National Institute for Health and Care Excellence

Final

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

Final

This evidence review was developed by the National Guideline Centre

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The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and, where appropriate, their carer or guardian.

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1.1 Review question: In adults with treated primary hypertension, what is the best method of measuring blood pressure (home, ambulatory or clinic measurement) to assess the response to treatment and prevent cardiovascular events?

1.2 Introduction

Once an individual has been diagnosed with hypertension, the person will be started on a treatment programme (both pharmacological and non-pharmacological) to lower blood pressure (BP). Individuals respond differently to different treatments and often combinations of multiple treatments are required to achieve the target blood pressure. It is therefore necessary to assess an individual's response to treatment to identify those who might need additional or alternative treatment strategies.

Current practice for monitoring response is variable and involves a combination of home, ambulatory and clinic blood pressure measurements. Clinic blood pressure measurements are often higher than those observed with ambulatory or home measurements and are not necessarily a true representation of an individual's day-to-day blood pressure. Ambulatory or home measurements may therefore provide a more accurate estimation of response to treatment and consequent reduction in cardiovascular events.

1.3 PICO table

For full details, see the review protocol in appendix A.

Table 1: PICO characteristics of review question

Population	Adults (over 18 years) with treated primary hypertension
Interventions	Different methods of measuring blood pressure followed by appropriate treatment* based on the blood pressure measurement (test plus treatment): • Home measurement (HBPM) without telemonitoring • Home measurement with telemonitoring • Ambulatory measurement (ABPM) • Clinic/office measurement (CBPM) • Pharmacy measurement
Comparisons	Compared against each other
Outcomes	All outcomes to be measured at a minimum of 12 months. Where multiple time points are reported within each study, the longest time point only will be extracted. **Critical** • All-cause mortality • Health-related quality of life • Stroke (ischaemic or haemorrhagic) • Myocardial infarction **Important** • Reduction in clinic BP

	• Proportion of people controlled to a target • Average daily dose of antihypertensive medication • Average number of visits • Side effect 1: Intolerance to device • Side effect 2: Hypotension (dizziness) • [Combined cardiovascular disease outcomes in the absence of MI and stroke data] • [Coronary heart disease outcome in the absence of MI data]
Study design	Randomised control trials (RCT) and systematic reviews (SR) Non-randomised studies in the absence of RCT and SR evidence

1.4 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual.[32] Methods specific to this review question are described in the review protocol in appendix A.

Declarations of interest were recorded according to NICE's 2018 conflicts of interest policy.

1.5 Clinical evidence

1.5.1 Included studies

Eight studies were included in the review[49, 73, 84, 85, 122, 131, 135, 136]; these are summarised in Table 2 below. Evidence from these studies is summarised in the clinical evidence summary below (Table 3).

There were 8 comparisons extracted from the included studies:

- Home monitoring without telemonitoring compared to clinic monitoring (n=2),
- Home monitoring with telemonitoring compared to clinical monitoring (n=3),
- Home monitoring with telemonitoring and pharmacist care compared to clinical monitoring (n=1)
- Home monitoring without telemonitoring compared to ambulatory/clinic monitoring (n=1)
- Home monitoring without telemonitoring compared to home monitoring with telemonitoring (n=2)
- Home monitoring with telemonitoring compared to home monitoring with telemonitoring and pharmacist care (n=1)
- Pharmacy monitoring compared to clinical monitoring (n=2)
- Home monitoring (with self-titration) and telemonitoring compared to clinic monitoring (n=1).

An individual patient data (IPD) meta-analysis was included Tucker 2017[135] and all the remaining included studies were open-label RCTs. As an IPD is the highest quality design, any trials prior and up to the date it was published were only included if they had any additional outcomes that were not found in the IPD. The IPD reported outcomes for reduction in clinic blood pressure and proportion controlled to a target. Any studies published after 2017 were included if they met the protocol for this review and all relevant outcomes were extracted.

See also the study selection flow chart in appendix C, study evidence tables in appendix D, forest plots in appendix E and GRADE tables in appendix F.

1.5.2 Excluded studies

The guideline committee identified 3 systematic reviews as key papers during the development of this evidence review protocol.[135, 137, 100]

Omboni 2013[100] could not be incorporated as it included trials which deviated from this review protocol, that is, indirect populations without primary hypertension, populations not receiving antihypertensive treatment and follow-up times of less than 12 months. All the trials included in Omboni 2013[100] were individually assessed for relevance for inclusion in this evidence review.

Uhlig 2013[137] was also excluded as it consisted of trials comparing blood pressure monitoring methods to usual care; the description of which was either not given or participants were told not to have their blood pressure measured for the duration of the trials (in these trials, the investigator measured all participants' blood pressure at specified time-points). Also, the treatments given within trials were not standardised for all the participants.

See the excluded studies lists in appendix I. Table 32 outlines the full excluded studies list, and Table 31 provides additional detail of studies that were included in the previous guideline iteration (CG127) but excluded from this update.

1.5.3 Summary of clinical studies included in the evidence review

Table 2: Summary of studies included in the evidence review

Study	Intervention and comparison	Details	Population	Outcomes	Comments
Green 2008[49]	Home monitoring with telemonitoring, n=259 versus Home monitoring with telemonitoring with pharmacist care in addition to physician contact, n=261 versus Usual Care, n=258	HBPM with telemonitoring: OmronHem-705 device used. Blood pressure measured for at least 2 days per week with a minimum of 2 measurements at a time (duration not specified). HBPM target of 135/85mmHg, CBPM target of 140/90mmHg. Readings sent via email. Number of GP visits or communications not specified. HBPM with telemonitoring and pharmacist care: Those assigned to home BP monitoring and Web training plus pharmacist care had the same strategy as home blood pressure monitoring with telemonitoring plus a pharmacist assisting them to improve their BP through telephone calls. HBPM target of 135/85mmHg, CBPM target of 140/90mmHg. The communication occurred every 2 weeks until BP was controlled. Number of GP visits not specified. Usual care: Those assigned to usual care were told their BP was not in control and were encouraged to work with their physician to improve it. No further details given for number of GP visits and communication.	Adults without Type 2 diabetes (n=778) Mean age =59.1 years (SD =8.5 years)	At 12 months: • Mortality • Non-fatal cardiovascular events • Change in blood pressure • Proportion controlled to a target • Quality of life	Downgraded for intervention indirectness as it was comparing with usual care not clearly stating clinic measurement

Study	Intervention and comparison	Details	Population	Outcomes	Comments
Logan 2012[73]	Home monitoring with telemonitoring, n=55 versus Home monitoring without telemonitoring, n=55	HBPM with telemonitoring: Validated Bluetooth-enabled home BP device used. Guideline target of <130/80mmHg. BP readings were automatically transmitted by a smartphone to application servers. Messages instructed people whose BP fell outside the target range to take additional BP readings, which were then used to provide advice on the urgency to make a follow-up visit with their physician. No further details given for number of measurements, GP visits or how often measurements were taken. HBPM without telemonitoring: Subjects were issued with an identical appearing home BP device but without built-in Bluetooth capability for use during the study. No further details given for GP visits, communications or how often measurements were taken.	Adults with diabetes (n=110) Mean age =62.9 years (SD=8.4 years)	At 12 months: • Number of GP visits	Downgraded for population indirectness, as it did not specify type of diabetes present
McManus 2010[84]	Home monitoring (with self-titration) and telemonitoring, n=263 versus Clinic monitoring, n=264	Home monitoring (HM) with telemonitoring: Participants were trained to monitor their own blood pressure for the first week of each month, with 2 self-measurements being made each morning with a 5-min interval and the second reading acted upon. A validated automated sphygmomanometer (Omron 705IT) was used to transmit blood pressure readings to the research team by means of an automated modem device, which was connected to the sphygmomanometer and plugged into a	Adults with diabetes (n=35) Mean age =66.4 years (SD=8.8 years)	At 12 months: • Quality of life • Change in clinic blood pressure	Downgraded for population indirectness, as it did not specify type of diabetes Participants receiving more than 2 antihypertensive drugs at baseline were excluded

Study	Intervention and comparison	Details	Population	Outcomes	Comments
		telephone socket. If participants had 2 consecutive months of readings above target, they were instructed to make medication changes in accordance with the titration schedule by requesting a new prescription without seeing their family doctor. Participants returned to their family doctor for a further titration schedule if blood pressure remained above target after 2 changes. Home targets were 130/85 mmHg for people without diabetes and 130/75 mmHg for participants with diabetes. Monthly summaries of each participant's blood pressure readings were sent to their family doctor. Number of GP visits not stated. Clinic monitoring: They were asked to attend a review by their family doctor. Number of GP visits not stated. No specific instructions were given to the clinicians about the content of this visit other than to review medication. Thereafter, care was at the discretion of the family doctor. No further details given for communications and targets were not specified.			
McManus 2018[85]	Home monitoring without telemonitoring, n=395 versus Home monitoring with telemonitoring, n=393 versus Clinic monitoring, n=394	HBPM without telemonitoring: Device used was a validated automated electronic sphygmomanometer (Omron M10-IT). Participants were asked to monitor their own blood pressure in their non-dominant arm, twice each morning and evening, for the first week of every	Adults with diabetes (n=108) Mean age =66.93 years (SD=9.43 years)	At 12 months: • Change in clinic blood pressure • Cardiovascular events • Overall	Downgraded for population indirectness, as it did not specify type of diabetes present

Study	Intervention and comparison	Details	Population	Outcomes	Comments
		month using standard recommendations. At the end of each monitoring week, they were asked to record their readings on paper and send them for review to their practice in a reply-paid envelope. Attending clinicians were asked to review their readings on a monthly basis. BP targets: <135/85 mmHg at home for those younger than 80 years, <145/85 mmHg at home for those 80 years or older, and <135/75 mmHg at home for those with diabetes. Clinicians in the trial had complete freedom to adjust antihypertensive and other medication as they sought fit, regardless of which group an individual was randomly assigned to and with no restriction on type of drug used. No further details given on number of GP visits. HBPM with telemonitoring: Participants were trained to send readings via a simple free SMS text-based telemonitoring service with web-based data entry back up. They were asked to monitor their own blood pressure in their non-dominant arm, twice each morning and evening, for the first week of every month using standard recommendations. They were prompted to make contact with their practice if their average blood pressure was above target, and presented readings to attending clinicians via a web interface. Attending clinicians were asked to review their readings on a monthly basis. BP targets:		defined daily dose • Mean number of consultations • Quality of life • Dizziness	

Study	Intervention and comparison	Details	Population	Outcomes	Comments
		<135/85 mmHg at home for those younger than 80 years, <145/85 mmHg at home for those 80 years or older, and <135/75 mmHg at home for those with diabetes. Clinicians in the trial had complete freedom to adjust antihypertensive and other medication as they sought fit, regardless of which group an individual was randomly assigned to and with no restriction on type of drug used. No further details given on number of GP visits. Clinic monitoring: Participants were managed with titration of antihypertensive treatment based on clinic blood pressure measurements at the discretion of their attending health-care professional. Attending clinicians were asked to review participants as often as they wished. BP targets: <135/85 mmHg at home for those younger than 80 years, <145/85 mmHg at home for those 80 years or older, and <135/75 mmHg at home for those with diabetes. Clinicians in the trial had complete freedom to adjust antihypertensive and other medication as they sought fit, regardless of which group an individual was randomly assigned to and with no restriction on type of drug used. No further details given on number of GP visits or communications.			

Study	Intervention and comparison	Details	Population	Outcomes	Comments
Simpson 2011[122]	Pharmacy monitoring, n=131 versus Usual care, n=129	Pharmacy monitoring: Blood pressure was measured according to the Canadian Hypertension Education Program recommendations using the BPTru BPM-100 automated machine set to report the average of 5 measurements at 1-minute intervals, no further details on how often. Pharmacists collaborated with primary care physicians and recommended medication changes where appropriate, as per guideline recommendations. No further details given on number of GP visits or communication and targets were not specified. Usual care: Participants received usual care by the primary care team without contributions from study pharmacists, except for standardized blood pressure measurements at the end of the follow-up period. No further details given for number of GP visits or communication and targets were not specified.	Adults with Type 2 diabetes (n=260) Mean age =59.1 years (SD=11.6 years)	At 12 months: • All-cause mortality • Change in blood pressure • Number of visits	Downgraded for intervention indirectness as it was comparing with usual care not clearly stating clinic measurement.
Stergiou 2014[131]	Home monitoring without telemonitoring, n=73 versus Ambulatory and clinic monitoring, n=72	HBPM without telemonitoring: Used validated oscillometric devices with automated memory. Treatment titration during the 12-month follow-up period was made exclusively based on home BP measurements. Target of average home BP <135/85 mmHg for low/moderate-risk participants and <125/80 mmHg for high-risk participants. Treatment titration was performed at 4-week intervals until the pre-set BP goal	Adults with diabetes (n=145) Mean age=50.75 years (SD=10.3 years)	At 12 months: • Change in clinic blood pressure	Downgraded for population indirectness, as it did not specify type of diabetes present

Study	Intervention and comparison	Details	Population	Outcomes	Comments
		was reached. Participants were treated for 12 months with the aim to reach the pre-set BP goals. Controlled hypertension was defined as home BP levels at the pre-set goal in 2 visits 4 weeks apart. No further details given for number of GP visits, communication or number of measurements. Ambulatory and clinic monitoring: Ambulatory BP was monitored on a routine workday at 20-minute intervals for 24 hours using validated oscillometric devices. Treatment titration during the 12-month follow-up period was made on clinic and ambulatory BP measurements. Target was to reach clinic BP <140/90 mmHg and awake ambulatory BP <135/85 mmHg for low/moderate-risk people and <130/80 mmHg and <125/80 mmHg, respectively, for high-risk people. Treatment titration was performed at 4-week intervals until the pre-set BP goal was reached. Participants were treated for 12 months with the aim to reach the pre-set BP goals. No further details given for number of GP visits, communication or number of measurements.			
Tucker 2017[135]	Home monitoring with telemonitoring (HM with TM), n=616 versus Home monitoring without telemonitoring (HM), n=973	HBPM with telemonitoring: Self-monitoring had to be without medical professional input (that is, by participant with or without carer support) and using a validated monitor, with or without other co-interventions, and where a comparator group had no organised self-	Adults (n=3,123)	At 12 months: • Proportion of people controlled to a target • Change in clinic blood	IPD Tucker 2015[136] merged with this study Downgraded once for intervention indirectness

Study	Intervention and comparison	Details	Population	Outcomes	Comments
	versus Usual care, (n=961 in HM, n=573 in HM with TM)	measurement of BP. Targets ranged from 120/75 to 140/90 from home and from 130/80 to 140/90 for clinic. Number of readings/sessions ranged from 1 to 3. Self-monitoring ranged from occurring daily for 1 week every 2 months to daily for the first week of each month. No further details given on number of GP visits or communication. HBPM without telemonitoring: Self-monitoring had to be without medical professional input (that is, by participant with or without carer support) and using a validated monitor, with or without other co-interventions, and where a comparator group had no organised self-measurement of BP. Targets ranged from 120/75 to 140/90 from home and from 130/80 to 140/90 for clinic. Number of readings/sessions ranged from 1 to 3. Self-monitoring ranged from occurring daily for 1 week every 2 months to daily for the first week of each month. No further details given on the telemonitoring aspect. No further details given on number of GP visits or communication. Usual care: No further details given about usual care. Targets ranged from 120/75 to 140/90 from home and from 130/80 to 140/90 for clinic. No further details given on number of GP visits or communication.		pressure	and once for population indirectness, as it was comparing with usual care not clearly stating clinic measurement and did not specify type of diabetes present

See appendix D for full evidence tables.

1.5.4 Quality assessment of clinical studies included in the evidence review

Table 3: Clinical evidence summary: Home monitoring versus clinic monitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Home monitoring without telemonitoring versus clinic monitoring (95% CI)
Cardiovascular events (new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure)	678 (1 study) 1 years	VERY LOW[2,3,4] due to risk of bias, indirectness, imprecision	RR 1.42 (0.61 to 3.33)	Moderate	
				26 per 1,000	11 more per 1,000 (from 10 fewer to 61 more)
Reduction in clinic blood pressure, (systolic blood pressure, change scores)	2,610 (2 studies) 1 years	VERY LOW[2,5] due to risk of bias, indirectness,		[1] Control group risk not available.	The mean reduction in clinic blood pressure, systolic blood pressure, in the intervention groups was 2.23 mmHg lower (3.84 to 0.63 lower)
Reduction in clinic blood pressure, (diastolic blood pressure, change scores)	2,610 (2 studies) 1 years	VERY LOW[2,5] due to risk of bias, indirectness		[1] Control group risk not available.	The mean reduction in clinic blood pressure, diastolic blood pressure, in clinic diastolic blood pressure in the intervention groups was 1.31 mmHg lower (2.19 to 0.44 lower)
Proportion not meeting target (varied target due to IPD – mode 140/90mmHg) (Uncontrolled blood pressure – not meeting	1,934 (1 study) 1 years	VERY LOW[2,4,5] due to risk of bias, indirectness, imprecision	RR 0.99 (0.72 to 1.36)	Moderate	
				73 per 1,000	1 fewer per 1,000 (from 20 fewer to 26 more)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Home monitoring without telemonitoring versus clinic monitoring (95% CI)
trial target)					
Overall defined daily dose	678 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness		The mean overall defined daily dose in the control groups was 2.27	The mean overall defined daily dose in the intervention groups was 0.15 higher (0.11 lower to 0.41 higher)
Mean number of consultations for hypertension	678 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness		The mean number of consultations for hypertension in the control groups was 2.1	The mean number of consultations for hypertension in the intervention groups was 0.30 lower (0.65 lower to 0.05 higher)
Dizziness, hypertension specific symptoms, (no further details of definition)	672 (1 study) 1 years	VERY LOW[2,3,4] due to risk of bias, indirectness, imprecision	RR 0.88 (0.63 to 1.24)	Moderate	
				175 per 1,000	21 fewer per 1,000 (from 65 fewer to 42 more)

[1] Control group risk not available.
[2] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[3] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.
[4] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[5]Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population and intervention respectively.

Table 4: Clinical evidence summary: Home monitoring without telemonitoring versus ambulatory and clinic monitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Ambulatory monitoring	Risk difference with home monitoring without TM (95% CI)
Reduction in clinic blood pressure, systolic blood pressure, change score	145 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness,		[1] Control group risk not available	The mean reduction in clinic blood pressure, systolic blood pressure, in the intervention groups was 2.1 mmHg lower (6.8 lower to 2.6 higher)
Reduction in clinic blood pressure, diastolic blood	145 (1 study)	LOW[2,3] due to risk of bias,		[1] Control group risk not available	The mean reduction in clinic blood pressure, diastolic blood pressure, in the intervention groups

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Ambulatory monitoring	Risk difference with home monitoring without TM (95% CI)
pressure, change score	1 years	indirectness,			was 1.4 mmHg lower (4.3 lower to 1.5 higher)

[1] Control group not available.
[2] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[3] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.

Table 5: Clinical evidence summary: Home monitoring with telemonitoring versus home monitoring without telemonitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Home monitoring without TM	Risk difference with home monitoring with TM (95% CI)
Cardiovascular events (new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure)	658 (1 study) 1 years	VERY LOW[2,3,4] due to risk of bias, indirectness, imprecision	RR 0.91 (0.41 to 2.04)	Moderate	
				37 per 1,000	3 fewer per 1,000 (from 22 fewer to 38 more)
Reduction in clinic blood pressure, systolic blood pressure, final score	655 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness		The mean change in clinic blood pressure, systolic in the control group was 137 mmHg	The mean reduction in clinic blood pressure, systolic blood pressure, in the intervention group was 1.00 mmHg lower (3.51 lower to 1.51 higher)
Reduction in	655	LOW[2,3]		The mean change in clinic blood	The mean reduction in clinic blood

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Home monitoring without TM	Risk difference with home monitoring with TM (95% CI)
clinic blood pressure, diastolic blood pressure, final score	(1 study) 1 years	due to risk of bias, indirectness		pressure, diastolic in the control groups was 77.8 mmHg	pressure, diastolic blood pressure, in the intervention group was 0.90 mmHg higher (0.62 lower to 2.42 higher)
Overall defined daily dose	658 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness		The mean overall defined daily dose in the control groups was 2.42	The mean overall defined daily dose in the intervention groups was 0.27 higher (0 to 0.54 higher)
Average number of GP visits	100 (1 study) 1 years	VERY LOW[3,4] due to indirectness, imprecision	RR 0.64 (0.19 to 2.13)	Moderate	
				122 per 1,000	44 fewer per 1,000 (from 99 fewer to 138 more)
Mean number of consultations for hypertension	658 (1 study) 1 years	LOW[2,3] due to risk of bias, indirectness		The mean number of consultations for hypertension in the control groups was 1.8	The mean number of consultations for hypertension in the intervention groups was 0.40 higher (0.01 to 0.79 higher)
Dizziness, hypertension specific symptoms	650 (1 study) 1 years	VERY LOW[2,3,4] due to risk of bias, indirectness, imprecision	RR 1.43 (1.03 to 1.98)	Moderate	
				154 per 1,000	66 more per 1,000 (from 5 more to 151 more)

[1] Control group risk not available.
[2] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[4]Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.

Table 6: Clinical evidence summary: Home monitoring with telemonitoring versus clinic monitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Home monitoring with telemonitoring versus clinic monitoring (95% CI)
All-cause mortality	493	VERY LOW[3,6]	Peto OR	Moderate	

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Home monitoring with telemonitoring versus clinic monitoring (95% CI)
	(1 study) 1 years	due to indirectness, imprecision	7.45 (0.46 to 119.44)	0 events in control arm	10 more per 1,000 (from 10 fewer to 20 more)
Cardiovascular events (defined as new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure in 1 study, defined as non-fatal cardiovascular events in another)	1,173 (2 studies) 1 years	VERY LOW[1,2,3,6] due to risk of bias, indirectness, imprecision	RR 1.43 (0.66 to 3.08)	Moderate	
				17 per 1,000	7 more per 1,000 (from 6 fewer to 35 more)
Quality of life, SF-12, emotional subscale, 0-100, high is good outcome	493 (1 study) 1 years	LOW[1,6] due to risk of bias, indirectness		The mean quality of life -– emotional scale in the control groups was 71.5	The mean quality of life - emotional scale in the intervention groups was 0.6 higher (2.45 lower to 3.65 higher)
Quality of life, SF-12, physical subscale, 0-100, high is good outcome	493 (1 study) 1 years	LOW[1,6] due to risk of bias, indirectness		The mean quality of life – physical in the control groups was 78.1	The mean quality of life - physical in the intervention groups was 0.4 lower (5.53 lower to 4.73 higher)
Quality of life, SF-12, general subscale, 0-100, high is good outcome	493 (1 study) 1 years	LOW[1,6] due to risk of bias, indirectness		The mean quality of life – general in the control groups was 66.7	The mean quality of life - general in the intervention groups was 0.1 lower (3.75 lower to 3.55 higher)
Reduction in clinic blood pressure – systolic blood pressure, change score	2,357 (3 studies) 1 years	VERY LOW[1,2,5,6] due to risk of bias, inconsistency, indirectness		[4] Control group risk not available.	The mean reduction in clinic blood pressure – systolic blood pressure in the intervention groups was 3.08 mmHg lower (5.89 to 0.58 lower)
Reduction in clinic blood pressure - diastolic blood pressure, change score	2,357 (3 studies) 1 years	VERY LOW[1,2 ,6] due to risk of bias, indirectness,		[4] Control group risk not available.	The mean reduction in clinic blood pressure - diastolic blood pressure in the intervention groups was 0.83 mmHg lower (1.51 to 0.15 lower)

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Control	Risk difference with Home monitoring with telemonitoring versus clinic monitoring (95% CI)
Proportion controlled to a target	493 (1 study) 1 years	LOW[3,6] due indirectness, imprecision	RR 1.22 (0.95 to 1.56)	Moderate	
				304 per 1,000	67 more per 1,000 (from 15 fewer to 170 more)
Proportion not meeting target (varied target due to IPD – mode 140/90 mmHg) (Uncontrolled blood pressure – not meeting trial target)	1,189 (1 study) 1 years	VERY LOW[1,2,3,6] due to risk of bias, indirectness, imprecision	RR 0.90 (0.69 to 1.15)	Moderate	
				164 per 1,000	16 fewer per 1,000 (from 51 fewer to 25 more)
Overall defined daily dose	680 (1 study) 1 years	VERY LOW[1,2] due to risk of bias, indirectness		The mean overall defined daily dose in the control groups was 2.27	The mean overall defined daily dose in the intervention groups was 0.42 higher (0.16 to 0.68 higher)
Mean number of consultations for hypertension	680 (1 study) 1 years	VERY LOW[1,2] due to risk of bias, indirectness		The mean number of consultations for hypertension in the control groups was 2.1	The mean number of consultations for hypertension in the intervention groups was 0.10 higher (0.25 lower to 0.45 higher)
Dizziness, hypertension specific symptoms, (no further details of definition)	674 (1 study) 1 years	VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision	RR 1.26 (0.93 to 1.71)	Moderate	
				175 per 1,000	45 more per 1,000 (from 12 fewer to 124 more)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[4] Control group risk not available.
[5] 'Downgraded by 1 or 2 incrments due to heterogeneity, unexplained by subgroup analyses so random effects was used.
[6]Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.

