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Self-monitoring blood pressure in patients with hypertension:

an internet-based survey of UK GPs

Abstract

Background
Previous research suggests that most GPs in the UK use self-monitoring of blood pressure (SMBP) to monitor the control of hypertension rather than for diagnosis. This study sought to assess current practice in the use of self-monitoring and any changes in practice following more recent guideline recommendations.

Aim
To survey the views and practice of UK GPs in 2015 with regard to SMBP and compare them with a previous survey carried out in 2011.

Design and setting
Web-based survey of a regionally representative sample of 300 UK GPs.

Method
GPs completed an online questionnaire concerning the use of SMBP in the management of hypertension. Analyses comprised descriptive statistics, tests for between-group differences (*z*, Wilcoxon signed-rank, and χ^2 tests), and multivariate logistic regression.

Results
Results were available for 300 GPs (94% of those who started the survey). GPs reported using self-monitoring to diagnose hypertension (169/291; 58%; 95% confidence interval (CI) = 52 to 64) and to monitor control (245/291; 84%; 95% CI = 80 to 88), the former having significantly increased since 2011 (from 37%; 95% CI = 33 to 41; $P<0.001$) with no change in monitoring for control. More than half of GPs used higher systolic thresholds for diagnosis (118/169; 70%; 95% CI = 63 to 77) and treatment (168/225; 75%; 95% CI = 69 to 80) than recommended in guidelines, and under half (120/289; 42%; 95% CI = 36 to 47) adjusted the SMBP results to guide treatment decisions.

Conclusion
Since new UK national guidance in 2011, GPs are more likely to use SMBP to diagnose hypertension. However, significant proportions of GPs continue to use non-standard diagnostic and monitoring thresholds. The use of out-of-office methods to improve the accuracy of diagnosis is unlikely to be beneficial if suboptimal thresholds are used.

Keywords
blood pressure monitoring, self; general practice; hypertension.

INTRODUCTION

How, where, and when blood pressure (BP) is measured are key aspects in the diagnosis and management of hypertension.[1] In the UK and increasingly elsewhere, 24-hour ambulatory BP monitoring (ABPM) has replaced clinic measurement as the gold standard for the diagnosis of hypertension.[2–4]

Patient self-monitoring of BP (SMBP) provides an alternative to clinic measurement: it is a better predictor of cardiovascular risk than clinic measurements;[5,6] monitors are widely available and less expensive than ABPM.[7] SMBP is generally more acceptable to patients[8,9] and provides information about day-to-day variability of BP, whereas ABPM is generally only used over a single 24-hour period.[10] Self-monitoring involves patients in the management of their own health and has been shown to lead to small but significant improvements in BP, which is potentially important given the ongoing suboptimal BP in the community.[11,12] SMBP has been shown to support medication adherence in patients and aid in overcoming clinical inertia in the doctors managing their care.[13,14]

In the UK, the National Institute for Health and Care Excellence (NICE) updated its guidelines for the clinical management of hypertension in adults in 2011 to include recommendations for self-monitoring in response to the developing evidence base.[1] A survey was conducted immediately before their release in 2011 to assess the knowledge and practice of SMBP in UK GPs.[15] The aim of the current survey was to reassess GPs' use of SMBP in the diagnosis and management of hypertension in light of the change in guidance.

METHOD

Participants and recruitment

An invitation to participate in the survey was made available to GPs on the website Doctors.net.uk for 6 days from 26 to 31 May 2015. Doctors.net.uk provides information services to 212 000 UK registered doctors, of whom 60 000 are GPs; 8125 GPs were active on the site at the time of the survey. Responses were accepted until there were at least 300 completed questionnaires and responses had been received from GPs in each region of the UK in approximate proportion to the number in each region, achieved using a sampling algorithm. Only doctors who identified themselves as GPs could undertake the survey. This is the same methodology used in the original survey in 2011.[15]

As part of a linked methodological study carried out in November 2014, in addition to the responses reported here, the same questionnaire was tested through passive recruitment (that is, an open link on the website available to all as used in this study) and direct recruitment (a representative

