What constitutes controlled hypertension? Patient based comparison of hypertension guidelines

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Abstract

Objectives—To investigate and quantify the extent to which variations in guidelines influence assessment of control of hypertension.

Design—Cross sectional study. Selected patients had hypertension assessed as controlled or uncontrolled with guidelines from New Zealand, Canada, the United States, Britain, and the World Health Organisation.

Setting—18 general practices in Oxfordshire.

Subjects—876 patients with diagnosed hypertension and taking antihypertensive drugs.

Main outcome measures—Proportion of patients with controlled hypertension according to each set of guidelines.

Results—The proportion of patients with controlled hypertension varied from 17.5% to 84.6% with the different guidelines after adjustment for the sampling method. All five sets of guidelines agreed on the classification for 31% (277) of the patients. The New Zealand guidelines calculate an absolute risk of a cardiovascular event. When this was taken as the standard half of the patients with uncontrolled hypertension by the United States criteria would be treated unnecessarily and 31% of those classified as having controlled hypertension by the Canadian guidelines would be denied beneficial treatment.

Conclusions—Hypertension guidelines are inconsistent in their recommendations and need to make clear the absolute benefits and risks of treatment.

Introduction

Treatment of hypertension has been shown to reduce the relative risk of cardiovascular mortality and morbidity by 30%.¹ National experts have produced recommendations on detecting and treating hypertension.²⁻⁶ However, despite the wealth of evidence from randomised controlled trials these guidelines differ both in content and in emphasis.⁷

Recently, more emphasis has been put on targeting treatment at people who have a higher absolute risk of cardiovascular disease (box 1).⁸ A recent systematic review showed that 58 elderly people need to be treated for five years to prevent one cardiovascular death compared with 205 people in middle age.⁹ Similarly, history of a cardiovascular event, presence of diabetes, left ventricular hypertrophy, and continued smoking increase absolute risk from 5.4% to 32.9% over 10 years.¹⁰ Guidelines on managing hypertension have tried to reflect this variation in risk. The attempts vary between an explicit risk matrix according to age, sex, blood pressure, and the presence of major and minor risk factors² to a guideline mentioning that "several factors other than diastolic and systolic blood pressure...may influence the decision to begin drug treatment" followed by a list of the factors that should be taken into account.⁵

Box 1—Definitions of absolute and relative risks for stroke in the management of hypertension. Adapted from Sackett and Cook¹¹

Drug	Outcome at 5 years	
	Death	Survival
Active (n = 15 000)	1800	13 200
Placebo (n = 15 000)	3000	12 000

Risk of death at 5 years without treatment (baseline risk):
 $3000/15\ 000 = 0.20$ or $20\%(X)$.
 Risk of death at 5 years with treatment: $1800/15\ 000 = 0.12$ or $12\%(Y)$ Relative risk $(Y/X) = 0.6$.
 Relative risk reduction $(100 \times (X-Y)/X)$ or $(1-(Y/X)) \times 100 = 40\%$.
 Absolute risk reduction $(X-Y) = 8\%$.
 Number needed to be treated for five years to prevent one stroke $(1/(X-Y)) = 1/0.08 = 13$.

Population studies on detection and control of hypertension in middle aged and elderly people have used blood pressure alone for assessment.^{12 13} Since the risk factors for a cardiovascular event and their emphasis differ between guidelines⁷ we used data from hypertensive patients in primary care to investigate the agreement between five sets of guidelines²⁻⁶ on the definition of controlled hypertension. We also analysed how well this definition reflected absolute risk, as set out in the New Zealand guidelines.^{2 14}

Patients and methods

We collected data on patient morbidity from 18 of the 20 Oxfordshire practices who subscribe to the VAMP (Value Added Medical Products) computer system. A systematic sample of 50 patients was obtained by taking every 10th person from the practices' hypertension register. To be defined as hypertensive for the purposes of this study patients had to have hypertension clearly marked in their record in the computer database and be taking drugs to lower blood pressure at the time of the study.

We recorded the patients' age, sex, blood pressure (averaged over three most recent readings, when present), and the presence of major and minor risk factors (box 2).² Patients were defined as having "controlled" or "uncontrolled" hypertension in accordance with the recommendations of each set of hypertension guidelines. Although the New Zealand guidelines contain no explicit statement about the reduction in absolute risk to prevent a cardiovascular event over the next 10 years, they suggest that treatment should be started when absolute risk levels exceed 20%.² Thus we took an absolute risk of 20% or above as uncontrolled hypertension and below 20% as controlled hypertension for the purposes of this study. This level of risk equates to 150 people requiring treatment for one year to prevent a single cardiovascular event.² For the other guidelines uncontrolled hypertension was defined as the blood pressure above which the guideline recommends starting treatment (box 2).