Table 7: Clinical evidence summary: Home monitoring with telemonitoring and pharmacist care versus clinic monitoring

Outcomes	No of	Quality of the	Relative	Anticipated absolute effects

	Participants (studies) Follow up	evidence (GRADE)	effect (95% CI)	Risk with Clinic monitoring	Risk difference with Home monitoring with TM and pharmacist care (95% CI)
All-cause mortality	484 (1 study) 1 years	VERY LOW[2,3] due to indirectness, imprecision	Peto OR 7.71 (0.15 to 388.76)	Moderate	
				0 events in control group	0 more per 1,000 (from 10 fewer to 20 more)
Non-fatal Cardiovascular events, no further details given	484 (1 study) 1 years	VERY LOW[2,3] due to indirectness, imprecision	RR 1.56 (0.26 to 9.27)	Moderate	
				8 per 1,000	5 more per 1,000 (from 6 fewer to 67 more)
Reduction in blood pressure, systolic change score	484 (1 study) 1 years	LOW[2,3] due to indirectness, imprecision		The mean change in systolic blood pressure in the control group was -5.3 mmHg	The mean change in systolic blood pressure in the intervention groups was 8.90 mmHg lower (11.43 to 6.37 lower)
Reduction in blood pressure, diastolic change score	484 (1 study) 1 years	LOW[2,3] due to indirectness, imprecision		The mean change in diastolic blood pressure in the control groups was -3.5 mmHg	The mean change in diastolic blood pressure in the intervention groups was 3.50 mmHg lower (4.91 to 2.09 lower)
Proportion controlled to a target	484 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness	RR 1.84 (1.48 to 2.28)	Moderate	
				308 per 1,000	259 more per 1,000 (from 148 more to 394 more)
Quality of life, SF-12, emotional subscale, 0-100, high is good outcome	484 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life - emotional scale in the control groups was 71.5	The mean quality of life - emotional scale in the intervention groups was 0.20 higher (3.14 lower to 3.54 higher)
Quality of life, SF-12, physical subscale, 0-100, high is good outcome	484 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life - physical in the control groups was 78.1	The mean quality of life - physical in the intervention groups was 2.90 higher (1.93 lower to 7.73 higher)
Quality of life, SF-12, general subscale, 0-100, high is good outcome	484 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life - general in the control groups was 66.7	The mean quality of life - general in the intervention groups was 0.10 lower (3.9 lower to 3.7 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Clinic monitoring	Risk difference with Home monitoring with TM and pharmacist care (95% CI)

bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 8: Clinical evidence summary: Home monitoring with telemonitoring and pharmacist care versus home monitoring with telemonitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Home monitoring with telemonitoring	Risk difference with Home monitoring with TM + pharmacist care (95% CI)
All-cause mortality	483 (1 study) 1 years	VERY LOW[2,3] due to indirectness, imprecision	RR 0.52 (0.05 to 5.69)	Moderate	
				8 per 1,000	4 fewer per 1,000 (from 8 fewer to 38 more)
Non-fatal Cardiovascular events	483 (1 study) 1 years	VERY LOW[2,3] due to indirectness, imprecision	RR 0.78 (0.18 to 3.44)	Moderate	
				16 per 1,000	4 fewer per 1,000 (from 13 fewer to 39 more)
Reduction in blood pressure, systolic change score	483 (1 study) 1 years	LOW[2,3] due to indirectness, imprecision		The mean change in systolic blood pressure in the control groups was -8.2mmHg	The mean change in systolic blood pressure in the intervention groups was 6.00 mmHg lower (8.53 to 3.47 lower)
Reduction in blood pressure, diastolic change score	483 (1 study) 1 years	LOW[2,3] due to indirectness, imprecision		The mean change in diastolic blood pressure in the control groups was -4.4mmHg	The mean change in diastolic blood pressure in the intervention groups was 2.60 mmHg lower (4.01 to 1.19 lower)
Quality of life, SF-12, emotional sub scale, 0-100, high is good outcome	483 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life - emotional scale in the control groups was 72.1	The mean quality of life - emotional scale in the intervention groups was 0.40 lower (3.67 lower to 2.87 higher)
Quality of life, SF-12, physical sub scale,	483 (1 study)	LOW[1,2] due to risk of bias,		The mean quality of life - physical in the control groups was 77.7	The mean quality of life - physical in the intervention groups was 3.30

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Home monitoring with telemonitoring	Risk difference with Home monitoring with TM + pharmacist care (95% CI)
0-100, high is good outcome	1 years	indirectness			higher (1.77 lower to 8.37 higher)
Quality of life, SF-12, general sub scale, 0-100, high is good outcome	483 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life - general in the control groups was 66.6	The mean quality of life - general in the intervention groups was 0.00 higher (3.85 lower to 3.85 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 9: Clinical evidence summary: Home-monitoring (with self-titration) and telemonitoring versus clinic monitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Clinic/office	Risk difference with Self-monitoring (with self-titration) and telemonitoring (95% CI)
Reduction in blood pressure, systolic final score	480 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean blood pressure systolic in the control groups was 140.3mmHg	The mean change in blood pressure systolic in the intervention groups was 5.60mmHg lower (8.91 to 2.29 lower)
Reduction in blood pressure, diastolic final score	480 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean blood pressure diastolic in the control groups was 79.8mmHg	The mean change in blood pressure diastolic in the intervention groups was 2.30 mmHg lower (4.41 to 0.19 lower)
Quality of life, EQ-5D,	480 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean quality of life, EQ-5D, in the control groups was 0.838	The mean quality of life, eq-5d, in the intervention groups was 0.01 lower (0.06 lower to 0.03 higher)
Mean number of consultations for hypertension	480 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean number of consultations in the control groups was 3.5	The mean number of consultations in the intervention groups was 0.30 lower (0.72 lower to 0.12 higher)
Mean number of antihypertensive	480 (1 study)	LOW[1,2] due to risk of bias,		The mean number of antihypertensive drugs in the control	The mean number of antihypertensive drugs in the intervention groups was

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Clinic/office	Risk difference with Self-monitoring (with self-titration) and telemonitoring (95% CI)
drugs	1 years	indirectness		groups was 1.7	0.40 higher (0.12 to 0.68 higher)

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.

Table 10: Clinical evidence summary: Pharmacy monitoring versus clinic monitoring

Outcomes	No of Participants (studies) Follow up	Quality of the evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects	
				Risk with Clinic/office	Risk difference with Pharmacy (95% CI)
All-cause mortality	260 (1 study) 1 years	VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision	Peto OR 0.13 (0 to 6.72)	Moderate	
				8 per 1,000	10 fewer per 1,000 (from 30 fewer to 10 more)
Reduction in blood pressure, systolic blood pressure, change score	260 (1 study) 1 years	VERY LOW[1,2,3] due to risk of bias, indirectness, imprecision		The mean change in blood pressure, systolic in the control group was 2.5 mmHg	The mean reduction in blood pressure, systolic blood pressure, in the intervention group was 4.90 mmHg lower (8.75 to 1.05 lower)
Reduction in blood pressure, diastolic blood pressure, change score	260 (1 study) 1 years	LOW[1,2] due to risk of bias, indirectness		The mean change in blood pressure, diastolic in the control group was 0.6 mmHg	The mean reduction in blood pressure, diastolic blood pressure, in the intervention group was 2.90 mmHg lower (5.70 to 0.10 lower)
Contacts per patients with all resources (excluding pharmacists)	260 (1 study) 1 years	VERY LOW due to risk of bias, indirectness,		The median number of contacts per participant in the control group was 2. The interquartile range was 2 to 5.	The median number of contacts per participant in the intervention group was 3. The interquartile range was 1 to 6.

[1] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[2] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[3] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.

See appendix F for full GRADE tables.

1.6 Economic evidence

1.6.1 Included studies

One health economic study identified with the relevant comparison and has been included in this review.[62] This is summarised in the health economic evidence profile below (Table 11) and the health economic evidence tables in appendix H.

1.6.2 Excluded studies

Ten economic studies relating to this review question were identified but were excluded due to a combination of limited applicability and methodological limitations, as well as the availability of more applicable evidence. [17, 74, 76, 87, 104, 107, 115, 128, 133, 143]

These are listed in appendix I, with reasons for exclusion given.

See also the health economic study selection flow chart in appendix G.

1.6.3 Summary of studies included in the economic evidence review

Table 11: Health economic evidence profile: Self-monitoring (with self-titration) and telemonitoring versus usual care

Study	Applicability	Limitations	Other comments	Incremental cost	Incremental effects (QALYs)	Cost effectiveness	Uncertainty
Kaambwa 2013[93] (UK)	Directly applicable[(a)]	Potentially serious limitations [(b)]	Cost–utility analysis. Markov model comparing self-management with usual care. One-year cycles. 35-year time horizon. People begin in a 'well' state with poorly controlled hypertension, with the possibility of moving to other states of stroke, myocardial infarction, angina, heart failure, and death. Each event state has a post state. Baseline risk based on Framingham. Extrapolation of effect from a 12-month trial based on translating BP reduction from TASMINH2 trial into a relative risk reduction from Law 2009.	Men: £383 Women: £576	Men: 0.24 Women: 0.12	Men: £1,624 per QALY gained Women: £4,923 per QALY gained	Probabilistic sensitivity analysis undertaken. Probability of being cost effective at £20,000 threshold was 99% for both men and women. Sensitivity analyses undertaken varying time horizon and relaxing assumption that extrapolated effectiveness difference in BP for entire time horizon by reducing the effectiveness for both men and women at different time points in the model. The only time this made self-management not cost effective was when no effectiveness difference between the interventions was assumed for women at year 2 in the model, at year 3, and at year 5.

Abbreviations: CUA: cost utility analysis; ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life years; RCT: randomised controlled trial
(a) UK study, CUA, long-term time horizon. Appropriate interventions.
(b) Based on a trial of only 12 months and extrapolating this effect. CV events based on risk equation rather than directly from a trial. Relative treatment effect based on mapping BP changes. No adverse events. Costs may be out of date.

1.6.4 Resource costs

Some unit costs and considerations are presented and discussed below.

Table 12: Staff costs

Resource	Cost per appointment	Source
GP	£37	Per patient contact lasting 9.22 minutes. PSSRU 2018[36]
Nurse (GP practice)	£10.85	Based on 15.5 minutes of patient contact from PSSRU 2015, and £42 per hour (including qualifications) from PSSRU 2018[36]
Community pharmacist	£18.75	Assuming the same duration of contact as a nurse (15.5 minutes of patient contact). Community pharmacist cost was last included in the 2014 PSSRU[34], this has been inflated to 2015/16 costs(a).

(a) This is the latest available inflation index available from the PSSRU2017 based on the hospital & community health services (HCHS) pay and prices index. [35]

1.7 Evidence statements

1.7.1 Clinical evidence statements

Home monitoring versus clinic monitoring

Very low quality evidence from one study with 678 participants showed a clinically important increase of cardiovascular events for home monitoring compared to clinic monitoring.

Very low quality evidence from 2 studies with a total of 2,610 participants showed no clinically important difference between home and clinic monitoring for reduction in systolic or diastolic clinic blood pressure.Low to very low quality evidence from single studies ranging from 672 to 1,934 particpants, showed no clinically important difference between home monitoring and clinic monitoring for proportion not meeting target, mean number of consultations and overall defined daily dose and dizziness.

Home monitoring without telemonitoring versus ambulatory and clinic monitoring

Low quality evidence from 1 study with 145 participants showed no clinically important difference between home monitoring compared to ambulatory and clinic monitoring for reduction in systolic and diastolic clinic blood pressure.

Home monitoring with telemonitoring versus home monitoring without telemonitoring

Very low quality evidence from one study with 650 participants showed a clinically important increase in occurrence of dizziness for home monitoring with telemonitoring compared to without telemonitoring.

Low to very low quality evidence from 1 study (658 participants) showed no clinically important difference between home monitoring with or without telemonitoring for cardiovascular events, reduction in systolic and diastolic clinic blood pressure, mean number of consultations or overall defined daily dose (number of participants was 655–658

depending on the outcome). Very low quality evidence from 1 study with 100 participants showed no clinically important difference for average number of visits.

Home monitoring with telemonitoring versus clinic monitoring

Low quality evidence from 1 study with 493 participants showed a clinically important benefit for home monitoring with telemonitoring compared to clinic monitoring in terms of proportion controlled to a target.

Very low quality evidence from 1 study with 493 participants showed a greater occurrence of all-cause mortality with home monitoring with telemonitoring compared to clinic monitoring. Very low quality evidence from 2 studies with 1,173 participants showed a greater occurrence of cardiovascular events for home monitoring with telemonitoring.

Very low quality evidence from 3 studies with a total of 2,357 participants showed no clinically important difference between the monitoring methods for reduction in systolic and diastolic clinic blood pressure. Low to very low quality evidence from single studies ranging from 493 to 1,189 participants showed no clinically important difference between home monitoring with clinic monitoring for quality of life on the emotional, physical and general SF-12 subscale, for proportion not meeting a target, mean number of consultations and overall defined daily dose and dizziness.

Home monitoring with telemonitoring and pharmacist care versus clinic monitoring

Low quality evidence from 1 study with 484 participants showed a clinically important benefit of home monitoring with telemonitoring and pharmacist interaction for change in systolic blood pressure, proportion controlled to a target and quality of life with the physical SF-12 subscale.

Very low quality evidence from this study showed a greater occurrence of non-fatal cardiovascular events with home monitoring with telemonitoring and pharmacist interaction compared to clinic monitoring.

Low to very low quality evidence from the same study showed no clinically important difference for all-cause mortality, change in diastolic blood pressure or quality of life measured on the emotional or general subscales of the SF-12 scale.

Home monitoring with telemonitoring and pharmacist care versus home monitoring with telemonitoring

Low to very low quality evidence from the same study failed to demonstrate a clinically important difference for occurrence of non-fatal cardiovascular events, change in diastolic blood pressure or quality of life on the emotional and general subscale of the SF-12 scale.

Low to very low quality evidence from 1 study with 483 participants showed a clinically important benefit of home monitoring with telemonitoring and pharmacist care compared to home monitoring with telemonitoring (without pharmacist care) for all-cause mortality, change in systolic blood pressure and quality of life on the physical subscale of the SF-12 scale.

Home monitoring (with self-titration) and telemonitoring versus clinic monitoring

Low quality evidence from 1 study with 480 participants showed a clinically important benefit of self-monitoring with self-titration for change in systolic blood pressure.

Low quality evidence from the same study showed no clinically important difference for change in diastolic blood pressure, quality of life, mean number of consultations and mean number of antihypertensive drugs.

Pharmacy monitoring versus clinic monitoring

Very low quality evidence from one study with 260 participants showed a clinically important benefit of pharmacy compared to clinic monitoring for all-cause mortality and reduction in systolic blood pressure, but no difference in terms of reduction in diastolic blood pressure, and an increased number of contacts per patient for pharmacy monitoring.

1.7.2 Health economic evidence statements

One cost utility analysis found that self-monitoring with self-titration and telemonitoring was cost effective compared to usual care for monitoring blood pressure (ICER: £1,624 for men and £4,923 for women). This analysis was assessed as directly applicable with potentially serious limitations.

1.8 The committee's discussion of the evidence

1.8.1 Interpreting the evidence

1.8.1.1 The outcomes that matter most

The committee considered all-cause mortality, quality of life, stroke and myocardial infarction as critical outcomes during decision-making. Reduction in clinic blood pressure, proportion controlled to a target, average daily dose of antihypertensive medication, average number of visits, intolerance to device and hypotension were considered important for decision-making. There was no evidence on the outcomes of stroke and intolerance to devices.

1.8.1.2 The quality of the evidence

Seven studies were included, with evidence ranging from very low to low quality. The evidence was rated as low or very low quality due to risk of bias, imprecision or population indirectness. Although there is evidence for cardiovascular events, it is noted the studies did not pre-specify this as an outcome, which led to questions of reliability and whether these events were recorded systematically within the studies. The events were reported, as it is good practice; however, they were not validated by checking if hospital records tallied up with notes reviews carried out during the study. Furthermore, it was noted that the mortality events were not entirely accurate as some people were lost to follow up, which may also have included more mortality events. The studies within the evidence were also small and therefore not powered to detect differences in cardiovascular events. These factors suggest that this evidence should be interpreted with caution.

It was noted that the number of people involved in the included studies and the number of events were relatively small, leading to statistical variation. However, the committee acknowledged that these studies were designed and powered to detect achievement of blood pressure targets, rather than the reduction of cardiovascular events. It was noted that the key aspects to consider were the monitoring endpoints rather than cardiovascular events, as that is what most studies accurately report to demonstrate the accuracy and effects of various monitoring technology.

1.8.1.3 Benefits and harms

There was a clinically important benefit of home monitoring with telemonitoring when compared to clinic monitoring for the proportion of people controlled to a target. There was a clinically important benefit of home monitoring with telemonitoring and pharmacist care when compared to clinic monitoring for systolic blood pressure reduction, proportion controlled to a target and quality of life with the physical SF-12 subscale. Home monitoring with telemonitoring and pharmacist care also showed a clinically important benefit when

compared to home monitoring with telemonitoring, for mortality, systolic blood pressure reduction and quality of life with the physical SF-12 subscale. In addition, home monitoring with self-titration and telemonitoring showed a clinically important benefit when compared to clinic monitoring (for systolic blood pressure reduction). Finally, pharmacy monitoring showed a clinically important benefit when compared to clinic monitoring (for mortality and reduction in systolic blood pressure). There was a clinically important harm for home monitoring with telemonitoring compared to home monitoring without telemonitoring (dizziness) and home monitoring with telemonitoring compared to clinic monitoring (mortality and cardiovascular events). Due to the low quality of the evidence, the committee agreed it was not robust enough to make a strong recommendation to offer home blood pressure monitoring.

It was noted that the aim of the interventions was to deliver better blood pressure control to a specified target and to make efficient use of NHS resources. The outcome for average number of visits was included, as it was agreed to be the best indicator for this. Furthermore, it was noted that a reduction in number of visits to the GP would help inform patient choice when choosing which monitor to use, as well as being a relevant outcome for the NHS.

It was noted that the greatest blood pressure reduction was seen with pharmacist input in monitoring; however, the evidence was not considered strong enough to make a recommendation in favour of pharmacist input.

The committee agreed the evidence showed no difference between clinic and home monitoring. However, it was also noted that the evidence was not robust (as discussed above). It was noted the person's choice is important and that some will be more willing and motivated to use home monitoring. It is important that people know they have the option to choose the type of monitoring most suitable and preferred to them. The recommendations from CG127 were carried forward to recommend CPMB but with the option to consider HBMP for those who chose to self-monitor their blood pressure.

It was discussed that home blood pressure monitoring is routinely used and is widespread practice already, especially for those known to have a white coat effect. The committee agreed that adequate training would have to be in place to ensure it is being measured correctly and the machines are used correctly, perhaps through demonstrations. It was also noted that suitably trained personnel or a robust system would have to be available to deal with any problems arising from use of the machines. Additionally, it was discussed that people with hypertension would receive target instructions and those higher than their target would be able to make an appointment to discuss it further. Therefore, the committee agreed to make a consider recommendation on home monitoring provided the correct training and guidance is given, as it is realistic with the most time being spent at home.

The committee agreed it could not make a recommendation on telemonitoring, as the evidence was not sufficient to support a clear benefit of this technique. In addition, there were variations in the types of telemonitoring methods within the evidence studied. The committee agreed that this was not a priority area for a research recommendation within the guideline as multiple trials were likely on-going as this is a fast-moving field of research, furthermore any specific trial design recommended was likely to be out-of-date by the time it was performed.

The 2011 iteration of the guideline included a recommendation for further research for the best method of monitoring hypertension in people with atrial fibrillation. No evidence was identified in the updated reviews to inform recommendations for this group; therefore, the committee agreed that this research recommendation should be retained potentially to inform future updates of the guideline.

1.8.2 Cost effectiveness and resource use

One UK economic evaluation was identified that compared home measurement with telemonitoring (self-management including self-titration of medication) versus usual care.

Ten economic evaluations were excluded due to a combination of limited applicability and methodological limitations, as well as the availability of more applicable evidence.

The included study was a cost–utility analysis based on a Markov model with 1-year cycles and a 35-year time horizon. People began in a 'well' state with poorly controlled hypertension with the possibility of moving to other states of stroke, myocardial infarction, angina, heart failure, and death. Each event state had a post state. Baseline risk was based on the Framingham risk calculator. Treatment effect was based on the 12-month difference in systolic blood pressure from the TASMINH2 trial[84] and this was translated into a relative risk reduction using a published meta-analysis.[72] Treatment effect was assumed to stay the same after 12 months. There were subgroups by sex. The results showed that self-management was cost effective for both men and women with ICERs below £5,000.

Probabilistic sensitivity analysis was undertaken as well as various 1-way sensitivity analyses: varying the time horizon and relaxing the assumption that the 12-month treatment effect was extrapolated to a lifetime horizon. This was done by reducing the effectiveness for both men and women at different time points in the model. The only time self-management was not cost effective was when no effectiveness difference between the interventions was assumed for women at year 2, at year 3, and at year 5 in the model. The study was rated as directly applicable because it is a UK study from the NHS perspective; it is a cost–utility analysis and has relevant interventions. The quality was rated as having potentially serious limitations because treatment effect was based on a single trial of only 12 months with the effect extrapolated. Additionally, cardiovascular events were based on a risk equation that was based on blood pressure rather than directly from a trial. This possibly overestimates the treatment effect compared to other sources. The baseline risk calculator used is no longer used in practice and is known to overestimate baseline risk. These 2 factors together imply that the ICERs are possibly overestimating the cost effectiveness of the treatment.

Different methods of monitoring are associated with different costs and resource use. Ambulatory monitoring involves having to purchase the expensive machine and staff being trained to use it so that they can train people who need the device as well as interpret the results that are sent automatically to the surgery. As monitoring is ongoing, unlike diagnosis, then there is a resource impact to monitoring using ambulatory measurement because many more machines will be needed, as only 1 person at a time can use a machine. Home measurement also involves equipment being available for people who need the devices to borrow although machines are not as expensive as ambulatory machines. Again, because of the volume with which machines would be loaned for monitoring, more machines would be needed at GP surgeries. The method of managing the person's treatment based on the home measurement will also have variable resource use involved; for example, the person could be taught to self-titrate, or there is a telemonitoring component whereby the clinician still oversees medication changes via phone discussion or is alerted to the person's measurement results electronically somehow and contacts the person. Some of these methods may require infrastructure set up for results to be automatically sent to the clinician and involve training for staff as well as people who will use the devices. The final method is clinic measurement. This is perhaps the most staff-intensive method of monitoring because the person is required to attend a clinic and have a blood pressure measurement taken whenever blood pressure needs to be checked, such as annually. Given the high prevalence of hypertension, a lot of GP and nurse time is occupied with blood pressure monitoring. The main costs involved are therefore the cost of monitors needed, and the cost of staff time consulting with people or checking their blood pressure.

