**Levels of detection of hypertension in primary medical care and interventions to improve detection: a systematic review of the evidence since 2000**

**Authors**

Richard Baker, Professor Emeritus, Department of Health Sciences, University of Leicester, UK

Andrew Wilson, Professor of Primary Care Research, Department of Health Sciences, University of Leicester, UK

## Keith Nockels, Learning & Teaching Services Librarian, University of Leicester, UK

Shona Agarwal, Research Associate, Department of Health Sciences, University of Leicester, UK

Priya Modi, Medical Student, Faculty of Medicine Charles' University, Prague, Czech Republic

John Bankart, Honorary Associate Professor, Department of Health Sciences, University of Leicester, UK

**Wordcount** - 2655

**Address for correspondence**

Professor Andrew Wilson,

Department of Health Sciences, College of Life Sciences,

University of Leicester,

Centre for Medicine, University Road

LE1 7RH, UK

Email: aw7@le.ac.uk

**Abstract**

**Objectives:** In England, many people with hypertension are not detected by primary care. Higher detection is associated with lower premature mortality. We aimed to summarise recent evidence on detection and interventions to improve detection in order to inform policies to improve care.

**Design:** Structured review of articles published since 2000. Searches of Medline and Embase were undertaken. Inclusion criteria: published in English, any study design, the setting was general practice, and studies included patients aged 18 or over. Exclusion criteria: screening schemes, discussion or comment pieces. Study heterogeneity precluded a statistical synthesis, and papers were described in summary tables.

**Results:** Papers reporting 17 quantitative and one qualitative study were included. Detection rates varied by gender and ethnic group, but longitudinal studies indicated an improvement in detection. Patient socio-economic factors did not influence detection, but living alone was associated with lower detection. Few health system factors were associated with detection, but in two studies better supply of general practitioners was associated with higher detection. Three studies investigated interventions to improve detection, but none showed evidence of effectiveness.

**Conclusions:** Levels of detection of hypertension by general practices may be improving, but large numbers of people with hypertension remain undetected and therefore untreated. There is little evidence on approaches for improving detection by general practices.

**Keywords:** hypertension, detection, primary care, public health

**Strengths and limitations of this study**

* The review employed a structured approach to identify relevant articles and summarise the findings.
* Papers published before the year 2000 and those published in languages other than English were excluded.
* A meta-analysis was not undertaken because of the heterogeneity of the study questions and outcomes, the BP thresholds used, and patients included.

**Introduction**

Hypertension is a common risk factor for cardiovascular mortality. In 2015, an estimated 874 million adults worldwide had a systolic blood pressure of 140 mmHG or more.1 As in many countries, England has a national strategy to improve the detection and management of hypertension,2 and the proportion of adults with untreated hypertension was 13% in 2011 compared with 21% in 1994.3 In the 2015 Health Survey for England, 26.1% of women and 30.8% of men aged 16 or over had evidence of hypertension,4 although only 13.8% of the population were recorded on GP hypertension registers in 2015-16.5 Failure to detect hypertension continues to influence mortality rates, higher proportions of the population on general practice hypertension registers being associated with lower premature mortality.6  A scheme to offer health (including blood pressure) checks to people aged 40-75 without an existing cardiovascular condition was launched in primary care in 2009 but its impact has been modest,7 a finding consistent with a review of randomised trials of similar interventions that failed to find a reduction in mortality.8 Public Health England recently launched an initiative to reduce heart attacks and strokes through better detection of hypertension, raised cholesterol and atrial fibrillation,9 and NHS Right Care has developed a prevention pathway that includes promotion of real time audits for general practices to identify gaps in detection and opportunities for improvement.10

In England, general practitioners have for more than 35 years been encouraged to check the blood pressure of consulting patients.11 From 2004, a financial incentive scheme (the quality and outcomes framework) has rewarded general practitioners for the management of people with hypertension and for recording the blood pressures of people aged 45 or above at least once within the preceding five years.12 Data from the outcomes framework show that 90.6% of patients aged 45 or older had a blood pressure record within the last 5 years in their general practice notes in 2015-16.5 Since a third or more of adults with hypertension are not recorded on general practice registers, this suggests that the problem in detecting hypertension may not be primarily due to failure to check and record patients’ blood pressures, but that raised blood pressure readings are not adequately followed up until a diagnosis is confirmed, an example of diagnostic inertia (defined as a failure to diagnose disease).13 The English national guidelines on hypertension in adults recommend that in people whose blood pressure is 140/90 or above in the clinic (two or more readings advised), ambulatory blood pressure monitoring or home blood pressure monitoring should be offered.14 However, evidence about the factors explaining why these recommendations have not led to higher detection rates is limited. In one review of 53 studies of different designs of health system factors influencing hypertension awareness (i.e. the patient has been told they have hypertension), treatment and control.15 Only 7 studies investigated levels of awareness of hypertension, and they indicated that having a routine physician or usual source of care were positively associated with awareness, bur lack of health insurance was associated with lower awareness. A review of barriers to hypertension awareness, treatment and follow-up found 69 qualitative or quantitative studies undertaken in various settings.16 Patient, provider and system factors were identified as potential barriers, with knowledge, beliefs about the consequences of diagnosis and treatment, social influence and lack of time in consultations being described by providers, and lack of insurance and costs of treatment being reported by patients. Neither of these reviews specifically focused on the role of primary medical care.