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How this fits in

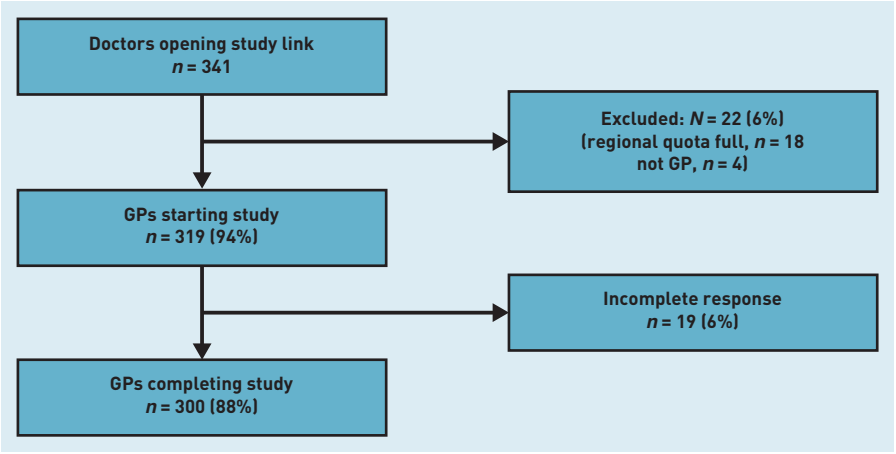
Self-monitoring of blood pressure (SMBP) has shown promise in improving the diagnosis and ongoing management of hypertension, and the UK guidelines were updated in 2011 to reflect this. This study shows that, compared with immediately after the guidelines update, GPs are now more likely to use SMBP to diagnose hypertension; however, significant proportions continue to use non-standard diagnostic and monitoring thresholds. GPs who were surveyed were aware of the benefits of self-monitoring and the practicalities of incorporating SMBP into routine care. There remains room for improvement in implementing appropriate thresholds for diagnosis with SMBP; encouraging and training patients in the use of SMBP; and incorporating new ways of communicating the results of SMBP.

sample of GPs was invited directly). The purpose was to investigate response rates, compare demographic characteristics, and determine whether different recruitment strategies would introduce any bias.

Questionnaire

The questionnaire was designed to ascertain the current use of SMBP to diagnose hypertension and manage control in treated patients; identify the protocols for the use and communication of SMBP; interpret the results of SMBP; identify training and influences on practice with regard to SMBP; and gather participant demographics. The questionnaire replicated a number of questions from a survey carried out in 2011 to allow comparison.[15] It was piloted among academic and non-academic GPs, and further information is available from the authors.

Figure 1. Participant flow chart.



Sample size

It was hypothesised that a greater proportion of GPs would report using SMBP to diagnose hypertension, and that a sample of 300 GPs would detect a 10% difference compared with previous results (one-tailed, 95% confidence interval (CI), 90% power).

Data analysis

Descriptive statistics with CIs around the means are reported. The proportions of GPs who reported using SMBP to confirm a diagnosis of hypertension in 2011 and 2015 were compared using a *z*-test. BP thresholds were compared between 2011 and 2015 using a Wilcoxon signed-rank test. Analyses were performed using Stata for Windows version 12.

Multivariate logistic regression was used to examine the association between physician and practice characteristics and the use of SMBP to diagnose hypertension. Demographic variables hypothesised to be predictive of GP use of SMBP in diagnosis were chosen a priori for inclusion based on the clinical judgement of the authors. These were: sex, age, GP role, year of qualification, country of training, years as a GP, UK region, practice setting, and practice list size. Predictor variables were tested pairwise for correlation before entry into the model.

RESULTS

Participants

A total of 341 doctors opened the study link; after exclusions for exceeding regional quotas and clinical role (that is, hospital doctor), 319 GPs started the survey, of whom 300 (94%) completed all of the questions. Participant flow through the study is shown in Figure 1.

The characteristics of the responders are summarised in Table 1 along with data from the 2011 survey and NHS national workforce data up to 2014 where available.[16] In the linked methodological study, the response rate for individuals who were directly targeted was 83% (248/300) and 79% (237/300) completed the survey. Participant demographics were similar for passive and direct recruitment, and compared well with the participants in this survey (data available from the authors.) The regional distribution of responders matched national proportions.[16]

Only 6% of responders (95% CI = 4 to 9) reported being involved in research involving hypertensive treatment in the past 5 years; 3% (95% CI = 2 to 6) in research involving ambulatory monitors; and 4% (95% CI = 2 to 6) in research involving SMBP in the past 5 years.

