to check their validation status.

Forty (61%) pharmacies used recommended validated clinical metres, 6 (9%) monitors had failed validation and 20 (30%) respondents provided too little information to enable us to determine their monitor’s status. One monitor was validated but listed as discontinued by dabl and archived by BIHS, which makes its continued use questionable.

Regarding available cuff sizes, 50 responses were received, shown in table 4.

Though some branches had several cuff sizes in use, 23 (46%) just had one cuff size.

Regarding length of monitor time in use, 43 valid responses were received. Dates ranged from 14 July 2005 to 01 September 2018, thus covering anywhere from over 13 years to 2 months. From this, we calculated length of

**Table 3** Number of patients screened in the last month

Number of patients screened	Response frequency
1–5	25 (38%)
6–10	22 (34%)
11–15	8 (12%)
16–20	2 (3%)
20+	8 (12%)
Total	65 (1 missing)

**Table 4** Available cuff sizes

Available cuff sizes	Response frequency (n=50)
Small (18–22 cm)	7 (14%)
Medium (22–32 cm)	39 (78%)
Large (32–45 cm)	27 (54%)
Extra large (42–50 cm)	7 (14%)
Other ‘24 to 40 cm 9.4–15.7’	1 (2%)
Missing	16 (24%)

time in service: 10 responders had their monitor in use between 0 to 1 year, 14 had their monitor in use between 1 to 2 years, 12 had had their monitor in use between 2 to 5 years, six had had their monitor in use between 5 to 10 years and one had their monitor in use over 10 years.

Respondents replaced their BP monitor at different intervals; one person (2%) said they replaced 6 monthly, eight (13%) said annually, 26 (41%) said 2 yearly, 19 (30%) said the metre had not been replaced and nine (14%) said other (three missing). We also asked if respondents sent their monitor for calibration. Three (5%) sent it back to the manufacturer, 13 (20%) sent it back to head office and 44 (67%) did not send their monitor for calibration (six missing). This demonstrates that community pharmacies to some extent replace the monitor rather than get it calibrated relying on monitors warranty status.

### Training

We explored issues around training to gain a better understanding of the level of knowledge, skill and education of respondents regarding the blood pressure monitoring service.

Fifty-nine (92%) respondents said they received some form of training and five (8%) said they did not (two missing). Of those who received training, 32 (54%) indicated only one form of training, while the others received multiple forms of training. The types of training are shown in table 5.

‘Other’ comments included training from internal and external providers (online and in-person), local clinical commissioning group training, British Heart Foundation training events and reading National Institute for Health and Care Excellence guidelines. This represents training with great variability, potential inadequacy (only reading material/online information/lack of practical experience) and some reliance on interested parties like manufacturers to deliver the training.

We found there was good correlation between BP training and medicine use reviews (MUR) or new medicine services (NMS) ( $r=0.605$  to  $0.715$ ), suggesting if pharmacists are trained on BP services, they are likely to have engaged in other professional training like MUR and NMS accreditation which is intended to encourage safe and appropriate use of medicines.<sup>45</sup>

**Table 5** Type of training received

Type of training	Response frequency
Informal chat with the senior pharmacist	33
Training provided by the monitor manufacturer	6
Read internal company standard operating procedures	41
Read Royal Pharmaceutical Society Guidelines	11
Completed Centre for Pharmacy Postgraduate Education training	13
Other	12

### Visual or manual checks of monitor

Respondents self-reported in-situ checks that were conducted during each consultation. Forty (61%) respondents performed some visual or manual checks to ensure they were achieving accurate results, 26 (39%) did not. These, variously, included a visual check of the integrity of the monitor, checks for properly affixed tubing, working batteries, appropriate and secure cuff positioning of Velcro, correct inflation and deflation without air leaks and of the display screen (no error codes). General cleanliness and physical damage (eg, holes) was assessed, in addition to simply checking that the machine was turned on and actually providing BP and pulse readings. Four respondents would check their own (and colleagues') BP to assess whether the monitor was working well.