The goal of monitoring blood pressure is to capture changes in blood pressure accurately that require treatment changes in order to avoid cardiovascular events. Additionally, efficiency is important if ways to monitor can be found that reduce the use of staff time. The different measurement methods themselves also have different accuracies, so this may impact whether someone is correctly identified as having their blood pressure controlled or not.

The clinical review identified many different monitoring methods for comparison. The outcome data for cardiovascular events had to be interpreted with caution because the studies were not powered to identify these endpoints. For home monitoring versus clinic monitoring, there was some reduction in systolic blood pressure that favoured home monitoring and also a slightly lower number of consultations in the home monitoring arm. For home monitoring with telemonitoring versus clinic, there was also felt to be a clinically beneficial reduction in systolic blood pressure favouring the home monitoring group. The biggest changes in blood pressure were seen when pharmacist involvement was also added to home monitoring. This was, however, considered to be a very intensive intervention involving around 11 sessions of 30 minutes with a pharmacist over the period of the trial, which would have large cost implications; the committee considered this unfeasible in practice. There was not felt to be any benefit of telemonitoring when compared directly to no telemonitoring.

For the resource use outcomes of average daily dose or number of medications, it was difficult to interpret these outcomes because more pills might also be a positive outcome if they are needed to manage blood pressure.

The study that the included economic evaluation was based on was an intervention that might be considered more intensive on the spectrum of home monitoring because people were also managing their own medication and therefore received some education as well. This might explain why this study showed a bigger impact on blood pressure reduction than some of the other studies in the review. The individual patient data meta-analysis (IPD) included in the review also showed that there was a positive correlation between the magnitude of the blood pressure decrease and intensity of the intervention. This might be explained because people feel more empowered if they are more in control of their own care and thus perhaps more likely to adhere to treatment. Although the economic evaluation showed that this intervention was cost effective, because it is self-management as a strategy rather than just home monitoring, it is not fully applicable in supporting a recommendation on home monitoring.

The committee felt that overall there was some evidence that home monitoring has a positive impact on surrogate outcomes of blood pressure and on some resource use outcomes, which led to them making a consider recommendation for home blood pressure monitoring, if the person prefers. It was not thought possible to be more detailed on the type of home monitoring, and this was left open.

Given this is a consider recommendation, the resource impact is uncertain; however, where it would be implemented if it isn’t already, this would involve some staff training, patient education, and investment in devices. Currently, around 30–40% of people have their own home monitors although not all these people would use them for monitoring. It was also discussed that around half of GP surgeries have the ability to loan home monitors.

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Appendices

Appendix A: Review protocols

Table 13: Review protocol: Monitoring

Field	Content
Review question	In adults with treated primary hypertension, what is the best method of measuring blood pressure (home, ambulatory or clinic measurement) to assess the response to treatment and prevent cardiovascular events?
Type of review question	Intervention review A review of health economic evidence related to the same review question was conducted in parallel with this review. For details, see the health economic review protocol for this NICE guideline.
Objective of the review	The aim of this review is to assess which is the best method of measuring blood pressure (home, ambulatory or clinic measurement) to assess the response to treatment and prevent cardiovascular events in adults aged 18 years or older with treated primary hypertension.
Eligibility criteria – population / disease / condition / issue / domain	Population: Adults (over 18 years) with treated primary hypertension
Eligibility criteria – intervention(s) / exposure(s) / prognostic factor(s)	Different methods of measuring blood pressure followed by appropriate treatment* based on the blood pressure measurement (test plus treatment): • HBPM without telemonitoring • HBPM with telemonitoring • ABPM • CBPM • Pharmacy measurement Stratify results by: • Upper arm cuff • Wrist cuff • Non-oscillometric * All participants in the study should be receiving the same treatment
Eligibility criteria – comparator(s) / control or reference (gold) standard	Compared against each other
Outcomes and prioritisation	All outcomes to be measured at a minimum of 12 months. Where multiple time points are reported within each study, the longest time point only will be extracted. **Critical** • All-cause mortality • Health-related quality of life • Stroke (ischaemic or haemorrhagic) • Myocardial infarction **Important** • Reduction in clinic BP

	• Proportion of people controlled to a target • Average daily dose of antihypertensive medication • Average number of visits • Side effect 1: Intolerance to device • Side effect 2: Hypotension (dizziness) • [Combined cardiovascular disease outcomes in the absence of MI and stroke data] • [Coronary heart disease outcome in the absence of MI data]
Eligibility criteria – study design	RCTs and SRs Non-randomised studies in the absence of RCT and SR evidence
Other inclusion exclusion criteria	Minimum follow up time: 1 year Exclusions: • Studies including participants with type 1 diabetes or chronic kidney disease (A3 or above [heavy proteinuria]). • Indirect populations with secondary causes of hypertension such as tumours or structural vascular defects (Conn's adenoma, phaeochromocytoma, renovascular hypertension) • Pregnant women • Crossover trials • Children (younger than 18 years) • Studies with a population of inpatients
Proposed sensitivity / subgroup analysis, or meta-regression	Subgroups in the presence of heterogeneity: • Age (75 as a cut off)* • Presence or absence of type 2 diabetes • Family origin(African and Caribbean, White, South Asian) • Severity (stage 1 [BP 140-59/90-99] versus moderate stage 2 to severe [BP 160/100]) *To note that we will also extract evidence in those aged 80 years and older if this evidence is reported separately.
Selection process – duplicate screening / selection / analysis	A senior research fellow will undertake quality assurance prior to completion.
Data management (software)	Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5). GRADEpro will be used to assess the quality of evidence for each outcome. Endnote will be used for bibliography, citations, sifting and reference management.
Information sources – databases and dates	Medline, Embase, the Cochrane Library Language: Restrict to English only Key paper: • SR Tucker 2017: Self-monitoring of blood pressure in hypertension: A systematic review and individual patient data meta-analysis • Uhlig 2013: Self-Measured Blood Pressure Monitoring in the Management of hypertension. A Systematic Review and Meta-analysis • Omboni 2013: Clinical usefulness and cost effectiveness of home blood pressure telemonitoring: meta-analysis of randomized controlled studies
Identify if an update	Yes, 2011
Author contacts	https://www.nice.org.uk/guidance/cg127

Highlight if amendment to previous protocol	For details, please see section 4.5 of Developing NICE guidelines: the manual.
Search strategy – for 1 database	For details, please see appendix B Cut off of 2000
Data collection process – forms / duplicate	A standardised evidence table format will be used, and published as appendix D of the evidence report.
Data items – define all variables to be collected	For details, please see evidence tables in Appendix D (clinical evidence tables) or H (health economic evidence tables).
Methods for assessing bias at outcome / study level	Standard study checklists were used to appraise individual studies critically. For details please see section 6.2 of Developing NICE guidelines: the manual The risk of bias across all available evidence was evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/
Criteria for quantitative synthesis	For details, please see section 6.4 of Developing NICE guidelines: the manual.
Methods for quantitative analysis – combining studies and exploring (in)consistency	For details, please see the separate Methods report for this guideline.
Meta-bias assessment – publication bias, selective reporting bias	For details, please see section 6.2 of Developing NICE guidelines: the manual.
Confidence in cumulative evidence	For details, please see sections 6.4 and 9.1 of Developing NICE guidelines: the manual.
Rationale / context – what is known	For details, please see the introduction to the evidence review.
Describe contributions of authors and guarantor	A multidisciplinary committee developed the evidence review. The committee was convened by the National Guideline Centre (NGC) and chaired by Anthony Wierzbicki in line with section 3 of Developing NICE guidelines: the manual. Staff from the NGC undertook systematic literature searches, appraised the evidence, conducted meta-analysis and cost-effectiveness analysis where appropriate, and drafted the evidence review in collaboration with the committee. For details, please see Developing NICE guidelines: the manual.
Sources of funding / support	The NGC is funded by NICE and hosted by the Royal College of Physicians.
Name of sponsor	The NGC is funded by NICE and hosted by the Royal College of Physicians.
Roles of sponsor	NICE funds the NGC to develop guidelines for those working in the NHS, public health and social care in England.
PROSPERO registration number	CRD42018087407

Table 14: Health economic review protocol

Review question	All questions – health economic evidence
Objectives	To identify health economic studies relevant to any of the review questions.
Search criteria	• Populations, interventions and comparators must be as specified in the clinical review protocol above. • Studies must be of a relevant health economic study design (cost–utility analysis,

	cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis). • Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.) • Unpublished reports will not be considered unless submitted as part of a call for evidence. • Studies must be in English.
Search strategy	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below. No date cut-off from the previous guideline was used.
Review strategy	Studies not meeting any of the search criteria above will be excluded. Studies published before 2002, abstract-only studies and studies from non-OECD countries or the US will also be excluded. Studies published after 2002 that were included in the previous guideline(s) will be reassessed for inclusion and may be included or selectively excluded based on their relevance to the questions covered in this update and whether more applicable evidence is also identified. Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).[92] **Inclusion and exclusion criteria** • If a study is rated as both 'Directly applicable' and with 'Minor limitations', then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile. • If a study is rated as either 'Not applicable' or with 'Very serious limitations', then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health economic evidence profile. • If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both, then there is discretion over whether it should be included. **Where there is discretion** The health economist will make a decision based on the relative applicability and quality of the available evidence for that question in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to exclude selectively the remaining studies. All studies excluded based on applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below. The health economist will be guided by the following hierarchies. *Setting:* • UK NHS (most applicable). • OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden). • OECD countries with predominantly private health insurance systems (for example, Switzerland). • Studies set in non-OECD countries or in the US will be excluded before being assessed for applicability and methodological limitations. *Health economic study type:*

	• Cost–utility analysis (most applicable). • Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis). • Comparative cost analysis. • Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations. *Year of analysis:* • The more recent the study, the more applicable it will be. • Studies published in 2002 or later (including any such studies included in the previous guideline[s]) but that depend on unit costs and resource data entirely or predominantly before 2002 will be rated as 'Not applicable'. • Studies published before 2002 (including any such studies included in the previous guideline[s]) will be excluded before being assessed for applicability and methodological limitations. *Quality and relevance of effectiveness data used in the health economic analysis:* • The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review, the more useful the analysis will be for decision-making in the guideline. • Generally, economic evaluations based on excludes from the clinical review will be excluded.

Appendix B: Literature search strategies

The literature searches for this review are detailed below and complied with the methodology outlined in Developing NICE guidelines: the manual 2014, updated 2017.

For more detailed information, please see the Methodology Review.

B.1 Clinical search literature search strategy

Searches were constructed using a PICO framework where population (P) terms were combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are rarely used in search strategies for interventions as these concepts may not be well described in title, abstract or indexes and therefore difficult to retrieve. Search filters were applied to the search where appropriate.

Table 15: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline (OVID)	1946–02 October 2018	Exclusions Randomised controlled trials Systematic review studies Observational studies Diagnostic tests studies
Embase (OVID)	1974–02 October 2018	Exclusions Randomised controlled trials Systematic review studies Observational studies Diagnostic tests studies Prognostic studies Qualitative studies
The Cochrane Library (Wiley)	Cochrane Reviews to Issue 8 of 12, August 2018 CENTRAL to Issue 7 of 12, July 2018 DARE and NHSEED to Issue 2 of 4, April 2015 HTA to Issue 4 of 4, October 2016	None

Table 16: Medline (Ovid) search terms

1.	exp Hypertension/
2.	hypertens*.ti,ab.
3.	(elevat* adj2 blood adj pressur*).ti,ab.
4.	(high adj blood adj pressur*).ti,ab.
5.	(increase* adj2 blood pressur*).ti,ab.
6.	((systolic or diastolic or arterial) adj2 pressur*).ti,ab.
7.	or/1-6
8.	exp pregnancy/
9.	exp Hypertension, Pregnancy-Induced/ not exp Hypertension/
10.	(pre eclampsia or pre-eclampsia or preeclampsia).ti,ab.
11.	exp Hypertension, Portal/ not exp Hypertension/
12.	exp Hypertension, Pulmonary/ not exp Hypertension/

13.	exp Intracranial Hypertension/ not exp Hypertension/
14.	exp Ocular Hypertension/ not exp Hypertension/
15.	exp Diabetes Mellitus, Type 1/ not exp Diabetes Mellitus, Type 2/
16.	or/8-15
17.	7 not 16
18.	letter/
19.	editorial/
20.	news/
21.	exp historical article/
22.	Anecdotes as Topic/
23.	comment/
24.	case report/
25.	(letter or comment*).ti.
26.	or/18-25
27.	randomized controlled trial/ or random*.ti,ab.
28.	26 not 27
29.	animals/ not humans/
30.	exp Animals, Laboratory/
31.	exp Animal Experimentation/
32.	exp Models, Animal/
33.	exp Rodentia/
34.	(rat or rats or mouse or mice).ti.
35.	or/28-34
36.	17 not 35
37.	(exp child/ or exp pediatrics/ or exp infant/) not (exp adolescent/ or exp adult/ or exp middle age/ or exp aged/)
38.	36 not 37
39.	limit 38 to English language
40.	exp Blood Pressure Determination/
41.	Blood Pressure Monitoring, Ambulatory/
42.	((ambulatory or home or self or office or clinic or surgery or pharmac* or telemonitor* or daytime or 12 hour or 24 hour or continuous) adj3 (blood pressure* or BP)).ti,ab.
43.	(ABPM or HBPM).ti,ab.
44.	Blood Pressure Monitors/
45.	exp Sphygmomanometers/
46.	((blood pressure or BP) adj3 (monitor* or meter* or device*)).ti,ab.
47.	((arm* or wrist* or cuff or non cuff or automatic or electronic or digital or wireless or remote) adj3 (monitor* or meter* or measur*)).ti,ab.
48.	sphygmomanometer*.ti,ab.
49.	or/40-47
50.	39 and 49
51.	randomized controlled trial.pt.
52.	controlled clinical trial.pt.
53.	randomi#ed.ti,ab.
54.	placebo.ab.
55.	randomly.ti,ab.
56.	Clinical Trials as topic.sh.
57.	trial.ti.

58.	or/51-57
59.	Meta-Analysis/
60.	exp Meta-Analysis as Topic/
61.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
62.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
63.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
64.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
65.	(search* adj4 literature).ab.
66.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
67.	cochrane.jw.
68.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
69.	or/59-68
70.	Epidemiologic studies/
71.	Observational study/
72.	exp Cohort studies/
73.	(cohort adj (study or studies or analys* or data)).ti,ab.
74.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
75.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or review or analys* or cohort* or data)).ti,ab.
76.	Controlled Before-After Studies/
77.	Historically Controlled Study/
78.	Interrupted Time Series Analysis/
79.	(before adj2 after adj2 (study or studies or data)).ti,ab.
80.	or/70-79
81.	exp case control study/
82.	case control*.ti,ab.
83.	or/81-82
84.	80 or 83
85.	Cross-sectional studies/
86.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
87.	or/85-86
88.	80 or 87
89.	80 or 83 or 87
90.	exp "sensitivity and specificity"/
91.	(sensitivity or specificity).ti,ab.
92.	((pre test or pretest or post test) adj probability).ti,ab.
93.	(predictive value* or PPV or NPV).ti,ab.
94.	likelihood ratio*.ti,ab.
95.	likelihood function/
96.	((area under adj4 curve) or AUC).ti,ab.
97.	(receive* operat* characteristic* or receive* operat* curve* or ROC curve*).ti,ab.
98.	(diagnos* adj3 (performance* or accurac* or utilit* or value* or efficien* or effectiveness)).ti,ab.
99.	gold standard.ab.

100.	or/90-99
101.	comparative study.pt.
102.	50 and (58 or 69 or 89 or 100) or (50 and 101)

Table 17: Embase (Ovid) search terms

1.	exp Hypertension/
2.	hypertens*.ti,ab.
3.	(elevat* adj2 blood adj pressur*).ti,ab.
4.	(high adj blood adj pressur*).ti,ab.
5.	(increase* adj2 blood pressur*).ti,ab.
6.	((systolic or diastolic or arterial) adj2 pressur*).ti,ab.
7.	or/1-6
8.	exp pregnancy/
9.	exp Maternal Hypertension/
10.	(pre eclampsia or pre-eclampsia or preeclampsia).ti,ab.
11.	exp Hypertension, Portal/ not exp Hypertension/
12.	exp Hypertension, Pulmonary/ not exp Hypertension/
13.	exp Intracranial Hypertension/
14.	exp Ocular Hypertension/ not exp Hypertension/
15.	exp Diabetes Mellitus, Type 1/ not exp Diabetes Mellitus, Type 2/
16.	or/8-15
17.	7 not 16
18.	letter.pt. or letter/
19.	note.pt.
20.	editorial.pt.
21.	case report/ or case study/
22.	(letter or comment*).ti.
23.	or/18-22
24.	randomized controlled trial/ or random*.ti,ab.
25.	23 not 24
26.	animal/ not human/
27.	nonhuman/
28.	exp Animal Experiment/
29.	exp Experimental Animal/
30.	animal model/
31.	exp Rodent/
32.	(rat or rats or mouse or mice).ti.
33.	or/25-32
34.	17 not 33
35.	(exp child/ or exp pediatrics/) not (exp adult/ or exp adolescent/)
36.	34 not 35
37.	limit 36 to English language
38.	blood pressure measurement/
39.	*blood pressure monitoring/
40.	((ambulatory or home or self or office or clinic or surgery or pharmac* or telemonitor* or daytime or 12 hour or 24 hour or continuous) adj3 (blood pressure* or BP)).ti,ab.
41.	(ABPM or HBPM).ti,ab.

42.	exp blood pressure monitor/
43.	exp blood pressure meter/
44.	exp Sphygmomanometer/
45.	((blood pressure or BP) adj3 (monitor* or meter* or device*)).ti,ab.
46.	((blood pressure or BP) adj measur*).ti,ab.
47.	((arm* or wrist* or cuff or non cuff or automatic or electronic or digital or wireless or remote) adj3 (monitor* or meter* or measur*)).ti,ab.
48.	sphygmomanometer*.ti,ab.
49.	or/38-47
50.	37 and 49
51.	random*.ti,ab.
52.	factorial*.ti,ab.
53.	(crossover* or cross over*).ti,ab.
54.	((doubl* or singl*) adj blind*).ti,ab.
55.	(assign* or allocat* or volunteer* or placebo*).ti,ab.
56.	crossover procedure/
57.	single blind procedure/
58.	randomized controlled trial/
59.	double blind procedure/
60.	or/51-59
61.	systematic review/
62.	meta-analysis/
63.	(meta analy* or metanaly* or metaanaly* or meta regression).ti,ab.
64.	((systematic* or evidence*) adj3 (review* or overview*)).ti,ab.
65.	(reference list* or bibliograph* or hand search* or manual search* or relevant journals).ab.
66.	(search strategy or search criteria or systematic search or study selection or data extraction).ab.
67.	(search* adj4 literature).ab.
68.	(medline or pubmed or cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or science citation index or bids or cancerlit).ab.
69.	cochrane.jw.
70.	((multiple treatment* or indirect or mixed) adj2 comparison*).ti,ab.
71.	or/61-70
72.	Clinical study/
73.	Observational study/
74.	family study/
75.	longitudinal study/
76.	retrospective study/
77.	prospective study/
78.	cohort analysis/
79.	follow-up/
80.	cohort*.ti,ab.
81.	79 and 80
82.	(cohort adj (study or studies or analys* or data)).ti,ab.
83.	((follow up or observational or uncontrolled or non randomi#ed or epidemiologic*) adj (study or studies or data)).ti,ab.
84.	((longitudinal or retrospective or prospective or cross sectional) and (study or studies or

	review or analys* or cohort* or data)).ti,ab.
85.	(before adj2 after adj2 (study or studies or data)).ti,ab.
86.	or/72-78,81-85
87.	exp case control study/
88.	case control*.ti,ab.
89.	or/87-88
90.	86 or 89
91.	cross-sectional study/
92.	(cross sectional and (study or studies or review or analys* or cohort* or data)).ti,ab.
93.	or/91-92
94.	86 or 93
95.	86 or 89 or 93
96.	exp "sensitivity and specificity"/
97.	(sensitivity or specificity).ti,ab.
98.	((pre test or pretest or post test) adj probability).ti,ab.
99.	(predictive value* or PPV or NPV).ti,ab.
100.	likelihood ratio*.ti,ab.
101.	((area under adj4 curve) or AUC).ti,ab.
102.	(receive* operat* characteristic* or receive* operat* curve* or ROC curve*).ti,ab.
103.	(diagnos* adj3 (performance* or accurac* or utilit* or value* or efficien* or effectiveness)).ti,ab.
104.	diagnostic accuracy/
105.	diagnostic test accuracy study/
106.	gold standard.ab.
107.	or/96-106
108.	comparative study.pt.
109.	50 and (60 or 71 or 95 or 107) or (50 and 108)

Table 18: Cochrane Library (Wiley) search terms

#1.	MeSH descriptor: [Hypertension] explode all trees
#2.	hypertens*:ti,ab
#3.	(elevat* near/2 blood next pressur*):ti,ab
#4.	(high near/1 blood near/1 pressur*):ti,ab
#5.	(increase* near/2 blood pressur*):ti,ab
#6.	((systolic or diastolic or arterial) near/2 pressur*):ti,ab
#7.	(or #1 or #6)
#8.	MeSH descriptor: [Blood Pressure Determination] explode all trees
#9.	MeSH descriptor: [Blood Pressure Monitoring, Ambulatory] explode all trees
#10.	((ambulatory or home or self or office or clinic or surgery or pharmac* or telemonitor* or daytime or 12 hour or 24 hour or continuous) near/3 (blood pressure* or BP)):ti,ab
#11.	(ABPM or HBPM):ti,ab
#12.	MeSH descriptor: [Blood Pressure Monitors] this term only
#13.	MeSH descriptor: [Sphygmomanometers] explode all trees
#14.	((blood pressure or BP) near/3 (monitor* or meter* or device*)):ti,ab
#15.	((arm* or wrist* or cuff or non cuff or automatic or electronic or digital or wireless or remote) near/3 (monitor* or meter* or measur*)):ti,ab
#16.	sphygmomanometer*:ti,ab
#17.	(or #8-#16)

#18.	#7 and #17

B.2 Health Economics literature search strategy

Health economic evidence was identified by conducting a broad search relating to hypertension in adults population in NHS Economic Evaluation Database (NHS EED – this ceased to be updated after March 2015) and the Health Technology Assessment database (HTA) with no date restrictions. NHS EED and HTA databases are hosted by the Centre for Research and Dissemination (CRD). Additional searches were run on Medline and Embase for health economics, economic modelling and quality of life studies.

Table 19: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	2014 – 28 August 2018	Exclusions Health economics studies
Embase	2014 – 28 August 2018	Exclusions Health economics studies
Centre for Research and Dissemination (CRD)	HTA - Inception – 28 August 2018 NHSEED - Inception to March 2015	None

Table 20: Medline (Ovid) search terms

1.	exp Hypertension/
2.	hypertens*.ti,ab.
3.	(elevat* adj2 blood adj pressur*).ti,ab.
4.	(high adj blood adj pressur*).ti,ab.
5.	(increase* adj2 blood pressur*).ti,ab.
6.	((systolic or diastolic or arterial) adj2 pressur*).ti,ab.
7.	or/1-6
8.	letter/
9.	editorial/
10.	news/
11.	exp historical article/
12.	Anecdotes as Topic/
13.	comment/
14.	case report/
15.	(letter or comment*).ti.
16.	or/8-15
17.	randomized controlled trial/ or random*.ti,ab.
18.	16 not 17
19.	animals/ not humans/
20.	exp Animals, Laboratory/
21.	exp Animal Experimentation/
22.	exp Models, Animal/
23.	exp Rodentia/
24.	(rat or rats or mouse or mice).ti.

