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Development of quality indicators for hypertension, extractable from the electronic health record of the general practitioner: a rand-modified Delphi method

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Abstract

Background Hypertension, a chronic medical condition affecting millions of people worldwide, is a leading cause of cardiovascular diseases. A multidisciplinary approach is needed to reduce the burden of the disease, with general practitioners playing a vital role. Therefore, it is crucial that GPs provide high-quality care that is standardized and based on the most recent European guidelines. Quality indicators (QIs) can be used to assess the performance, outcomes, or processes of healthcare delivery and are critical in helping healthcare professionals identify areas of improvement and measure progress towards achieving desired health outcomes. However, QIs to evaluate the care of patients with hypertension in general practice have been studied to a limited extent. The aim of our study is to define quality indicators for hypertension in general practice that are extractable from the electronic health record (EHR) and can be used to evaluate and improve the quality of care for hypertensive patients in the general practice setting.

Methods We used a Rand-modified Delphi procedure. We extracted recommendations from European guidelines and assembled them into an online questionnaire. An initial scoring based on the SMART principle and extractability from the EHR was performed by panel members, these results were analyzed using a Median Likert score, prioritization and degree of consensus. A consensus meeting was set up in which all the recommendations were discussed, followed by a final validation round.

Results Our study extracted 115 recommendations. After analysis of the online questionnaire round and a consensus meeting round, 37 recommendations were accepted and 75 were excluded. Of these 37 recommendations, 9 were slightly modified and 4 were combined into 2 recommendations, resulting in a list of 35 recommendations. All recommendations of the final set were translated to QIs, made up of 7 QIs on screening, 6 QIs on diagnosis, 11 QIs on treatment, 5 QIs on outcome and 6 QIs on follow-up.

Conclusions Our study resulted in a set of 35 QIs for hypertension in general practice. These QIs, tailored to the Belgian EHR, provide a robust foundation for automated audit and feedback and could substantially benefit other countries if adapted to their systems.

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Keywords Hypertension, Primary care, Guideline adherence, Healthcare evaluation, Health services research, Public health, Quality indicators, Quality of healthcare

Background

Hypertension is a chronic medical condition that affects millions of people worldwide. It is a leading contributor to cardiovascular diseases and a significant risk factor for chronic kidney disease, stroke and heart failure. As a result, it is one of the most common causes of global morbidity and mortality [1].

According to recent statistics from the World Health Organization (WHO), hypertension affects approximately 1.28 billion people globally [1]. In Belgium, hypertension is also a significant health issue, with an estimated prevalence of 43.3% in adults aged 40–79 years [2]. The number of people with hypertension has increased over the last decades and is expected to increase even more in the coming years [3].

Despite its high prevalence and impact, hypertension often goes undiagnosed and untreated [1, 2, 4]. Studies have shown that adequate treatment and follow-up of hypertension can reduce the associated cardiovascular morbidity and mortality [5]. Moreover, early detection of people at increased risk of developing hypertension allows for age-specific prevention and intervention strategies [6].

A multidisciplinary approach is needed to reduce the burden of disease for the patient and society, in which the general practitioner plays a vital role [7]. To this end it is crucial that GP's perform high quality care that is standardized and based on the most recent (inter) national guidelines. A way to evaluate this is through the implementation of quality indicators (QIs).

QIs refer to quantifiable measures that can be used to assess the outcomes or processes of healthcare delivery. These measures are designed to evaluate and improve the quality of healthcare services and are critical in helping healthcare professionals identify areas of improvement and measure progress towards achieving desired health outcomes [8–12]. A good QI is specific, measurable, acceptable, realistic and timely (SMART). [13–17]. In addition, extractability from the electronic health record (EHR) must be taken into account. Since the EHR contains structured medical data, it can be used to assess the quality of care and monitor the performance of health care providers. Moreover, it could enable automated quality assessment which is cheap and fast, allowing it to be widely implemented [18].

QIs to evaluate the care of patients with hypertension in general practice have been studied to a limited extent.

