Home blood pressure measurement as a screening tool for hypertension in a web-based worksite health promotion programme

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Background: Guidelines on home blood pressure measurement (HBPM) recommend taking at least 12 measurements. For screening purposes, however, it is preferred to reduce this number. We therefore derived and validated cut-off values to determine hypertension status after the first duplicate reading of a HBPM series in a web-based worksite health promotion programme. Method: Nine hundred forty-five employees were included in the derivation and 528 in the validation cohort, which was divided into a normal (n = 297) and increased cardiometabolic risk subgroup (n = 231), and a subgroup with a history of hypertension (n = 98). Six duplicate home measurements were collected during three consecutive days. Systolic and diastolic readings at the first duplicate measurement were used as predictors for hypertension in a multivariate logistic model. Cut-off values were determined using receiver operating characteristics analysis. Results: Upper (≥150 or ≥95 mmHg) and lower limit (<135 and <80 mmHg) cut-off values were derived to confirm or reject presence of hypertension after one duplicate reading. The area under the curve was 0.94 (standard error 0.01, 95% confidence interval 0.93–0.95). In 62.5% of participants, hypertension status was determined, with 1.1% false positive and 4.7% false negatives. Performance was similar in participants with high and low cardiometabolic risk, but worse in participants with a history of hypertension (10.4% false negatives). Conclusion: One duplicate home reading is sufficient to accurately assess hypertension status in 62.5% of participants, leaving 37.5% in which the whole HBPM series needs to be completed. HBPM can thus be reliably used as screening tool for hypertension in a working population.

Introduction

Hypertension is a major risk factor for cardiovascular (CV) events,¹ and is estimated to affect up to one billion people worldwide.² Despite the importance of blood pressure (BP) lowering therapy in hypertensive patients, adequate BP control (office BP <140/90 mmHg) is achieved in merely half of the hypertensive cases. In addition, 20–50% of hypertensive individuals are unaware of their condition.³⁻⁷ These numbers indicate that there is still need to improve both awareness and control of hypertension. Potential tools to improve BP control and awareness are worksite health promotion programmes. Current health promotion programmes are often based on multiple risk factor interventions, in which BP is assessed as one of several CV risk factors. Although, in general, the benefit of these health promotion programmes in improving overall CV risk is limited,⁸⁻¹⁰ previous uncontrolled studies have shown a positive effect on BP control.¹⁰

BP is variable and influenced by many stressors, which include, among others, the white-coat effect.¹¹ Therefore, even for standardized office BP measurements, the current European and Canadian guidelines recommend to take BP at least at two to three different visits before establishing the diagnosis of hypertension.¹²,¹³ The British guideline of the National Institute for Health and Clinical Excellence recommends ambulatory BP measurement (ABPM) in every patient with an elevated office BP to confirm or rule out hypertension.¹⁴ For the purpose of mass screening of BP in health promotion programmes, however, ABPM has several disadvantages. It is expensive, not widely available, and patients experience more discomfort during measurement compared with home blood pressure measurement (HBPM).¹⁵,¹⁶ HBPM therefore seems more suitable for application in screening programmes to detect hypertension. HBPM measurements have similar reproducibility as ABPM measurements,¹² are void of the white coat effect,¹⁸ and show better correlation with target organ damage and CV events than conventional office BP measurements.¹⁹⁻²⁴ Despite these advantages, no health promotion programmes in which BP is assessed by HBPM have thus far been reported. Current recommendations on HBPM advocate to take at least 12 BP measurements.²⁵ For screening purposes, however, one or two duplicate BP measurements are preferred over a whole series to increase feasibility. Therefore, the aim of this study was to define and subsequently validate BP cut-off values to either confirm or reject the diagnosis of hypertension after one or two duplicate HBPMs in persons at low and high CV risk. In addition, we examined whether these cut-off values could be applied to establish hypertension control in patients already known with hypertension.

Methods

Participants

The web-based HBPM study was performed as part of a worksite health promotion programme (The Prevention Compass) as implemented at 16 Dutch companies during the period December 2010–September 2011.
Initial assessment with a web-based electronic health questionnaire included questions about medical and family history, health complaints, psychological functioning and health behaviour. Participants aged ≥60 years (aged ≥50 years for male and ≥55 years for female tobacco users), with a body mass index ≥30, with a medical history of cardiovascular diseases (CVD), symptoms suggestive of CVD or with a first-degree relative diagnosed with CVD before age 60 years were considered to be at high cardiometabolic risk (CMR). Subjects with an estimated SCORE (Systemic Coronary Risk Evaluation)26 risk of ≥5% based on age, gender, body mass index, tobacco use and medical history were also classified as high CMR.