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Box 2—Criteria used to define uncontrolled hypertension in five hypertension guidelines

NEW ZEALAND^{2 7}

Age, sex, blood pressure, and presence of minor and major risk factors.

Major risk factors include:

- Symptomatic cardiovascular disease
- Myocardial infarction
- Stroke
- Transient ischaemic attack
- Peripheral vascular disease
- Coronary artery bypass graft
- Coronary angioplasty
- Left ventricular hypertrophy
- Familial hypercholesterolaemia

Minor risk factors include:

- Current smoker
- Diabetes
- Body mass index >30
- High density lipoprotein cholesterol: cholesterol >6:1 (modified to British recommendation of cholesterol concentration >7.8 mmol/l)
- Family history of premature cardiovascular disease

CANADA^{6 7}

Diastolic blood pressure ≥ 100 mm Hg or ≥ 90 mm Hg if target organ damage is present.

Target organ damage includes:

- Left ventricular hypertrophy by electrocardiography
- History or electrocardiographic evidence of myocardial infarction
- History or clinical evidence of stroke
- History of intermittent claudication
- History of renal failure (creatinine >150 μ mol/l)

UNITED STATES^{4 7}

Blood pressure ≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic, or both.

BRITAIN^{3 7}

Elderly people (aged ≥ 60 years)

Systolic blood pressure ≥ 160 mm Hg or diastolic blood pressure ≥ 90 mm Hg, or both.

Middle aged people (<60 years)

Diastolic blood pressure ≥ 100 mm Hg or 90-99 mm Hg if target organ damage is present.

Target organ damage includes:

- Left ventricular hypertrophy
- History of renal failure
- Diabetes requiring drug treatment

Diastolic blood pressure in the higher portion of the range 90-99 mm Hg (taken here to be 95 mm Hg) if the following risk factors are present:

- Male sex
- Current smoking
- Serum cholesterol concentration >7.8 mmol/l
- Strong family history of cardiovascular disease

WHO^{5 7}

Young patients (aged 40-59 years)

Systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 80 mm Hg, or both, with additional risk factors:

- Male sex
- History of left ventricular hypertrophy, ischaemic heart disease, and cerebrovascular disease
- Raised serum creatinine concentration (history of renal failure)
- Diabetes
- Smoking, raised serum cholesterol concentration >7.8 mmol/l
- Family history of cardiovascular disease

Older patients (aged ≥ 60 years)

Systolic blood pressure ≥ 140 mm Hg or diastolic ≥ 90 mm Hg.

The proportions of patients classified as having controlled hypertension by each of the five guidelines were estimated with and without taking into account the different sampling fractions across the practices.¹⁵ In addition, 95% confidence intervals were calculated before and after adjustment for unequal sampling fractions and the clustering effects of sampling individuals through the practices—the second of these corrections requires the calculation of intrapractice correlation.^{16 17}

Although the New Zealand guidelines are more time consuming and difficult to use,⁷ they give a clearer absolute risk than the others. We therefore took these guidelines as the standard for analysis of sensitivity, specificity, and positive and negative predictive values of the other guidelines. All calculations were performed with Microsoft Excel, Minitab for Windows, and SPSS for Windows.

Results

We collected data on 895 patients selected from the 18 (90%) practices that gave us permission and provided a hypertension register. Nineteen (2.1%) of these patients had no blood pressure record on the database and were excluded from further analysis. Table 1 shows the proportions of the remaining 876 patients with controlled hypertension according to the five sets of guidelines. The complex adjustments necessitated by the sampling method had little effect on the results. We therefore did not use these adjustments for the more detailed analyses which follow. The intrapractice corre-

lation coefficients, which represent the inefficiency of the cluster sampling method compared with the (logistically much more difficult) simple random sampling approach, were similar for all the guidelines (table 1).

The guidelines agreed on the diagnosis of controlled hypertension for 18% (159) of patients and on uncontrolled hypertension for 13% (118) (table 2). The agreement on uncontrolled hypertension would be raised by another 19% (169) if the Canadian guidelines were excluded.