A study by Min et al. aimed to identify potential QIs for hypertension care in vulnerable elderly populations which resulted in 14 QIs that covered aspects of care such as blood pressure measurement, medication use, and follow-up. [19].

Various institutions, such as the World Health Organization have already published quality indicators for hypertension [20–25] However except for the QIs from the Canadian Cardiovascular Outcomes Research Team (CCORT) [23] these indicators are not specifically designed for primary care. Moreover, the extractability of these indicators from EHRs was not taken into account.

The aim of our study was to define quality indicators for hypertension in general practice that are extractable from the EHR and can be used to evaluate and improve the quality of care for hypertensive patients in primary care.

Methods

Study design

To develop the QIs for hypertension, we used the RAND-modified Delphi method [13–15, 24, 25], as was successfully applied in previous studies [14, 15] and contains 5 steps: (I) Extraction of recommendations from European guidelines and inclusion in a questionnaire. (II) Individual rating of the recommendations by an expert panel, followed by an analysis of the results and a feedback report (questionnaire round). (III) A consensus round to assess the recommendations for their eligibility (capability to measure the quality of hypertension care in primary care and prioritization), with a face-to-face discussion by the expert panel. (IV) Final evaluation (agree or disagree) of the set of recommendations by the panelists. (V) Transformation of the recommendations into the final set of QIs, by the authors.

Study population

The expert panel consisted of 12 members: 1 cardiologist, 1 resident in internal medicine, 5 general practitioners (GP), 1 resident in general practice, 2 nurses (1 working in cardiology, 1 working in a GP practice), 1 patient with hypertension, 1 programmer of an EHR software company. All professionals were selected based on their expertise with hypertension and were working in Belgium. The patient had the diagnosis of hypertension for 4 years.

Data collection

Extraction of recommendations

We selected the most recent national and international guidelines on hypertension. Guidelines were selected based on language (English and Dutch) and year of publication (after 2011). Non-European guidelines on hypertension were excluded because of geographically different approaches to hypertension. We included the following guidelines: guideline from Domus Medica (Belgium, 2013) [26], guideline from Nederlands Huisartsen Genootschap (NHG) (The Netherlands, 2019) [27], European guideline (2018) [28] and the NICE guideline (UK, 2019) [29]. The following commonly used sources in Belgium, based on (inter)national guidelines, were also included: Belgisch Centrum voor Farmacotherapeutische Informatie (BCFI) (Belgium, 2020) [30], Formularium Ouderenzorg (Belgium, 2020) [31].

All recommendations were assembled into an online questionnaire consisting of the following categories: screening, diagnosis, treatment (medical & non-medical and choice of antihypertensive agent), outcome (target, therapy-resistant hypertension, blood test at start treatment, start statin, duration of treatment) and follow-up. (See Additional File 1).

An adapted list was drafted for the patient and the nurses, taking into account their knowledge on the subject and the relevance of the recommendations for each of them. The programmer of the EHR company received the complete list of recommendations.

Questionnaire round

An online survey was created using Qualtrics. The panelists were invited to participate by email. Participants were asked to score each recommendation for their capability to measure the quality of hypertension care in primary care on a 9- point Likert scale, with 1 being the lowest score and 9 the highest score. More specifically, the panelists were assigned to score the recommendations based on the SMART-principle (specific, measurable, acceptable, realistic and timely), taking into account the benefit for the patient and the EHR extractability. The programmer of the EHR company was asked to rate the recommendations only on EHR extractability. In addition, we asked each panel member to prioritize the recommendations per category in a top-5 (prioritization) on relevance for measuring quality of care. Finally, all participants had the possibility to write down remarks.

The median Likert scale score for capability was calculated for each recommendation, ranging from 1 to 9. The prioritization was defined as a percentage, calculated on how the panel ranked the recommendation in the top-5 score. If a recommendation was mentioned first, it received 5 points, the second place received 4 points, etc. Recommendations that were not included in the top-5 list, received 0 points. These points were then converted into a percentage. The numerator was measured as the sum of the points a recommendation received and the denominator was the maximum priority score that recommendation could possibly receive (=5 times the number of panel members that scored that recommendation). For example, if 3 out of 12 panel members ranked a recommendation first and 7 did not mention it in their top-5, the prioritization percentage was 25% (=15/60).