### Instructions to patients/customers

We also inquired about the instructions provided to patients prior to screening. Sixty-four positive answers were received indicating that most respondents would instruct their patients, with only one respondent saying they would give no instructions (one missing). Instructions, variously, included to remove restrictive clothing, be seated, relax, have both feet on the ground, legs apart and not crossed, rest their elbow on the table with wrist facing up and not to talk. Respondents also, variously, inquired if patients needed to empty their bladder or had recently consumed caffeine, smoked, felt stressed, made any blood donations and asked about past medical history, and drug history including any prescribed BP medication. One respondent said they would go through the consenting process (telling the patient what was involved and what to expect). Some patients were given a customer card with a copy of their readings.

We asked if there were any other considerations respondents would make, and they responded in terms either of assessing the reliability of the BP readings generated, considering the most pragmatic way of conducting the tests or how best to communicate with patients. Forty-one comments were received. One respondent would consider patient age and weight as part of the assessment. A few suggested the need for multiple readings, that they 'might take an average of three readings'. Many would consider prescribed medicines currently taken by

the patient. Respondents also would explain the reading and give relevant lifestyle and health promotion advice with respect to exercise, diet, smoking and alcohol or other beverages (eg, coffee, energy drink). One considered if the patient had a pacemaker fitted or potential pregnancy. One respondent would consider if patients had breast or underarm surgery. Respondents would also generally take into consideration the patient's character, stress levels, demeanour, life and work and assess if white coat syndrome was present leading to unreliable readings. One respondent took into account ambient temperature, that is, heat. Some inquired why the patient is requesting a BP measurement.

We invited any other additional comments. Comments included that one respondent had ordered a large cuff and another was considering replacing or getting their monitor calibrated because of the survey. Some respondents were proactive at measuring BP by facilitating well-being days.

The potential extension to the role of community pharmacy was highlighted by one respondent who commented, '*Clients sometimes use us to record BP on their PMR (pharmacy patient medical records) & then take print out to GP to help record issues. When white coat syndrome, GPs will refer to us.*' This suggests current practice may include referring patients to GP for follow-on care. It also importantly hints at lower rates of white coat syndrome in pharmacy settings than in physician clinics and that GPs actively refer patients for screening in pharmacy settings for this reason.

### Deprivation

Pharmacies in all deciles from most deprived to least deprived responded, with relatively even distribution per decile. **Table 6** summarises our findings stratified by the most deprived deciles (a 1 of 10 subdivision) versus their more affluent counterparts.

**Table 6** suggests higher frequency of BP screening by community pharmacy providers in the most deprived post-codes, though this is not statistically significant reflecting small sample size. Service utilisation was approximately even. Respondents in less deprived areas were slightly more likely to have a validated monitor, though again this is not statistically significant. Calibration rates and length of time in service of monitors show limited relationship to deprivation of surrounding area. Granular decile information is available (see online supplementary appendix B).

Provision of the service was linked to lower income rank ( $F=4.029$ ,  $p=0.047$ ) and lower employment rank ( $F=4.651$ ,  $p=0.033$ ).

## DISCUSSION

### Summary

Hypertension-related appointments make up almost 1 in 10 of all GP consultations each year.<sup>46</sup> With the workload of GPs thought to be nearing saturation point,<sup>47</sup> alternative models of hypertension management such

**Table 6** Respondent Index of Multiple Deprivation decile distribution

Deciles (1=most deprived, 10=least deprived)	Number of respondents	BP service providers	Service utilisation (number of people screened)	Validated monitor status	Quality of service (calibration status)	Quality of service (purchase date)
Deprived deciles 1, 2 and 3.	49 (45%)	33 (67%)	1–5 people screened by 12 respondents. 6–10 people screened by 12 respondents. 11–15 people screened by five respondents. 15+ people screened by three respondents.	18 (55%)	Four calibrated 0–1 year ago. Two calibrated 1–2 years ago. Two calibrated 2–5 years ago. None calibrated 5–10 years ago. One calibrated 10+ years ago.	Four purchased 0–1 year ago. Eight purchased 1–2 years ago. Seven purchased 2–5 years ago. Two purchased 5–10 years ago. None purchased 10+ years ago.
Affluent deciles 4, 5, 6, 7, 8, 9 and 10.	60 (55%)	33 (55%)	1–5 people screened by 13 respondents. 6–10 people screened by 10 respondents. 11–15 people screened by three respondents. 15+ people screened by seven respondents.	22 (67%)	Three calibrated 0–1 year ago. Two calibrated 1–2 years ago. Four calibrated 2–5 years ago. One calibrated 5–10 years ago. None calibrated 10+ years ago.	Six purchased 0–1 year ago. Six purchased 1–2 years ago. Five purchased 2–5 years ago. Four purchased 5–10 years ago. One purchased 10+ years ago.
<b>Total</b>	<b>109</b>	<b>66</b>		<b>40</b>		