Our research questions was: in adult patients of primary medical care providers, what patient or system factors are associated with the detection of hypertension and what interventions improve rates of detection in comparison with current practice? We undertook a review with specific objectives to (a) describe the proportion of patients with hypertension who are detected by primary care; (b) identify factors (patient or provider) that may influence the likelihood of hypertension being detected; and (c) highlight interventions to assist primary health care teams improve detection among their patients. We excluded non-medical primary care providers such as pharmacies since our focus was on identifying potential approaches for improving the detection of hypertension in English primary medical care.

**Methods**

We defined detection of hypertension as either (i) a diagnosis of hypertension has been recorded in the general practice records, or (ii) the patient is on treatment for hypertension, or (iii) has been told by a doctor that they have hypertension.17 The latter is often referred to as awareness of hypertension, but in this paper we incorporate this term into the idea of detection.

***Search strategy***

We undertook searches of Medline and Embase in October 2016 for publications from 2000 to the October 2016. The strategy was first developed in Medline, and then adapted for Embase. An example search strategy is shown in the appendix, the same strategy being used in amended form for the Embase search. Search terms including delay, diagnosis, under-diagnosis, detection, and awareness were used along with terms including barriers and inertia to identify relevant studies. We had limited funding for completing the review and therefore did not extend the search to before the year 2000. We were also aware that electronic health records that would facilitate large studies based on medical records were not in wide use in primary care before that date. Also, changes over time in health system structures and policies (including the definition of hypertension) could affect detection levels and factors influencing detection rates. We did not undertake a search of the grey literature.

***Inclusion / exclusion criteria***

We included studies published in English, with any design (discussion and comment pieces were excluded) that were undertaken in the setting of general practice based primary care services, and involving patients aged 18 years and over. Studies undertaken in community settings other than general practice such as pharmacies or work places and studies that involved inviting people for a ‘health check’ were excluded, as were studies undertaken in accident and emergency departments or other hospital settings. We included studies (randomised and non-randomised) of interventions to improve detection rates, if any were found.

***Review procedure***

The titles and abstracts of articles identified in the searches were assessed for relevance by two reviewers independently, articles being obtained in full text for further assessment if either of the reviewers considered they were potentially relevant. These papers were assessed for inclusion in the review by two reviewers independently, differences being resolved through discussion with a third reviewer. Those papers agreed to be relevant went forward for data extraction and risk of bias assessment.

***Data extraction***

A data extraction form was developed and piloted, in order to collect information on study design, setting, population and findings. Two reviewers independently extracted data from each article, differences being resolved through discussion. The extracted data were entered into tables.

***Risk of bias assessment***

We included studies of different designs, and an assessment tool developed to accommodate a wide range of designs was therefore selected. We used the Mixed Methods Appraisal Tool (MMAT), which was designed to be applicable for qualitative, quantitative, randomised controlled or mixed methods studies. It can be used to assess the methods of a study in various domains, and a scoring metric (a percentage) can be used.16

***Data synthesis***

In view of the variety of study designs and the degree of heterogeneity, we undertook a qualitative analysis only, describing the papers and the findings in summary tables. Heterogeneity affected various aspects of the studies: different research questions and outcomes, differences in BP thresholds (most used <140/90, although some used a lower threshold for diabetes and chronic kidney disease (CKD), and others used >150/90); different patient groups – older people, younger people, people with anxiety and/or depression, people with diabetes, and whole populations; different measures of hypertension detection, including awareness and treatment, in addition to a record of the diagnosis; different designs – cross sectional and longitudinal designs in the observational studies, qualitative research and intervention studies with different interventions. Consequently, a quantitative synthesis was not attempted.

**Results**

The bibliographic searches identified 1175 articles, of which 103 were assessed as potentially relevant, with 18 being included after assessment of the full text manuscripts (see PRISMA flow diagram, figure 1). The most common reasons for exclusion were that studies had not been undertaken in general practice settings, or that they involved assessments of health system screening schemes such as the NHS health check scheme.

The studies had been undertaken in a narrow range of countries: UK 8, USA 6, Spain 2, and one each in Australia and San Marino. Fifteen were observational, of which one was a qualitative study of barriers to hypertension detection. The mean MMT rating of these papers was 3.3 (maximum possible 4.0, see Table 1). Three studies were evaluations of interventions to improve detection, two of these being randomised trials. The mean MMT rating of these three studies was 2.7 (see Table 2). Of the 17 quantitative studies, 9 used data from electronic health records, two used administrative data, three involved secondary analyses of existing health surveys, three used other sources of data (Table 3).

(a) The proportion of patients with hypertension who are detected by primary care.