"Consensus" was defined as ≥ 70% of the panel members awarding a score of ≥7 to the recommendation. When ≥ 30% of the panel members scored ≥7 AND ≥ 30% scoring ≤3, it was defined as "disagreement". Other outcomes were interpreted as having "no consensus".

Recommendations were classified into the categories high, uncertain or low potential as quality indicator by two steps. We first preselected, then in a second step we combined the results of the preselection with the degree of consensus to finally reach a conclusion on the classification of each recommendation.

The preselection was made using the median Likert scale score on the capability and the prioritization percentage. Recommendations with a median score on the Likert scale ≥ 7 and a prioritization percentage ≥ 20% were "selected". The ones with a median score ≥ 7 and prioritization percentage ≥ 1 and ≤ 20% AND the recommendations with a median score < 7 and top-5 percentage ≥ 20 were categorized as "discussion". Other outcomes were defined as "not selected", see Table 1.

The classification of the recommendations was based on the preselection and the degree of consensus. Recommendations that were selected and that had consensus, were ranked as high potential. In case of selection and disagreement or no consensus, or in case of discussion and consensus or disagreement, a recommendation was classified as "uncertain". In every other case, the recommendation had low potential, see Table 2.

Consensus meeting round

The results of the analysis were presented to the panel members in a feedback report which contained all recommendations with a color code representing its potential for measuring the quality of care (see Table 2). During the consensus meeting, the recommendations with a high potential were considered as included unless panel members asked for a decision making discussion. Recommendations with a low potential were excluded, unless panel members requested deliberation. Uncertain recommendations were always discussed more comprehensively for exclusion or inclusion. All accepted recommendations

Table 1 Preselection and consensus criteria

Preselection	Capability: median ≥ 7 and Prioritization percentage ≥ 20%	Selection
	Capability: median ≥ 7 and 1% ≤ prioritization percentage ≤ 20%	Discussion
	Capability: median < 7 and Prioritization percentage ≥ 20%	Discussion
	Other	No selection
Degree of consensus	≥ 70% of capability scores in highest tertile	Consensus
	≥ 30% of capability scores in highest tertile and ≥ 30% in lowest tertile	Disagreement
	Other	No consensus

Table 2 Classification of recommendations

	Preselection	Degree of consensus	Conclusion
Recommendation 1	Selection	Consensus	High potential
Recommendation 2	Selection	Disagreement	Uncertain
Recommendation 3	Selection	No consensus	Uncertain
Recommendation 4	Discussion	Consensus	Uncertain
Recommendation 5	Discussion	Disagreement	Uncertain
Recommendation 6	Discussion	No consensus	Low potential
Recommendation 7	No selection	Disagreement	Low potential
Recommendation 8	No selection	Consensus	Low potential
Recommendation 9	No selection	No consensus	Low potential

were then discussed, adjusted or modified, taking into account the SMART principle, the patient benefit, the recommendations' EHR extractability and the remarks of the panel members.

Final evaluation

The final set of all included recommendations was sent to the panel members for final appraisal.

Translation into quality indicators/ Formulation of the final set QIs

The recommendations were transformed into quality indicators as a percentage by the authors of the study. For example, "An electrocardiogram should be performed in patients with hypertension" thus became "The percentage of patients with hypertension in whom an electrocardiogram was performed". The final set of quality indicators was approved by all panel members.

Results

Extraction of recommendations

A total of 115 recommendations were extracted from the used European guidelines. Six recommendations which occurred twice with similar content were combined into 3 recommendations. The final result was a list of 112 recommendations (see additional file 2) which was then converted into an online questionnaire. The adapted list for the nurses consisted of 88 recommendations and the one for the patient of 63.