Table 1. Characteristics of responders

Characteristic	2015 survey (*N* = 300), *n* (%)	2011 survey[a] (*N* = 625), *n* (%)	2014 national workforce data,[a] %
Practice role			
Principal/partner	200 (67)	357 (57)	65
Salaried/locum	71 (24)	190 (30)	24
Registrar	28 (9)	60 (10)	11
Other	1 (0)	18 (3)	1
Sex			
Male	181 (60)	370 (59)	48
Female	119 (40)	255 (41)	52
Age group, years			
<30	1 (0)	–	1
30–39	114 (38)	–	28
40–49	99 (33)	–	31
50–59	65 (22)	–	30
>60	21 (7)	–	9
Year of qualification			
Median	1997	1995	–
Country of training			
UK	259 (86)	–	78
Europe (excluding UK)	23 (8)	–	5
Asia	11 (4)	–	13
Africa	5 (2)	–	3
Other	2 (1)	–	1
Practice list size			
Median	8500	7800	–
Mean (SD)	8590 (4100)	9154 (4530)	7171
Practice setting			
Urban	128 (43)	–	–
Suburban	78 (26)	–	–
Semi-rural	63 (21)	–	–
Rural	31 (10)	–	–
Region			
East Midlands	20 (7)	40 (6)	6
East of England	26 (9)	53 (8)	8
London	36 (12)	75 (12)	12
North East	13 (4)	28 (4)	4
North West	35 (12)	66 (11)	11
South Central	20 (7)	40 (6)	6
South East Coast	19 (6)	41 (7)	7
South West	29 (10)	58 (9)	10
West Midlands	26 (9)	51 (8)	9
Yorkshire and the Humber	25 (8)	52 (8)	9
Northern Ireland	8 (3)	18 (3)	3
Scotland	29 (10)	74 (12)	10
Wales	14 (5)	29 (5)	5

[a]*Where data were available.*[16] *SD = standard deviation.*

All but one GP were involved in the management of hypertension (99%; 95% CI = 98 to 100). The vast majority of GPs (97%; 95% CI = 95 to 99) were aware of self-monitoring among their patients, which represents an increase from 90% (95% CI = 87 to 92) in 2011. The denominator for the remainder of the results is those participants who were aware of patient self-monitoring, unless otherwise stated (*n* = 291). GPs estimated that 38% (95% CI = 35 to 41) of their patients self-monitored, an increase from 28% (95% CI = 25 to 31) in 2011.

Services available for BP monitoring

Table 2 summarises the services available to support BP measurement/monitoring.

A large proportion of GPs offered ABPM (82%; 95% CI = 77 to 86) and 65% (95% CI = 59 to 70; *n* = 189/291) saw SMBP as complementary to 24-hour ABPM, down from 81% (95% CI = 78 to 84; *n* = 453/557) in 2011.

In 2015 compared with 2011, GPs reported an increase in the availability of most services. However, fewer GPs reported that BP monitors were available for patient use in pharmacies in 2015 than in 2011: 32% (95% CI = 27 to 38) versus 43% (95% CI = 39 to 47).

Reasons for self-monitoring

The reasons given by responding GPs for the use of self-monitoring are reported in Table 3.

The proportion of GPs using self-monitoring to diagnose hypertension was 58% (95% CI = 52 to 64), compared with 37% (95% CI = 33 to 41) in 2011, an absolute increase of 21% (95% CI = 14 to 28; *P*<0.001), or a 57% relative increase; 87% (95% CI = 83 to 90) and 54% (95% CI = 48 to 59) of GPs used SMBP to exclude or confirm white coat and masked hypertension.

Similar proportions of GPs reported using SMBP to monitor control in treated patients in 2015 as in 2011. Half of the GPs used SMBP as an aid to monitor medication adherence and the effects of lifestyle changes (51% (95% CI = 45 to 57) and 49% (95% CI = 43 to 55), respectively).