A subset of the participants with increased CMR was offered HBPM as part of additional biometric measurements. All other participants were offered HBPM irrespective of their CMR. Pregnant women were excluded. Informed consent was obtained before the study in accordance with the requirements for identifiable data collection in the Dutch Code of Conduct for Observational Research (www.federa.org).

### Home blood pressure measurements

A validated HBPM device (Sensacare SAA-102, Sensacare Company, Hong Kong, China)27 was sent to participants who accepted additional biometric measurements. They were instructed through an enclosed leaflet to take duplicate BP measurements every morning and evening for three consecutive days. Participants were advised not to talk during the measurements and to relax for 5 min before commencing each duplicate measurement. They were instructed to place the cuff at heart level while resting their arm on a table. Participants noted down all readings on a chart enclosed with the measurement device. After all measurements were completed, participants entered the readings into a protected personal webpage. Based on the average BP a tailored advice was reported back to the participants online.

### Derivation cohort and validation cohorts

Participants who completed the HBPM before 13 April 2011 were assigned to the derivation cohort. The validation cohort consisted of all participants who completed the HBPM between 13 April 2011 and 23 September 2011.

From the total validation cohort, three predefined subgroups were selected. Those subgroups included participants with a normal CMR, participants with an increased CMR and participants with a history of diagnosed hypertension.

### Outcome measure

The main outcome measure was the presence of hypertension defined as an average BP over six duplicate HBPM readings equal to or exceeding 135 mmHg systolic or 85 mmHg diastolic. For participants with a history of hypertension the same BP limits were used to determine whether their BP was adequately controlled.

### Statistical analysis

Independent t-tests and $\chi^2$ were used to determine differences in baseline variables.

Repeated measures analysis of variance with Bonferroni post hoc correction for multiple testing was used to compare the average BP measurements of the first, second and third day. To determine the relevance of data derived from each increase of the number of duplicate BP measurements, intraclass correlation coefficients (ICCs) were calculated. Using the ICCs, the average BP of six duplicate HBPM readings was compared with the first duplicate BP reading, the (average of) the first and second duplicate BP reading and so on.

To determine cut-off values for normotension and hypertension, two multivariate logistic models were built. In the first model, the average systolic and diastolic BP readings at the first duplicate HBPM were used as predictors. In the second model, the average systolic and diastolic BP readings of the first and second duplicate HBPM were used as predictors.

For each participant, a logit score was calculated based on the unstandardized $\beta$s of systolic and diastolic BP (and the constant). The logit scores were subsequently entered into a receiver operating characteristic (ROC) curve analysis.

Based on predefined limits for the maximum allowed percentages of participants incorrectly diagnosed as, respectively, normotensive (false negative) and hypertensive (false positive), cut-off points on the ROC curve were chosen. Corresponding BP readings were rounded to the nearest 5 mmHg (i.e. 122.5/84 was rounded to 125/85) to ensure that clinically useful cut-off values would be validated. An accuracy measures matrix with incremental 5 mmHg BP steps was computed to determine the accuracy of the first duplicate HBPM for predicting hypertension at various other cut-off values. The performance of the models was assessed by the ROC curve and the area under the curve (AUC). The AUC of the model in the validation cohort(s) was tested for significant (one-tailed) differences with the AUC in the derivation cohort using Hanley and McNeil’s formula.28 The sensitivity, specificity, positive and negative predictive value, and the positive and negative likelihood ratio of the cut-off values were also calculated. All analyses were performed using SPSS 19.0 (SPSS inc., Chicago, Illinois, USA).