Online questionnaire round

The physicians and the programmer of the EHR company completed the full questionnaire and scored all of the 112 recommendations. One of the nurses and the patient also filled out the complete questionnaire they received respectively. The other nurse scored only the first 34 recommendations and did not complete the rest of the questionnaire. After analysis of the results, 20 recommendations had high potential, 36 were uncertain and 56 had low potential for measuring quality of care. (see additional file 3).

Consensus meeting round

At the consensus meeting, 5 panelists were able to participate, including three general practitioners from three different general practices, a general internal medicine resident and a software collaborator.

Following a comprehensive and detailed discussion, the panel resolved to endorse all 20 recommendations with a high potential, 15 out of 36 recommendations with uncertain potential, and only 2 out of 56 recommendations with low potential. These decisions led to a total of 37 recommendations being accepted while 75 were excluded. Fig. 1 illustrates the distribution of these recommendations.

Of these 37 recommendations, 9 were slightly modified, based on the remarks of the panel members and the smart principle. Two recommendations related to blood testing and two recommendations related to urine testing were merged into one recommendation each, respectively. Another 24 were accepted literally, which resulted in a final list of 35 recommendations.

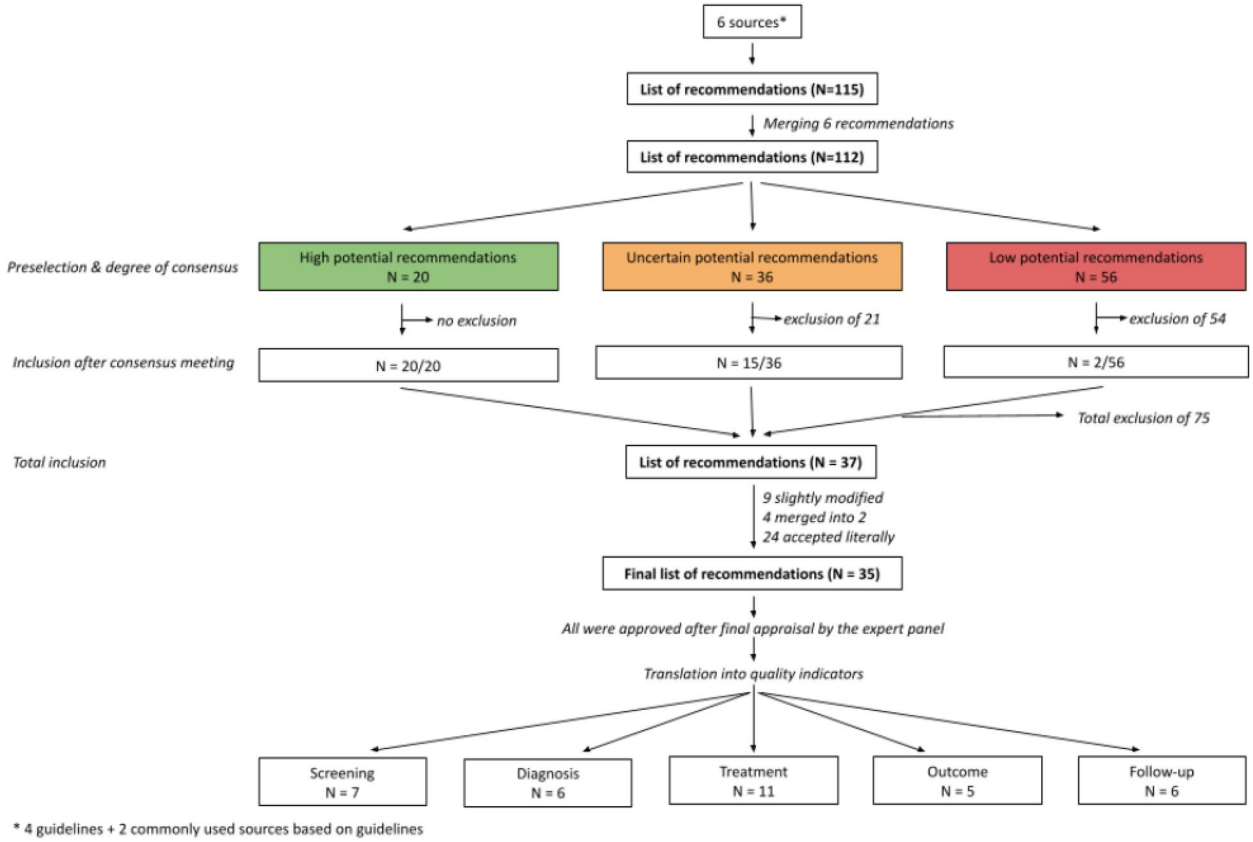

Fig. 1 Flowchart. Development of QIs for hypertension by the RAND-modified Delphi method (*N* = number)

Final appraisal/ evaluation

After the consensus meeting, 35 recommendations were sent to the expert panel by email for final approval. Except for the general practice nurse, who dropped out of the study early, every member of the panel agreed on the final list of recommendations.