Certain patient groups that might particularly benefit from SMBP were identified by 62% of participants (95% CI = 56 to 67), with the most commonly reported group being those with white coat hypertension 45% (95% CI = 38 to 52) (Table 4). A further 52% (95% CI = 47 to 58) recognised groups that would not benefit; patients with anxiety was the most common factor quoted (60%; 95% CI = 52 to 67).

Diagnosis of hypertension

The current NICE guidelines set a threshold of 135/85 mmHg for stage 1 hypertension and 150/95 mmHg for stage 2 hypertension when using SMBP. The suggested protocol to diagnose SMBP is: for each BP recording, two consecutive measurements should be taken, at least 1 minute apart and with the person seated; BP should be recorded twice

Table 2. Services available for blood pressure monitoring

Service	2015 survey (*N* = 291), (*n*) % [95% CI]	2011 survey (*N* = 557), (*n*) % [95% CI]
Clinic measurement by GP	(248) 85 [81 to 89]	–
Clinic measurement by nurse/allied healthcare professional	(250) 86 [81 to 89]	–
Ambulatory monitors for 24-hour measurement	(239) 82 [77 to 86]	–
Monitors to lend to patients	(134) 46 [40 to 52]	(191) 34 [30 to 38]
Patient training for self-monitoring	(114) 39 [34 to 45]	(171) 31 [27 to 35]
Monitor in waiting room	(103) 35 [30 to 41]	(122) 22 [19 to 25]
Monitors available for use in local pharmacies	(94) 32 [27 to 38]	(239) 43 [39 to 47]
Blood pressure taken by pharmacy staff	(148) 51 [45 to 57]	–
GP training	(57) 20 [15 to 25]	(52) 9 [7 to 11]
Other	(4) 1 [1 to 3]	–
None of the above	(0) 0	–

Table 3. Reasons for self-monitoring blood pressure

Reason given by GP	2015 (*N* = 291), (*n*) % [95% CI]	2011 (*N* = 557), (*n*) % [95% CI]
For diagnosis	(169) 58 [52 to 64][a]	(206) 37 [33 to 41][a]
To exclude or confirm white coat hypertension	(253) 87 [83 to 90]	(465) 83 [80 to 86]
To exclude or confirm masked hypertension	(156) 54 [48 to 59]	[b]
To monitor control	(245) 84 [80 to 88]	(462) 83 [80 to 86]
As an aid to medication adherence	(148) 51 [45 to 57]	(260) 47 [43 to 51]
As an aid to lifestyle changes	(143) 49 [43 to 55]	[b]
Other	(14) 5 [3 to 8]	(19) 3 [2 to 5]
None of the above	(3) 1 [0 to 3]	(4) 0 [0 to 2]

[a]z-test, P<0.001. [b]Option not included in 2011 survey.

Table 4. Patients who would or would not benefit from self-monitoring blood pressure

Response[a]	Would benefit from SMBP (*N* = 179), (*n*) % [95% CI]	Would not benefit from SMBP (*N* = 151), (*n*) % [95% CI]
White coat/potential white coat hypertension	(80) 45 [38 to 52]	–
Difficulty attending surgery because of time or mobility issues	(33) 18 [13 to 25]	–
Anxious	(26) 15 [10 to 20]	(90) 60 [52 to 67]
Diabetes	(12) 7 [4 to 11]	–
Poor compliance with medication	(10) 6 [3 to 10]	–
Older patient	(8) 4 [2 to 9]	(18) 12 [8 to 18]
Cognitive impairment/dementia	–	(19) 13 [8 to 19]
Neurotic/obsessive	–	(11) 7 [4 to 13]
Other	(54) 30 [24 to 37]	(22) 15 [10 to 21]

[a]Multiple responses accepted. SMBP = self-monitored blood pressure.

daily, ideally in the morning and evening; and BP recording should continue for at least 4 days, ideally for 7 days.[1]

Figures 2 and 3 show the frequency and duration of SMBP for the diagnosis of hypertension. GPs most commonly reported recommending SMBP to diagnose hypertension, with readings twice a day (60%; 95% CI = 52 to 67) for 7 days (50%; 95% CI = 40 to 55).