25.	or/18-24
26.	7 not 25
27.	limit 26 to English language
28.	Economics/
29.	Value of life/
30.	exp "Costs and Cost Analysis"/
31.	exp Economics, Hospital/
32.	exp Economics, Medical/
33.	Economics, Nursing/
34.	Economics, Pharmaceutical/
35.	exp "Fees and Charges"/
36.	exp Budgets/
37.	budget*.ti,ab.
38.	cost*.ti.
39.	(economic* or pharmaco?economic*).ti.
40.	(price* or pricing*).ti,ab.
41.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
42.	(financ* or fee or fees).ti,ab.
43.	(value adj2 (money or monetary)).ti,ab.
44.	or/28-43
45.	27 and 44

Table 21: Embase (Ovid) search terms

1.	exp Hypertension/
2.	hypertens*.ti,ab.
3.	(elevat* adj2 blood adj pressur*).ti,ab.
4.	(high adj blood adj pressur*).ti,ab.
5.	(increase* adj2 blood pressur*).ti,ab.
6.	((systolic or diastolic or arterial) adj2 pressur*).ti,ab.
7.	or/1-6
8.	letter.pt. or letter/
9.	note.pt.
10.	editorial.pt.
11.	case report/ or case study/
12.	(letter or comment*).ti.
13.	or/8-12
14.	randomized controlled trial/ or random*.ti,ab.
15.	13 not 14
16.	animal/ not human/
17.	nonhuman/
18.	exp Animal Experiment/
19.	exp Experimental Animal/
20.	animal model/
21.	exp Rodent/
22.	(rat or rats or mouse or mice).ti.

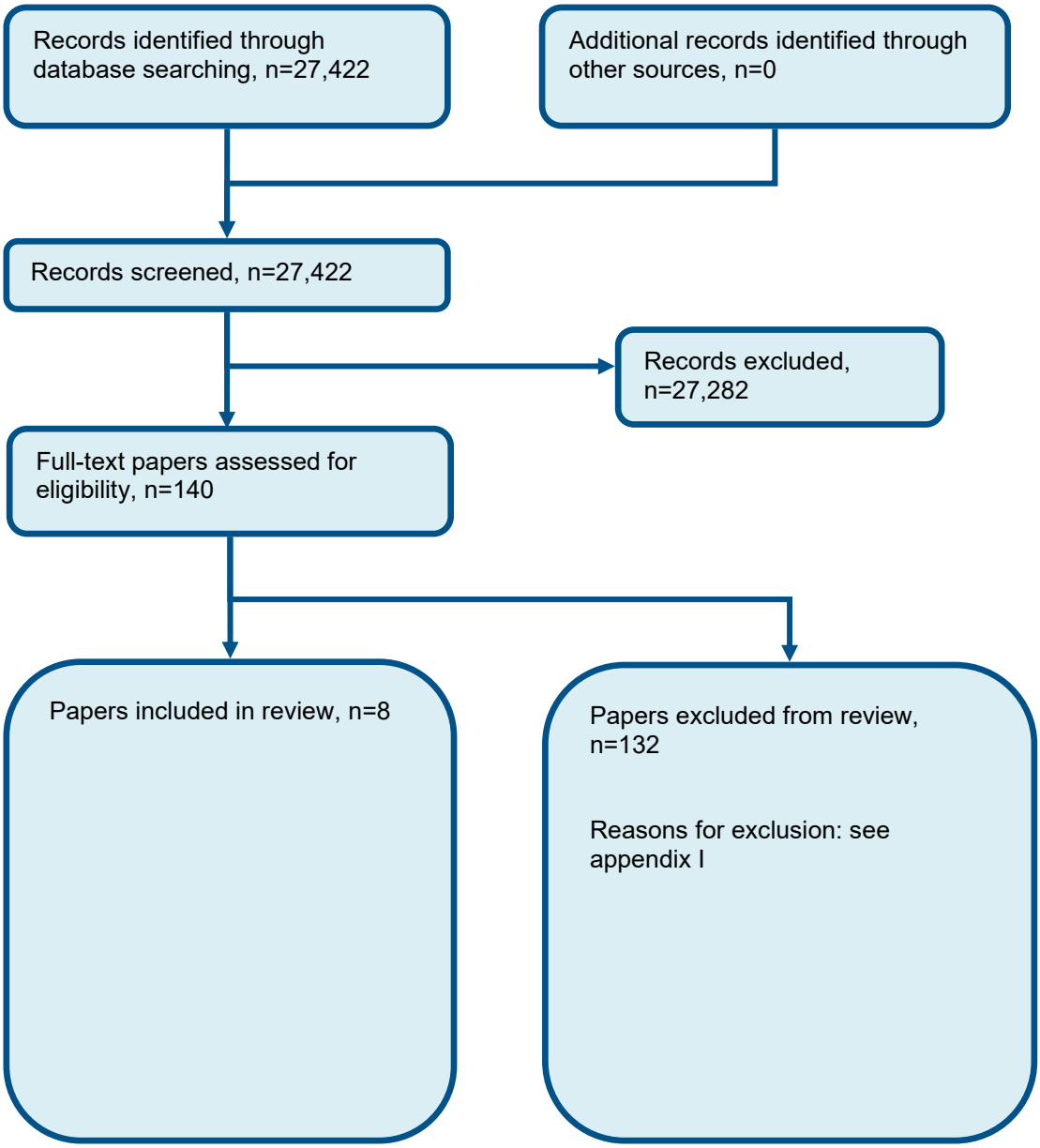
23.	or/15-22
24.	7 not 23
25.	limit 24 to English language
26.	health economics/
27.	exp economic evaluation/
28.	exp health care cost/
29.	exp fee/
30.	budget/
31.	funding/
32.	budget*.ti,ab.
33.	cost*.ti.
34.	(economic* or pharmaco?economic*).ti.
35.	(price* or pricing*).ti,ab.
36.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
37.	(financ* or fee or fees).ti,ab.
38.	(value adj2 (money or monetary)).ti,ab.
39.	or/26-38
40.	25 and 39

Table 22: NHS EED and HTA (CRD) search terms

#1.	MeSH DESCRIPTOR Hypertension EXPLODE ALL TREES IN NHSEED,HTA
#2.	(Hypertens*) IN NHSEED, HTA
#3.	(elevat* adj2 blood adj pressur*) IN NHSEED, HTA
#4.	(high adj blood adj pressur*) IN NHSEED, HTA
#5.	(increase* adj2 blood pressur*) IN NHSEED, HTA
#6.	((systolic or diastolic or arterial) adj2 pressur*) IN NHSEED, HTA
#7.	#1 OR #2 OR #3 OR #4 OR #5 OR #6

Appendix C: Clinical evidence selection

Figure 1: Flow chart of clinical study selection for the review of monitoring



Appendix D: Clinical evidence tables

Study	Green 2008[49]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=778)
Countries and setting	Conducted in the US; Setting: This study is being conducted at 10 Group Health-owned primary care medical centres in the Puget Sound Region.
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Not applicable
Inclusion criteria	Potential subjects aged 25–75 and continuously enrolled in Group Health for at least 1 year were identified through administrative data sources. They must not only have a diagnosis of hypertension through an outpatient diagnostic code but also be currently taking antihypertensive medications.
Exclusion criteria	Automated data are also used to exclude people who have heart disease (ischemic or valvular heart disease or arrhythmias), diabetes, renal failure, dementia, serious psychiatric disorders (for example, schizophrenia), treatment with chemotherapeutic, immunosuppressant, or antiretroviral agents, or hospitalization within 3 months. Those pregnant or planning either to move away from the area or to change health plans in the next 12 months were excluded.
Recruitment/selection of people	Those eligible based on automated data were sent recruitment letters to introduce the study. The research assistants then called potential participants to confirm eligibility, including the ability to use a computer in English, regular access to the Web, an e-mail address, and medication coverage that lets them refill prescriptions at Group Health (most Group Health members have all these).
Age, sex and family origin	Age - Mean (SD): 59.1 (8.5). Sex (M:F): 406 female, 372 male. Family origin: 644 White, 61 Black, 29 Asian and 44 other
Indirectness of population	Serious indirectness: Usual care comparison not in protocol
Interventions	(n=258) Intervention 1: Clinic/office measurement. Usual care without self-monitoring. They were told their BP was not in control and were encouraged to work with their physician to improve it. Duration 12 months. Concurrent medication/care: Not applicable. Indirectness: Serious indirectness; Indirectness comment: Usual care not stated in protocol

	(n=259) Intervention 2: Home measurement with telemonitoring - Home measurement with telemonitoring. People assigned to active interventions were first given a home BP monitor (the validated OmronHem-705-CP); with the cuff size based on upper arm measurements and training on its use, demonstrating that they could use it without help. They were instructed to use this monitor to check their BP at least 2 days per week with 2 measurements each time. They were told the goal for average home systolic and diastolic BP was 135 and 85 mmHg or less, respectively, and lower than the goal for clinic measurements for systolic and diastolic BP of less than 140 and 90 mmHg (based on observational data demonstrating that BP readings in individuals tend to be about 5 mmHg lower when taken at home) Second, they received training on how to use the website. They received a tour of the different utilities (secure e-mail, refilling medications, viewing portions of their medical record, use of the health library, and links to Group Health and community resources for lifestyle and behavioural change). After the initial training, the second opaque envelope was opened and people assigned to home BP monitoring and Web training only were told that their BP was not controlled and advised to work with their physician to improve this. They were given the following verbal and written instructions: As a participant in Group 2, you have 2 additional resources (the home BP monitor and MyGroupHealth) to help manage your high blood pressure. We encourage you to use the MyGroupHealth website. It gives you access to a suite of online services so you can e-mail your doctor, refill prescriptions, request appointments, get test results, and look up health information. Sending a message to your provider on MyGroupHealth is an easy way to report your home BP readings. Duration 12 months. Concurrent medication/care: Not applicable. Indirectness: Serious indirectness (n=261) Intervention 3: Home measurement with telemonitoring - Home measurement with telemonitoring. Home monitoring with telemonitoring and pharmacist care - Those assigned to home BP monitoring and web training plus pharmacist care were told a pharmacist would be assisting them to improve their BP control via home BP monitoring and web communications. The pharmacist welcomed the person to the study with a secure message and informed the person's physician of his or her participation with a staff message. The pharmacist also arranged a time for 1 planned telephone visit to obtain a more detailed medication history and review allergies, intolerances, and cardiovascular risk factors. At the end of the telephone call, the pharmacist introduced the person to the action plan. Pharmacists responded with specific recommendations (including medication changes) and people were encouraged to provide feedback and collaboratively change the action plan. Duration 12 months. Concurrent medication/care: Not applicable. Indirectness: Serious indirectness
Funding	Academic or government funding (This research was funded by grant R01-HL075263 from the National Heart, Lung, and Blood Institute of the National Institutes of Health and by the Electronic Communications and Blood Pressure Monitoring)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USUAL CARE versus HOME MEASUREMENT WITH	

TELEMONITORING

Protocol outcome 1: All-cause mortality at longest reported
- Actual outcome for Upper arm cuff: Mortality at 12 months; Group 1: 0/247, Group 2: 2/246; Comments: Died of cancer-related complications.
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 2: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: QoL - general health at 12 months: Group 1: mean 66.7 (SD 20.4); n=247, Group 2: mean 66.6 (SD 20.9); n=246
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - physical health at 12 months: Group 1: mean 78.1 (SD 27.7); n=247, Group 2: mean 77.7 (SD 30.3); n=246
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - emotional health at 12 months: Group 1: mean 71.5 (SD 17.7); n=247, Group 2: mean 72.1 (SD 16.8); n=246
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 3: Myocardial infarction at longest reported
- Actual outcome for Upper arm cuff: Non-fatal cardiovascular events at 12 months at 12 months: Group 1: 2/247, Group 2: 4/246
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 4: Reduction in clinic blood pressure at longest reported
- Actual outcome for Upper arm cuff: change in blood pressure, systolic, 12 months at 12 months: Group 1: mean -5.3 (SD 14.33); n=247, Group 2: mean -8.2 (SD 14.36); n=246
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: change in blood pressure, diastolic, 12 months at 12 months; Group 1: mean -3.5 (SD 7.9792); n=247, Group 2: mean -4.4 (SD 7.96); n=246
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed

visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 5: Proportion of people controlled to a target at longest reported
- Actual outcome for Upper arm cuff: Proportion controlled to a target, 12 months at 12 months; Group 1: 75/247, Group 2: 91/246
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: USUAL CARE versus HOME MEASUREMENT WITH TELEMONITORING and a PHARMACIST

Protocol outcome 1: All-cause mortality at longest reported
- Actual outcome for Upper arm cuff: Mortality at 12 months: Group 1: 0/247, Group 2: 1/237; Comments: Died of cardiac arrest.
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 2: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: QoL - general health at 12 months; Group 1: mean 66.7 (SD 20.4); n=247, Group 2: mean 66.6 (SD 22.2); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - physical health at 12 months; Group 1: mean 78.1 (SD 27.7); n=247, Group 2: mean 81 (SD 26.5); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - emotional health at 12 months; Group 1: mean 71.5 (SD 17.7); n=247, Group 2: mean 71.7 (SD 19.7); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 3: Myocardial infarction at longest reported
- Actual outcome for Upper arm cuff: Non-fatal cardiovascular events at 12 months at 12 months: Group 1: 2/247, Group 2: 3/237
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 4: Reduction in clinic blood pressure at longest reported

- Actual outcome for Upper arm cuff: Change in blood pressure, systolic, 12 months at 12 months: Group 1: mean -5.3 (SD 14.3625); n=247, Group 2: mean -14.2 (SD 14.0658); n=237
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: Change in blood pressure, diastolic, 12 months at 12 months; Group 1: mean -3.5 (SD 7.9792); n=247, Group 2: mean -7 (SD 7.8144); n=237
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 5: Proportion of people controlled to a target at longest reported
- Actual outcome for Upper arm cuff: Proportion controlled to a target, 12 months at 12 months: Group 1: 76/247, Group 2: 134/237
Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITH TELEMONITORING versus HOME MEASUREMENT WITH TELEMONITORING plus a PHARMACIST

Protocol outcome 1: All-cause mortality at longest reported
- Actual outcome for Upper arm cuff: Mortality at 12 months; Group 1: 2/246, Group 2: 1/237
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other

Protocol outcome 2: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: QoL - general health at 12 months; Group 1: mean 66.6 (SD 20.9); n=246, Group 2: mean 66.6 (SD 22.2); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - physical health at 12 months; Group 1: mean 77.7 (SD 30.3); n=246, Group 2: mean 81 (SD 26.5); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other
- Actual outcome for Upper arm cuff: QoL - emotional health at 12 months; Group 1: mean 72.1 (SD 16.8); n=246, Group 2: mean 71.7 (SD 19.7); n=237
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be

contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other Protocol outcome 3: Myocardial infarction at longest reported - Actual outcome for Upper arm cuff: Non-fatal cardiovascular events at 12 months at 12 months; Group 1: 4/246, Group 2: 3/237 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other Protocol outcome 4: Reduction in clinic blood pressure at longest reported - Actual outcome for Upper arm cuff: Change in blood pressure, systolic, 12 months at 12 months; Group 1: mean -8.2 (SD 14.3331); n=246, Group 2: mean -14.2 (SD 14.0658); n=237 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other - Actual outcome for Upper arm cuff: Change in blood pressure, diastolic, 12 months at 12 months; Group 1: mean -4.4 (SD 7.9629); n=246, Group 2: mean -7 (SD 7.8144); n=237 Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 13, Reason: 8 withdrew, 1 could not be contacted, 2 missed visit, 2 died; Group 2 Number missing: 11, Reason: 4 withdrew, 1 refused, 2 could not be contacted, 3 moved, 1 - other	
Protocol outcomes not reported by the study	Stroke (ischaemic or haemorrhagic) at longest reported; Average daily dose of antihypertensive medication at longest reported; Average number of visits at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

Study	Logan 2012[73]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=110)
Countries and setting	Conducted in Canada; Setting:
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Not applicable
Inclusion criteria	People with diabetes and uncontrolled systolic hypertension, defined as a mean daytime systolic BP of >130 mmHg on ambulatory BP monitoring were eligible.
Exclusion criteria	Severe or end-stage organ disease (liver, kidney, heart, and lung), a history of diabetic ketoacidosis, any illness with expected survival <1 year, severe cognitive impairment, mental illness or disability, clinically significant cardiac arrhythmia, symptomatic orthostatic hypotension, or were pregnant, unsuitable for participation in the opinion of their primary care physician, or not fluent in English.
Recruitment/selection of people	Men and women, >30 years of age, with diabetes mellitus were recruited from family physicians' office or hospital-based speciality clinics and advertisements in public areas of hospitals.
Age, sex and family origin	Age - Mean (SD): 62.9 (8.4). Sex (M:F): 61 male, 49 female. Family origin: Control - 60% White, 18.1% African or West Indian, 12.7% Asian, 1.8% Hispanic, 7.4% other Intervention - 70.9% White, 14.6% African or West Indian, 7.2% Asian, 5.5% Hispanic, 1.8% Other
Indirectness of population	No indirectness
Interventions	(n=55) Intervention 1: Home measurement without telemonitoring. Home BP monitoring without self-care support. Duration 12 months. Concurrent medication or care: Participants in both groups were taught how to measure their BP correctly, instructed to measure their BP 2 days per week twice in the morning and twice in the evening, provided with a validated home BP monitoring device with appropriate-sized upper arm cuff, and given a booklet with detailed information on the self-measurement of BP, treatment of hypertension, and goals of therapy. Their primary care physician was given an outline of the study's objectives and BP treatment goal, asked to provide relevant medical information, and given a copy of the 24-hour ambulatory BP monitoring report. In both groups, treatment decisions, including medication adjustments and changes in lifestyle, were made by the person's primary care physician. Indirectness: No indirectness. (n=55) Intervention 2: Home measurement with telemonitoring - Home measurement with telemonitoring. Self-care support people were taught how to use the telemonitoring system, review past readings on their

	smart phone and the study-specific web site (these activities were optional), and generate a 1-page patient summary report. They were instructed to take their smart phone to all doctor visits. The person's physician was shown the patient summary report, asked to indicate the low and high threshold BP values for critical alert messages (default options were provided), and taught how to change the threshold values. Optionally, they were shown how to visit the study's password-protected website. The research team did not contact the subjects in either group or their physician during the course of the study. Duration 12 months. Concurrent medication or care: Participants in both groups were taught how to measure their BP correctly, instructed to measure their BP 2 days per week twice in the morning and twice in the evening, provided with a validated home BP monitoring device with appropriate-sized upper arm cuff, and given a booklet with detailed information on the self-measurement of BP, treatment of hypertension, and goals of therapy. Their primary care physician was given an outline of the study's objectives and BP treatment goal, asked to provide relevant medical information, and given a copy of the 24-hour ambulatory BP monitoring report. In both groups, treatment decisions, including medication adjustments and changes in lifestyle, were made by the person's primary care physician. Indirectness: No indirectness.
Funding	Academic or government funding (The Heart and Stroke Foundation of Ontario (ESA 5970) was the sole source of funding for this project and was not involved in any aspect of the study.)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITHOUT TELEMONITORING versus HOME MEASUREMENT WITH TELEMONITORING Protocol outcome 1: Average number of visits at longest reported - Actual outcome for Upper arm cuff: Number of GP visits at 12 months: Group 1: 6/49, Group 2: 4/51; Comments: Median reported IQR 3-8 control group, 3-7 intervention group Risk of bias: All domain - Low, Selection - Low, Blinding - Low, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 2, Reason: 2 refused full 24hr monitoring; Group 2 Number missing: 4, Reason: 1 died, 3 refused exit blood pressure assessment	
Protocol outcomes not reported by the study	All-cause mortality at longest reported; Health-related quality of life at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Myocardial infarction at longest reported; Reduction in clinic blood pressure at longest reported; Proportion of people controlled to a target at longest reported; Average daily dose of antihypertensive medication at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

Study	McManus 2010[84]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=527)
Countries and setting	Conducted in United Kingdom
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment or diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Not applicable
Inclusion criteria	Define
Exclusion criteria	Define
Recruitment/selection of people	Potential participants were identified by their own family doctor by use of electronic searches of practice clinical record systems in 24 general practices in the West Midlands, UK.
Age, sex and family origin	Age - Mean (SD): 66.4 (8.8). Sex (M: F): Define. Family origin: 461 White, 7 Black, 10 Asian, 2 other
Indirectness of population	No indirectness
Interventions	(n=264) Intervention 1: Clinic or office measurement. All participants in the control group were asked to attend a review by their family doctor. No specific instructions were given to the clinicians about the content of this visit other than to review medication. Thereafter, care was at the discretion of the family doctor. Duration 12 months. Concurrent medication or care: All participants received information based on literature produced by the British Hypertension Society about non-pharmacological interventions to reduce blood pressure. All participating family doctors were given a copy of current National Institute for Health and Clinical Excellence (NICE) guidelines. Indirectness: No indirectness. (n=263) Intervention 2: Home measurement with telemonitoring - Home measurement with telemonitoring. People assigned to the intervention group were invited to 2 training sessions the research team ran. Participants were trained to monitor their own blood pressure for the first week of each month with a validated automated sphygmomanometer and to transmit blood pressure readings to the research team by means of an automated modem device, which was connected to the sphygmomanometer and plugged into a normal telephone socket like an answer phone. Two self-measurements were made each morning with a 5-minute interval and the second reading acted upon. A colour traffic light system was used by participants to code these readings as green (below target but above safety limit), amber (above target but below safety limits) and red (outside of safety limits). A month was deemed to be ‘above target’ if the readings on 4 or more days were above target. Duration 12 months. Concurrent medication or care: All participants received

	information based on literature produced by the British Hypertension Society about non-pharmacological interventions to reduce blood pressure. All participating family doctors were given a copy of current National Institute for Health and Clinical Excellence (NICE) guidelines. Indirectness: No indirectness.
Funding	Academic or government funding (Department of Health Policy Research Programme, National Coordinating Centre for Research Capacity Development, and Midlands Research Practices Consortium.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: CLINIC/OFFICE MEASUREMENT versus HOME MEASUREMENT WITH TELEMONITORING

Protocol outcome 1: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: Quality of life measured by EQ-5D (adjusted) at 12 months; Mean; , Comments: Mean (95% CI)
TM - 0.826 (0.792 to 0.859)
Usual care - 0.838 (0.805 to 0.871);
Risk of bias: All domain - Very high, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 29/263, Reason: Did not attend follow-up, discontinued intervention; Group 2 Number missing: 18/264, Reason: Did not attend follow-up

Protocol outcome 2: Reduction in clinic blood pressure at longest reported
- Actual outcome for Upper arm cuff: Change in blood pressure, systolic, 12 months at 12 months; Group 1: mean 140.3 (SD 18.3146); n=246, Group 2: mean 134.7 (SD 18.6341); n=234
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 29/263, Reason: Did not attend follow-up, discontinued intervention; Group 2 Number missing: 18/264, Reason: Did not attend follow-up
- Actual outcome for Upper arm cuff: Change in blood pressure, diastolic, 12 months at 12 months; Group 1: mean 79.8 (SD 11.9443); n=246, Group 2: mean 77.5 (SD 11.6463); n=234
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 29/263, Reason: Did not attend follow-up, discontinued intervention; Group 2 Number missing: 18/264, Reason: Did not attend follow-up

Protocol outcome 3: Average daily dose of antihypertensive medication at longest reported
- Actual outcome for Upper arm cuff: Mean number of antihypertensive drugs, 1 year at 12 months; Group 1: mean 1.7 (SD 1.5926); n=246, Group 2: mean 2.1 (SD 1.5528); n=234
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 29/263, Reason: Did not attend follow-up, discontinued intervention; Group 2 Number missing: 18/264, Reason: Did not attend follow-up

Protocol outcome 4: Average number of visits at longest reported
- Actual outcome for Upper arm cuff: Mean number of consultations, 1 year at 12 months; Group 1: mean 3.5 (SD 2.3889); n=246, Group 2: mean 3.2 (SD 2.3293); n=234

Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 29/263, Reason: Did not attend follow-up, discontinued intervention; Group 2 Number missing: 18/264, Reason: Did not attend follow-up	
Protocol outcomes not reported by the study	All-cause mortality at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Myocardial infarction at longest reported; Proportion of people controlled to a target at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