Translation into quality indicators/ Formulation of the final set QIs

All recommendations of the final set were transformed to QIs. The result was a final set of 35 QIs, made up of 7 QIs on screening, 6 QIs on diagnosis, 11 QIs on treatment, 5 QIs on outcome and 6 QIs on follow-up, see Table 3.

Discussion

Principal findings

This study used a RAND-modified Delphi method to develop a list of 35 quality indicators for evaluating the quality of care of patients with hypertension in primary care.

The quality indicators on screening demonstrate the importance of being aware of the potential existence of hypertension. Furthermore, the expert panel discussed that when elevated conventional blood pressure measurements were noted multiple times, a home measurement should follow before a diagnosis of hypertension can be made. In patients diagnosed with hypertension, cardiovascular risk factors should be assessed. For this purpose, it is suggested to question smoking status, alcohol consumption and physical activity, calculate the BMI and perform a blood test to measure cholesterol. The panel found it important to redetermine this cardiovascular risk score every year. Performing a blood test, urinalysis and electrocardiogram are key quality indicators to screen for organ damage. Among the various quality indicators related to hypertension treatment, healthcare professionals and patients alike perceived non-pharmacological interventions as the most crucial. Physicians indicated that this is often discussed with the patient, but rarely recorded properly. Panelists questioned whether we should include this quality indicator due to its difficult extractability, but precisely because of the significance of this lifestyle advice, it was deemed necessary to include it anyway. Three quality indicators were selected by the panel concerning the indications for starting medication. The