as pharmacist-led care have the potential to alleviate this increasing burden on primary healthcare systems. Evidence from systematic reviews shows that such interventions can significantly reduce blood pressure compared with usual GP care.<sup>25 48</sup> To explore the potential of implementing extended pharmacist roles in the management of hypertension in community settings, it is essential to describe current practice.

We found between 1 to 10 people were routinely screened monthly by each pharmacy. Annually, respondents said they screened between 10 to 2000 people (where 2000 could be an outlier). These figures seem credible as they give annualised average figures of at least 10 to 12 people screened by each service provider (the higher annual figures may reflect pharmacies participating in national campaigns such as ‘Know Your Numbers’ (<http://www.bloodpressureuk.org/HealthProfessionals/KnowyourNumbersWeek>) at other points in the year). This rate of screening conservatively detected one to two undiagnosed hypertensive patients monthly per service provider. If these estimates are scaled-up for England and annualised across the 11 619 pharmacies in England, assuming a 60% service provision rate, it would represent detection of an additional 83 657 to 167 314 undiagnosed hypertensives, identifying 2% of the total undiagnosed hypertensive English population. In 7 years, in its current state, the service could help diagnose 1.185 million people saving the NHS £120 million.<sup>9</sup>

Most monitors were automatic digital monitors, selected by head office or as a convenient model, but price and product guarantees may also play an influential role in monitor selection, rather than validation status. Lack of a range of cuff sizes per provider appears a major

issue, as only 59% (39/66) stocked a medium cuff and 41% (27/66) a large cuff, with only a minority reporting they stocked multiple cuff sizes.

Many monitors were old which may risk inaccuracy. Fifty-six percent of service providers replaced the monitors at least every 2 years, but only 14% (9/63) every year or more frequently, and 30% did not replace at all. This may be because often calibration is guaranteed for up to 2 years from the date of purchase by manufacturers. However, previous studies recommend at least annual calibration with evidence suggesting declining performance after 18 months.<sup>22</sup>

Calibration of devices was reported by 27% of service providers. Overall, this means 23% (15/66) of service providers neither replaced nor calibrated their devices.

While 92% of service providers received some training of variable quality, 8% reported not receiving any. While this is poor, it provides a benchmark for future training-quality enhancements.

### Strengths and limitations

This study provides needed evidence on the quality of BP screening from community pharmacy. There are several novelties to our study. We have for the first time reported on prevalence of service provision (61%), level of service utilisation and validation and calibration status within community pharmacy practice in England. This is the most comprehensive service evaluation on BP monitoring service provision in pharmacies in the UK.

Though we have structured this study robustly, there is a risk of bias. Key limitations of our study are small sample size and low response rate. It is possible that our results may be biased towards more provision than is actually

**Table 7** Respondent bias assessment based on dispensing volumes

NHS dispensing monthly (March 2018) statistics	Number of prescription forms (nominal)	Number of prescription items (nominal)
Mean		
(England) Population	3564 (3564±0)	7132 (7132±0)
Invited	3633 (3564+69)	7366 (7132+234)
Respondent	3693 (3564+129)	7444 (7132+312)
Non-respondent (excluding closures and abatements)	3666 (3564+102)	7444 (7132+312)
SD		
(England) Population	2692 (2692±0)	5167 (5167±0)
Invited	2053 (2692–639)	4296 (5167–871)
Respondent	2154 (2692–538)	4569 (5167–598)
Non-respondent (excluding closures and abatements)	1999 (2692–693)	4171 (5167–996)

NHS, National Health Service.

available, if pharmacies providing the service were more likely to respond. However, we did specify we were interested in hearing from non-service providers, and respondents in such pharmacies would have needed much less time to complete the survey.