The mean threshold for diagnosis using SMBP was 141.7 mmHg systolic (95% CI = 140.9 to 142.6) and 87.2 mmHg diastolic (95% CI = 86.6 to 87.7). This compares with mean thresholds in 2011 of 145.9 mmHg systolic (95% CI = 45.2 to 146.6) and 89.5 mmHg diastolic (95% CI = 89.0 to 90.0; *t*-test *P*<0.001 for both systolic and diastolic comparisons). Seventy per cent of GPs (95% CI = 63 to 76) used a systolic threshold ≥136 mmHg, and 54% (95% CI = 46 to 61) used a diastolic threshold >85 mmHg for diagnosis.

The majority of GPs (81%; 95% CI = 75 to 86) reported different diagnostic thresholds for some groups of patients, most commonly patients with diabetes (73%; 95% CI = 66 to 79) and chronic kidney disease (40%; 95% CI = 33 to 47). Fewer reported different thresholds for patients with cardiovascular disease (11%; 95% CI = 7 to 16) or because of advanced age (14%; 95% CI = 9 to 20).

Use of SMBP in managing control in treated patients with hypertension

Overall, the median treatment target in 2015 was 140 mmHg systolic (interquartile range (IQR) 135–145) and 89 mmHg diastolic (IQR 85–90), which had decreased from 150 mmHg systolic (IQR 140–150) and 90 mmHg diastolic (IQR 90–90) in 2011 (Mann–Whitney *U* tests: systolic *P*<0.0001 and diastolic *P*<0.001).

GPs differed in how often they would request a set of measurements from patients, ranging from 24% monthly (95% CI = 20 to 30) to 6% annually (95% CI = 4 to 10). The most popular frequency of measurement was twice a year (34%; 95% CI = 28 to 40).

Adjustment of self-monitored results

The proportion of GPs who reported that they would adjust SMBP readings rather than use them directly increased from 32% (95% CI = 29 to 36) in 2011 to 42% (95% CI = 36 to 47) in 2015. The mean adjustments reported were 8.3 mmHg systolic (95% CI = 7.5 to 9.1) and 5.6 mmHg diastolic (96% CI = 5.1 to 6.2).

Type of monitor and calibration

The majority of GPs recommended that patients use an upper-arm monitor (81%; 95% CI = 76 to 85), with the remaining 19% (95% CI = 15 to 24) not recommending any

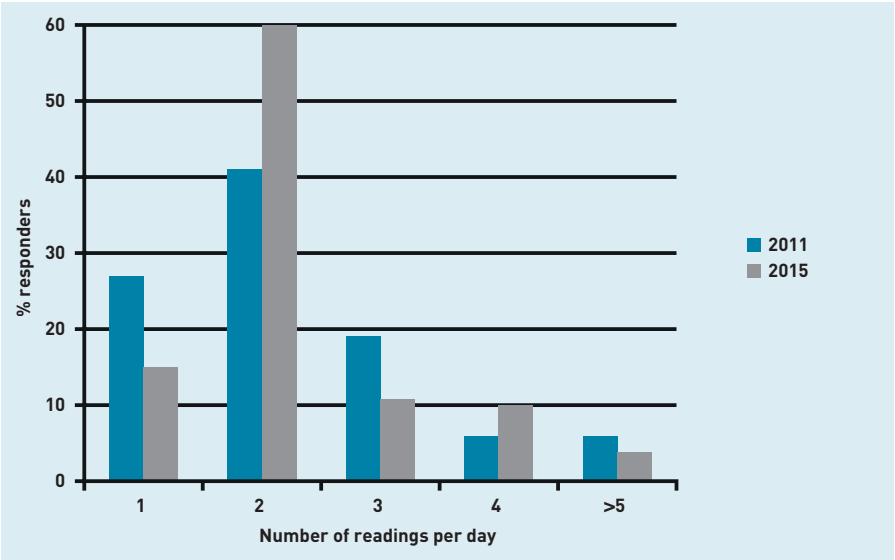


Figure 2. Frequency of self-monitoring.