Table 3 Quality indicators (QIs) on hypertension care

Quality indicators (QIs) on hypertension care
SCREENING
Screening
1. Percentage of patients aged 40–70 years whose blood pressure was measured at least every 5 years
2. Percentage of patients diagnosed with migraine or headache whose blood pressure was measured at the time of diagnosis
3. Percentage of patients with type 2 diabetes without already diagnosed hypertension or kidney disease whose blood pressure was measured yearly
4. Percentage of patients prescribed oral contraception for the first time whose blood pressure was measured at the moment of prescription
5. Percentage of pregnant patients whose blood pressure was measured at least once during pregnancy
Home measurement
6. Percentage of adult patients in whom multiple conventional blood pressures of ≥ 140 mmHg systolic and/or ≥ 90 mmHg diastolic were measured in whom a home measurement was done
Screening for atrial fibrillation
7. Percentage of patients whose pulse regularity was assessed during blood pressure measurement
DIAGNOSIS
Assessment of cardiovascular risk factors
8. Percentage of patients diagnosed with hypertension whose smoking status, alcohol consumption and sedentariness were questioned once
9. Percentage of patients diagnosed with hypertension whose BMI was calculated
10. Percentage of patients diagnosed with hypertension in whom a cardiovascular risk assessment (using the SCORE table) was done
Blood analysis at diagnosis
11. Percentage of patients diagnosed with hypertension who had a blood test in which hemoglobin, fasting glycemia, total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, sodium, potassium, uric acid, creatinine, eGFR and liver function were measured
Urine analysis at diagnosis
12. Percentage of patients diagnosed with hypertension who had a urinalysis in which albumin/creatinine ratio and hematuria were measured
ECG at diagnosis
13. Percentage of patients diagnosed with hypertension who had an electrocardiogram
TREATMENT
Non-pharmacological treatment
14. Percentage of patients diagnosed with hypertension in whom lifestyle interventions such as salt restriction, alcohol reduction, healthy diet, exercise, weight control and smoking cessation were advised
Pharmacological treatment
15. Percentage of patients younger than 80 years of age with grade 1 hypertension (conventional blood pressure measurement 140/90—159/100 mmHg and ABPM or HBPM 135/85—149/94 mmHg) and end-organ damage, cardiovascular disease, renal disease, diabetes or cardiovascular risk ≥ 10% who started with antihypertensive medication
16. Percentage of patients under 80 years of age with grade 1 hypertension (systolic 140–159 mmHg and/or diastolic 90–99 mmHg) who started with antihypertensive medication if blood pressure was not < 140 mmHg systolic and/or 90 mmHg diastolic after 3–6 months of lifestyle interventions
17. Percentage of patients under 80 years of age diagnosed with hypertension and a high cardiovascular risk (> 5% on the SCORE2 table) or organ damage who started with antihypertensive medication
18. Percentage of patients with very high blood pressure values (systolic > 180 mmHg and/or diastolic > 110 mmHg) in whom antihypertensive medication was immediately initiated, regardless of their cardiovascular risk
19. Percentage of patients with hypertensive crisis referred to the hospital
Choice of antihypertensive
First choice if no comorbidity
20. Percentage of patients who were switched to an Angiotensin-II-receptor blocker if an ACE-inhibitor was not tolerated
First choice if diabetes mellitus type II is present
21. Percentage of patients with type II diabetes mellitus who received a diuretic, calcium antagonist, β-blocker or ACE-inhibitor as the first choice of antihypertensive
First choice if nephropathy is present
22. Percentage of patients with hypertension and nephropathy with proteinuria who receive an ACE-inhibitor as the first choice of antihypertensive
First choice if coronary artery disease is present
23. Percentage of patients with hypertension and stable angina, experienced myocardial infarction, coronary artery disease or atrial fibrillation who received a β-blocker as the first choice of antihypertensive

Table 3 (continued)

Quality indicators (QIs) on hypertension care
First choice if heart failure or albuminuria is present
24. Percentage of patients with hypertension and heart failure (including left ventricular dysfunction) or (diabetic and non-diabetic) micro- or macroalbuminuria, who received an ACE inhibitor or Angiotensin II receptor blocker as the first choice of antihypertensive
OUTCOME
Target blood pressure values
25. Percentage of patients aged 70 years or younger with hypertension in whom the target is to achieve a systolic blood pressure of < 140 mmHg and a diastolic blood pressure of < 90 mmHg 3 months after initiation of treatment
Treatment
Choice if blood pressure is not adequately controlled with current antihypertensive treatment
26. Percentage of patients with hypertension with no adequate response to a single antihypertensive agent who received a combination of low-dose antihypertensive agents instead of the maximum dose of a single agent. Percentage of patients with hypertension with no adequate response to the maximally tolerated dual therapy who received triple therapy
Treatment-resistant hypertension
27. Percentage of patients with treatment-resistant hypertension who were referred to a specialist
Blood analysis on initiation of antihypertensive medication
28. Percentage of patients in whom a diuretic, an ACE inhibitor or an Angiotensin II receptor blocker was started in whom a blood analysis was done prior to the start of these medications with analysis of eGFR, sodium and potassium
Statin treatment
29. Percentage of patients aged 70 years old or younger who are at moderate to high cardiovascular risk (> 5% on the SCORE2 table) and any patient with cardiovascular disease who received a statin
FOLLOW-UP
Conventional blood pressure measurement
30. Percentage of patients with unstabilize hypertension in whom blood pressure was measured monthly
31. Percentage of patients with hypertension in whom blood pressure was measured at least 6-monthly
32. Percentage of patients with hypertension and type 2 diabetes in whom blood pressure was measured at least 3-monthly
Cardiovascular risk assessment
33. Percentage of patients with hypertension in whom their cardiovascular risk (according to SCORE table) was determined annually
Blood analysis in follow-up
34. Percentage of patients with hypertension and taking a diuretic, ACE-inhibitor or angiotensin-II- receptor blocker in which annual blood tests were done in which creatinine, eGFR, sodium and potassium were measured
35. Percentage of patients with spironolactone added to treatment in whom 1 month after the start of this medication a blood test was done with control of sodium, potassium and renal function