Some missing information may make the findings unreliable. This is a potential limitation of our study and in the future, we may seek ethical permission to telephone pharmacies to confirm missing information. For some respondents, there is discrepancy between monthly and annual screening numbers, which is a potential limitation of this study and could reflect erratic answers, but it highlights the need for more research beyond a survey methodology.

We acknowledge that respondents often represent multiple chain pharmacies that have uniform standard operating procedures (SOPs) in branches across the country. Theoretically, this could bias our results. However, SOPs are interpreted, adapted and implemented differently within each branch and so our research provides a more authentic representation of practice.

Potential bias was assessed by examining the total number of prescription forms and items dispensed across England (table 7). Respondents tended to be from slightly busier pharmacies than non-respondents, though by a small margin, making our findings relevant.

Our pharmacies were typical of those nationwide, including in terms of deprivation of surrounding catchment area. There was a good spread in terms of typology of pharmacy and location (geographically; urban, suburban, rural). Therefore, our results are robust, credible and generalisable.

Comparison with existing literature: Pharmacists can provide BP screening service at much reduced cost to the NHS compared with GP services.<sup>49</sup> Pharmacists are generally available without appointment, open for extended hours during unsociable hours and have been shown to provide greater care in areas of highest deprivation.<sup>27</sup>

Our mapping provides tentative support for this positive care law.

There may be a lower incidence of white coat syndrome in community pharmacy,<sup>50</sup> and we found evidence of GPs using pharmacies to screen for white coat hypertension. The potential role of pharmacies in hypertension management through BP testing (checking for white coat syndrome, monitoring the effectiveness of medication) is there, in addition to screening for new hypertension cases. Lower rates of white coat syndrome in these settings is supported in the Palmera study.<sup>50</sup>

### Implications for clinical practice

Significant quality enhancements need to be implemented. It is important to consider the patient population this study may impact most. The 'hard to reach' groups of patients are typically less affluent and are also less likely to see their GP (or not have a GP), and have poor health literacy. There may be a greater likelihood of identifying new previously undetected cases of hypertension in this group of the population. Community pharmacies are easily accessible and located in all areas, and have been shown to provide greater care in areas of highest deprivation which may be more conducive for the 'hard to reach' patient groups and could assist in reducing health inequalities nationally. Focusing attention on these people at the right time can avoid hospital costs and allow the patient to remain within the community.

Pharmacies deliver a valuable service of providing free BP checks to those who feel they cannot afford to buy monitors. In affluent areas, it may be that more people are self-monitoring with their own-bought home-monitors, and there is simply less demand on pharmacies.

Collectively, this provides a social and health economic argument for pharmacists to be involved in routine, NHS-commissioned, hypertension screening for the general population with needed quality enhancements.



## Our recommendations

Based on these results, we recommend in-service redesign and delivery improvements, and suggest professional bodies and researchers work together to create clearer frameworks for front-line practitioners, creating appropriate incentives to facilitate this service redesign.

Specifically we recommend that pharmacies providing this service: (1) Use validated BP monitors, calibrated at 1 yearly intervals; (2) Maintain audited records incorporating monitor details, service history and use frequency; (3) Stock at least three cuff sizes; (4) Train service staff to quality standards both in a theoretical-based and competency-based framework, which is accredited.

Further research needs to be conducted to demonstrate the sufficiency of these measures, which once achieved, could be a nationally commissioned service. Ongoing analysis of this work needs to consider local area deprivation status with priority given to these service providers.

## CONCLUSION

The majority of pharmacies use validated BP monitors. In general, responding pharmacies were able to provide useful BP monitoring services to their patients, though quality enhancements need to be implemented. There was a lack of range of cuff sizes, variation in recruitment and calibration of monitors and apparent absence of any replacement or calibration in a minority of pharmacies, variation in training standards. Community pharmacists could play a leading role in BP screening in England.

