

# Physician, Organizational, and Patient Factors Associated With Suboptimal Blood Pressure Management in Type 2 Diabetic Patients in Primary Care

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**OBJECTIVE** — To assess the quality of hypertension care in patients with type 2 diabetes in general practice and identify physician, organizational, and patient factors associated with suboptimal care.

**RESEARCH DESIGN AND METHODS** — Data from 895 randomly selected diabetic patients were extracted from the electronic medical records of 95 general practitioners. Physician and organizational characteristics were collected with a questionnaire. We conducted a multi-level analysis to identify associations with blood pressure registration, hypertension treatment, and achievement of target blood pressure levels.

**RESULTS** — For 652 patients (73%), a blood pressure measurement was recorded in the last year. Of these patients, 132 (20%) reached a target level of 135/85 mmHg. In total, 595 patients were classified as having hypertension, of whom 192 received no treatment (32%), 193 received an ACE inhibitor (32%), and 210 received other antihypertensives. Patients visiting a diabetes facility, referred to a specialist, with a female general practitioner, or with a general practitioner with  $\leq 10$  years work experience had better recordings of their blood pressure. Suboptimal treatment was higher in older patients and smoking patients. Treatment was better in patients with coronary comorbidity, hyperlipidemia, or those referred to a specialist. Not achieving the blood pressure target was related to older age of the patients.

**CONCLUSIONS** — Hypertension management of type 2 diabetic patients in primary care is suboptimal. Characteristics of general practitioners as well as additional care provided by a diabetes facility or a specialist are associated with better processes of care, but blood pressure outcomes are not as clearly related to these factors.

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**T**reatment guidelines uphold stringent target levels for blood pressure control in patients with diabetes because this significantly reduces the risk of developing cardiovascular and microvascular diseases. This has not resulted in adequate blood pressure control (1). Sub-

optimal management in both diagnosis and treatment of hypertension in type 2 diabetic patients has repeatedly been shown (1–6).

The quality of diabetes management can be influenced by physician, organizational, and patient factors (7). Variation in

quality of care has been found between physicians as well as patients (5,6,8–11). Factors of influence are the age and work experience of the physician, size of the practice, presence of a recall system, and proportion of patients attending hospital clinics (5,9,11). Patient characteristics influencing the quality of diabetes and blood pressure management include age, sex, ethnicity, and presence of comorbidities, such as coronary artery disease (6,10,12–14).

To determine which aspects interventions should target for change, the influence of physician-related factors on the quality of care must be assessed in relation to the impact of patient-related factors (15). In a multilevel approach, one can account for possible confounding effects of patient characteristics or case-mix differences on the physician or practice level. Recently, a study using this approach (16) showed that poor blood pressure outcomes in type 2 diabetic patients depended partly on the organizational setting and the physician's sex. No attention was paid to the management activities performed by the physicians, leaving unanswered questions about the association between these factors and the blood pressure monitoring and treatment.

The aim of this study is to identify the relative influence of physician, organizational, and patient factors on the quality of blood pressure management in type 2 diabetic patients in primary care. Quality of management is assessed in terms of registration of blood pressure, treatment of hypertension, and achievement of blood pressure target levels.