### Results

A total of 1852 persons participated in the study. Of these participants, 378 (20.5%) did not complete or report their HBPM readings, leaving 1473 (79.5%) persons for analysis, including 52% with increased CMR. Persons who did not complete or report their HBPM readings were younger (48.0±10.0 vs. 53±5.6 years, $P<0.01$) and less highly educated (42.0% vs. 51.8% higher education; $P<0.01$) than those who did. No sex differences were observed. A total of 945 participants (64.2%) completed the HBPM before 13 April 2011 and were assigned to the derivation cohort. The remaining 528 (35.8%) participants were assigned to the validation cohort. Table 1 summarizes the baseline characteristics of the study cohorts. There were no differences between the derivation and the total validation cohort. Compared with the participants with a normal CMR, individuals with a high CMR were older ($P<0.01$) and more often male ($P=0.01$). Also, their mean systolic ($P<0.01$) and diastolic ($P=0.04$) BP was higher.

### Derivation Cohort

Two hundred sixty-one (27.6%) subjects were diagnosed with (uncontrolled) hypertension based on their HBPM series. The average morning BP (123±14/78±10 mmHg) was lower than the average evening BP (126±14/78±10 mmHg, $P<0.01$ for systolic, $P=0.01$ for diastolic BP). Also, the average BP of the first, second and third measurement day were significantly different ($P<0.01$ for systolic, $P<0.01$ for diastolic BP). Systolic BP of the first day (125±14 mmHg) was higher than the systolic BP of the second (124±14 mmHg, $P<0.01$), but not of the third day (124±14 mmHg, $P=0.11$). The average diastolic BP of the first day (79±10 mmHg) was higher compared with the diastolic BP of the second (78±10 mmHg, $P=0.01$), and the third day (78±10 mmHg, $P<0.01$).

The average of each consecutively included duplicate HBPM was compared with all six duplicate measurements using ICC. As shown in figure 1, all ICCs were $>0.9$. The largest increase in ICC was observed between the average of the first (morning), and the average of the first and second (evening) duplicate HBPM. Addition of other duplicate measurements did not further increase ICC.
Two separate cut-off values were selected and subsequently rounded to their nearest 5 mmHg. The first cut-off BP value was set to discriminate normotensive from possible hypertensive persons. For the purpose of this study, the false-negative rate for hypertension was not allowed to exceed 5%. A reading of 135/80 mmHg at the first duplicate HBPM was chosen as the ‘lower limit’ cut-off value, indicating that participants with a first duplicate reading of 135 or 80 mmHg (sensitivity: 0.96, specificity: 0.71) were classified as having possible hypertension. Vice versa, those with a first duplicate HBPM reading of <135 mmHg and <80 mmHg were labelled as normotensive (sensitivity: 0.71, specificity: 0.96). Sensitivity and specificity of other cut-off values are shown in the Supplementary table S1.

The second cut-off BP value was set to positively diagnose hypertension. For the purpose of this study, the false-positive rate for hypertension was minimized at 1%. A value of ≥150/90 mmHg (sensitivity: 0.96, specificity: 0.92) was selected as the ‘upper limit’ cut-off value. Thus, participants with a first duplicate HBPM reading of ≥150 or ≥90 mmHg (sensitivity: 0.33, specificity: 1.00) were classified as having possible hypertension. For those with a first duplicate HBPM between the lower and upper cut-off limits, no accurate diagnosis was possible based on the first duplicate HBPM. The AUC of the second model, using the average readings of the first and second duplicate HBPM to predict hypertension, was 0.97 (standard error [SE] 0.01, 95% confidence interval [CI] 0.96–0.98), representing a marginal improvement on the first model [AUC 0.94, SE 0.01, 95% CI 0.93–0.95]]. We therefore proceeded to validate the cut-off scores based only on the first duplicate HBPM.

Validation cohorts

Figure 2 depicts the ROC curves of both the total validation and the derivation cohort. The AUC of the validation cohort [AUC 0.94, SE 0.01, 95% CI (0.92–0.96)] was not different (P = 0.45) from the AUC in the derivation cohort. Table 2 shows the accuracy measures for the validation cohorts, using the cut-off values chosen in the derivation cohort.