first choice of antihypertensive medication depends on the patient's comorbidities. For example, the panel had different preferences regarding the choice of first initiated antihypertensive in patients with diabetes, chronic renal insufficiency, coronary artery disease and heart failure. For the patient population with hypertension younger than 70 years, the expert panel selected a target blood pressure lower than 140/90 mmHg, which should be achieved no more than 3 months after starting treatment. The experts agreed that if there is insufficient response to antihypertensive treatment, a combination of low-dose antihypertensive drugs is preferable to the maximum dose of a single agent. If blood pressures are not under control with a combination of 3 antihypertensive medications, the hypertension is considered "therapy-resistant" and the patient should be referred to a specialist. Again, the panel cited that this referral to a specialist will rarely be coded correctly in the EHR. Nevertheless, again because of the risks of leaving this untreated, it was opted to include this recommendation anyway, as it could possibly be of value in the future. This is especially true if this could be recorded in a more user-friendly way, if it were more established among physicians to record this and data sharing between primary and secondary care would be improved. In addition to treatment with antihypertensive drugs, treatment with statins was also debated. The experts chose to include the respective recommendation, which says that any patient younger than 70 years and at moderate to high cardiovascular risk (via SCORE2 table) and any patient with cardiovascular disease should be treated with a statin. Because diuretics, ACE inhibitors and Angiotensin II receptor blockers can affect kidney function, sodium and potassium,

a blood test verifying these values should be done prior to starting these medications. In any patient with hypertension whose blood pressure has not yet stabilized, blood pressure should be determined monthly. Once blood pressure is stabilized, the frequency of blood pressure follow-up can go to 6-monthly.

As mentioned above, there is only a limited amount of research on QIs for hypertension. When comparing our set of QIs to those previously developed, similarities and differences emerge. Our findings align with the QIs defined by the American College of Cardiology/American Heart Association (ACC/AHA) [22] in certain areas, such as the importance of non-pharmacological treatment, assessing the cardiovascular risk score and treatment based on the grade of hypertension. However, screening is recommended differently, as the ACC/AHA suggest to start screening at 18 years old, with a screening protocol based on blood pressure values, whereas our QI suggest screening to begin at 40 years old and to be performed every 5 years. Furthermore, the use of home blood pressure monitoring (HBPM) is recommended for the follow-up of hypertension and not for screening. Additionally, the ACC/AHA also defined several QIs that are not EHR-extractable in Belgium, including QIs on medication adherence and shared decision-making. Finally, they also have a number of structural quality measures relating to telemedicine, EHR usage and screening protocols, which is not the subject of our study. The 6 QIs identified by NICE [21], such as screening for target organ damage, target values, assessing cardiovascular risk score annually and referral to a cardiologist for treatment-resistant hypertension are largely reflected in our QIs, which does not surprise as the NICE guidelines were used as a base. A difference is the recommendation of ambulatory blood pressure monitoring (ABPM) to confirm the diagnosis of hypertension. While ABPM is indeed the most accurate method for confirming the diagnosis of hypertension, our experts preferred a home measurement because this is much more commonly done in practice than an ABPM. In Belgium, ABPM is not reimbursed in primary practice and referral to a specialist is required, whereas home measurements can be easily conducted. The QIs from the CCORT [23] focus on screening and follow-up and largely overlap with our QIs. A difference is the varying target blood pressure values based on comorbidities, which are part of the CCORT recommendations, but not reflected in ours.