## RESEARCH DESIGN AND METHODS

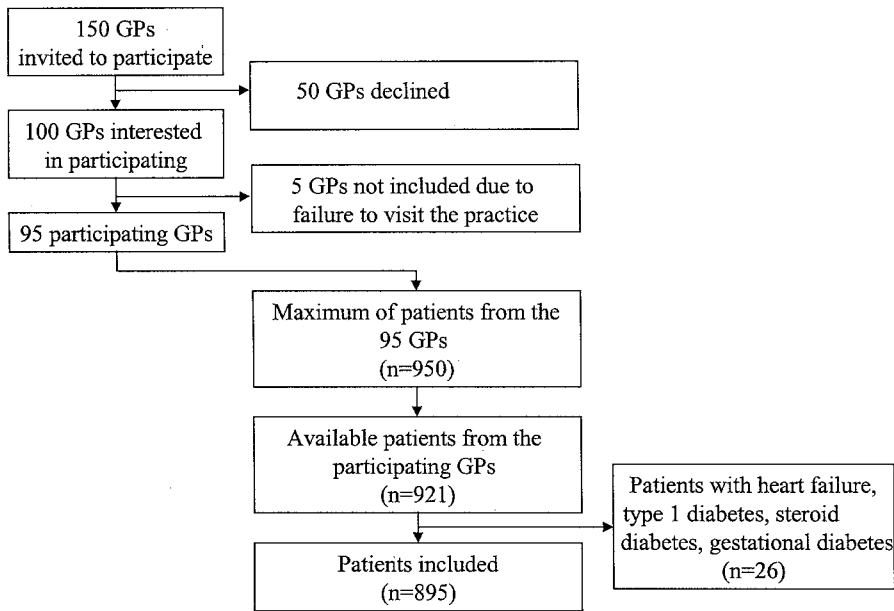
This study is part of a larger study evaluating the effect of two audit programs for general practitioner peer review groups on the management of hypertension in type 2 diabetes and on the management of heart failure. The study was conducted in 21 peer groups

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**Figure 1**—General practitioners (GPs) and patients in the study.

consisting of 150 general practitioners in the northern region of the Netherlands. In total, 95 general practitioners were included in this study (Fig. 1). Physician characteristics and organizational factors were determined by a structured questionnaire. All practices were computerized. Patient data were extracted from electronic medical records by trained abstractors who visited the general practitioners in the baseline period from September 2001 to May 2002. A maximum of 10 type 2 diabetic patients were randomly selected per general practitioner. The general practitioners were asked to verify the diagnosis of the obtained cases. All extracted cases were subsequently screened to exclude remaining cases of type 1, gestational, and steroid-induced diabetes and patients with heart failure as comorbidity (Fig. 1). Patients with this comorbidity were excluded because they fell into both the control and intervention groups for the larger study.

**Measurements**

Patient data included demographics, clinical background, and the three most recently registered blood pressure measurements. Data were collected on prescriptions of blood glucose-lowering and antihypertensive medication, possible contraindications for antihypertensive drugs, and previous medication problems mentioned in the medical records. All prescriptions with a calculated end date

not more than 3 months before the data collection were included. This time window was chosen to adjust for prescriptions collected at irregular times. In the Netherlands, chronic medication is commonly prescribed for 3-month periods.

The outcome variables were based on recommendations given in the regional treatment guideline, i.e., hypertension should be treated in type 2 diabetic patients with a blood pressure >135/85 mmHg, and an ACE inhibitor is the recommended first-choice drug. Because there are other national and international guidelines available that have slightly different recommendations (17), we included additional outcome variables focusing on the annual registration of blood pressure, the treatment with other antihypertensive drugs, and the continuous range of blood pressure levels. Registration of blood pressure was defined as having at least one blood pressure measurement recorded during the previous year. Treatment of patients with hypertension was subdivided into “no treatment,” “treatment with first-choice antihypertensive” (ACE inhibitor), and “treatment with other antihypertensives” (diuretics,  $\beta$ -blocking agents, calcium-channel blockers, angiotensin II antagonists,  $\alpha$ -blocking agents, and centrally acting antihypertensives). Patients were defined as having hypertension when this diagnosis was recorded in their medical record or when their average blood pres-

sure during the previous year was >135/85 mmHg. Achievement of target level was defined as having an average systolic blood pressure  $\leq$ 135 mmHg and diastolic blood pressure  $\leq$ 85 mmHg.

General physician and organizational characteristics previously identified as being related to quality of diabetes care were included as explanatory variables (5,7,9,11). Physician factors were the general practitioner’s sex, work experience ( $\leq$ 10, 10–20, >20 years), and license to dispense medicines. Organizational factors at practice level were the size and type of the practice (single handed versus partnership) and location of the practice (urban, semirural, and rural). Organizational factors included at the individual patient level were visits to a cardiologist or internist for cardiovascular or diabetes-related problems and visits to a diabetes facility during the previous year. Patients can be referred to this diabetes facility for evaluation and education, but the general practitioner retains responsibility for the treatment. Patient characteristics in the analysis included documented cardiovascular risk factors such as smoking, being overweight, hyperlipidemia, and comorbidities, including cerebrovascular disease (stroke and transient ischemic attack), coronary artery disease (angina pectoris and myocardial infarction), and asthma or chronic obstructive pulmonary disease.