There were 169 (32.0%) subjects diagnosed with (uncontrolled) hypertension in the total validation cohort. After the first duplicate measurement, 62.5% of the total validation cohort could be classified. The classified group included 71.8% of the normotensive and 37.3% of the hypertensive participants, while four individuals (1.1%) with a normal BP were incorrectly labelled as hypertensive, and eight persons with hypertension (4.7%) were incorrectly labelled.

| Table 1 Baseline characteristics of health risk assessment participants

<table>
<thead>
<tr>
<th></th>
<th>Derivation cohort</th>
<th>Validation cohort</th>
<th>Validation cohort</th>
<th>Validation cohort</th>
<th>Validation cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 945)</td>
<td>I (n = 528)</td>
<td>II (n = 297)</td>
<td>III (n = 231)</td>
<td>IV (n = 98)</td>
</tr>
<tr>
<td>Male (%)</td>
<td>493 (52.2%)</td>
<td>299 (56.6%)</td>
<td>150 (50.5%)</td>
<td>149 (64.5%)</td>
<td>56 (57.1%)</td>
</tr>
<tr>
<td>Age (SD)</td>
<td>53.1 (5.2)</td>
<td>53.1 (6.2)</td>
<td>52.0 (5.3)</td>
<td>54.4 (7.0)</td>
<td>53.9 (4.9)</td>
</tr>
<tr>
<td>Education level a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>177 (18.7%)</td>
<td>84 (15.9%)</td>
<td>45 (15.2%)</td>
<td>39 (16.9%)</td>
<td>21 (21.4%)</td>
</tr>
<tr>
<td>Mid level</td>
<td>253 (26.8%)</td>
<td>171 (32.4%)</td>
<td>82 (27.6%)</td>
<td>89 (38.5%)</td>
<td>35 (35.7%)</td>
</tr>
<tr>
<td>High</td>
<td>486 (51.4%)</td>
<td>254 (48.1%)</td>
<td>156 (52.5%)</td>
<td>98 (42.4%)</td>
<td>40 (40.8%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>29 (3.1%)</td>
<td>19 (3.6%)</td>
<td>14 (4.7%)</td>
<td>5 (2.2%)</td>
<td>2 (2.0%)</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>177 (18.7%)</td>
<td>98 (18.6%)</td>
<td>49 (16.5%)</td>
<td>49 (21.2%)</td>
<td>98 (100.0%)</td>
</tr>
<tr>
<td>SBP (SD)</td>
<td>124.5 (13.3)</td>
<td>126.0 (15.1)</td>
<td>123.9 (15.4)</td>
<td>128.6 (14.3)</td>
<td>130.1 (16.2)</td>
</tr>
<tr>
<td>DBP (SD)</td>
<td>78.3 (9.6)</td>
<td>79.3 (10.9)</td>
<td>78.4 (11.5)</td>
<td>80.4 (10.1)</td>
<td>83.0 (10.4)</td>
</tr>
</tbody>
</table>

Values are expressed as mean with standard deviation (SD) or total number with percentages. Hypertension was defined as a history of diagnosed hypertension. For description of different cohorts see text. BP values are expressed in mmHg.

SBP, systolic blood pressure; DBP, diastolic blood pressure.

a: Education level: low, lower general secondary/lower vocational; mid-level, higher general secondary/pre-university/intermediate vocational; high, higher vocational/university.
as normotensive. The average BP of these eight participants was 138/83 mmHg. The average BP of the uncategorized participants (37.5%) was 131/83 mmHg with 50% being hypertensive.

The AUC in the normal and high CMR subgroups were, respectively, 0.95 [SE 0.01, 95% CI (0.92–0.97)] and 0.92 [SE 0.02, 95% CI (0.89–0.96)]. The AUCs of the derivation cohort did not differ from the AUCs of both the normal (P = 0.35) and high (P = 0.23) CMR validation cohorts. After the first HBPM, 67.0% of the normal CMR subgroup was classified. The first duplicate HBPM, 44.9% of this subgroup was classified. The AUC in the normal and high CMR subgroups were, respectively, 0.95 [SE 0.01, 95% CI (0.92–0.97)] and 0.92 [SE 0.02, 95% CI (0.89–0.96)]. The AUCs of the derivation cohort did not differ from the AUC in the derivation cohort (whose BP values do not exceed the cut-off limits) are advised to complete the whole series of HBPM. Because the duplicate measurement from which the cut-off values were derived was taken in the morning, it is advised to apply the cut-off values on a duplicate measurement that is taken in the morning.

For participants with a history of hypertension, assessment of BP status after one duplicate measurement was considerably less accurate than in the other validation cohorts. This can most likely be explained by the fairly large amount of participants with uncontrolled hypertension (49%) within this subgroup combined with a higher average BP (139/84 mmHg). These findings underscore the importance of including participants with an established history of hypertension in health screening programmes, as there is evidence that uncontrolled hypertension leads to excess CV mortality in treated hypertensive patients. This also suggests that patients with a history of hypertension should always complete the minimally recommended number of 12 HBPM readings to assess BP control.