Study	**McManus 2018[85]**
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=1,182)
Countries and setting	Conducted in United Kingdom; Setting:
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Not applicable:
Inclusion criteria	Older than 35 years, with a diagnosis of hypertension, taking no more than 3 antihypertensive agents, but with clinic blood pressure not controlled below 140/90 mmHg. They had to be on stable antihypertensive medication for at least 4 weeks before randomisation and free from orthostatic hypotension, atrial fibrillation, dementia, or chronic kidney disease of grade 4 or worse, or chronic kidney disease with proteinuria.
Exclusion criteria	Exclusion criteria will be orthostatic hypertension (20 mmHg or more systolic drop after standing for 1 minute, in order to avoid adverse events), BP not managed by their GP (limited possibility of antihypertensive titration), diagnosed atrial fibrillation (automated monitors not validated), unwilling to self-monitor, dementia or score over 10 on the short orientation memory concentration test (inability to undertake self-monitoring), female participant who is pregnant, lactating or planning pregnancy during the trial (management of essential hypertension in pregnancy is different), the partner or spouse of an individual already randomised in the trial (to avoid clustering within families), Chronic Kidney Disease (CKD) grade 4 or worse, any grade of CKD with proteinuria (both may have different BP targets), participants who have participated in another research trial involving antihypertensive medication in the past 4 weeks.
Recruitment/selection of people	Potentially eligible participants were identified using automated searches of electronic primary care patient records in practices in England, UK. The searches identified individuals potentially eligible in terms of age,

	hypertension diagnosis, current medication, and last recorded systolic blood pressure above 145 mmHg.
Age, sex and family origin	Age - Mean (SD): 66.93 (9.43). Sex: (M:F): 545 female, 628 male. Family origin: 1127 white, 20 black, 16 Asian, 7 mixed, 3 other
Indirectness of population	No indirectness
Interventions	(n=395) Intervention 1: Home measurement without telemonitoring. Participants randomly assigned to self-monitoring were taught to use a validated automated electronic sphygmomanometer. They were asked to monitor their own blood pressure in their non-dominant arm, twice each morning and evening, for the first week of every month using standard recommendations and their GPs were asked to use the self-monitored measurements for titration of antihypertensive medication. A simple colour chart was used to train participants to attend their practice for blood pressure checks in the light of very high or very low readings. At the end of each monitoring week, they were asked to record their readings on paper and send them for review to their practice in a reply-paid envelope. Duration 12 months. Concurrent medication/care: Attending clinicians were asked to review both self-monitoring and tele monitoring groups' readings on a monthly basis and usual care people as often as they wished. All participants were followed up at 6 and 12 months by research nurses. Indirectness: No indirectness (n=393) Intervention 2: Home measurement with telemonitoring - Home measurement with telemonitoring. Participants randomly assigned to self-monitoring were taught to use a validated automated electronic sphygmomanometer. They were asked to monitor their own blood pressure in their non-dominant arm, twice each morning and evening, for the first week of every month using standard recommendations and their GPs were asked to use the self-monitored measurements for titration of antihypertensive medication. Participants in the telemonitoring group were trained to send readings via a simple free SMS text-based telemonitoring service with web-based data entry back-up. The telemonitoring system incorporated an algorithm that alerted participants to contact their surgery in the light of very high or very low readings, reminded them if insufficient readings were transmitted, prompted them to make contact with their practice if their average blood pressure was above target, and presented readings to attending clinicians via a web interface. This secure web page automatically calculated mean blood pressure for each monitoring week, highlighted very high or very low readings, and presented a graphical display of blood pressure measurements. Duration 12 months. Concurrent medication/care: Attending clinicians were asked to review both self-monitoring and tele monitoring groups' readings on a monthly basis and usual care people as often as they wished. All participants were followed up at 6 and 12 months by research nurses. Indirectness: No indirectness (n=394) Intervention 3: Clinic/office measurement. Participants randomly assigned to usual care were thereafter managed with titration of antihypertensive treatment based on clinic blood pressure measurements at the discretion of their attending health-care professional. Duration 12 months. Concurrent medication/care: Attending clinicians were asked to review both self-monitoring and tele monitoring groups' readings on a monthly basis

	and usual care people as often as they wished. All participants were followed up at 6 and 12 months by research nurses. Indirectness: No indirectness.
Funding	Academic or government funding (The trial was funded by an National Institute for Health Research (NIHR) Programme grant (RP-PG-1209-10051), and by an NIHR Professorship awarded to RJM, the Chief Investigator (NIHR-RP-R2-12-015).)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITHOUT TELEMONITORING versus HOME MEASUREMENT WITH TELEMONITORING

Protocol outcome 1: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: EQ-5D-5L at 12 months; MD; -0.02 (95%CI -0.06 to 0.01);
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 2: Myocardial infarction at longest reported
- Actual outcome for Upper arm cuff: Cardiovascular events, 12 months at 12 months; Group 1: 12/328, Group 2: 11/330
Risk of bias: All domain - Very high, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 3: Reduction in clinic blood pressure at longest reported
- Actual outcome for Upper arm cuff: Reduction in blood pressure, systolic, at 1 year at 12 months; Group 1: mean 137 (SD 16.7); n=328, Group 2: mean 136 (SD 16.1); n=327
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals or lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals or lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up
- Actual outcome for Upper arm cuff: Reduction in blood pressure, diastolic, at 1 year at 12 months; Group 1: mean 77.8 (SD 10.1); n=328, Group 2: mean 78.7 (SD 9.7); n=328
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew

from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 4: Average daily dose of antihypertensive medication at longest reported
- Actual outcome for Upper arm cuff: Overall defined daily dose at 12 months; Group 1: mean 2.42 (SD 1.75); n=328, Group 2: mean 2.69 (SD 1.82); n=330
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 5: Average number of visits at longest reported
- Actual outcome for Upper arm cuff: Mean number of consultations between baseline and 12 months at 12 months; Group 1: mean 1.8 (SD 2.54); n=328, Group 2: mean 2.2 (SD 2.53); n=330
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 6: Hypotension (dizziness) at longest reported
- Actual outcome for Upper arm cuff: Dizziness at 12 months; Group 1: 50/324, Group 2: 72/326
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals and lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITHOUT TELEMONITORING versus CLINIC/OFFICE MEASUREMENT

Protocol outcome 1: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: EQ-5D-5L at 12 months; MD; -0.01 (95%CI -0.04 to 0.02);
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 2: Myocardial infarction at longest reported
- Actual outcome for Upper arm cuff: Cardiovascular events, 12 months at 12 months; Group 1: 12/328, Group 2: 9/350
Risk of bias: All domain - Very high, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 3: Reduction in clinic blood pressure at longest reported
- Actual outcome for Upper arm cuff: 12 month adjusted MD HM without TM versus usual care - systolic at 12 months; MD; –3·5 (95%CI -5.8 to -1.2);
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up
- Actual outcome for Upper arm cuff: 12 month adjusted MD HM without TM versus usual care - diastolic at 12 months; MD; -1.5 (95%CI -2.7 to -0.2);
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 4: Average daily dose of antihypertensive medication at longest reported
- Actual outcome for Upper arm cuff: Overall defined daily dose at 12 months; Group 1: mean 2.42 (SD 1.75); n=328, Group 2: mean 2.27 (SD 1.65); n=350
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 5: Average number of visits at longest reported
- Actual outcome for Upper arm cuff: Mean number of consultations between baseline and 12 months at 12 months; Group 1: mean 1.8 (SD 2.54); n=328, Group 2: mean 2.1 (SD 2.03); n=350
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason,

lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 6: Hypotension (dizziness) at longest reported
- Actual outcome for Upper arm cuff: Dizziness at 12 months; Group 1: 50/324, Group 2: 61/348
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITH TELEMONITORING versus CLINIC/OFFICE MEASUREMENT

Protocol outcome 1: Health-related quality of life at longest reported
- Actual outcome for Upper arm cuff: EQ-5D-5L at 12 months; MD; -0.03 (95%CI -0.06 to -0.001);
Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - Low, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 2: Myocardial infarction at longest reported
- Actual outcome for Upper arm cuff: Cardiovascular events, 12 months at 12 months; Group 1: 11/330, Group 2: 9/350
Risk of bias: All domain - Very high, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up

Protocol outcome 3: Reduction in clinic blood pressure at longest reported
- Actual outcome for Upper arm cuff: 12 month adjusted MD HM with TM versus usual care - systolic at 12 months; MD; –4·7 (95%CI -7 to -2.4);
Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up
- Actual outcome for Upper arm cuff: 12 month adjusted MD HM with TM versus usual care - diastolic at 12 months; MD; -1.3 (95%CI -2.5 to -0.02);

Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up Protocol outcome 4: Average daily dose of antihypertensive medication at longest reported - Actual outcome for Upper arm cuff: Overall defined daily dose at 12 months: Group 1: mean 2.69 (SD 1.82); n=330, Group 2: mean 2.27 (SD 1.65); n=350 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up Protocol outcome 5: Average number of visits at longest reported - Actual outcome for Upper arm cuff: Mean number of consultations between baseline and 12 months at 12 months; Group 1: mean 2.2 (SD 2.54); n=330, Group 2: mean 2.1 (SD 2.03); n=350 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up; Group 2 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up Protocol outcome 6: Hypotension (dizziness) at longest reported - Actual outcome for Upper arm cuff: Dizziness at 12 months; Group 1: 72/326, Group 2: 61/348 Risk of bias: All domain - High, Selection - Low, Blinding - High, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: N/A, Reason: Partial withdrawals, withdrew from treatment, complete withdrawals/lost to follow-up, withdrew from treatment and follow-up, withdrew consent, ineligible, disease progression, other reason, lost to follow-up	
Protocol outcomes not reported by the study	All-cause mortality at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Proportion of people controlled to a target at longest reported; Intolerance to device at longest reported

Study	**Simpson 2011[122]**
Study type	RCT (Patient randomised; Parallel)

Number of studies (number of participants)	(n=260)
Countries and setting	Conducted in Canada
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment or diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Not applicable
Inclusion criteria	People were eligible if they had type 2 diabetes, were regularly seen by the primary care team and did not qualify for urgent specialist referral and assessment (according to protocol, a fasting blood glucose ≥ mmol/l, blood pressure ≥220/120 mmHg, or triglycerides ≥15 mmol/l).
Exclusion criteria	We excluded people who were followed in specialty clinics for diabetes, hypertension, or dyslipidaemia; who were cognitively impaired; who were not responsible for their own medication administration; or who were unable to communicate in English.
Recruitment/selection of people	Eligible people were identified from the clinic roster, and a clinic staff member made initial contact to tell people about the study.
Age, sex and family origin	Age - Mean (SD): 59.1 (11.6). Sex: (M:F): 149 female, 111 male. Family origin: N/A
Indirectness of population	No indirectness
Interventions	(n=129) Intervention 1: Clinic/office measurement. Control people received usual care by the primary care team without contributions from study pharmacists, except for standardized blood pressure measurements at the end of the follow-up period. No further details stated. Duration 12 months. Concurrent medication/care: N/A. Indirectness: Serious indirectness; Indirectness comment: Usual care (n=131) Intervention 2: Pharmacy measurement. Conducted by 2 pharmacists. The intervention program began with an in-person visit with a study pharmacist to identify all prescription, non-prescription, complementary, and alternative medications. Pharmacists also measured the person's height, weight, heart rate, and blood pressure. Blood pressure was measured according to the Canadian Hypertension Education Program recommendations using the BPTru BPM-100 (VSM Med Tech, Coquitlam, BC) automated machine set to report the average of 5 measurements at 1-minute intervals. Pharmacists then formulated guideline-concordant recommendations to optimize medication management of blood pressure and other cardiovascular risk factors. Duration 12 months. Concurrent medication/care: N/A. Indirectness: Serious indirectness
Funding	Academic or government funding (Operating grant funding was provided by the Canadian Diabetes Association, the Institute of Health Economics, and the Alberta Heritage Foundation for Medical Research

	[AHFMR])
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: CLINIC/OFFICE MEASUREMENT versus PHARMACY MEASUREMENT Protocol outcome 1: All-cause mortality at longest reported - Actual outcome for Upper arm cuff: All-cause mortality at 12 months; Group 1: 1/129, Group 2: 0/131 Risk of bias: All domain - Very high, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - High, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: 16, Reason: withdrew, lost to follow-up, died; Group 2 Number missing: 21, Reason: withdrew, lost to follow-up Protocol outcome 2: Reduction in clinic blood pressure at longest reported - Actual outcome for Upper arm cuff: Reduction in blood pressure, systolic at 12 months; Group 1: mean -2.5 (SD 15.4983); n=129, Group 2: mean -7.4 (SD 16.1988); n=131 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: 16, Reason: withdrew, lost to follow-up, died; Group 2 Number missing: 21, Reason: withdrew, lost to follow-up - Actual outcome for Upper arm cuff: Reduction in blood pressure, diastolic at 12 months; Group 1: mean 0.6 (SD 11.4802); n=129, Group 2: mean -2.3 (SD 11.5706); n=131 Risk of bias: All domain - High, Selection - Low, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: 16, Reason: withdrew, lost to follow-up, died; Group 2 Number missing: 21, Reason: withdrew, lost to follow-up Protocol outcome 3: Average number of visits at longest reported - Actual outcome for Upper arm cuff: Contacts per patient for all resources (excluding pharmacists) at 12 months; Pharmacy group: Median (IQR) - 3 (1-6) Usual care group: Median (IQR) - 2 (2 - 5); Risk of bias: All domain -; Indirectness of outcome: Serious indirectness	
Protocol outcomes not reported by the study	Health-related quality of life at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Myocardial infarction at longest reported; Proportion of people controlled to a target at longest reported; Average daily dose of antihypertensive medication at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

Study	Stergiou 2014[131]
Study type	RCT (Patient randomised; Parallel)
Number of studies (number of participants)	(n=145)
Countries and setting	Conducted in United Kingdom, Unknown
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Upper arm cuff
Subgroup analysis within study	Stratified then randomised
Inclusion criteria	Consecutive adults aged >30 years referred to a hospital outpatient hypertension clinic untreated or treated for <2 weeks were considered for inclusion.
Exclusion criteria	Exclusion criteria were clinic BP ≥180 mmHg systolic and/or ≥110 mmHg diastolic; secondary hypertension; sustained arrhythmia; pregnancy; history of coronary heart disease, heart failure, or stroke; serum creatinine >2 mg/dl or overt proteinuria; uncontrolled diabetes (HbA1c >8%); use of any drugs known to affect BP (excluding aspirin up to 300 mg/day and statins); any severe non-cardiovascular disease (for example, cancer, liver cirrhosis, respiratory failure); inability to self-monitor BP at home; clinic systolic BP <160 mmHg and diastolic BP <100 mmHg in <6 months of follow-up in subjects with no other cardiovascular risk factors.
Age, sex and family origin	Age - Mean (SD): 50.75 (10.3). Sex (M:F): 69 male, 47 female. Family origin: N/A
Indirectness of population	No indirectness
Interventions	(n=73) Intervention 1: Home measurement without telemonitoring. In arm A, neither clinic nor ambulatory BP measurements were made during the 12-month follow-up period. In arm A, controlled hypertension was defined as home BP levels at the pre-set goal in 2 visits 4 weeks apart. Performed for 7 routine workdays within 2 weeks, with duplicate self-measurements in the morning (06.00–09.00, before drug intake if treated) and the evening (18.00–21.00) after 5 minutes sitting rest and with 1 minute between measurements, using validated oscillometric devices with automated memory and PC link capacity. Duration 1 year. Concurrent medication/care: In both arms, treatment titration was performed at 4-week intervals until the pre-set BP goal was reached. After 12 months of follow-up, all participants were re-evaluated with the same tests as at baseline, including BP measurements (clinic, home, and ambulatory), laboratory investigation, and assessment of target organ damage. A form was supplied to the participants to report all their home BP readings, which were verified against those downloaded from the device memory. Indirectness: No indirectness. (n=72) Intervention 2: Ambulatory measurement. Ambulatory and clinic - Home BP monitoring was

	discouraged and not reviewed by the investigators (if reported by people) or taken into account in decision-making. In arm B, when clinic BP reached the pre-set goal, ambulatory BP monitoring was performed and hypertension was regarded as controlled if both clinic and awake ambulatory BP were at goal. At each clinic visit, duplicate BP measurements were taken by a doctor after 5 minutes sitting rest and with a 1-minute interval between measurements using a validated professional oscillometric device. Ambulatory BP was monitored on a routine workday at 20-minute intervals for 24 hours using validated oscillometric devices. In each participant, the same type of ambulatory monitor was used throughout the study. Duration 1 year. Concurrent medication/care: In both arms, treatment titration was performed at 4-week intervals until the pre-set BP goal was reached. After 12 months of follow-up, all participants were re-evaluated with the same tests as at baseline, including BP measurements (clinic, home, and ambulatory), laboratory investigation, and assessment of target organ damage. Indirectness: No indirectness.
Funding	Principal author funded by industry (G.S. Stergiou has received consulting fees by Microlife, Widnau, Switzerland)
RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITHOUT TELEMONITORING versus AMBULATORY AND CLINIC MEASUREMENT Protocol outcome 1: Reduction in clinic blood pressure at longest reported - Actual outcome for Upper arm cuff: Mean difference in systolic clinic BP decline at 1 year; Mean; -2.1 (95%CI -6.8 to 2.6; 2.4 SE); Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 14/73, Reason: missed follow-up visits, unwillingness to initiate treatment, treatment-related reasons, white coat hypertension, and non-study-related issues; Group 2 Number missing: 15/72, Reason: missed follow-up visits, unwillingness to initiate treatment, treatment-related reasons, white coat hypertension, and non-study-related issues - Actual outcome for Upper arm cuff: Mean difference in diastolic clinic BP decline at 1 year; Mean: -1.4 (95%CI -4.3 to 1.4; 1.4 SE); Risk of bias: All domain - High, Selection - High, Blinding - Low, Incomplete outcome data - High, Outcome reporting - Low, Measurement - Low, Crossover - Low, Subgroups - Low; Indirectness of outcome: No indirectness; Group 1 Number missing: 14/73, Reason: missed follow-up visits, unwillingness to initiate treatment, treatment-related reasons, white coat hypertension, and non-study-related issues; Group 2 Number missing: 15/72, Reason: missed follow-up visits, unwillingness to initiate treatment, treatment-related reasons, white coat hypertension, and non-study-related issues	
Protocol outcomes not reported by the study	All-cause mortality at longest reported; Health-related quality of life at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Myocardial infarction at longest reported; Proportion of people controlled to a target at longest reported; Average daily dose of antihypertensive medication at longest reported; Average number of visits at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

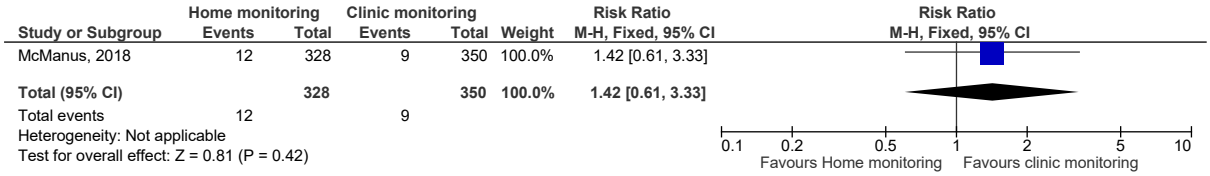
Study (subsidiary papers)	Tucker 2017[135] (Tucker 2015[136])
Study type	Systematic Review
Number of studies (number of participants)	25 (n=11,015)
Countries and setting	Conducted in Multiple countries
Line of therapy	Adjunctive to current care
Duration of study	Intervention time: 12 months
Method of assessment of guideline condition	Adequate method of assessment/diagnosis
Stratum	Mixed/unspecified
Subgroup analysis within study	Stratified then randomised
Inclusion criteria	Randomised trials were eligible that recruited people with hypertension being managed as outpatients using an intervention that included self-measurement of BP. Self-monitoring had to be without medical professional input (that is, by person with or without carer support) and using a validated monitor, with or without other co-interventions, and where a comparator group had no organised self-measurement of BP. Included studies were required to have involved at least 100 people, followed up for at least 24 weeks, and to have been published since 2000.
Exclusion criteria	Studies unable to provide individual patient data
Age, sex and family origin	Age - Other: Adults, details not stated. Sex (M:F): Not stated. Family origin: Mixed populations from Europe and North America.
Indirectness of population	Serious indirectness: Usual care comparison and treatments in trial were not standardised
Interventions	(n=973) Intervention 1: Home measurement without telemonitoring. Self-monitoring with no feedback. Duration 12 months. Concurrent medication/care: Combination of 5 trials data. Indirectness: No indirectness. (n=961) Intervention 2: Clinic or office measurement. Usual care without self-monitoring. Duration 12 months. Concurrent medication/care: data pooled from 5 trials. Indirectness: Serious indirectness. (n=616) Intervention 3: Home measurement with telemonitoring - Home measurement with telemonitoring. Self-monitoring with web or phone feedback. Duration 12 months. Concurrent medication/care: summary of 4 trials. Indirectness: No indirectness. (n=573) Intervention 4: Clinic/office measurement. Usual care. Duration 12 months. Concurrent medication/care: data pooled from 4 trials. Indirectness: Serious indirectness.
Funding	Other (Public/government grants, charity, commercial.)

RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITHOUT TELEMONITORING versus CLINIC/OFFICE MEASUREMENT 1 Protocol outcome 1: Reduction in clinic blood pressure at longest reported - Actual outcome for Mixed/unspecified: Change in clinic systolic BP at 12 months; Risk of bias: All domain - High, Crossover - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: N/A; Group 2 Number missing: N/A - Actual outcome for Mixed/unspecified: Change in clinic diastolic BP at 12 months; Risk of bias: All domain - High, Crossover - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: N/A; Group 2 Number missing: N/A Protocol outcome 2: Proportion of people controlled to a target at longest reported - Actual outcome for Mixed/unspecified: Impact of self-monitoring on the RR of uncontrolled BP at 12 months; Risk of bias: All domain –; Indirectness of outcome: Serious indirectness RESULTS (NUMBERS ANALYSED) AND RISK OF BIAS FOR COMPARISON: HOME MEASUREMENT WITH TELEMONITORING versus CLINIC/OFFICE MEASUREMENT 2 Protocol outcome 1: Reduction in clinic blood pressure at longest reported - Actual outcome for Mixed/unspecified: Change in clinic diastolic BP at 12 months; Risk of bias: All domain - High, Crossover - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: N/A; Group 2 Number missing: N/A - Actual outcome for Mixed/unspecified: Change in clinic systolic BP at 12 months; Risk of bias: All domain - High, Crossover - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: N/A; Group 2 Number missing: N/A Protocol outcome 2: Proportion of people controlled to a target at longest reported - Actual outcome for Mixed/unspecified: Impact of self-monitoring on the RR of uncontrolled BP at 12 months; Risk of bias: All domain - High, Crossover - Low; Indirectness of outcome: Serious indirectness; Group 1 Number missing: N/A; Group 2 Number missing: N/A	
Protocol outcomes not reported by the study	All-cause mortality at longest reported; Health-related quality of life at longest reported; Stroke (ischaemic or haemorrhagic) at longest reported; Myocardial infarction at longest reported; Average daily dose of antihypertensive medication at longest reported; Average number of visits at longest reported; Intolerance to device at longest reported; Hypotension (dizziness) at longest reported

Appendix E: Forest plots

E.1 Home monitoring versus clinic monitoring

Figure 2: Cardiovascular events[1] , 12 months



[1](new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure)

Figure 3: Reduction in clinic blood pressure (mmHg), systolic (change in clinic systolic blood pressure), 12 months

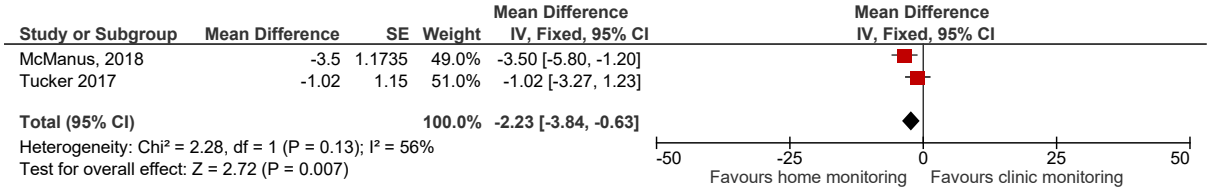


Figure 4: Reduction in clinic blood pressure (mmHg), diastolic (change in clinic diastolic blood pressure), 12 months

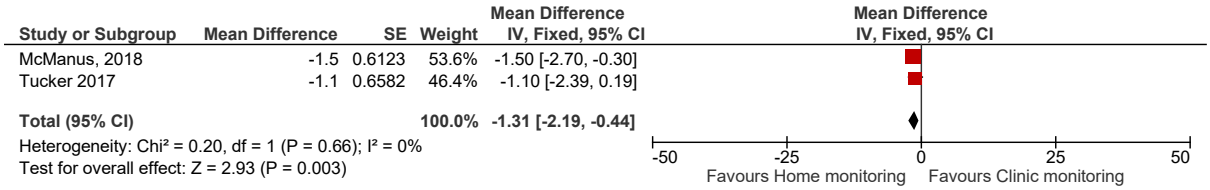


Figure 5: Proportion not meeting target (varied target due to IPD – mode 140/90 mmHg), 12 months

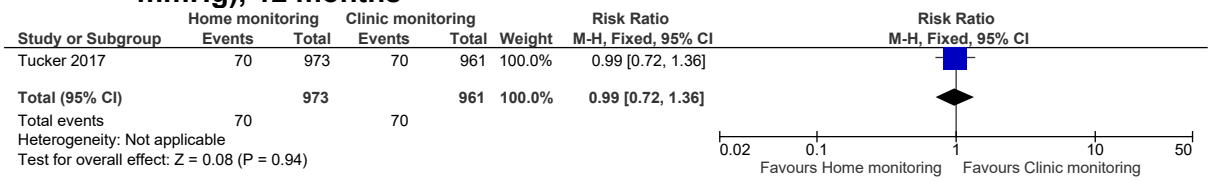


Figure 6: Overall defined daily dose, 12 months

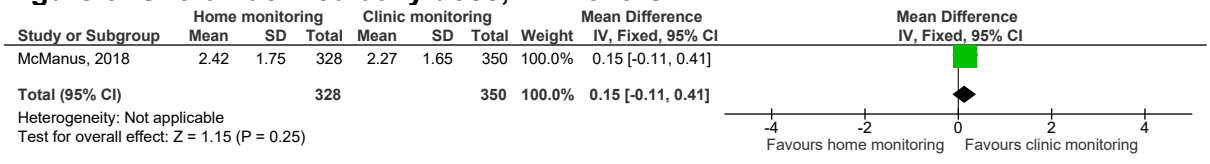


Figure 7: Mean number of consultations for hypertension, 12 months

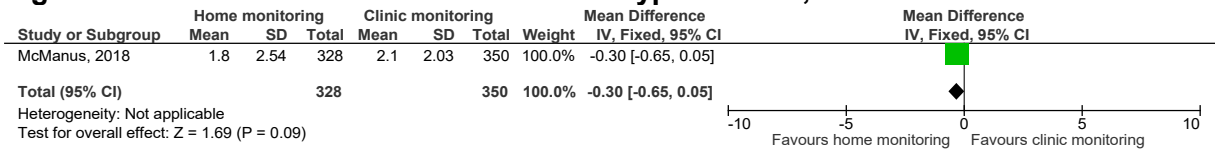


Figure 8: Dizziness, hypertension specific symptoms (no further details of definition) 12 months

E.2 Home monitoring without telemonitoring versus ambulatory and clinic monitoring

Figure 9: Reduction in clinic blood pressure (mmHg), systolic, 12 months

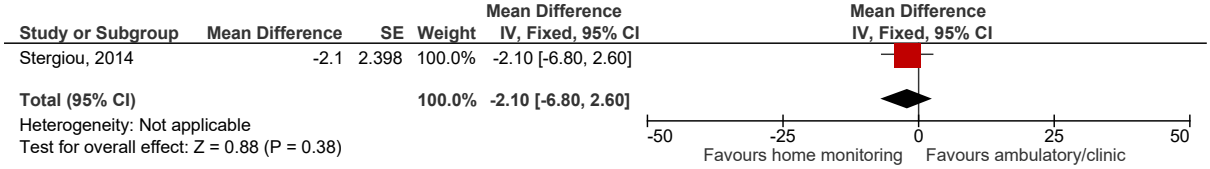
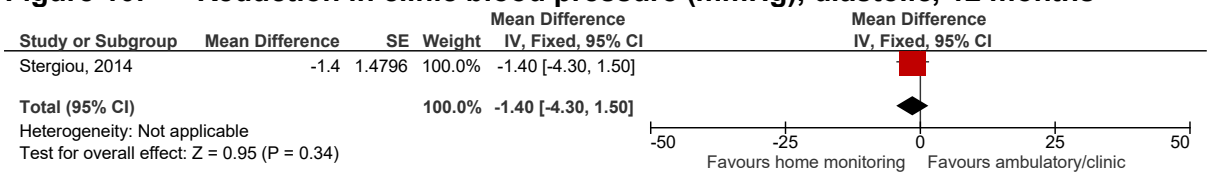
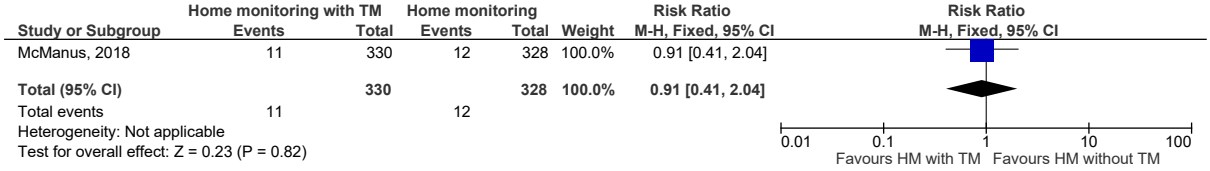


Figure 10: Reduction in clinic blood pressure (mmHg), diastolic, 12 months



E.3 Home monitoring with telemonitoring versus home monitoring without telemonitoring

Figure 11: Cardiovascular events[1], 12 months[a]



[1] *(new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure,*

[a] Home monitoring (HM), Telemonitoring (TM)

Figure 12: Clinic blood pressure (mmHg), systolic, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Home monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
McManus, 2018	136	16.1	327	137	16.7	328	100.0%	-1.00 [-3.51, 1.51]
Total (95% CI)			**327**			**328**	**100.0%**	**-1.00 [-3.51, 1.51]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.78 (P = 0.44)

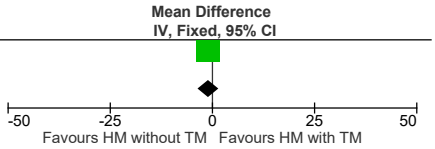


Figure 13: Clinic blood pressure (mmHg), diastolic, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Home monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
McManus, 2018	78.7	9.7	328	77.8	10.1	328	100.0%	0.90 [-0.62, 2.42]
Total (95% CI)			**328**			**328**	**100.0%**	**0.90 [-0.62, 2.42]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.16 (P = 0.24)

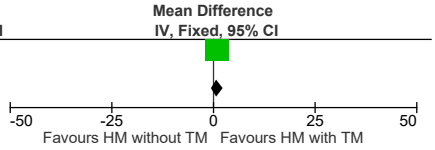


Figure 14: Overall defined daily dose, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Home monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
McManus, 2018	2.69	1.82	330	2.42	1.75	328	100.0%	0.27 [-0.00, 0.54]
Total (95% CI)			**330**			**328**	**100.0%**	**0.27 [-0.00, 0.54]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.94 (P = 0.05)

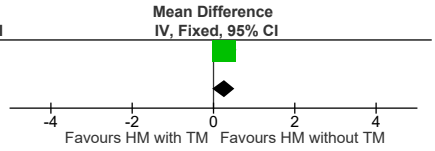


Figure 15: Average number of GP visits, 12 months[a]

Study or Subgroup	Home monitoring with TM Events	Total	Home monitoring Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Logan, 2012	4	51	6	49	100.0%	0.64 [0.19, 2.13]
Total (95% CI)		**51**		**49**	**100.0%**	**0.64 [0.19, 2.13]**
Total events	4		6			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.73 (P = 0.47)

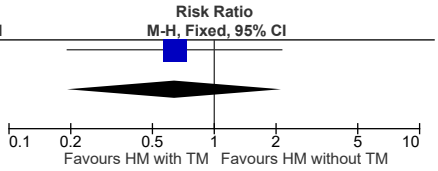


Figure 16: Mean number of consultations for hypertension, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Home monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
McManus, 2018	2.2	2.53	330	1.8	2.54	328	100.0%	0.40 [0.01, 0.79]
Total (95% CI)			**330**			**328**	**100.0%**	**0.40 [0.01, 0.79]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.02 (P = 0.04)

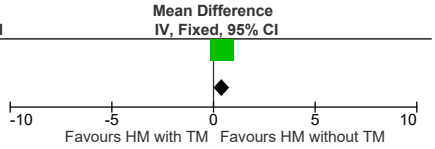
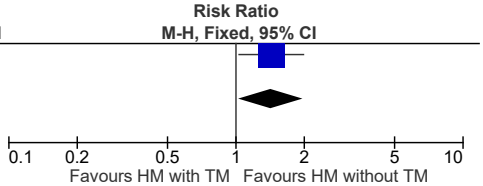


Figure 17: Dizziness, hypertension specific symptoms (no further details of definition) 12 months[a]

Study or Subgroup	HM with TM Events	Total	HM without TM Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
McManus, 2018	72	326	50	324	100.0%	1.43 [1.03, 1.98]
Total (95% CI)		**326**		**324**	**100.0%**	**1.43 [1.03, 1.98]**
Total events	72		50			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.15 (P = 0.03)



E.4 Home monitoring with telemonitoring versus clinic monitoring

Figure 18: All-cause mortality, 12 months[a]

Study or Subgroup	Home monitoring with TM Events	Total	Clinic monitoring Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Green, 2008	2	246	0	247	100.0%	7.45 [0.46, 119.44]
Total (95% CI)		**246**		**247**	**100.0%**	**7.45 [0.46, 119.44]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.42 (P = 0.16)

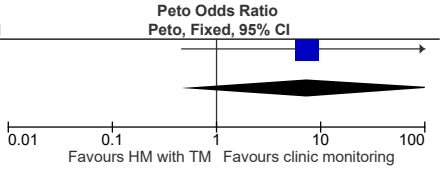
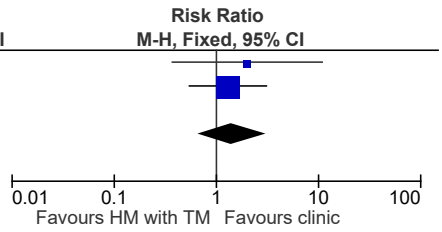


Figure 19: Cardiovascular events[1] 12 months[a]

Study or Subgroup	HM with TM Events	Total	Clinic/office Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Green, 2008	4	246	2	247	18.6%	2.01 [0.37, 10.86]
McManus, 2018	11	330	9	350	81.4%	1.30 [0.54, 3.09]
Total (95% CI)		**576**		**597**	**100.0%**	**1.43 [0.66, 3.08]**
Total events	15		11			

Heterogeneity: Chi² = 0.20, df = 1 (P = 0.65); I² = 0%
Test for overall effect: Z = 0.91 (P = 0.36)



[1](defined as new atrial fibrillation, angina, myocardial infarction, coronary artery bypass graft or angioplasty, stroke, peripheral vascular disease, or heart failure in 1 study, defined as non-fatal cardiovascular events in another),

Figure 20: Quality of life, SF-12, emotional subscale, 0–100 scale, higher score is better, 12 months

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Clinic monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Green, 2008	72.1	16.8	246	71.5	17.7	247	100.0%	0.60 [-2.45, 3.65]
Total (95% CI)			**246**			**247**	**100.0%**	**0.60 [-2.45, 3.65]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.39 (P = 0.70)

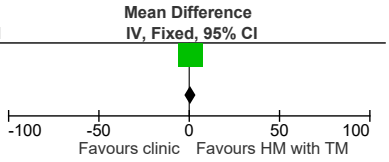


Figure 21: Quality of life, SF-12, physical subscale, 0–100 scale, higher score is better, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Clinic monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Green, 2008	77.7	30.3	246	78.1	27.7	247	100.0%	-0.40 [-5.53, 4.73]
Total (95% CI)			**246**			**247**	**100.0%**	**-0.40 [-5.53, 4.73]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.15 (P = 0.88)

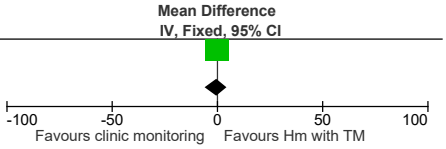


Figure 22: Quality of life, SF-12, general subscale, 0–100 scale, higher score is better, 12 months[a]

Study or Subgroup	Home monitoring with TM Mean	SD	Total	Clinic monitoring Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Green, 2008	66.6	20.9	246	66.7	20.4	247	100.0%	-0.10 [-3.75, 3.55]
Total (95% CI)			**246**			**247**	**100.0%**	**-0.10 [-3.75, 3.55]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.05 (P = 0.96)

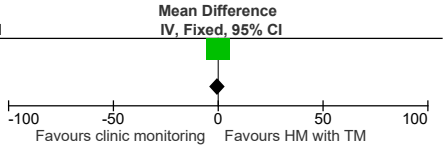


Figure 23: Reduction in clinic blood pressure (mmHg), systolic 12 months

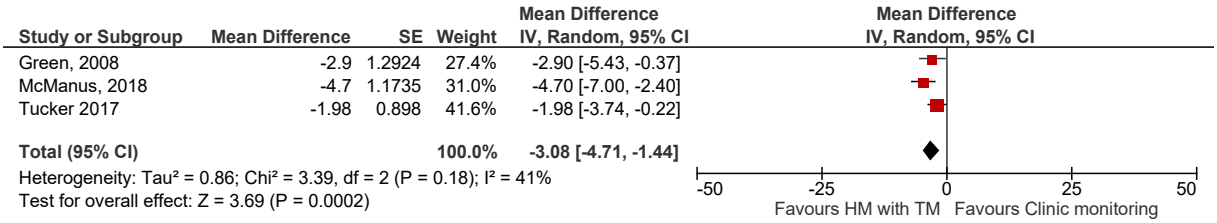


Figure 24: Reduction in clinic blood pressure (mmHg), diastolic 12 months

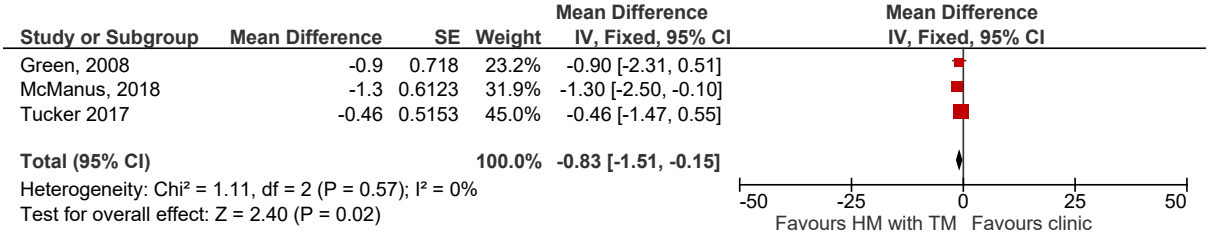


Figure 25: Proportion controlled to a target, higher score is better, 12 months[a]

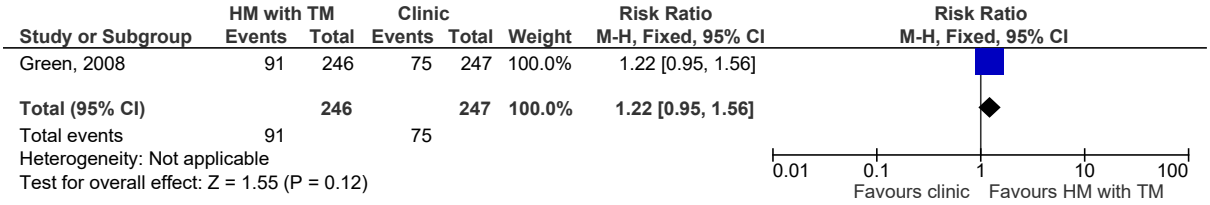


Figure 26: Proportion not meeting target (varied target due to IPD – mode 140/90 mmHg), 12 months

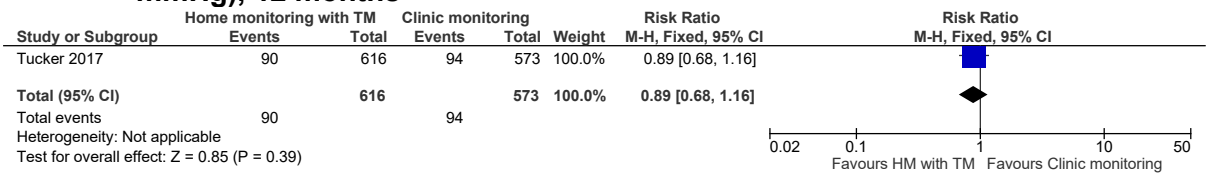


Figure 27: Overall defined daily dose, 12 months[a]

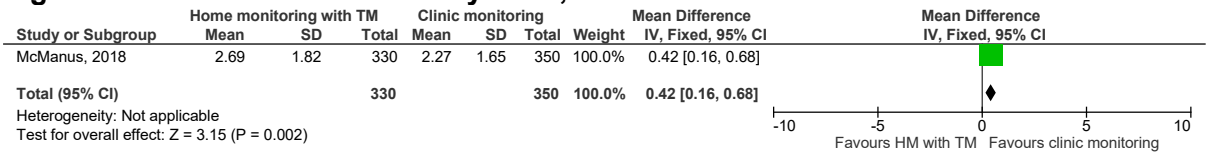


Figure 28: Mean number of consultations for hypertension, 12 months[a]

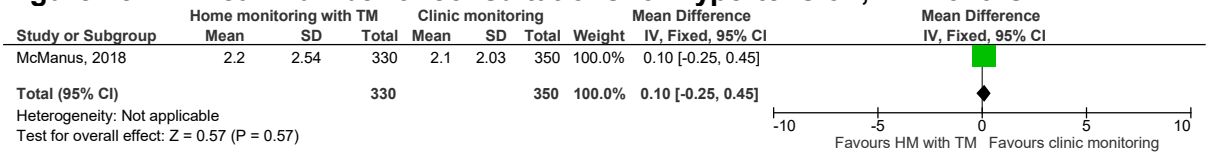
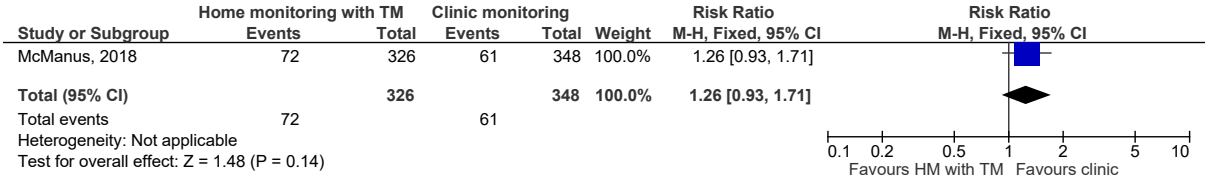


Figure 29: Dizziness, hypertension specific symptoms (no further definition), 12 months



E.5 Home monitoring with telemonitoring and pharmacist care versus clinic monitoring

Figure 30: All-cause mortality, 12 months[a]

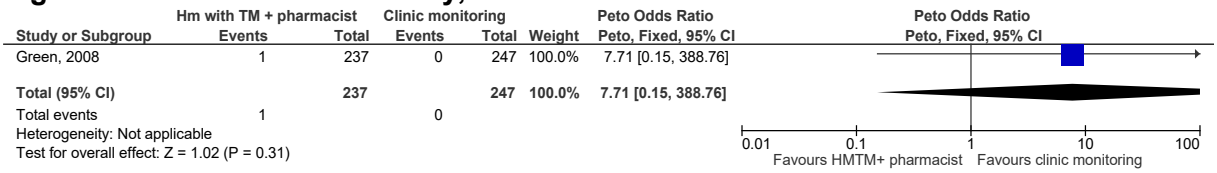


Figure 31: Non-fatal Cardiovascular events (no further details given), 1 year[a]

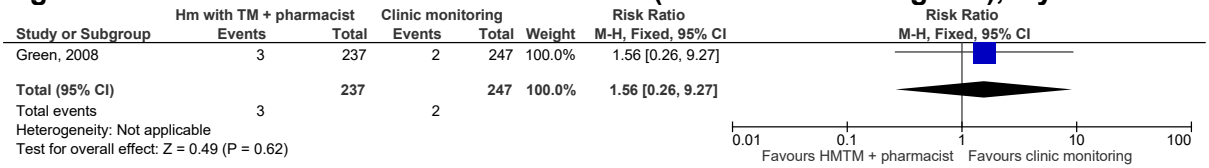


Figure 32: Reduction in blood pressure (mmHg), systolic, 12 months[a]

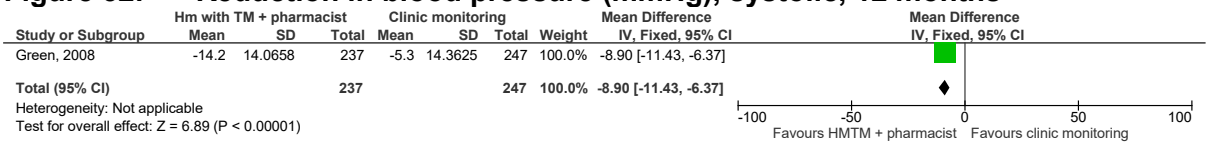


Figure 33: Reduction in blood pressure (mmHg), diastolic, 12 months[a]

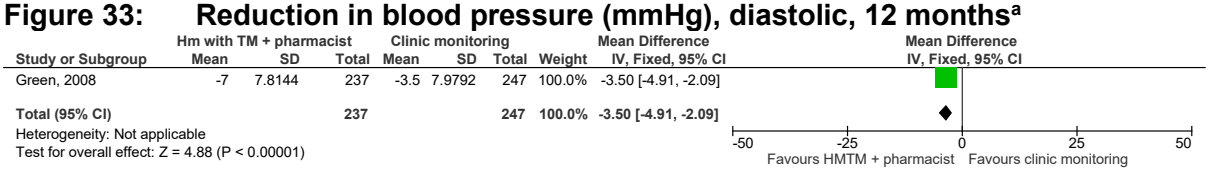


Figure 34: Proportion controlled to a target, higher score is better, 12 months[a]

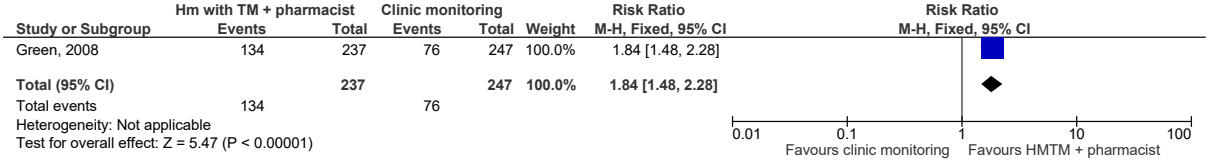


Figure 35: Quality of life, SF-12, emotional subscale, 0–100 scale, higher score is better, 12 months[a]

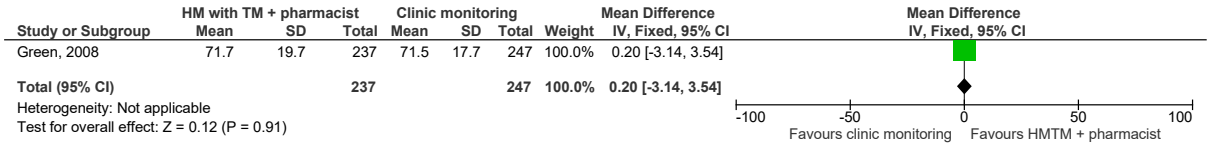


Figure 36: Quality of life, SF-12, physical subscale, 0–100 scale, higher score is better, 12 months[a]