**Statistical analysis**

Possible associations were first tested in univariate analyses using  $\chi^2$  tests, *t* tests, or ANOVA. To assess the influence of physician, organizational, and patient characteristics simultaneously on each of the outcome variables, we used multilevel analysis. Hierarchical models were estimated taking the clustering of patients (level 1) within the practice of a general practitioner (level 2) into account (18). Random intercept models were used incorporating random effects at both levels in addition to the levels 1 and 2 explanatory variables. For dichotomous outcome variables, i.e., the registration and achievement of blood pressure levels, hierarchical logistic regression models were estimated using the statistical program MLwiN (19). Continuous explanatory variables were centered around the mean. For the treatment of hypertension, a multinomial logistic regression model was fitted using the MIXNO program,

which allows for the analysis of categorical outcomes (18,20). The likelihood of receiving treatment with an ACE inhibitor was compared with receiving no antihypertensive treatment and with receiving a treatment with another antihypertensive drug. The deviance test was used to assess whether the proportion of variance at the physician level significantly differed from zero. Finally, a multilevel multivariate regression model was used to estimate the effect of the explanatory variables on diastolic and systolic blood pressures as continuous outcome variables. The multivariate term refers to the two dependent variables (diastolic and systolic blood pressures) that are analyzed jointly (18).

The asthma/chronic obstructive pulmonary disease comorbidity was only included in the treatment model because it may affect the choice of treatment. Furthermore, a possible interaction effect between age and sex of the patient was included in the treatment model because it appears that older women especially receive more diuretics and fewer ACE inhibitors for hypertension (13).

**RESULTS**— Most of the 95 general practitioners were men (85.3%), and their mean age was  $47 \pm 6.4$  years (mean  $\pm$  SD). Work experience was <10 years for 28.4% and >20 years for 38.9%. The majority worked in a single-handed practice (57.9%) and in a rural area (61.1%). The mean practice size was  $2,299 \pm 531$  patients, and 25.3% were dispensing practices. Of the 895 type 2 diabetic patients, 56% were women, and their mean age was 67 years (Table 1). The average recorded duration of diabetes was 5.5 years, ranging from 0.5 to 31 years (median 4.1). Of the 481 (54%) patients having a recent HbA<sub>1c</sub> measurement, 36% had a value <7%, whereas 14% had an HbA<sub>1c</sub> >8.5%.

### Blood pressure management

Registration of blood pressure in the past year was found in 652 (73%) of the case subjects. In the 243 subjects without recent registration, 115 had blood pressure measurements recorded >1 year before, 80% of which were >135/85 mmHg. Of the 595 type 2 diabetic patients with hypertension, 32% were not receiving antihypertensive treatment, 32% were receiving an ACE inhibitor as monotherapy or in combination with other antihypertensives, and 35% were receiving

**Table 1—Patient factors registered in medical records (n = 895)**

	Mean $\pm$ SD	% (SE)
Age (years)	67.3 $\pm$ 12.7	—
Duration of diabetes (years)*	5.5 $\pm$ 5.2	—
Diastolic blood pressure (mmHg)†	83.3 $\pm$ 9.2	—
Systolic blood pressure (mmHg)†	149.9 $\pm$ 18.2	—
HbA <sub>1c</sub> (%)‡	7.5 $\pm$ 1.2	—
Women	—	55.8 (1.7)
Hyperlipidemia§	—	16.0 (1.2)
Overweight	—	25.1 (1.5)
Smoking	—	9.7 (1.0)
Cerebrovascular disease	—	5.9 (0.8)
Coronary artery disease	—	17.9 (1.3)
Asthma/chronic obstructive pulmonary disease	—	14.6 (1.2)
Specialist care	—	20.4 (1.4)
Care by diabetes facility	—	38.1 (1.6)
Antidiabetic treatment		
No medication	—	18.2 (1.3)
Oral blood glucose-lowering drugs	—	67.5 (1.6)
Insulin alone or with oral agents	—	14.4 (1.2)