Funders and policy setters should consider the value added to the NHS and other healthcare agencies of such screening by pharmacy providers both nationally and internationally. It has the potential to reduce complications of undiagnosed hypertension and the medicines burden that it creates.

## Future research needs

A larger study is required to validate our findings. Future work should examine the impact of pharmacist-led BP screening on patients. At the very least, we need to study the patient population, their needs in their local context and which areas or groups represent most undiagnosed people. We encourage the international research community to use our survey to report their findings.

**Acknowledgements** Thank you to the 109 retail pharmacy respondent-employees who took the time to provide honest opinions, Carla Orszulik and Sophie Doughty for helping with study administration and data collection, Michelle Sumner for providing excellent technical help to allow data capture and processing and Martin Schaefer for his help with ArcGIS publisher requests.

**Contributors** RB led on the literature search, conduct, data acquisition and statistical analysis. RB and JH were involved in study conception and design, data analysis and interpretation of data, manuscript preparation, editing and revision and agreed upon the final version of the paper.

**Funding** This study was funded by the University of Portsmouth.

**Disclaimer** The views expressed in this publication are those of the authors and not those of the University of Portsmouth, University of Brighton, University of Birmingham nor the NHS.

**Map disclaimer** The depiction of boundaries on this map does not imply the expression of any opinion whatsoever on the part of BMJ (or any member of its group) concerning the legal status of any country, territory, jurisdiction or area or of its authorities. This map is provided without any warranty of any kind, either express or implied.

**Competing interests** None declared.

**Patient consent for publication** Not required.

**Ethics approval** University of Portsmouth, Science Faculty Ethics Committee provided a favourable ethical review (Reference Number: SFEC 2018-061, Date Submitted: 31 May 2018).

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** No data are available.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iD

Ravina Barrett <http://orcid.org/0000-0003-0004-2131>

## REFERENCES

- Rothwell PM, Howard SC, Dolan E, *et al.* Prognostic significance of visit-to-visit variability, maximum systolic blood pressure, and episodic hypertension. *The Lancet* 2010;375:895–905.
- Webb AJS, Fischer U, Mehta Z, *et al.* Effects of antihypertensive-drug class on interindividual variation in blood pressure and risk of stroke: a systematic review and meta-analysis. *The Lancet* 2010;375:906–15.
- Clement DL, De Buyzere ML, De Bacquer DA, *et al.* Prognostic value of ambulatory blood-pressure recordings in patients with treated hypertension. *N Engl J Med* 2003;348:2407–15.
- Verdecchia P, Porcellati C, Schillaci G, *et al.* Ambulatory blood pressure: an independent predictor of prognosis in essential hypertension. *Hypertension* 1994;24:793–801.
- Hansen TW, Jeppesen J, Rasmussen S, *et al.* Ambulatory blood pressure and mortality: a population-based study. *Hypertension* 2005;45:499–504.
- Chobanian AV *et al.* The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure The JNC 7 Report. *JAMA* 2003;289:2560–72.
- NHS Digital. Health survey for England, 2016. NHS digit. Available: <https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2016> [Accessed 20 Aug 2019].
- Public Health England. About us. GOV.UK. Available: <https://www.gov.uk/government/organisations/public-health-england/about> [Accessed 20 Aug 2019].
- New figures show high blood pressure costs NHS billions each year. Available: <https://www.gov.uk/government/news/new-figures-show-high-blood-pressure-costs-nhs-billions-each-year> [Accessed 29 Jan 2018].
- High blood pressure: plan and deliver effective services and treatment. GOV.UK. Available: <https://www.gov.uk/guidance/high-blood-pressure-plan-and-deliver-effective-services-and-treatment> [Accessed 21 Jan 2019].
- Tsuyuki RT, Houle SKD, Charrois TL, *et al.* Randomized trial of the effect of pharmacist prescribing on improving blood pressure in the community: the Alberta clinical trial in optimizing hypertension (RxACTION). *Circulation* 2015;132:93–100.
- Okada H, Onda M, Shoji M, *et al.* Effects of lifestyle advice provided by pharmacists on blood pressure: the community pharmacists assist for blood pressure (COMPASS-BP) randomized trial. *Biosci Trends* 2017;11:632–9.
- Pharmacy voice. Tackling high blood pressure through community pharmacy. Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/693902/PV\\_Blood\\_Pressure\\_Report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693902/PV_Blood_Pressure_Report.pdf)
- Lamb SA, Al Hamarneh YN, Houle SKD, *et al.* Hypertension Canada's 2017 guidelines for diagnosis, risk assessment, prevention and treatment of hypertension in adults for pharmacists: An update. *Can Pharm J* 2018;151:33–42.