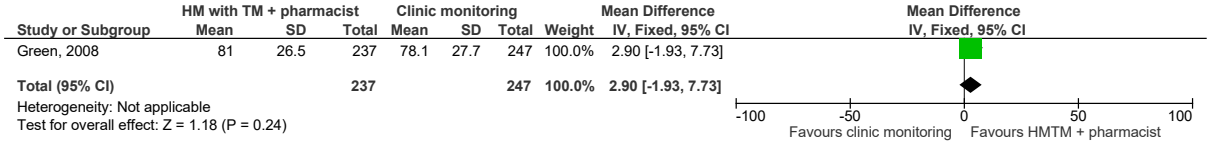
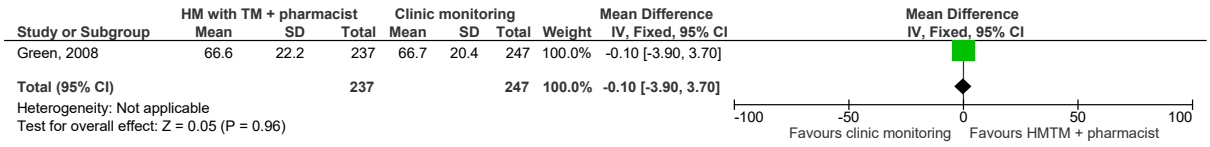


Figure 37: Quality of life, SF-12, general subscale, 0–100 scale, higher score is better, 12 months[a]



E.6 Home monitoring with telemonitoring and pharmacist care versus home monitoring with telemonitoring

Figure 38: All-cause mortality, 12 months

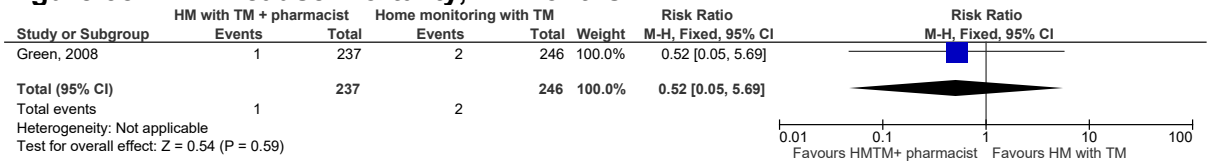


Figure 39: Non-fatal Cardiovascular events (no further details given), 12 months

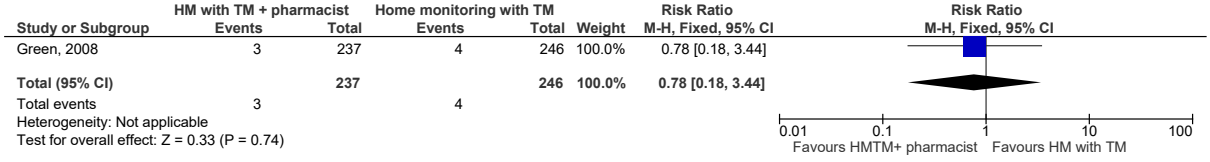


Figure 40: Change in blood pressure (mmHg), systolic, 12 months[a]

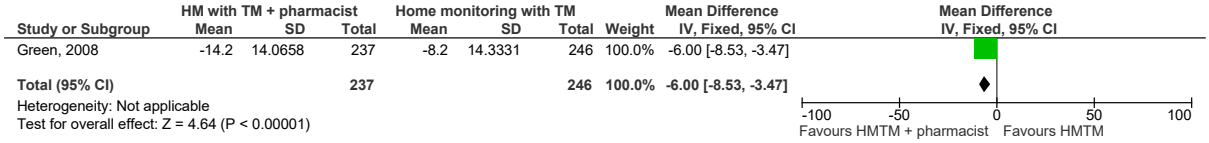


Figure 41: Reduction in blood pressure (mmHg), diastolic, 12 months[a]

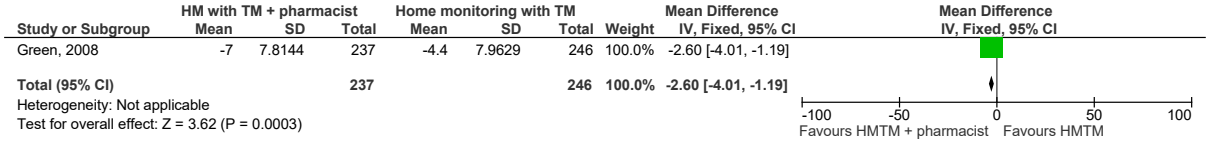


Figure 42: Quality of life, SF-12, emotional subscale, 0–100 scale, higher score is better, 12 months[a]

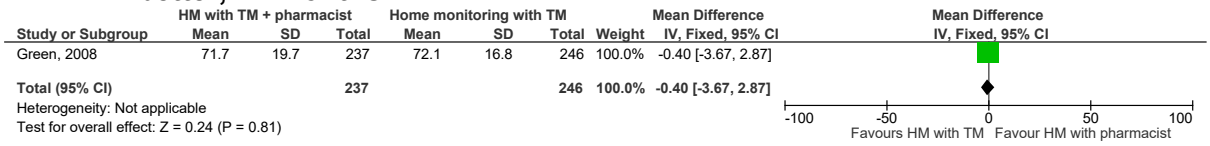


Figure 43: Quality of life, SF-12, physical subscale, 0–100 scale, higher score is better, 12 months[a]

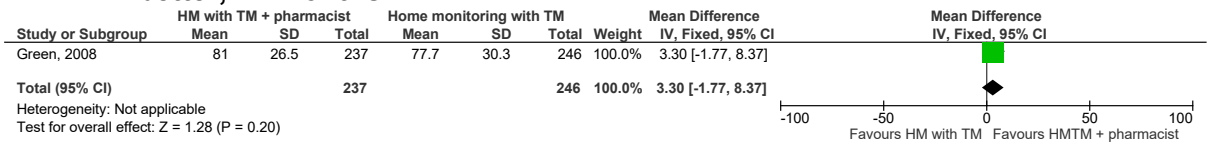
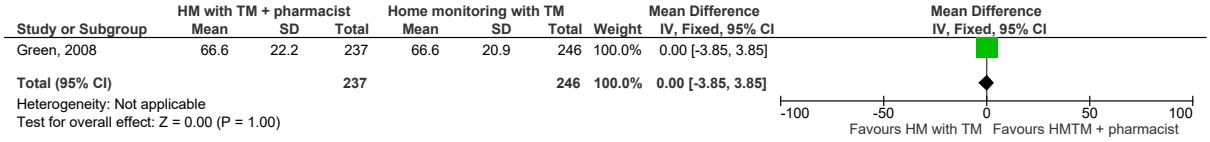


Figure 44: Quality of life, SF-12, general subscale, 0–100 scale, higher score is better, 12 months[a]



E.7 Home-monitoring (with self-titration) and telemonitoring versus clinic monitoring

Figure 45: Clinic blood pressure (mmHg), systolic, 12 months[a]

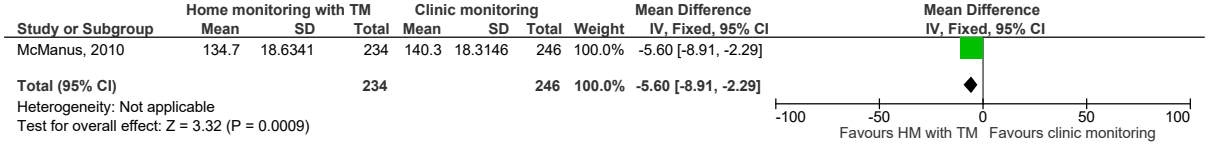


Figure 46: Clinic blood pressure (mmHg), diastolic, 12 months[a]

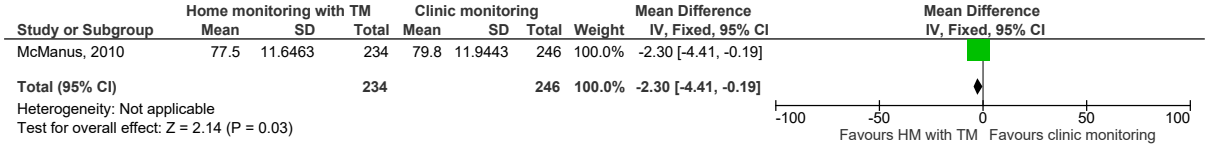


Figure 47: Quality of life, EQ-5D, 0.594 to 1, higher score is better, 12 months[a]

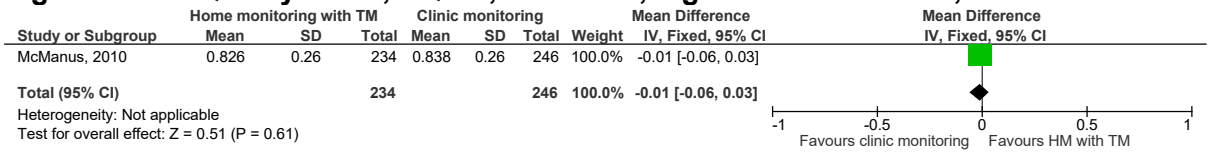


Figure 48: Mean number of consultations for hypertension, 12 months[a]

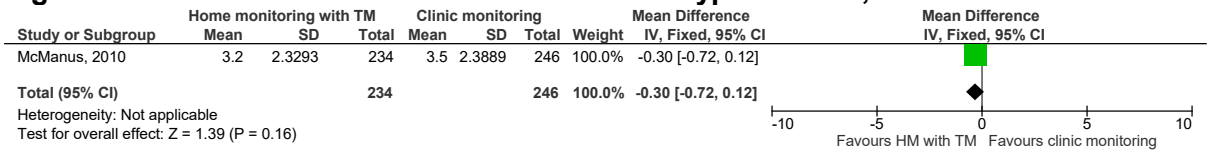
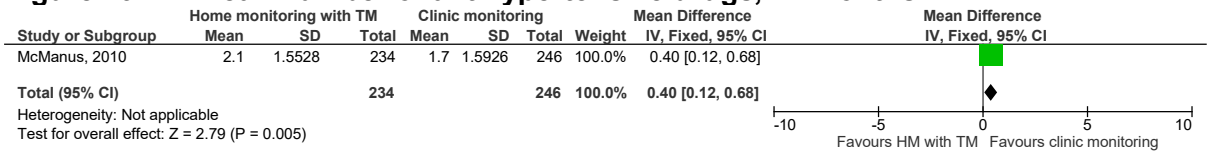


Figure 49: Mean number of antihypertensive drugs, 12 months[a]



E.8 Pharmacy monitoring versus clinic monitoring

Figure 50: All-cause mortality, 12 months

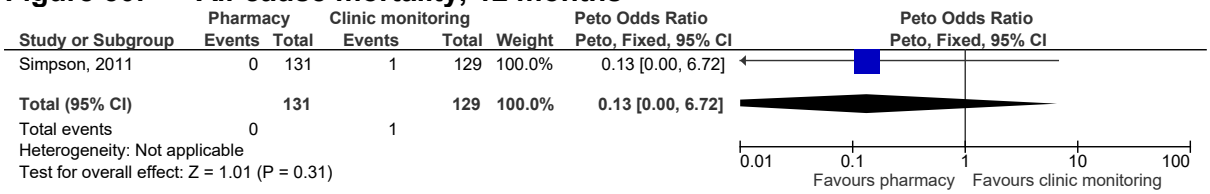


Figure 51: Reduction in blood pressure (mmHg), systolic, 12 months

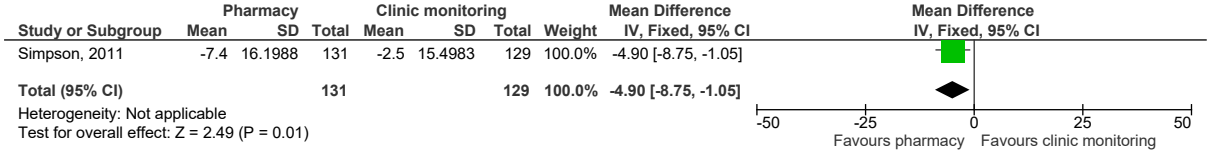
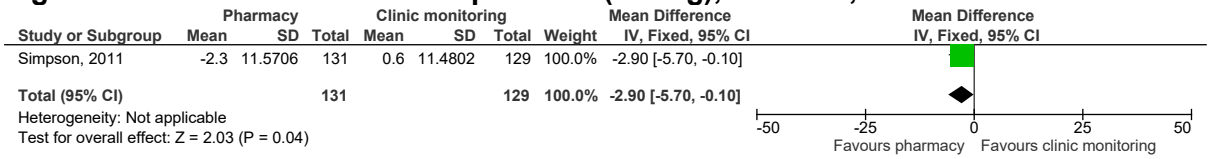


Figure 52: Reduction in blood pressure (mmHg), diastolic, 12 months



Appendix F: GRADE tables

Table 23: Clinical evidence profile: Home monitoring versus clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Home monitoring without telemonitoring versus clinic/office monitoring	Control	Relative (95% CI)	Absolute		
Cardiovascular events (follow-up 1 years)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	12/328 (3.7%)	2.6%	RR 1.42 (0.61 to 3.33)	11 more per 1,000 (from 10 fewer to 61 more)	⊕OOO VERY LOW	CRITICAL
Reduction in clinic BP - change in clinic systolic BP (follow-up 1 years; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	very serious[4]	no serious imprecision	none	1301	1309	-	MD 2.23 lower (3.84 to 0.63 lower)	⊕OOO VERY LOW	IMPORTANT
Reduction in clinic BP - change in clinic diastolic BP (follow-up 1 years; Better indicated by lower values)												
2	randomised trials	serious[1]	no serious inconsistency	very serious[4]	no serious imprecision	none	1301	1309	-	MD 1.31 lower (2.19 to 0.44 lower)	⊕OOO VERY LOW	IMPORTANT
Uncontrolled BP (not meeting trial target; follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	very serious[4]	very serious[3]	none	70/973 (7.2%)	7.3%	RR 0.99 (0.72 to 1.36)	1 fewer per 1,000 (from 20 fewer to 26 more)	⊕OOO VERY LOW	IMPORTANT
Overall defined daily dose (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	328	350	-	MD 0.15 higher (0.11 lower to 0.41	⊕⊕OO LOW	IMPORTANT

										higher)		
Mean number of consultations for hypertension (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	328	350	-	MD 0.30 lower (0.65 lower to 0.05 higher)	⊕⊕OO LOW	IMPORTANT
Dizziness (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	none	50/324 (15.4%)	17.5%	RR 0.88 (0.63 to 1.24)	21 fewer per 1,000 (from 65 fewer to 42 more)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[4]Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population and intervention respectively.

Table 24: Clinical evidence profile: Home monitoring versus ambulatory/clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Home monitoring without TM**	**Ambulatory/clinic monitoring**	**Relative (95% CI)**	**Absolute**		
Reduction in blood pressure - Systolic (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	73	72	-	MD 2.1 lower (6.8 lower to 2.6 higher)	⊕⊕OO LOW	IMPORTANT
Reduction in blood pressure - Diastolic (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	73	72	-	MD 1.4 lower (4.3 lower to 1.5 higher)	⊕⊕OO LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.

Table 25: Clinical evidence profile: Home monitoring with telemonitoring versus home monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Home monitoring with TM	Home monitoring without TM	Relative (95% CI)	Absolute		
Cardiovascular events (follow-up 1 years)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	11/330 (3.3%)	3.7%	RR 0.91 (0.41 to 2.04)	3 fewer per 1,000 (from 22 fewer to 38 more)	⊕OOO VERY LOW	CRITICAL
Clinic blood pressure, systolic (follow-up 1 years; better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	327	328	-	MD 1.00 lower (3.51 lower to 1.51 higher)	⊕⊕OO LOW	IMPORTANT
Clinic blood pressure, diastolic (follow-up 1 years; better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	328	328	-	MD 0.90 higher (0.62 lower to 2.42 higher)	⊕⊕OO LOW	IMPORTANT
Overall defined daily dose (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	330	328	-	MD 0.27 higher (0 to 0.54 higher)	⊕⊕OO LOW	IMPORTANT
Average number of GP visits (follow-up 1 years)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	very serious[3]	none	4/51 (7.8%)	12.2%	RR 0.64 (0.19 to 2.13)	44 fewer per 1,000 (from 99 fewer to 138 more)	⊕OOO VERY LOW	IMPORTANT
Mean number of consultations for hypertension (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	330	328	-	MD 0.40 higher (0.01 to 0.79 higher)	⊕⊕OO LOW	IMPORTANT

Dizziness (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	none	72/326 (22.1%)	15.4%	RR 1.43 (1.03 to 1.98)	66 more per 1,000 (from 5 more to 151 more)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 26: Clinical evidence profile: Home monitoring with telemonitoring versus clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Home monitoring with telemonitoring versus clinic/office monitoring**	**Control**	**Relative (95% CI)**	**Absolute**		
All-cause mortality (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[5]	very serious[3]	none	2/246 (0.81%)	0%	Peto OR 7.45 (0.46 to 119.44)	10 more per 1,000 (from 0.01 fewer to 0.02 more)	⊕OOO VERY LOW	CRITICAL
Cardiovascular events (follow-up 1 years)												
2	randomised trials	very serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	15/576 (2.6%)	1.69%	RR 1.43 (0.66 to 3.08)	7 more per 1,000 (from 6 fewer to 35 more)	⊕OOO VERY LOW	CRITICAL
Quality of life - Emotional scale (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	246	247	-	MD 0.6 higher (2.45 lower to 3.65 higher)	⊕⊕OO LOW	CRITICAL
Quality of life - Physical (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	246	247	-	MD 0.4 lower (5.53 lower to 4.73 higher)	⊕⊕OO LOW	CRITICAL

Quality of life - General (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	246	247	-	MD 0.1 lower (3.75 lower to 3.55 higher)	⊕⊕OO LOW	CRITICAL
Reduction in clinic BP - change in clinic systolic BP (follow-up 1 years; Better indicated by lower values)												
3	randomised trials	serious[1]	serious[4]	very serious[2,5]	no serious imprecision	none	1189	1168	-	MD 3.08 lower (4.71 to 1.44 lower)	⊕OOO VERY LOW	IMPORTANT
Reduction in clinic BP - change in clinic diastolic BP (follow-up 1 years; Better indicated by lower values)												
3	randomised trials	serious[1]	no serious inconsistency	very serious[2,5]	no serious imprecision	none	1189	1168	-	MD 0.83 lower (1.51 to 0.15 lower)	⊕OOO VERY LOW	IMPORTANT
Uncontrolled BP (not meeting trial target; follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	very serious[2,5]	serious[3]	none	90/616 (14.6%)	16.4%	RR 0.90 (0.69 to 1.15)	16 fewer per 1,000 (from 51 fewer to 25 more)	⊕OOO VERY LOW	IMPORTANT
Proportion controlled to a target (follow-up 1 years)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	none	91/246 (37%)	30.4%	RR 1.22 (0.95 to 1.56)	67 more per 1,000 (from 15 fewer to 170 more)	⊕⊕OO LOW	IMPORTANT
Overall defined daily dose (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	very serious[2]	no serious imprecision	none	330	350	-	MD 0.42 higher (0.16 to 0.68 higher)	⊕OOO VERY LOW	IMPORTANT
Mean number of consultations for hypertension (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	very serious[2]	no serious imprecision	none	330	350	-	MD 0.10 higher (0.25 lower to 0.45 higher)	⊕OOO VERY LOW	IMPORTANT
Dizziness (follow-up 1 years)												

1	randomised trials	serious[1]	no serious inconsistency	very serious[2]	serious[3]	none	72/326 (22.1%)	17.5%	RR 1.26 (0.93 to 1.71)	45 more per 1,000 (from 12 fewer to 124 more)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.
[4] 'Downgraded by 1 or 2 incrments due to heterogeneity, unexplained by subgroup analyses so random effects was used.
[5]Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.

Table 27: Clinical evidence profile: Home monitoring with telemonitoring and pharmacist care versus clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Home monitoring with TM and pharmacist interaction**	**Clinic/office monitoring**	**Relative (95% CI)**	**Absolute**		
Quality of life - Emotional scale (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	247	-	MD 0.20 higher (3.14 lower to 3.54 higher)	⊕⊕OO LOW	CRITICAL
Quality of life - Physical (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	247	-	MD 2.90 higher (1.93 lower to 7.73 higher)	⊕⊕OO LOW	CRITICAL
Quality of life - General (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	247	-	MD 0.10 lower (3.9 lower to 3.7 higher)	⊕⊕OO LOW	CRITICAL
Non-fatal Cardiovascular events (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	3/237 (1.3%)	0.81%	RR 1.56 (0.26 to 9.27)	5 more per 1,000 (from 6 fewer to 67 more)	⊕OOO VERY LOW	CRITICAL

All-cause mortality (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	1/237 (0.42%)	0%	Peto OR 7.71 (0.15 to 388.76)	0 more per 1,000 (from 0.01 fewer to 0.02 more)	⊕OOO VERY LOW	CRITICAL
Reduction in systolic BP (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	none	237	247	-	MD 8.90 lower (11.43 to 6.37 lower)	⊕⊕OO LOW	IMPORTANT
Reduction in diastolic BP (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	none	237	247	-	MD 3.50 lower (4.91 to 2.09 lower)	⊕⊕OO LOW	IMPORTANT
Proportion controlled to a target (follow-up 1 years)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	no serious imprecision	none	134/237 (56.5%)	30.8%	RR 1.84 (1.48 to 2.28)	259 more per 1,000 (from 148 more to 394 more)	⊕⊕⊕O MODERATE	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 28: Clinical evidence profile: Home monitoring with telemonitoring and pharmacist care versus home monitoring with telemonitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Home monitoring with TM + pharmacist care**	**Home monitoring with telemonitoring**	**Relative (95% CI)**	**Absolute**		
All-cause mortality (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	1/237 (0.42%)	0.81%	RR 0.52 (0.05 to	4 fewer per 1,000 (from 8	⊕OOO VERY	CRITICAL

									5.69)	fewer to 38 more)	LOW	
Non-fatal Cardiovascular events (follow-up 1 years)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	3/237 (1.3%)	1.6%	RR 0.78 (0.18 to 3.44)	4 fewer per 1,000 (from 13 fewer to 39 more)	⊕OOO VERY LOW	CRITICAL
Reduction in systolic BP (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	none	237	246	-	MD 6.00 lower (8.53 to 3.47 lower)	⊕⊕OO LOW	IMPORTANT
Reduction in diastolic BP (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	no serious risk of bias	no serious inconsistency	serious[2]	serious[3]	none	237	246	-	MD 2.60 lower (4.01 to 1.19 lower)	⊕⊕OO LOW	IMPORTANT
Quality of life - Emotional scale (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	246	-	MD 0.40 lower (3.67 lower to 2.87 higher)	⊕⊕OO LOW	CRITICAL
Quality of life - Physical (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	246	-	MD 3.30 higher (1.77 lower to 8.37 higher)	⊕⊕OO LOW	CRITICAL
Quality of life - General (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	237	246	-	MD 0.00 higher (3.85 lower to 3.85 higher)	⊕⊕OO LOW	CRITICAL

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Table 29: Clinical evidence profile: Home-monitoring (with self-titration) and telemonitoring versus clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Self-monitoring (with self-titration) and telemonitoring	Clinic monitoring	Relative (95% CI)	Absolute		
Clinic blood pressure, systolic, final score (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	234	246	-	MD 5.60 lower (8.91 to 2.29 lower)	⊕⊕OO LOW	IMPORTANT
Clinic blood pressure, diastolic, final score (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	234	246	-	MD 2.30 lower (4.41 to 0.19 lower)	⊕⊕OO LOW	IMPORTANT
Quality of life, EQ-5D, (follow-up 1 years; Better indicated by higher values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	234	246	-	MD 0.01 lower (0.06 lower to 0.03 higher)	⊕⊕OO LOW	CRITICAL
Mean number of consultations for hypertension (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	234	246	-	MD 0.30 lower (0.72 lower to 0.12 higher)	⊕⊕OO LOW	IMPORTANT
Mean number of antihypertensive drugs (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	234	246	-	MD 0.40 higher (0.12 to 0.68 higher)	⊕⊕OO LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect population respectively.