Seven articles 17,19, 20,,22,23, 12, 30 reported studies using primary care electronic health records to investigate whether people with raised blood pressure readings were followed up to confirm or refute a diagnosis of hypertension. They were undertaken in various years, and investigated different outcomes, including the proportions with evidence of hypertension (ie consistently raised BP readings) who were diagnosed (62.9% in one study17 andvarying between nine ethnic groups from 57.0% in males and 64.6% in females among whites to 70.9% (males) and 77.8% (females) among Filipinos in another30), and changes in detection rates over time which were shown to have increased from 45.2% to 60.3% over nine years in one study.23 They also investigateddiagnostic delay among those with detected hypertension, the delay being 8.9 months in one study,19 and 1.9 months in another, 29 although 60% or more of hypertensive patients in these studies had not been detected during the period of follow-up. In a third study of delay, 34% of adult aged 18-39 years meeting criteria for hypertension were detected after 20 months follow-up (44% among 40-59 year olds and 56% among those aged 60 or older).22

Two other studies used different sources of data, one of which investigated people aged 40 - 75 years consulting general practitioners, of whom 62.3% of hypertensives were aware of their condition and 58.6% were treated.24 Another study used a national survey of a random sample of adults, reporting that 50.7% of males and 57.6% of females with hypertension were receiving anti-hypertensive medication.27

(b) Factors (patient or provider) that may influence the likelihood of hypertension being detected.

Of patient related factors, the quantitative studies indicated a greater likelihood of detection in older people12,19,24 and women.12,19,24,27,30 Patient socio-economic factors did not appear to influence detection,26 but living alone was associated with lower detection,27 and the presence of some physical health conditions was associated with higher detection rates.12, 19,22,23,29 There were few differences by ethnic group, Caribbeans in a study in England being less likely to be undiagnosed than whites25 and Asian Americans and non-Hispanic blacks being more likely to be treated than whites in a US study.30 Of the health system factors investigated, few were associated with detection rates, but a greater supply of general practitioners was associated with higher detection.18, 28 In the only qualitative study of barriers to detection,21 general practitioners reported several factors influencing their decisions on detecting hypertension, including uncertainty about the true BP level, patient characteristics such as the age, the limited time available in consultations, and distrust of the evidence on hypertension management.

(c) Interventions to assist primary health care teams improve detection among their patients.

Three studies investigated interventions to improve detection rates. An uncontrolled evaluation of a protocol implemented using telehealth to encourage people with isolated high blood pressure to text in further readings suggested this could have potential in the diagnosis of hypertension, although the study design precluded firm conclusions.32 A randomised trial of a multifaceted intervention was not effective31 and another randomised trial of targeted nurse led case finding found an increase in BP measurement, although the improvement in starting patients on antihypertensive treatment just failed to reach statistical significance.33

**Discussion**

In this review of studies published since 2000 on the detection of hypertension in primary medical care, we found only 18 studies from a limited range of countries. The available evidence suggests that levels of detection are around 60%, and also that detection rates have improved in recent years. Delays in detection remain common, however. Several patient factors are associated with detection rates, with women, older people and those with higher levels of blood pressure and those with co-existing cardiovascular and some other conditions being more likely to be detected. There is some reassurance, therefore, in that people at greater risk of cardiovascular events are more likely to have their hypertension diagnosed. Ethnicity and socioeconomic factors are not major influences on detection, but social isolation may be associated with lower detection. The supply of general practitioners was found in two studies from one country (England) to be associated with detection, but consistent evidence on other provider factors was limited. There was limited evidence on the potential of interventions such as use of telehealth and proactive case-finding to improve detection rates. Qualitative evidence on the barriers to detection faced by providers was likewise very limited.

***Strengths and limitations***

This is a structured review of recent literature on the detection of hypertension including several large studies using a range of methodologies. Although the quantitative studies were too heterogeneous to allow meta-analysis, a number of consistent findings emerged. However, our study also has a number of limitations. The search was restricted to studies published in English since 2000, and it is likely that earlier studies and those in other languages could contribute useful evidence on improving detection rates. However, the studies we did include did not draw on many references to older studies and those not published in English. Furthermore, the studies were undertaken in only a limited number of countries, and some caution is needed in assuming the findings would be replicated in other developed countries. We also acknowledge that interventions undertaken outside primary medical care, such as screening programmes, may improve detection rates for hypertension, but our focus was on the contribution routine primary care itself can make.

***Implications***

Reducing the fatal and non-fatal consequences of untreated hypertension is a priority for many countries, and detection is a key element of strategies to achieve this. Over several decades, policies and systems have aimed to improve detection, and although detection rates have gradually improved, it is notable that a third or more of people with hypertension are still not detected and therefore offered appropriate management. In England, practice nurses and health care assistants are increasingly involved in the detection and management of hypertension, and it is important they are involved in developing policies and local initiatives to improve detection rates.10 Policymakers should continue to give attention to the development and implementation of initiatives to improve detection, and should note the finding that the supply of primary care (as indicated in the reviewed studies by the number of general practitioners per unit of population) is associated with detection rates. Primary care services that are under-resourced appear to be at risk of failing to detect a proportion of people with hypertension. Our study suggests a need in particular to increase attention to the follow-up of patients found to have an elevated BP reading, until a diagnosis is confirmed or refuted. Practices should consider their arrangements for following up patients until a diagnosis is confirmed or ruled out, including how they will make use of home blood pressure monitoring or ambulatory blood pressure monitoring.