- 15 O'Brien E, Petrie J, Littler W, *et al.* The British hypertension Society protocol for the evaluation of blood pressure measuring devices. *J Hypertens* 1993;11:S43–62.
- 16 Stergiou GS, Asmar R, Myers M, *et al.* Improving the accuracy of blood pressure measurement: the influence of the European Society of hypertension international protocol (ESH-IP) for the validation of blood pressure measuring devices and future perspectives. *J Hypertens* 2018;36:479–87.
- 17 O'Brien E, Atkins N, Stergiou G, *et al.* European Society of hypertension international protocol revision 2010 for the validation of blood pressure measuring devices in adults. *Blood Press Monit* 2010;15:23–38.
- 18 Stergiou GS, Alpert BS, Mieke S, *et al.* Validation protocols for blood pressure measuring devices in the 21st century. *J Clin Hypertens* 2018;20:1096–9.
- 19 Clark CE, Horvath IA, Taylor RS, *et al.* Doctors record higher blood pressures than nurses: systematic review and meta-analysis. *Br J Gen Pract* 2014;64:e223–32.
- 20 Little P *et al.* Comparison of agreement between different measures of blood pressure in primary care and daytime ambulatory blood pressure. *BMJ* 2002;325:254.
- 21 A'Court C, Stevens R, Sanders S, *et al.* Type and accuracy of sphygmomanometers in primary care: a cross-sectional observational study. *Br J Gen Pract* 2011;61:e598–603.
- 22 Hodgkinson J, Koshariis C, Martin U, *et al.* Accuracy of monitors used for blood pressure checks in English retail pharmacies: a cross-sectional observational study. *Br J Gen Pract* 2016;66:e309–14.
- 23 Pappacogli M, Ravetto Enri L, Perlo E, *et al.* Assessment of a Non-physician screening program for hypertension and cardiovascular risk in community pharmacies. *Nutr Metab Cardiovasc Dis* 2019;29:1316–22.
- 24 Fleming S, Atherton H, McCartney D, *et al.* Self-Screening and Non-physician screening for hypertension in communities: a systematic review. *Am J Hypertens* 2015;28:1316–24.
- 25 Cheema E, Sutcliffe P, Singer DRJ. The impact of interventions by pharmacists in community pharmacies on control of hypertension: a systematic review and meta-analysis of randomized controlled trials. *Br J Clin Pharmacol* 2014;78:1238–47.
- 26 Ryan K, Patel N, Lau WM, *et al.* Pharmacists in general practice: a qualitative interview case study of stakeholders' experiences in a West London GP federation. *BMC Health Serv Res* 2018;18:234.
- 27 Todd A, Copeland A, Husband A, *et al.* The positive pharmacy care law: an area-level analysis of the relationship between community pharmacy distribution, urbanity and social deprivation in England. *BMJ Open* 2014;4:e005764 <http://bmjopen.bmj.com/content/4/8/e005764.short>
- 28 General Pharmaceutical Counsel. Pharmacist independent prescribing-learning outcomes and indicative content. Available: <https://www.pharmacyregulation.org/education/pharmacist-independent-prescriber>
- 29 United Nations Statistics Division. SDG Indicators - Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. Available: <https://unstats.un.org/sdgs/indicators/indicators-list/> [Accessed 5 Dec 2018].
- 30 United Nations Publications. Sustainable development goals report 2018. S.I United Nations Pubns; 2018.
- 31 Ministry of Housing, Communities & Local Government. English indices of deprivation 2015. Natl. STAT. 2015. Available: <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015> [Accessed 4 Mar 2019].