The prevalence of hypertension in the current study population varied from 27.6% (derivation cohort) to 32.0% (validation cohort), which is similar to a previous report of a random Dutch population sample of subjects aged 35–60 years, showing a hypertension prevalence of 33% for men and 20% for women. This indicates that the current population seems a good representation of the general population in terms of hypertension prevalence.

Because morning BP readings were significantly lower than evening readings, it could be argued that including them both would better reflect an individual’s true BP. However, when predicting the binary outcome of hypertension status, the second model (first and second duplicate HBPM) showed only marginal improvement upon the first model (first duplicate HBPM), which would not be commensurate to the burden of taking a second duplicate HBPM.

This study has some limitations. First, although HBPM seems a useful tool for mass screening of hypertension, we did not investigate whether its use in a screening programme leads to better hypertension awareness and control. Second, we can not know whether the participants fully complied with the HBPM instructions. They could have, for example, taken BP outside the standardized condition or have uploaded a wrong BP. However, the same applies to regular HBPM. Third, in our population, 20% failed to record all requested measurements. Because these subjects were different in education and age compared with those who completed the HBPM series, this might decrease the external validity of the proposed cut-off

### Table 2 Diagnostic classification accuracy by first duplicate HBPM reading

<table>
<thead>
<tr>
<th>Validation cohorts</th>
<th>TP</th>
<th>FN</th>
<th>FP</th>
<th>TN</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>LR+</th>
<th>LR-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total validation cohort (n = 528)</td>
<td>63</td>
<td>106</td>
<td>4</td>
<td>355</td>
<td>37.3%</td>
<td>98.9%</td>
<td>94.0%</td>
<td>77.0%</td>
<td>33.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Cut-off for hypertensive (≤150 or ≥95 mmHg)</td>
<td>255</td>
<td>104</td>
<td>8</td>
<td>161</td>
<td>71.0%</td>
<td>95.3%</td>
<td>97.0%</td>
<td>60.8%</td>
<td>15.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Normal CMR subgroup (n = 297)</td>
<td>33</td>
<td>48</td>
<td>2</td>
<td>214</td>
<td>40.7%</td>
<td>99.1%</td>
<td>94.3%</td>
<td>81.7%</td>
<td>44.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Cut-off for hypertensive (≤150 or ≥95 mmHg)</td>
<td>161</td>
<td>55</td>
<td>3</td>
<td>78</td>
<td>74.5%</td>
<td>96.3%</td>
<td>98.2%</td>
<td>58.6%</td>
<td>20.1</td>
<td>0.3</td>
</tr>
<tr>
<td>High CMR subgroup (n = 231)</td>
<td>30</td>
<td>58</td>
<td>2</td>
<td>141</td>
<td>34.1%</td>
<td>98.6%</td>
<td>93.8%</td>
<td>70.9%</td>
<td>24.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Cut-off for hypertensive (≤150 or ≥95 mmHg)</td>
<td>94</td>
<td>49</td>
<td>5</td>
<td>83</td>
<td>65.7%</td>
<td>94.3%</td>
<td>94.9%</td>
<td>62.9%</td>
<td>11.6</td>
<td>0.4</td>
</tr>
<tr>
<td>History of hypertension subgroup (n = 98)</td>
<td>14</td>
<td>34</td>
<td>0</td>
<td>50</td>
<td>29.2%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>59.5%</td>
<td>∞</td>
<td>0.7</td>
</tr>
<tr>
<td>Cut-off for controlled hypertensive (≤135 and &lt;80 mmHg)</td>
<td>25</td>
<td>25</td>
<td>5</td>
<td>43</td>
<td>50.0%</td>
<td>89.6%</td>
<td>83.3%</td>
<td>63.2%</td>
<td>4.8</td>
<td>0.6</td>
</tr>
</tbody>
</table>
values. However, additional analysis showed no difference in the performance of the cut-off values between both education and age categories within the validation cohort (data not shown). Finally, in the current health programme, a web-based approach was used in which participants electronically uploaded their readings. Although 94% of the Dutch households have Internet access,3,2 not all health programmes currently use this web-based approach. Perhaps future HBPM devices can be developed that are equipped with a build-in algorithm or a ‘screening mode’, which can be used in health programmes.