Further research is also needed. New studies should aim to improve understanding of the barriers to detecting hypertension in primary medical care, and qualitative and ethnographic research could have valuable roles to play. The perceptions of medical and nursing primary care practitioners of the priority that hypertension detection merits and the processes involved in detecting hypertension in large numbers of patients need to be understood. It is also important to understand patients’ perceptions of systematic case finding by practices. There is also a need for studies to develop and evaluate interventions to improve detection. Few intervention studies were found in our review. Interventions that include coordination with screening schemes both in practices and other settings such as pharmacies or the workplace are particularly needed.

**Conclusions**

In the studies included in the review, around 60% of people with hypertension have been detected, and levels of detection have tended to improve in recent years. People who are older, women, or have existing medical conditions appear more likely to have their hypertension detected. Greater supply of general practitioners was associated with higher detection. There is insufficient evidence to enable any conclusion on the effectiveness of interventions to improve detection rates.

**Contributionship**

RB. Conceived the study, contributed to study design, data extraction and interpretation of the results, and prepared the first draft of the paper.

AW. Contributed to study design and data extraction, interpretation of the results, and revised drafts of the paper.

KN. Planned and conducted the literature searches, and revised drafts of the paper.

SA. Contributed to data extraction and interpretation of the results, and revised drafts of the paper.

PM. Contributed to study design and data extraction, interpretation of the results, and revised drafts of the paper.

JB. Advised on the potential for meta-analyses, contributed to interpretation of the results and revised drafts of the paper.

**Competing interests**

The authors declare no competing interests.

**Funding statement**

This work was supported by a small grant from NHS Leicester City Clinical Commissioning Group.

**Data Sharing**

This article reports a review; all the data summarised in the review are reported in published studies, and are therefore already in the public domain.

**References**

1. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, Alexander L, Estep K, Abate KH et al. Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115mmHg, 1990-2015. JAMA. 2017;317(2):165-182. doi:10.1001/jama.2016.19043
2. Public Health England. Tackling high blood pressure. From evidence into action. Public Health England, 2014.
3. Falaschetti E, Mindell J, Knott C, Poulter N. Hypertension management in England: a serial