The potential for overtreatment and undertreatment becomes explicit when the other four guidelines are compared with those from New Zealand (table 3). The Canadian guidelines have a high threshold for uncontrolled hypertension and so a high proportion of patients are classified as controlled with this guideline (table 1). However, table 3 shows that 31% (238) of those with controlled hypertension by the Canadian standard have an absolute risk above 20% over 10 years (uncontrolled by the New Zealand standard). Conversely, with the United States guidelines half of the patients defined as uncontrolled (359) have an absolute risk under 20% over 10 years by the New Zealand guidelines. Guidelines from Britain and the World Health Organisation lie between these two extremes. The overall misclassification of patients (combination of those inappropriately classified as having uncontrolled and controlled hypertension compared with the New Zealand standard) was 41% for the United States guidelines, 35% for the WHO guidelines, 27% for the Canadian, and 25% for the British.

Table 1—Proportions of patients (95% confidence interval) with controlled hypertension according to five guidelines (n = 876)

Guideline	Before adjustment for sampling method	After adjustment for sampling method	Intrapractice correlation coefficient
New Zealand ²	57.9 (55.9 to 62.4)	57.8 (51.3 to 64.3)	0.0551
Britain ³	47.6 (44.3 to 50.9)	46.8 (39.8 to 53.8)	0.0644
United States ⁴	18.2 (15.6 to 20.7)	17.5 (12.4 to 22.7)	0.0522
WHO ⁵	28.9 (25.9 to 31.9)	28.9 (23.0 to 34.8)	0.0479
Canada ⁶	86.3 (84.0 to 88.6)	84.6 (80.3 to 88.8)	0.0528

Table 2—Frequencies (%) of patients in the 32 possible combinations* of uncontrolled hypertension according to five guidelines (0 = controlled, 1 = uncontrolled)

New Zealand ²	Britain ³	United States ⁴	WHO ⁵	Canada ⁶	No of guidelines indicating "uncontrolled" hypertension	No (%) of patients
0	0	0	0	0	0	159 (18)
0	0	1	0	0	1	54 (6)
0	0	1	1	0	2	143 (16)
0	1	1	0	0	2	19 (2)
1	0	1	0	0	2	11 (1)
0	1	1	1	0	3	143 (16)
1	0	1	1	0	3	50 (6)
1	1	1	0	0	3	8 (1)
1	1	1	1	0	4	169 (19)
1	1	1	0	1	4	2 (0)
1	1	1	1	1	5	118 (13)

*Combinations with a frequency of 0 are omitted.

Table 3—Contingency tables for four sets of guidelines with New Zealand guidelines as standard (n = 876)

	New Zealand ²		Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
	Uncontrolled	Controlled				
United Kingdom³			83	68.7	64.7	85.4
Uncontrolled	297	162				
Controlled	61	356				
United States⁴			100	30.7	49.9	100
Uncontrolled	358	359				
Controlled	0	159				
WHO⁵			94.1	44.8	54.1	91.7
Uncontrolled	337	286				
Controlled	21	232				
Canada⁶			33.5	100	100	68.5
Uncontrolled	120	0				
Controlled	238	518				

*For the New Zealand guidelines uncontrolled hypertension equates to a risk of a cardiovascular event in absolute terms of > 20% over 10 years.

Discussion

Our study confirms that the emphasis and consistency of the hypertension guidelines differ.⁸ Furthermore, we have quantified control of hypertension and shown that the definition varies widely. This variation has a large effect when using the hypertension guidelines to manage patients.

Our study shows that the definition of controlled hypertension and thus the threshold for treatment varies considerably among the guidelines. The New Zealand guidelines allow the absolute level of risk to be estimated because they give the baseline risk and the consequent benefits of treating hypertension in different categories of patients. These guidelines do, however, require a great deal of information for each patient, which may prove to be a barrier to implementation.^{7 18} The other consequence of using the New Zealand guidelines is that, given their sensitivity to age, a greater proportion of elderly patients are likely to become candidates for treatment.

Nevertheless, if risk factors are not quantified and taken into account many people will have their hypertension misclassified and the risks and benefits of treatment cannot be clearly outlined for each patient. Patients with a low absolute risk may be exposed to the potential side effects of treatment for little or no therapeutic benefit.¹⁹ Conversely, those with a high absolute risk who are misclassified as having controlled hypertension will have a higher chance of a cardiovascular event than is necessary.

REASONS FOR VARIATION

Some authors have suggested that there may be a level at which the benefits of treatment are outweighed by its side effects.²⁰ The best estimates of treatment effects in patients with hypertension are likely to be determined from meta-analyses of risk reduction based on data from individual patients across different risk groups.²¹ But it is already clear that the absolute benefits gained differ substantially between elderly and middle aged people and those with or without pre-existing cardiovascular disease.^{9 22} Until good experimental evidence exists on appropriate targets for reducing blood pressure the guidelines will continue to differ.