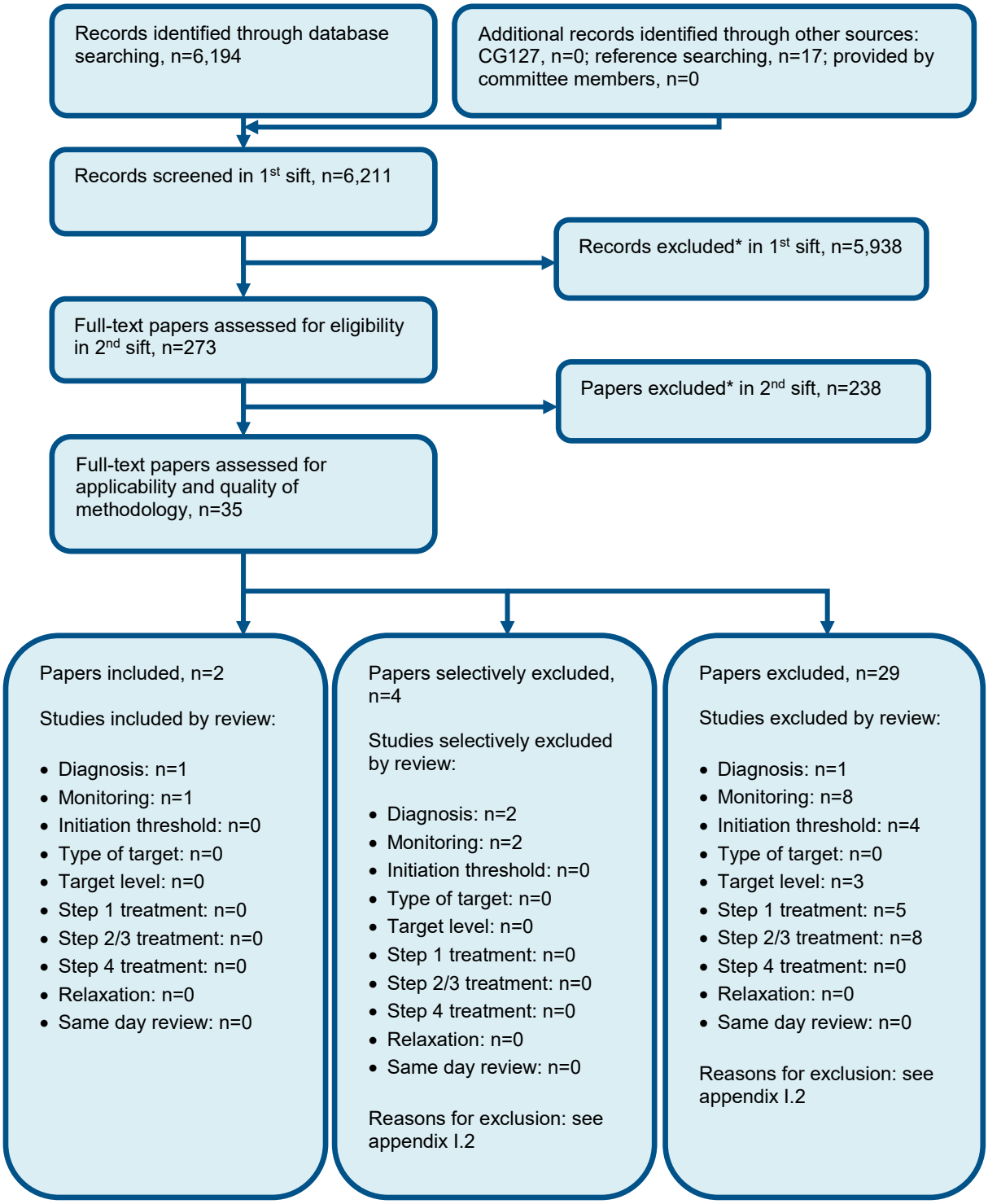
Table 30: Clinical evidence profile: Pharmacy versus clinic monitoring

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Pharmacy	Clinic/office	Relative (95% CI)	Absolute		
All-cause mortality (follow-up 1 years)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	very serious[3]	none	0/131 (0%)	0.8%	Peto OR 0.13 (0 to 6.72)	1 fewer per 1,000 (from 3 fewer to 1 more)	⊕OOO VERY LOW	CRITICAL
Reduction in clinic BP, systolic (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	serious[3]	none	131	129	-	MD 4.90 lower (8.75 to 1.05 lower)	⊕OOO VERY LOW	IMPORTANT
Reduction in clinic BP, diastolic (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	131	129	-	MD 2.90 lower (5.7 to 0.1 lower)	⊕⊕OO LOW	IMPORTANT
Contacts per patients with all resources (excluding pharmacists), 12 months (follow-up 1 years; Better indicated by lower values)												
1	randomised trials	very serious[1]	no serious inconsistency	serious[2]	no serious imprecision	none	131	129	-	MD 0 higher (0 to 0 higher)	⊕OOO VERY LOW	IMPORTANT

[1] Downgraded by 1 increment if the majority of the evidence was at high risk of bias and downgraded by 2 increments if the majority of the evidence was at very high risk of bias.
[2] Downgraded by 1 or 2 increments because the majority of the evidence included an indirect or very indirect intervention respectively.
[3] Downgraded by 1 increment if the confidence interval crossed 1 MID or by 2 increments if the confidence interval crossed both MIDs.

Appendix G: Health economic evidence selection

Figure 53: Flow chart of health economic study selection for the guideline



* Non-relevant population, intervention, comparison, design or setting; non-English language

Appendix H: Health economic evidence tables

Study	Kaambwa 2013[62]			
Study details	**Population & interventions**	**Costs**	**Health outcomes**	**Cost effectiveness**
Economic analysis: CUA (health outcome: QALYs) **Study design:** Probabilistic decision analytic model **Approach to analysis:** Markov model comparing self-management and telemonitoring with usual care. One-year cycles. Thirty-five-year time horizon. People begin in a 'well' state with poorly controlled hypertension, with the possibility of moving to other states of stroke, myocardial infarction, angina, heart failure, and death. Each event state has a post state. Baseline risk based on Framingham. Extrapolation of effect from a 12-month trial based on translating BP reduction into a RR	**Population:** People with a BP at baseline of over 140/90 and receiving treatment with 2 or fewer antihypertensives (that is, uncontrolled hypertension). **Cohort settings:** Start age: 66 Separate analyses for men and women. **Intervention 1:** Usual care People received an annual hypertension review as per UK national guidelines. **Intervention 2:** Self-management. People were trained in the use of an automated sphygmomanometer to take readings. Home targets were adjusted from	**Total costs (mean per patient) – MEN:** Intervention 1: £6,707 Intervention 2: £7,090 Incremental (2−1): £383 (95% CI: NR; p=NR) **Total costs (mean per patient) – WOMEN:** Intervention 1: £6,720 Intervention 2: £7,296 Incremental (2−1): £576 (95% CI: NR; p=NR) **Currency & cost year:** 2009/10 UK pounds **Cost components incorporated:** Inpatient and outpatient visits, primary care consultations, drugs, equipment, training.	**QALYs (mean per patient) – MEN:** Intervention 1: 8.92 Intervention 2: 9.16 Incremental (2−1): 0.24 (95% CI: NR; p=NR) **QALYs (mean per patient) – WOMEN:** Intervention 1: 10.46 Intervention 2: 10.57 Incremental (2−1): 0.12 (95% CI: NR; p=NR)	**ICER (Intervention 2 versus Intervention 1) – MEN:** £1,624 per QALY gained (pa) 95% CI: NR Probability Intervention 2 cost effective (£20K/30K threshold): 99%/99% **ICER (Intervention 2 versus Intervention 1) – WOMEN:** £4,923 per QALY gained (pa) 95% CI: NR Probability Intervention 2 cost effective (£20K/30K threshold): 99%/99% **Analysis of uncertainty:** PSA based on 50,000 Monte Carlo simulations. Sensitivity analyses included: • Varying the time horizon from between 5 to 30 years in 5-year increments. • Assumption regarding long-term effectiveness was tested by assessing the impact of reductions in effectiveness after the initial year – a 20% reduction in BP lowering in the intervention arm. Also, complete loss of incremental

reduction from Law 2009. **Perspective:** UK NHS **Time horizon/Follow-up:** 35 years **Treatment effect duration:**[(a)] 12 months – assumed the same beyond 12 months. **Discounting:** Costs: 3.5%; Outcomes: 3.5%	140/90 by 10/5 mmHg to take into account lower home BP. People used a colour traffic light system to code readings. Based on their readings and following an initial consultation with their physician, people could make medication changes without needing to re-consult.			effectiveness was modelled (36% decline in impact of intervention in men and 26% in women). These reduced effects were applied at arbitrarily chosen time points. The only analyses that led to ICERs of more than £20,000 for the intervention was: • a 26% decline in the impact of the intervention on BP reduction (that is no incremental benefit of intervention) for women in the second year (ICER of £44,423) • as above but effectiveness reduces in the third year (ICER of £27,801) • as above but effectiveness reduces in the fifth year (ICER of £24,420).
Data sources				
Health outcomes: Risk of secondary events not modelled. Transition probabilities for moving between the well and CV health and dead states obtained from published sources. Baseline risk: The mean 10-year CV risk for each patient cohort was calculated using the Framingham equations. This risk estimate was converted to a 1-year probability. And split between the 4 possible CV events. The weights attributed to each type of event was determined by CV risk profiles measured within Framingham, with coronary heart disease further subdivided into MI, HF, and angina. Treatment effect: Age related relative risk of having a CV event following the use of antihypertensive treatment, together with associated reductions in blood pressure, was derived from Law 2009.[72] This information was used to extrapolate from the 12-month reductions in BP recorded in McManus 2010[84] to the age-related relative risks subsequently used in the model. The base case assumed that the 12-month difference in BP between self-management and usual care groups was maintained over the lifetime of the model. The extrapolated relative risk for CHD was also assumed for MI, angina, and heart failure health states. **Quality-of-life weights:** Starting QoL obtained from UK age and sex specific estimates.[70] Utilities for health states were all obtained from Cooper et al.[91] Future utilities were applied as multiplicative values of the UK age and sex specific estimates. **Cost sources:** 2009/10 UK prices. Resource use and subsequent costs per person were applied to the initial health state in the model. Total costs per person in the trial were calculated as the sum of the costs of inpatient and outpatient visits, primary care consultations, drugs, equipment, and training. Equipment costs were annuitised and assumed a lifetime of 5 years. Replacement costs for equipment and additional training were included at 5 yearly intervals over the lifetime of the model. Cost sources not stated for intervention costs as these were reported in the original trial. Costs of CV health states based on various published sources.				
Comments				

Source of funding: NIHR, DH,

Limitations: UK study, CUA, long-term time horizon. Appropriate interventions.

Based on a trial of only 12 months and extrapolating this effect. CV events based on risk equation rather than directly from a trial. And relative treatment effect based on mapping BP changes. No adverse events. Costs could be out of date now.

Overall applicability: Directly applicable (b) **Overall quality: Potentially serious limitations**(c)

Abbreviations: BP: blood pressure; CV: cardiovascular; CUA: cost–utility analysis; EQ-5D: Euroqol 5 dimensions (scale: 0.0 [death] to 1.0 [full health], negative values mean worse than death); ICER: incremental cost-effectiveness ratio; NR: not reported; PA: probabilistic analysis; QALYs: quality-adjusted life years; RR: relative risk.

(a) For studies where the time horizon is longer than the treatment duration, an assumption needs to be made about the continuation of the study effect. For example, does a difference in utility between groups during treatment continue beyond the end of treatment and if so for how long.

(b) Directly applicable / Partially applicable / Not applicable

(c) Minor limitations / Potentially serious limitations / Very serious limitations

Appendix I: Excluded studies

I.1 Excluded clinical studies

Table 31: Studies excluded from the clinical review that were included in the previous guideline (CG127)

Study	Exclusion details
Bray 2010 [18]	Systematic review with relevant PICO. Each individual study included within the review was assessed for inclusion. The majority of the studies were conducted before the year 2000 and so were excluded. Other studies had a follow up of less than 12 months and so did not meet the inclusion criteria for this review.
Conen 2009 [33]	Incorrect study design with less than minimum follow up duration. Not all participants were assessed at 12 months.
Ishikawa 2008 [59]	Systematic review with relevant PICO. Each individual study included within the review was assessed for inclusion. The majority of the studies were conducted before the year 2000 and so were excluded. Other studies were not included because they compared antihypertensive drugs rather than measurement methods.
Niiranen 2006 [95]	Less than minimum follow up duration. The follow up was 24 weeks, not meeting the 12 month minimum follow up specified by the protocol.
Staessen 2004 [128]	Inappropriate comparison. All participants had home and clinic monitoring, resulting in the control group not being a control group and all were using the same target.

Table 32: Studies excluded from the clinical review

Study	Exclusion reason
Abdoh 2003[1]	Incorrect interventions
Aekplakorn 2016[2]	No relevant outcomes
Albasri 2017[3]	Systematic review - references checked
Anderegg 2016[4]	Incorrect interventions
Anderson 2017[5]	Protocol
Anonymous 2004[6]	Conference abstract
Antonicelli 1995[7]	Inappropriate comparison
Aoki 2004[8]	Inappropriate comparison
Artinian 2001[10]	No relevant outcomes
Artinian 2007[9]	No relevant outcomes
Asayama 2016[11]	No relevant outcomes
Bailey 1999[12]	Less than minimum duration
Bliziotis 2012[13]	Not review population
Bosworth 2007[14]	Protocol
Bosworth 2009[15]	Included in IPD - no extra outcomes to add
Bosworth 2011[16]	Included in IPD - no extra outcomes to add
Bray 2010 [18]	Systematic review - references checked
Bray 2015[19]	Included in IPD - no extra outcomes to add
Breaux-Shropshire 2015[20]	Less than minimum duration
Brzozowska-Kiszka 2010[21]	Not in English

Study	Exclusion reason
Carnahan 1975[22]	No relevant outcomes
Carter 2008[25]	Less than minimum duration
Carter 2009[23]	Not in English
Carter 2009[24]	Less than minimum duration
Castro 2006[26]	Less than minimum duration
Celis 2005[27]	Review
Chabot 2003[28]	Less than minimum duration
Chambers 2013[29]	No relevant outcomes
Chatellier 1996[30]	No relevant outcomes
Chen 2013[31]	Less than minimum duration
Conen 2009 [33]	Incorrect study design, inappropriate comparison
Dalfó i Baqué 2005[37]	Not in English
Davidson 2015[38]	Less than minimum duration
Dean 2014[39]	Less than minimum duration
Doane 2018[40]	Incorrect interventions
Duan 2017[41]	Systematic Review - references checked
Earle 2001[43]	Less than minimum duration
Earle 2010[42]	Less than minimum duration
Fikri-Benbrahim 2013[44]	Less than minimum duration
Franssen 2017[45]	Protocol
Fuchs 2013[46]	Systematic review - references checked
Fujiwara 2002[47]	Protocol
George 2010[48]	Abstract
Halme 2005[50]	Less than minimum duration
Hansen 2014[51]	Incorrect study design
He 2017[52]	Incorrect interventions
Hebert 2012[53]	Included in IPD - no extra outcomes to add
Heinemann 2008[54]	Inappropriate comparison
Hond 2004[55]	Inappropriate comparison
Hosseininasab 2014[56]	Less than minimum duration
Hunt 2008[57]	Incorrect interventions
Irving 2016[58]	Systematic review - references checked
Ishikawa 2008 [59]	Systematic review - references checked
Jegatheswaran 2017[60]	Incorrect study design. No relevant outcomes
Jones 2013[61]	Incorrect study design
Kaambwa 2010[63]	Incorrect study design
Kaihara 2014[64]	Less than minimum duration
Kawano 2010[65]	Incorrect interventions
Kerby 2012[66]	Less than minimum duration
Kerry 2013[67]	Not review population
Kim 2015[69]	Inappropriate comparison
Kim 2016[68]	Less than minimum duration
Kushiro 2017[71]	Incorrect study design
Maciejewski 2014[75]	Included in IPD - no extra outcomes to add
Madsen 2008[77]	Less than minimum duration

Study	Exclusion reason
Magid 2013[78]	Different treatment pathways. Unclear interventions
Margolis 2010[80]	Unavailable. Conference abstract
Margolis 2013[79]	Not review population
Martinez 2017[81]	No relevant outcomes
Mckinstry 2013[82]	Less than minimum duration
McManus 2005[87]	Incorrect population setting
McManus 2009[83]	Incorrect study design. Protocol
McManus 2014[86]	More than 20% population indirectness
Myers 2012[88]	Inappropriate comparison
Myers 2012[89]	Not all receiving same treatment pathway
Nakao 2004[90]	Inappropriate comparison
Niiranen 2006 [95]	Less than minimum duration
Niiranen 2010[94]	Incorrect study design
O'Brien 1996[97]	Inappropriate comparison
O'Brien 2013[96]	Inappropriate comparison
Ogedegbe 2005[98]	Abstract
Omboni 2011[101]	Systematic review - references checked
Omboni 2013[100]	Severely indirect population
Omboni 2015[99]	Incorrect study design
Onzenoort 2010[103]	No relevant outcomes
Onzenoort 2012[102]	Incorrect study design
Parati 1996[106]	Incorrect study design
Parati 2009[104]	Not all participants were receiving antihypertensive treatment
Parati 2013[105]	Protocol
Piper 2015[108]	Inappropriate comparison. Systematic review: study designs inappropriate
Poteshkina 2015[109]	Not in English
Qi 2017[110]	Not all receiving same treatment pathway
Ragot 2000[111]	Inappropriate comparison
Ralston 2014[112]	Included in IPD - no extra outcomes to add
Reboldi 2014[113]	Inappropriate comparison
Rifkin 2013[114]	Not review population
Rogers 2001[117]	Less than minimum duration
Rogers 2002[116]	No relevant outcomes
Santschi 2014[118]	Systematic review - references checked
Schrader 2000[119]	No relevant outcomes
Schroeder 2004[120]	Systematic review - references checked
Sharman 2012[121]	Incorrect interventions
Smith 2016[123]	Less than minimum duration
Soghikian 1992[124]	Published before 2000
Spieker 1991[125]	Incorrect interventions
Spruill 2015[126]	Incorrect interventions
Staessen 1997[127]	Less than minimum duration
Staessen 2004[128]	Inappropriate comparison
Stahl 1984[129]	No relevant outcomes
Stergiou 2011[130]	Systematic review - references checked

Study	Exclusion reason
Stewart 2014[132]	Less than minimum duration
Torres 2010[134]	Not in English
Uhlig 2013[137]	Systematic review - references checked
Ulm 2010[138]	Included in IPD - no extra outcomes to add
Van der Wel 2011[139]	No relevant outcomes
Varis 2010[140]	No usable outcomes
Verberk 2003[142]	Protocol
Verberk 2007[143]	no outcomes to add to IPD
Verberk 2011[141]	Systematic review is not relevant to review question or unclear PICO
Verdecchia 2016[144]	Inappropriate comparison
Vollmer 2005[145]	Incorrect study design
Wakefield 2011[146]	Not all receiving same treatment pathway
Wakefield 2012[147]	Not all receiving same treatment pathway
Wakefield 2014[148]	Less than minimum duration
Wang 2011[149]	Not all receiving same treatment pathway
Weber 2010[150]	Less than minimum duration
Xu 2017[151]	Protocol
Yatabe 2018[152]	Protocol
Yates 2004[153]	Incorrect study design
Zarnke 1997[155]	Less than minimum duration
Zarnke 1998[154]	No relevant outcomes
Zhao 2012[156]	Not review population. Incorrect interventions

I.2 Excluded health economic studies

Table 33: Studies excluded from the health economic review

Reference	Reason for exclusion
Boubouchairopoulou 2014[17]	This study was assessed as partially applicable with potentially serious limitations. It is a cost comparison and a within trial analysis. However, given that a more applicable UK analysis[32] was available that is also a cost utility analysis, this study was selectively excluded.
Verberk 2007[143]	This study was assessed as partially applicable with potentially serious limitations. It is a cost consequences analysis. However, given that a more applicable UK analysis[32] was available that is also a cost utility analysis, this study was selectively excluded.
Lorgelly 2003[74]	This study was assessed as partially applicable with very serious limitations as it is an observational study not an RCT, and there are methodological concerns about costing methods.
Rodriguez-Roca 2006[115]	This study was assessed as partially applicable with very serious limitations as it is based on a cross sectional study and not an RCT.
Panaloza-Ramos 2016[107]	This study was assessed as not applicable because the population is a high-risk population that is excluded from the clinical review. It is, however, a UK cost utility analysis.
Madsen 2011[76]	This study was assessed as partially applicable with very serious limitations because the clinical trial the economic evaluation is based on did not meet the length of follow up criteria on the clinical protocol.

Reference	Reason for exclusion
Stoddart 2013[133]	This study was assessed as partially applicable with very serious limitations because the clinical trial the economic evaluation is based on did not meet the length of follow up criteria on the clinical protocol.
Parati 2008[104]	This study was assessed as partially applicable with very serious limitations because the clinical trial the economic evaluation is based on is a study protocol and therefore does not meet the review criteria.
McManus 2005[87]	This study was assessed as not applicable because the clinical trial the economic evaluation is based on does not have the right comparison.
Staessen 2004[128]	This study was assessed as not applicable because the clinical trial the economic evaluation is based on does not have the right comparison.

Appendix J: Research recommendations

J.1 Automated blood pressure monitoring in people with atrial fibrillation

Research question: Which automated blood pressure monitors are most accurate for people with hypertension and atrial fibrillation?

Why this is important:

Atrial fibrillation (AF) is a key risk factor for stroke and is increasingly prevalent with an ageing population. The combination of AF and hypertension puts individuals at a higher risk still. Overall, it is estimated that 1.4 million people in England have AF, which is 2.5% of the population, and 65% of those with AF are aged over 65. Currently, automated blood pressure monitors are used for the majority of NHS consultations and blood pressure measurements both in primary and secondary care; however, most measurements from automated blood pressure monitors are inaccurate in people with AF because the oscillometric algorithms designed to measure blood pressure are validated in sinus rhythm and do not necessarily function in AF, especially when the heart rhythm is very irregular.

Criteria for selecting high-priority research recommendations:

PICO question	Population: People with atrial fibrillation with or suspected to have hypertension. Target condition: Hypertension Index test: measurement of blood pressure using automated blood pressure monitors. Reference test: measurement of blood pressure using a manual mercury sphygmomanometer. Outcome(s): accuracy as defined by a recognised validation protocol, for example, BHS, ESH or AAMI (level of agreement with reference standard).
Importance to patients or the population	Treatment of both hypertension and atrial fibrillation aims to reduce stroke risk. The accurate measurement of blood pressure is a prerequisite for hypertension management.
Relevance to NICE guidance	High quality research in this area may enable future updates of this guidance to make a strong recommendation on the use of automated blood pressure monitoring in atrial fibrillation, which was not possible in the present guideline due to the lack of good quality evidence.
Relevance to the NHS	Most blood pressure measurement in the NHS utilises automated blood pressure monitors and this is likely to be the case even in AF. Inaccurate measurement of blood pressure in these people may lead to both over and under treatment of hypertension.
National priorities	N/A
Current evidence base	Evidence for blood pressure measurement in people with atrial fibrillation was not reviewed, However the suerveillance review informing the update of this guideline didn't identify sufficient new evidence to inform this, so the research recommendation has been carried forward.
Equality	None.
Study design	Validation study.
Feasibility	No major feasibility or ethical issues.
Other comments	None
Importance	High: the research is essential to inform future updates of key recommendations in the guideline.

guideline.