cross-sectional study from 1994 to 2011. Lancet 2014; 383: 1912–19

1. Health Survey for England 2015. Methods, NHS Digital, December 2016. <http://content.digital.nhs.uk/searchcatalogue?productid=23711&q=title%3a%22Health+Survey+for+England%22&sort=Relevance&size=10&page=1#top>
2. Quality and Outcomes Framework 2015-16. Recorded disease prevalence, achievements and exceptions. NHS Digital, October 2016. <http://www.content.digital.nhs.uk/catalogue/PUB22266>
3. Baker R, Honeyford K, Levene LS, Mainous AG III, Jones DR, Bankart MJ, Stokes T. Population characteristics, mechanisms of primary care and premature mortality in England: a cross-sectional study. BMJ Open 2016;6: e009981. doi:10.1136/ bmjopen-2015-009981
4. Chang KC-M, Lee JT, Vamos EP, Soljak M, Johnston D, Khunti K, Majeed A, Millett C. Impact of the National Health Service Health Check on cardiovascular disease risk: a difference-in-differences matching analysis. CMAJ 2016. DOI:10.1503 / cmaj.151201
5. Krogsbøll LT, Jørgensen KJ, Grønhøj Larsen C, Gøtzsche PC. General health checks in adults for reducing morbidity and mortality from disease. Cochrane Database of Systematic Reviews 2012, Issue 10. Art. No.: CD009009. DOI: 10.1002/14651858.CD009009.pub2
6. Public Health England. New approach to preventing heart attacks and strokes. 12 September 2017. [www.gov.uk/government/news/new-approach-to-preventing-heart-attacks-and-strokes](http://www.gov.uk/government/news/new-approach-to-preventing-heart-attacks-and-strokes)
7. NHS England. NHS Right Care. Tackling blood pressure: the size of the prize. 24 January 2017. www.england.nhs.uk/rightcare.2017/01/24/matt-kearney-huon-gray/
8. Royal College of General Practitioners. Report from General Practice 19. Prevention of Arterial Disease in General Practice. Sub-committee chair Hart JT. London, RCGP: 1981.
9. NHS Employers, British Medical Association, NHS England. 2014/15 General Medical Services (GMS) Contract Quality and Outcomes Framework (QOF). Guidance for GMS Contract 2014/15. NHS Employers, London: 2014 . http://www.nhsemployers.org/~/media/Employers/Documents/Primary%20care%20contracts/QOF/2014-15/2014-15%20General%20Medical%20Services%20contract%20-%20Quality%20and%20Outcomes%20Framework.pdf
10. Martínez-St John DRJ, Palazón-Bru A, Gil-Guillén VF, Sepehri A, Navarro-Cremades F, Ramírez-Prado D, Orozco-Beltrán D, Carratalá-Munuera C, Cortés E, Rizo-Baeza MM. Diagnostic inertia in obesity and the impact on cardiovascular risk in primary care: a cross-sectional study. Br J Gen Pract 2015; DOI: 10.3399/bjgp15X685669
11. National Institute for Health and Care Excellence (NICE). Hypertension in adults: diagnosis and management . Clinical guideline [CG127]. Published 2011, updated 2016. <https://www.nice.org.uk/guidance/CG127/chapter/1-Guidance#diagnosing-hypertension-2>
12. Muntner P, Gu D, Wu X, Duan X, Wenqi G, Whelton PK, He J, for the InterASIA Collaborative Group. Factors Associated With Hypertension Awareness, Treatment, and Control in a Representative Sample of the Chinese Population. Hypertension. 2004;43:578-585
13. Pallares-Carratalá V, Bonig-Triguerros I, Palazón-Bru A, Lorenzo-Piqueres A, Valls-Roca F, Orozco-Beltrán D, Gil-Guillen VF, Steering Committee ESCARVAL study. International Journal of Clinical Practice 2016;70(2):619-624.
14. Pace R, Pluye P, Bartlett G, Macaulay AC, Salsberg J, Jagosh J, Seller R. Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. International Journal of Nursing Studies 2012;49:47-53
15. Bannerjee D, Chung S, Wong EC, Wang EJ, Stafford RS, Palaniappan LP. Underdiagnosis of hypertension using electronic records. Am J Hypertens 2012[25(1):97-102. Doi:10.1038/ajh.2011.179
16. Bankart MJ, Anwar MS, Walker N, Mainous AG, Baker R. Are there enough GPs in England to detect hypertension and maintain access? Br J Gen Pract 2013;Doi:103399/bjgp13x667204
17. Burgos-Lunar C de, Cura-González I del, Salinero-Fort MA, Gómez-Campelo P, Isla LP de, Jiménez-García R. Delayed diagnosis of hypertension in diabetic patients monitored in primary care. Rev Esp Cardiol 2013;66(9):700-706.
18. Byrd JB, Powers D, Magid DJ, Tavel HM, Schmittdiel JA, O’Connor PJ, Beck AL, Butler MG, Ho P-J M. Detection and recognition of hypertension in anxious and depressed patients. J Hypertens 2012;30:2293-2298. Doi:10.1097/HJH.0b013e328359b6e6
19. Howes F, Hansen E, Williams D, Nelson M. Barriers to diagnosing and managing hypertension. Australian Family Physician 2010;39(7):511-516.
20. Johnson HM, Thorpe CT, Bartels CM, Schumacher JR, Palta M, Pandhi N, Sheehy AM, Smith MA. Antihypertensive medication initiation among young adults with regular primary care use. J Gen Intern Med 2014;29(5):723-31. Doi:10.1007/s11606-014-2790-4.
21. MacDonald TM, Morant SV. Prevalence and treatment of isolated and concurrent hypertension and hypercholesterolaemia in the United Kingdom. Br J Clin Pharmacol 2008;65(5):775-786. Doi: 10.1111/j.1365-2125.2007.03072.x
22. Mancia G, Parati G, Borghi C, Ghironzi G, Andriani E, Marinelli L, Valentini M, Tessari F, Ambrosioni E. Hypertension prevalence, awareness, control and association with metabolic abnormalities in the San Marino population: the SMOOTH study. Journal of Hypertension 2006;24:837-843.
23. Nazroo JY, Falaschetti E, Pierce M, Primatesta P. Ethnic inequalities in access to and outcomes of healthcare: analysis of the Health Survey for England. J Epidemiol Community Health 2009;63:1022-1027. Doi:10.1136/jech.2009.089409.
24. Patel R, Lawlor DA, Whincup P, Montaner D, Papacosta O, Brindle P, Ebrahim S. The detection, treatment and control of high blood pressure in older British adults: cross-sectional findings from the British Women’s Heart and Health Study and the British Regional Heart Study. Journal of Human Hypertension 2006;20:733-741. Doi:10.1038/sj.jhh.1002064
25. Shah S, Cook DG. Inequalities in the treatment and control of hypertension: age, social isolation and lifestyles are more important than economic circumstances. Journal of Hypertension 2001;19:13333-1340.
26. Soljak M, Samarasundera E, Indulkar T, Walford H, Majeed A. Variations in cardiovascular disease under-diagnosis in England: national cross-sectional spatial analysis. BMC Cardiovascular Disorders 2011;11:12. Doi:10.1186/1471-2261-11-12
27. Wallace ML, Magnan EM, Thorpe CT, Schumacher JR, Smith MA, Johnson HM. Diagnosis and treatment of incident hypertension among patients with diabetes: a US multi-disciplinary group practice observational study. J Gen Intern Med 2015;30(6):768-776. Doi:10.1007/s11606-015-3202-0.
28. Zhao B, Jose PO, Pu J, Chung S, Ancheta IB, Fortmann SP, Palaniappan LP. Racial/ethnic differences in hypertension prevalence, treatment, and control for outpatients in northern California 2010-2012. Am J Hypertension 2015;28(5):631-639. Doi:10.1093/ajh/hpu189.
29. Bonds DE, Hogan PE, Bertoni AG, Chen H, Clinch CR, Hiott AE, Rosenberger EL, Goff DC. A multifaceted intervention to improve blood pressure control: the Guideline Adherence for Heart Health (GLAD) study. Am Heart J 2009;157:278-84. Doi:10.1016/j.ahj.2008.09.021.
30. Cottrell E, Cox T, O’Connell P, Chambers R. Implementation of simple telehealth to manage hypertension in general practice: a service evaluation. BMC Family Practice 2015;16:83.doi:10.1186/s12875-015-0301-2.
31. Hemming K, Ryan R, Gill P, Westerby P, Jolly K, Marshall T. Targeted case finding in the prevention of cardiovascular disease: a stepped wedge cluster randomised controlled trial. Br J Gen Pract 2016;doi:10.3399/bjgp16X686629.
32. Mejzner N, Clark CE, Smith LFP, Campbell JL. Trends in the diagnosis and management of

hypertension: repeated primary care survey in South West England. Br J Gen Pract 2017;