The main limitation of this study is that because of the cross sectional design we could not assess whether risk stratification accurately predicted future cardiovascular events. The predictive values of the guidelines can be confirmed only in a cohort study in which the cardiovascular outcome of the population is followed up for 10 years. A cohort study which assessed the performance of three sets of cholesterol guidelines and a simulation model based on Framingham multivariable equations showed that accuracy in predicting future coronary death varied significantly among guidelines.²³

All except the Canadian guidelines were published after the results of three large randomised controlled trials in elderly people were reported.²⁴⁻²⁶ Most of the guidelines therefore used the same main sources of evidence, and all would claim to be evidence based. All of them used an explicit process to identify and select evidence; what is not clear is how similar studies were combined to produce differing recommendations.²⁸ Our findings highlight the need for a systematic approach to development, production, and presentation of guidelines.

The content of national guidelines seems to be influenced by factors other than results from randomised controlled trials. National culture and expectations influence the way in which medical care is organised and delivered,²⁷ and the variation in content of hypertension guidelines may be a manifestation of the cultural expectations of apparent benefits and risks when treating this condition.

IMPLICATIONS FOR PRIMARY CARE

Most patients with hypertension in the United Kingdom are treated in the community by their general practitioners. General practitioners are more likely to read guidelines on the management of hypertension than the original randomised controlled trials. Differences in the guidelines may therefore be a further barrier to their implementation in primary care.¹⁸

General practitioners are poor at assessing risk, and particularly absolute risk, according to risk factor profiles in patients with coronary heart disease.^{29 30} Guidelines that are explicit about the risk factors that need to be taken into account and the absolute benefits of treatment should improve estimates of risk and enable doctors and patients to make more informed choices about treatment. In addition, the way that results of clinical trials are presented influences the prescribing propensity of doctors and patients' willingness to accept treatment.¹¹ Guidelines should try to convey

Key messages

- The recommendations of hypertension guidelines differ in content and emphasis
- This study applied the recommendations of guidelines from New Zealand, Canada, the United States, Britain, and the WHO to a sample of 879 hypertensive patients
- The proportion with controlled hypertension varied between 17.5% and 84.6% according to which set of guidelines was followed
- Overall, the five sets of guidelines agreed for 31% of the patients
- Hypertension guidelines are inconsistent and unclear on the absolute benefits of treatment

benefits and risks of treatment clearly and in terms that are readily accessible to both patient and doctor.

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Why me, doctor?

One of the more difficult and therefore frequently more irritating questions which patients ask me about their diagnoses—often with the pained reflection, "But I've never had it before"—is: "Why have I got it?" More often than not, I do not have the faintest idea. I admit this only in selected cases, since the mere tone of asking the question betokens the patient's restless quest for rationality and a low tolerance for ambiguity. I avoid saying, "Because an enemy has put a curse on you," but if my patient looks Calvinistic I sometimes say, "Because God has predestined you for this disease," which often seems to go down better than I expect. I also use a technique which I learnt from a famous dermatologist 25 years ago and long before I ever thought of going to medical school.

I had developed a few itchy red patches on my lower legs. After a while I went to my kindly doctor. He looked doubtfully at my lower limbs (at that time devoid of the varices subsequently acquired from ward rounds and assisting in the operating theatre) and prescribed some fungicidal ointment. But the rash got worse, so a week or two later I went again. As was often the case when stuck, he went to ask his wife, who practised in the adjoining room, what to do next. "My wife thinks that you should see a specialist," he said when he returned. He seemed

relieved when I helped him out by mentioning that since I worked in a famous teaching hospital I could see the dermatologist there.

The dermatologist, whom I had come to know quite well as a business colleague, came in and took a quick look at my shins. "Ah, it's you. You should have asked me before without coming in here," he said. "Your doctor thought the rash was a fungal infection, but as it happens he was wrong. It's discoid eczema, and this ointment will get rid of it," he added as he wrote the prescription.

My spots were not to be brushed off that easily. "Why have I got this discoid eczema?" I began. "It's no good asking me that," he interrupted with evident ennui. "If I knew the answer to that question they would put up a statue of me in the hall." This put my problem into perspective, and I have never worried about my eczema since, even though neither his nor subsequently my own treatments have ever done it much permanent good.—TIM DAVIES is a general practitioner in Littlehampton

We welcome filler articles of up to 600 words on topics such as *A memorable patient*, *A paper that changed my practice*, *My most unfortunate mistake*, or any other piece conveying instruction, pathos, of humour. If possible the article should be supplied on a disk.