- 32 Cook JV, Dickinson HO, Eccles MP. Response rates in postal surveys of healthcare professionals between 1996 and 2005: an observational study. *BMC Health Serv Res* 2009;9:160.
- 33 UK Statistic. Community pharmacies in England 2006-2018. Statista. Available: <https://www.statista.com/statistics/418071/community-pharmacies-in-england/> [Accessed 11 Dec 2018].
- 34 Barrett R. Blood pressure monitor validation, calibration, and community pharmacy practice: a pilot cross-sectional survey in Hampshire, UK. *Blood Press Monit* 2018;23:281–2.
- 35 Barrett R, Costa D. An evaluation of community pharmacist perception the misuse and abuse of over-the-counter Co-codamol in Cornwall and Devon, UK: a cross-sectional survey. *Heroin Addict Relat Clin Probl* 2018;20.
- 36 Barrett R, Al-Mousawi HA. Development and initial validation of a postal survey evaluation of community pharmacists' opinion regarding falsified (counterfeit) medicines in Hampshire (UK). *J Pharm Pharmacogn Res* 2018;6:242–9.
- 37 Mavis BE, Brocato JJ. Postal surveys versus electronic mail surveys. The tortoise and the hare revisited. *Eval Health Prof* 1998;21:395–408.
- 38 Nota SPFT, Strooker JA, Ring D. Differences in response rates between mail, e-mail, and telephone follow-up in hand surgery research. *HAND* 2014;9:504–10.
- 39 Raziano DB, Jayadevappa R, Valenzuela D, *et al.* E-Mail versus conventional postal mail survey of geriatric Chiefs. *Gerontologist* 2001;41:799–804.
- 40 IBM Corp. IBM SPSS statistics for windows. Armonk, NY; 2014.
- 41 Odom LR, Morrow, Jr. JR. What's this R? A correlational approach to explaining validity, reliability and Objectivity coefficients. *Meas Phys Educ Exerc Sci* 2006;10:137–45.
- 42 von Elm E, Altman DG, Egger M, *et al.* The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Int J Surg* 2014;12:1495–9.
- 43 dabl@Educational Trust Ltd. Sphygmomanometers for clinical use. Available: [http://www.dableducational.org/sphygmomanometers/devices\\_1\\_clinical.html](http://www.dableducational.org/sphygmomanometers/devices_1_clinical.html)
- 44 British and Irish Hypertension Society. Validated BP monitors for for specialist use.
- 45 NHSBSA. Medicines use review (Mur) / new medicine services (NmS) quarterly submission. Available: <https://www.nhsbsa.nhs.uk/pharmacies-gp-practices-and-appliance-contractors/dispensing-contractors-information/medicines-use> [Accessed 11 Sep 2019].
- 46 Public Health England. Tackling high blood pressure from evidence into action. Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/527916/Tackling\\_high\\_blood\\_pressure.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/527916/Tackling_high_blood_pressure.pdf)
- 47 Hobbs FDR, Bankhead C, Mukhtar T, *et al.* Clinical workload in UK primary care: a retrospective analysis of 100 million consultations in England, 2007–14. *The Lancet* 2016;387:2323–30.
- 48 Albasri A, Prinjha S, McManus RJ, *et al.* Hypertension referrals from community pharmacy to general practice: multivariate logistic regression analysis of 131 419 patients. *Br J Gen Pract* 2018;68:e541–50.
- 49 Dalton K, Byrne S. Role of the pharmacist in reducing healthcare costs: current insights. *Integr Pharm Res Pract* 2017;6:37–46.
- 50 Sendra-Lillo J, Sabater-Hernández D, Sendra-Ortolá Angel, *et al.* Comparison of the white-coat effect in community pharmacy versus the physician's office. *Blood Press Monit* 2011;16:62–6.