DOI: <https://doi.org/10.3399/bjgp17X690461>

**Figure. PRISMA 2009 Flow Diagram**

Studies included in quantitative synthesis (meta-analysis)  
(n = 0 )

Studies included in qualitative synthesis  
(n = 18 )

Full-text articles excluded, with reasons  
(n = 85 )

Full-text articles assessed for eligibility  
(n = 103 )

Records excluded  
(n = 1045 )

Records screened  
(n = 1175 )

Records after duplicates removed  
(n = 1175 )

## Identification

## Eligibility

## Included

## Screening

Records identified through database searching  
(n = 534 in Medline, 628 in Embase )

Additional records identified through other sources  
(n = 13 )

**Table 1. Studies of levels of detection and factors associated with detection**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **paper** | **country** | **setting** | **design** | **Sample** | **MMAT rating** |
| Banerjee 201217 | USA | Primary care clinics | Cross sectional analysis of electronic health records | 251,590 adults with at least 2 clinic visits in a 3 year period | 4 |
| Bankart 201318 | England | 8052 general practices | Cross sectional analysis of routinely collected administrative data about practices | The 13.3% of patients on general practice hypertension registers | 4 |
| Burgos-Lunar 201319 | Spain | 21 health centres in Madrid | Retrospective cohort study, using electronic health records | 8074 adults with diabetes, who during the study period, met the criteria for hypertension | 4 |
| Byrd 201220 | USA | 3 HMOs | Longitudinal analysis, using a hypertension registry derived from electronic health records, of time to detection of hypertension | 168630 patients | 3 |
| Howes 201021 | Australia | General practice | Qualitative study of barriers to diagnosing hypertension | 30 clinicians in 6 focus groups | 2.5 |
| Johnson 201422 | USA | Multi-disciplinary academic group practice | Using electronic medical records, a retrospective analysis of time from meeting hypertension diagnosis criteria to antihypertensive treatment. | 10,022 patients aged >18 years with incident hypertension | 4 |
| MacDonald 200723 | UK | 326 general practices | Cross sectional analyses for 3 separate years of electronic health records | Up to 2.58 million patients aged >16 years | 3.5 |
| Mancia 200624 | San Marino | 9 general practitioners | Cross sectional phase identifying people with raised BP followed by 2 yr longitudinal follow up, using an ad-hoc designed database | Patients aged 40-75 yrs consulting over an 8 month period | 3 |
| Nazroo 200925 | England | The general population | Analysis of four years’ data from a national household survey (Health Survey for England) | 23,987 adults | 3.5 |
| Pallares-Carratalá 201612 | Spain | Primary care health centres in one region | Cross sectional observational study, using electronic health records | 48,605 patients without hypertension | 3.5 |
| Patel 200626 | UK | Patients registered with general practices in 24 British towns | Cross-sectional study of people randomly selected from general practice lists, patients undergoing an examination including BP measurement | 3059 women and 3007 men aged 60-79 years | 2.5 |
| Shah 200127 | England | The general population | Analysis of two year’s data from a national household survey (Health Survey for England) | Aged over 25, with raised BP or on antihypertensive treatment (2208 males, 2811 females) | 3.5 |
| Soljak 201128 | England | 351 local authorities and 8,372 general practices | Cross-sectional observational study, using routinely available administrative data on general practices and local government | The English population | 4 |
| Wallace 201529 | USA | A large primary care academic group practice | Retrospective analysis of 4 years electronic health record data | Aged >18 with diabetes and incident hypertension | 4 |
| Zhao 201530 | USA | Ambulatory care organisation (same place as Banerjee 2012) | Cross-sectional study, using electronic health records | Patients aged >18 with at least 2 consultations in a 3 year period | 3.5 |

**Table 2. Interventions to improve detection**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Paper** | **country** | **setting** | **intervention** | **design** | **MMAT rating** |
| Bonds 200931 | USA | 61 primary care practices in North Carolina | Multi-faceted, targeting providers, involving an educational session, academic detailing, written educational materials, tools for patients, audit and feedback | RCT, data being extracted from medical charts | 2 |
| Cottrell 201532 | England | 425 general practices | Hypertension protocol on diagnosis implemented using telehealth: participants asked to text at least 5 5 further BP readings within a week. | Uncontrolled descriptive analysis, data being extracted from the telehealth software | 2 |
| Hemming 201633 | England | 26 general practices | Nurse led targeted case finding: patients at high risk invited to attend for assessment. | Cluster RCT with stepped wedge design, data being extracted from electronic health records | 4 |