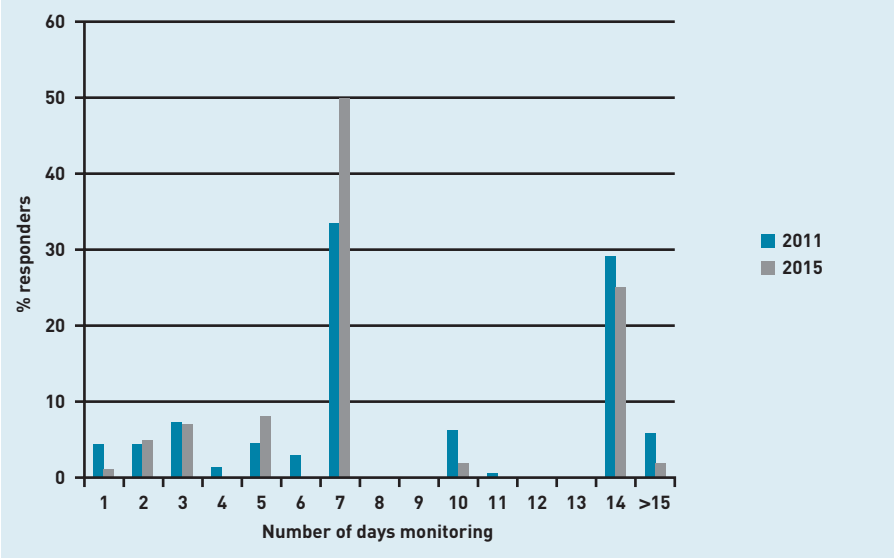
monitor in particular. Thirty-six per cent (95% CI = 30 to 42) specifically warned against certain types of monitor, most commonly wrist or finger monitors (91%; 95% CI = 84 to 95).

Checking the accuracy of their patients' monitors was suggested by 89% (95% CI = 85 to 92) of GPs. Most recommended annual checks (74%; 95% CI = 69 to 79) by practice nurses (57%; 95% CI = 50 to 63). Only 10% (95% CI = 7 to 15) of GPs were willing to check patients' monitors themselves.

Patient recording and communication of SMBP results

The majority of GPs recommended that their patients record their SMBP results in a handwritten diary (86%; 95% CI = 81 to 89) or using a computer spreadsheet (30%; 95% CI = 25 to 36), and that they bring the results in person to consultation (69%; 95% CI = 64 to 74) rather than communicate them by phone (13%; 95% CI = 9 to 17), text (1%; 95% CI = 0 to 3), or e-mail (6%; 95% CI = 4 to 10).

Figure 3. Duration of self-monitoring.



Regression analysis

Logistic regression analysis showed that none of the following variables in the model was a significant predictor of GPs' use of SMBP to diagnose hypertension: sex, GP role, year of qualification, country of training, UK region, practice location, and practice list size. (Full results are available from the authors.) Backwards selection did not result in a model with any significant predictors.

DISCUSSION

Summary

This survey has shown that the majority of GPs now use SMBP to diagnose hypertension, an increase of more than 50% since the implementation of the NICE hypertension guidelines in 2011. In contrast, the proportions of GPs using self-monitoring in general and for ongoing management have stayed stable and at a high level. The increase in use of self-monitoring to diagnose hypertension might be expected to reduce unnecessary treatment of white coat hypertension; interestingly, over 80% of GPs also reported access to ambulatory monitoring. This suggests a mixed picture with a combination of self- and ambulatory monitoring being used. To our knowledge these data are unique.

Significant variation in diagnostic thresholds and protocols for measurement remains. Over half of GPs reported a threshold higher than the NICE threshold for diagnosis with SMBP (135/85 mmHg). This proportion was less than in 2011, but, given that SMBP is usually lower than clinic BP, this may result in undertreatment and worse outcomes.[17] Potential explanations for the discrepancy between guidelines and practice include: not being aware of the different thresholds; using a self-imposed higher target to avoid overdiagnosis; or having different individual practice policies.

The majority of GPs reported using SMBP to monitor BP control in treated patients, despite a relative paucity of evidence.[12] As with diagnostic thresholds, GPs generally reported a higher target for treatment than recommended by the guidelines, but again this had improved since 2011.