Over the years, HBPM has proven its value within medical clinics owing to its reliable results and general acceptance by both patients and clinicians. This study shows that HBPM can be easily and reliably applied as a screening tool for hypertension. In a health screening programme, one duplicate measurement was sufficient to either diagnose or reject the presence of (uncontrolled) hypertension in more than six out of every 10 participants. Future studies should elucidate whether HBPM can also be used as a screening tool in primary care and, ultimately, whether HBPM-based screening programmes lead to better hypertension awareness and control.

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Conflicts of interest: C.v.K. and R.K. are directors and co-owners of NIPED Research Foundation. This institute developed the worksite health promotion programme in which HBPM’s are implemented. M.N. is full-time and N.v.d.H. is part-time employed as researcher by NIPED Research Foundation. No other relationships or activities could appear to have influenced the submitted work.

Key points

- Home blood pressure measurement in a worksite health promotion programme is feasible when limiting the number of measurements.
- Using validated cut-off values, one duplicate measurement was sufficient to either diagnose or reject the presence of hypertension in more than six out of every 10 employees.
- In patients with a history of hypertension, the proposed cut-off values are less accurate and should therefore not be used. These patients should always complete their whole series of home blood pressure measurement.

References

Introduction

Hepatitis C virus (HCV) infection represents a major public health problem worldwide.\(^1\) Within the World Health Organization European region, approximately 9 million people are chronically infected with the HCV,\(^2\) and as in other high-income regions, people who inject drugs (PWIDs) are at greatest risk of acquiring infection.\(^3\) Despite the burden associated with HCV, it is still a neglected disease in many countries in Europe.\(^4\) A Call to Action for the EU and Member States on hepatitis B and C was launched in 2011 with the goal of making viral hepatitis a public health priority.\(^5\) Within the past decade, calls for action have also been launched in individual European countries, but with differing levels of success.\(^6\) So far, government-led sustainable improvements in screening of high-risk groups have only been made in France and Scotland.\(^4\) Whereas effective antiviral therapies for HCV have become available within the past decade, coordinated and robust responses to the broader public health issues associated with tackling transmission of the virus have lagged behind.\(^7\) In many European countries, problems persist in the effective diagnosis and referral of patients, and although knowledge of HCV status is critical for preventing transmission and for initiating early treatment and care, the European Liver Patients Association found that many people are unaware of their HCV status at the time of infection.\(^8\) Furthermore, although an increasing number of studies have shown that PWIDs who have acquired HCV can be successfully treated,\(^9\) very few go on to receive HCV treatment.\(^10\)\(^11\)\(^12\)

European countries are therefore facing a major challenge to improve identification of individuals at high risk of HCV. To inform policy and practice responses, we carried out a systematic review of the effectiveness of interventions aimed at increasing uptake of case finding and testing among high-risk groups and health professionals involved in the promotion or provision of HCV testing.

Effectiveness of interventions to increase hepatitis C testing uptake among high-risk groups: a systematic review

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Background: People who inject drugs are at the greatest risk of acquiring hepatitis C virus infection in many high-income countries, including those in Europe. Our review examined the effectiveness of interventions aimed at increasing hepatitis C virus testing uptake. Methods: We undertook a systematic review of controlled studies. Searches of 13 databases were supplemented with citation searching, and manual searches of reference lists and websites. Studies of interventions that aimed to increase testing uptake among high-risk groups were included. Testing uptake was our primary outcome measure of interest and secondary outcomes were engagement in follow-up services and treatment. A narrative synthesis was undertaken. Results: Eight controlled studies were included. Three studies examined interventions in primary care; one examined dried blood spot testing as an alternative method of testing, and two examined outreach provision. Two further studies examined interventions to improve hepatitis C management. Targeted case finding in primary care, support and training for primary care practitioners, offering alternative testing and provision of outreach testing all increased uptake of testing; however, intervention effects were variable. Conclusions: Evidence from the available studies suggests that increases in testing uptake can be achieved. Careful attention needs to be paid to the resource implications associated with implementation of interventions in primary care settings and also of the potential for interventions to improve outcomes once a positive diagnosis has been made. Further research on the cost-effectiveness of the intervention approaches examined in this review is required.