**Table 3. Findings of studies of detection rates**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **paper** | **Thresholds for hypertension diagnosis** | **Outcome of interest** | **Detection rates** | **Factors associated with detection** (findings with significant p values or outside 95% confidence intervals) |
| Banerjee 201217 | At least 2 BP readings >140/90 | % of adults (aged >18) with hypertension who had a record of the diagnosis. Two groups investigated: 1. Prevalent (those with raised readings and/or on anti-hypertensives) and 2. incident (new cases during study period) | 62.9% of hypertensives had a recorded diagnosis (45,365/72,206) among the prevalent group; 19.9% among the incident group (figures not given) | Odds ratios: Prevalent hypertension: age 1.046, females 0.760, Asian 1.67, black/African American 1.979, BMI 1.064, number of BP readings >160/100 1.716.  Incident hypertension: age 1.030, Asian 1.577, black/African American 2.420,, BMI 1.039, number of BP readings >140/90 1.195, number BP readings >160/100 2.273. |
| Bankart 201318 | BP >150/90 | Numbers (%) of patients on general practice hypertension registers | 13.3% of the population were on practice hypertension registers, a mean of 750 patients per practice | Predictors of numbers on registers (IRRs): deprivation 1.001, aged >65 1.04, white ethnicity 1.000007, poor health 1.013, practice list size 0.999992, GPs/1000 population 1.06, performance points for hypertension 1.006. |
| Burgos-Lunar 201319 | >140/90 and >130/80 | Correct diagnosis of hypertension defined as the recording of the diagnosis during the first 6 months after the diagnostic criteria were met. Patients had type 2 diabetes; those with hypertension at the time of diagnosis of diabetes were excluded. | For those meeting the diagnostic threshold of >140/90 during follow up, 42.4% remained undiagnosed after a median follow up of 3.6 yrs. Mean delay in those diagnosed 8.9 mths. | OR for correct diagnosis: women 1.288, age 1.006, BMI 25-30 1.460, >30 1.696, prior MI 0.448, not depressed 1.630, on anti-platelet treatment 1.469, BP above 140/90 2.770 |
| Byrd 201220 | >140/90, or >130/80 in diabetes or chronic kidney disease | Time to recognition of hypertension in patients with an inpatient or outpatient diagnosis for anxiety or depression before first elevated BP | Hypertension recognized within 12 months of second BP reading in 30.1% of those with depression and anxiety, 34.4% of those without. | Median days to recognition longer among patients with anxiety and depression (45 days vs 56 days), adjusted HR 1.30. |
| Howes 201021 | - | Barriers to detection of hypertension in general practice, as perceived by general practitioners. |  | Barriers included: clinical uncertainty about the true BP values, mistrust of the evidence on BP management, patient age, gender and comorbidity, perceived patient attitude, clinical inertia, patient centred care, system issues. |
| Johnson 201422 | >140/90 | Patient and provider explanatory variables to identify barriers to hypertension management were based on a model for clinical inertia. | Among 10,022 patients with hypertension, 4,149 commenced medication or achieved control (41.4%); of the 2,606 young adults, 451 (17.3%) received medication before receiving medication. | Adjusted HRs of predictors of medication initiation included younger age 0.56, BMI 1.014, stage of hypertension 0.63, diabetes 1.44, having a low prevalence condition 1.26, adjusted clinical risk group score 1.06, number of primary care visits 1.06. |
| MacDonald 200723 | >140/90 | Outcomes were the prevalence and treatment of hypertension (data for 1998, 2003 and 2006). | Among those with hypertension, treatment rates increased from 45.2% (1998), 54.4% (2003), 60.3% (2006) | The likelihood of hypertension being diagnosed and recorded was 2.0 times greater in patients who also had hypercholesterolaemia. |
| Mancia 200624 | >140/90 | Detection and treatment of hypertension among a sample of patients undergoing a general practice check-up | 62.3% of hypertensives were aware of their condition and 58.6% were on drug treatment. | Awareness more common in women (67.1% vs 56.9%) and older people (74.3% aged 66-75, 43.7% aged 40-50). Treatment more common in women (63.6% vs 53.0%) and older people (71.5% aged 66-75 vs 39.1% aged 40-50). |
| Nazroo 200925 | >140/90 | The result of BP readings related to the patient reporting they had been diagnosed as having hypertension, or were on anti-hypertension medication | Undiagnosed hypertension was present in 12.6% of whites, 12.7% Irish, 9.4% Caribbeans, 9.7% Indians, 6.7% Pakistanis, 5.6% Bangladeshis, 8.2% Chinese. | ORs for undiagnosed hypertension: compared to whites, Caribbean 0.43. |
| Pallares-Carratalá 201612 | >140/90 | New diagnoses of hypertension in a population without a diagnosis of hypertension who had at least 3 BP readings | Of 48,605 people without a diagnosis of hypertension, 6,450 13.3% presented diagnostic inertia (raised BP without the diagnosis being made) | Variables associated with diagnostic inertia (odds ratios): male gender 1.46, atrial fibrillation 0.73, having a health professional 0.88, diabetes 0.93, cardiovascular disease 0.77, and older age 20.4. |
| Patel 200626 | >150/90 | High blood pressure on examination, related to recall of a doctor diagnosis of hypertension, or on anti-hypertensive medication | Of those with raised BP on examination (949), 54.5% (517) recalled being told by a doctor they had high BP, and 35.4% (336) were on anti-hypertensive treatment | Socioeconomic factors, area of residence, behavioural risk factors not associated with good BP control in either sex, apart from alcohol in men (OR 0.67). |
| Shah 200127 | >160/100 | Anti-hypertensive medication and control of hypertension among adults found to have raised BP on examination | 1119/2208 (50.7%) hypertensive men and 1620/2811 (57.6%) hypertensive women were receiving anti-hypertensive medication. | In a fully adjusted model, odds ratios for treatment were: men – younger age 0.39, housing tenure 0.75, living alone 0.49, smoker 0.61, heavy alcohol consumption 0.49, overweight 1.41, family history of heart disease 1.83, lack social support 1.33; women – older age 1.36, family history of heart disease 1.30, obese 1.43, lack social support 1.48. |
| Soljak 201128 | >150/90 and >140/90 | Numbers of patients on general practice hypertension registers (observed prevalence) compared to the modelled (expected) prevalence | The observed prevalence for England was 4,530,369 (8.95%), the expected was 12,356,995 (24.7%). | Regression of expected prevalence plus GP supply gave adjusted correlation coefficient of 0.407 |
| Wallace 201529 | >130/80 and >140/90 | The probability of receiving a diagnosis and anti-hypertension medication at specific time points | Of 771 people with diabetes and incident hypertension included in the study, 315 (40.9%) received a hypertension diagnosis, and 286 (37.1%) received anti-hypertensives. The median time to diagnosis was 1.9 months. | Associations with diagnosis rates (HRs): atrial fibrillation 2.18, peripheral vascular disease 0.18, fewer primary care visits 0.93. |
| Zhao 201530 | >140/90 | Age-adjusted prevalence, treatment and control of hypertension | In 9 ethnic groups, prevalence varied in women from 30.0% to 59.1%, treatment rates varying from 64.6% to 77.8%. Figures for men: prevalence 35.9%-59.9%, treatment 57.0%-70.9%. | Compared to whites, hypertension treatment was more likely in Asian Indians (females/males) OR 1.25, 1.17, Chinese 1.38, 1.34, Filipinos 1.97, 1.64, Japanese 1.32, 1.29, Vietnamese 1.40, n.s., and Non-Hispanic Black 1.92, 1.72. |