There has been an almost universal increase in the services delivered by GPs to support SMBP since 2011, suggesting increasing enthusiasm for SMBP, but only a

minority offer training in self-monitoring to patients (currently 39%). Modern monitors are relatively easy to use but minimal training, especially in cuff positioning, might be expected to improve accuracy of measurement. This need not be a GP-led service and could be delivered equally well by pharmacists or district nurses.

GPs generally recommended that their patients record SMBP results in a handwritten diary and bring them to consultation. Few GPs wanted their patients to communicate their results by phone, text, or e-mail; this may be a missed opportunity or simply reflect the realities of contemporary practice in the NHS. A number of trials have demonstrated the potential benefits of communicating by text or telemonitoring, and that this is well liked by patients and clinicians.[12] BP telemonitoring is cost-effective, with the costs of equipment and technology offset by lower medical costs.[18] Patients also have a generally positive attitude towards telemonitoring, and a high level of compliance with telemonitoring programmes and data transfer.[19] Remote communication of results (not routinely available on the NHS) would be of particular benefit to those patients who have difficulty getting to the clinic for appointments, the group GPs identified as potentially benefiting most from SMBP in this survey.

Strengths and limitations

This is the first study to compare self-monitoring practice in UK GPs with data both before and after changes to national guidelines. Both surveys used the same sampling methodology, as well as the same questions. Additional questions and options were added to strengthen and fill gaps identified through feedback from the previous survey. A regionally representative sample of UK GPs was recruited, and responders were similar to national data across a range of demographics, with the greater proportion of GPs being male in the survey as the only significant difference. The average practice list size reported by GPs was slightly higher than the national average (8590 versus 7171); however, this may well be because this is a comparison of self-reported data with general practice census data. Larger practices may have more resources for home and ambulatory monitoring, but small differences such as this are unlikely to have an effect on the results.

Recruitment of the sample was passive by placing an advert online rather than directly contacting GPs. It is therefore impossible to know how many of the GPs active on the website saw the advert; however, a high proportion of those who clicked on the link completed the questionnaire. This method was used to allow comparison with the 2011 data. The linked methodological study using the same questionnaire with direct targeting via the same website found comparable demographics with similar responses to the questionnaire used for those recruited passively. This suggests that passive recruitment did not introduce significant bias.

The decision to complete the survey may have been influenced by the extent to which the responder was interested in the topic. This is unlikely to have affected the validity of the comparison between 2011 and 2015, but may have led to overestimation of the proportion of GPs who use SMBP.

Comparison with existing literature

GPs estimated that just over one-third of their patients with hypertension currently self-monitor BP, which was slightly higher than the results of a cross-sectional survey in the UK in 2011.[20] Despite this, the number who were self-monitoring still fell behind estimates from other countries where the figure is over 70%.[21–23] GPs could help increase this number by communicating the potential benefits of self-monitoring to patients, as well as providing services to support SMBP.

GPs reported being concerned that SMBP may be unsuitable for anxious or neurotic patients. However, a review of qualitative studies found that few patients shared this concern, and that in fact many patients felt empowered by and enjoyed self-monitoring.[24]

Implications for practice

Since the guidelines changed in 2011, GPs appear more aware of the benefits of SMBP, and of the practicalities of incorporating SMBP into routine care. However, there remains room for improvement in implementing appropriate thresholds for diagnosis with SMBP, encouraging and training patients in the use of SMBP, and incorporating new ways of communicating the results of SMBP. Guidance for clinicians and patients could be standardised to provide useful information to guide practice, while not being overburdensome to either group.

Since new NICE guidance in 2011, UK GPs are more likely to use SMBP to diagnose hypertension but significant proportions continue to use different diagnostic and monitoring thresholds than recommended. The use of out-of-office methods to improve the accuracy of diagnosis is unlikely to be beneficial if suboptimal thresholds are used.

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Ethical approval

This study was approved by the Medical Sciences Interdivisional Research Ethics Committee at the University of Oxford, reference number MSD-IDREC-C1-2014-120.

Provenance

Freely submitted; externally peer reviewed.

Competing interests

FD Richard Hobbs has received limited research support in terms of BP devices from Microlife and BpTRU. Richard J McManus has received research funding in the form of BP monitoring equipment from LloydsPharmacy Limited and Omron. All other authors have declared no competing interests.

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