As a next step these quality indicators can be converted into queries to develop an automated audit and feedback intervention to evaluate and improve the quality of care for patients with hypertension by giving practices insight into their strengths and areas of work. Audit and feedback is a strategy used worldwide to encourage professionals to optimize their clinical practice [32]. An audit is a systematic assessment of clinical practice based on explicit criteria/standards. [32] This assessment can include data on a variety of issues, for example process of care, clinical endpoints and number of patients treated correctly according to guidelines. [33] Using these data to provide feedback to the involved caregiver, as described above, small but significant changes in care delivery can be gained [34].

Strengths and limitations

One of the primary strengths of this study is its novelty in developing QIs for hypertension that are extractable from the EHR, in Belgium. This feature enables the QIs to be utilized for monitoring and potentially improving the quality of care for patients with hypertension, through the implementation of audit and feedback interventions.

In general, the topics of our QIs overlap with those of other guidelines. However, our QIs cover all aspects of healthcare (screening, diagnosis, treatment and follow-up) which none of the other sets of QIs do. Within each domain, our QIs are more comprehensive and specific compared to other QIs.

Another strength is that a varied panel of experts that have different viewpoints on the subject was questioned, so in addition to general practitioners, we included 2 specialists (one cardiologist and one resident in internal medicine), 2 nurses (one nurse from the general practice and one nurse working in the internal medicine department) and a patient. To gain better insight into the extractability of the QIs, we also included a software programmer specialized in electronic medical records.

One of the limitations of this study is that there were some absentees at the consensus meeting and thus only a relatively small group could discuss with each other. Since both the cardiologist, the nurses and the patient were absent during the consultation moment, it was mainly the general practitioners and the resident in internal medicine who engaged in discussion with each other. Also one nurse started the survey but did not complete it and decided to drop out of the study early. Additionally, we chose guidelines based on geography, which meant that some major guidelines such as the American ACC/AHA guidelines [35] were not included. Lastly, since the extractability of the QIs is specific to the Belgian EHR, other countries should verify the extractability of these QIs within their own EHR systems before implementation. This limitation on extractability is one reason why certain QIs, such as those related to medication adherence, were not included, despite their potential relevance.

Conclusion

This study used a RAND-modified Delphi method to identify a set of 35 EHR-extractable QIs to measure the quality of primary care for patients with hypertension, in Belgium. Focused on core aspects of primary hypertension care, these QIs provide a robust foundation for automated audit and feedback. Although their extractability is tailored to the Belgian EHR, these QIs are highly relevant and could offer substantial benefits to other countries if adapted to their own EHR systems.

Abbreviations

GP	General Practitioner
QIs	Quality Indicators
SMART	Specific, Measurable, Achievable, Relevant, Timely
EHR	Electronic Health Record
WHO	World Health Organization
CCORT	Canadian Cardiovascular Outcomes Research Team
NICE	National Institute for Health and Care Excellence
NHG	Nederlands Huisartsen Genootschap (Dutch College of General Practitioners)
BCFI	Belgisch Centrum voor Farmacotherapeutische Informatie (Belgian Center for Pharmacotherapeutic Information)
ACC/AHA	American College of Cardiology/American Heart Association
HBPM	Home Blood Pressure Monitoring
ABPM	Ambulatory Blood Pressure Monitoring

Supplementary Information

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Additional file 1: Online questionnaires

Additional file 2: Exhaustive list of recommendations

Additional file 3: Analysis of the questionnaire round

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Authors' contributions

BV and SVdB contributed to the conceptualization of the study. KD, MH, SL, PT, LVV, BV and SVdB contributed to the design of the study. Data collection and analysis was performed by MH, SL, PT, LVV and supervised by KD, BV and SVdB. KD, MH, SL, PT, LVV, BV and SVdB contributed to the final manuscript. KD and SVdB are the guarantors of this work.

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SVdB is general practitioner and postdoctoral researcher.

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Availability of data and materials

Data is provided within the manuscript and the supplementary information files.

Declarations

Ethics approval and consent to participate

The research project was presented to the KU Leuven ethics committee and was granted approval with a positive final decision under the reference number MP018005 on 18–01-2022. Informed consent was given by all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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