**Table 4. Findings of intervention studies**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Paper** | **BP thresholds** | **outcome** | **results** | **significance** |
| Bonds 200931 | >140/90 (>130/90 with diabetes or renal disease) | Rates of undiagnosed hypertension | 18.1% in the intervention group, 13.6% in the controls | P 0.12 |
| Cottrell 201532 | >140/90 or >130/90 in diabetes or CKD | % of patients with an initial raised BP who have hypertension confirmed or not. | 1166 of 1468 (79%) submitted further BP readings | - |
| Hemming 201633 | Not stated | Measurement of BP; treatment with anti-hypertensives | BP was measured in 27.8% of control and 43.9% of intervention group patients.  7.5% of control and 11.4% of intervention group patients started on anti-hypertensives | BP measurement – p 0.022; starting anti-hypertensives - time adjusted OR 7.7 (-0.1-15.5) p 0.054 |

**Appendix. Medline search strategy**

Database: Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid

MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to Present>

Search Strategy:

--------------------------------------------------------------------------------

1 exp blood pressure determination/ (34934)

2 blood pressure/ (260920)

3 exp hypertension/di (19935)

4 blood pressure.mp. (407094)

5 hypertension.mp. (429586)

6 Delayed Diagnosis/ (3897)

7 delay\*.mp. (456923)

8 (undiagnosed or under diagnos\* or underdiagnos\*).mp. [mp=title, abstract,

original title, name of substance word, subject heading word, keyword heading word,

protocol supplementary concept word, rare disease supplementary concept word,

unique identifier] (24481)

9 inertia.mp. (6377)

10 barrier\*.mp. (226282)

11 (poor\* adj diagnos\*).mp. [mp=title, abstract, original title, name of substance

word, subject heading word, keyword heading word, protocol supplementary concept

word, rare disease supplementary concept word, unique identifier] (740)

12 awareness.mp. (115140)

13 detect\*.mp. (1946083)

14 primary health care/ (62400)

15 (primary adj (health or care or healthcare)).mp. [mp=title, abstract, original title,

name of substance word, subject heading word, keyword heading word, protocol

supplementary concept word, rare disease supplementary concept word, unique

identifier] (130753)

16 general pract\*.mp. (78683)

17 exp General Practice/ (69783)

18 General Practitioners/ (5036)

19 or/1-5 (695421)

20 or/6-13 (2687818)

21 or/14-18 (224807)

22 19 and 20 and 21 (2011)

23 limit 22 to (yr="2010 -Current" and (clinical study or clinical trial, all or

comparative study or controlled clinical trial or evaluation studies or meta analysis or

multicenter study or observational study or pragmatic clinical trial or randomized

controlled trial or systematic reviews or twin study or validation studies)) (278)

24 limit 22 to yr="2010 - 2017" (924)

25 limit 22 to (yr="2000 - 2009" and (clinical study or clinical trial, all or

comparative study or controlled clinical trial or evaluation studies or meta analysis or

multicenter study or observational study or pragmatic clinical trial or randomized

controlled trial or systematic reviews or twin study or validation studies)) (258).

The Medline search was undertaken 19 October 2016 and the Embase search 25 October 2016. The search was run in two stages, first for the period 2010 to the date of the search, and then for the years 2000 to 2009.