\*Available for 599 patients; †average blood pressure in the last year in the 652 patients (73%) with available measurements; ‡latest recording in the 481 patients (54%) with HbA<sub>1c</sub> measurements in the last year; §total cholesterol measured in the last year (22%) >5.0 mmol/l and/or hyperlipidemia in the medical record; and ||BMI measured in the last 3 years (23%), >27 kg/m<sup>2</sup>, and/or being overweight in the medical record.

antihypertensive treatment not including an ACE inhibitor, such as monotherapy with a  $\beta$ -blocking agent (7.4%), diuretic (5.0%), or treatment including an angiotensin II antagonist (6.3%). As for the number of antihypertensives prescribed, 46% of the 403 treated hypertension patients received monotherapy, whereas 18% received three or more different antihypertensives. Of the patients not receiving ACE inhibitor treatment, five had side effects mentioned in their medical record as reason to quit ACE inhibitor use. In another three patients there was mention of previous ACE inhibitor use, but no reasons for quitting were documented. For another nine patients, problems with medication compliance were stated in their medical records.

In the 652 patients with available blood pressure measurements, the mean systolic blood pressure was 150 mmHg and the mean diastolic blood pressure was 83 mmHg (Table 1). Twenty percent of the population with available blood pressure measurements had a blood pressure  $\leq$ 135/85, 24% were <140/90, and 66% were <160/95 mmHg. Most of the problems in achieving target levels were seen in the systolic blood pressure because only 21% of the patients achieved a systolic blood pressure  $\leq$ 135 mmHg, whereas 63% had a diastolic blood pres-

sure  $\leq$ 85 mmHg. There were four patients with a diastolic blood pressure  $\leq$ 60 mmHg, and they all had a systolic blood pressure  $\leq$ 120 mmHg.

### Factors associated with blood pressure management and control

Patient factors associated with a good registration of blood pressure were being overweight and having coronary artery disease (Table 2, model 1). In the univariate analysis, mean duration of diabetes was significantly shorter and HbA<sub>1c</sub> lower for patients with a blood pressure registration in comparison with those without blood pressure registration (duration 5.2 vs. 6.4 years,  $P = 0.02$ ; HbA<sub>1c</sub> 7.4 vs. 7.7%,  $P = 0.03$ ). Both of these variables could not be incorporated in the multilevel analyses because information was lacking in >30% of patients. Taking all of the other patient factors into account in the multilevel model, patients receiving care from a specialist or the diabetes facility were more likely to have a good blood pressure registration. Adjusting for patient- and practice-related characteristics, patients treated by female general practitioners had a significantly better registration of blood pressure compared with male general practitioners, as did patients treated by general practitioners with <10 years of work experience compared with

Table 2—Multilevel analyses for the three aspects of hypertension management

	Registration of blood pressure (n = 895) Model 1	Treatment of hypertension (n = 595)		Blood Pressure target level ≤135/85 mmHg (n = 652) Model 3
		No treatment versus ACE inhibitor Model 2A	Other treatment versus ACE inhibitor Model 2B	
<b>Patient factors</b>				
Age	1.01 (1.00–1.03)	1.01 (0.99–1.04)	1.05 (1.01–1.09)	0.97 (0.95–0.98)
Sex (male)	0.75 (0.52–1.07)	1.51 (0.76–3.00)	1.07 (0.61–1.89)	1.20 (0.78–1.84)
Overweight	1.87 (1.16–3.03)	0.92 (0.48–1.79)	0.85 (0.41–1.77)	0.67 (0.40–1.11)
Smoking	1.05 (0.57–1.93)	3.78 (1.09–13.11)	3.15 (0.79–12.63)	1.41 (0.74–2.69)
Hyperlipidemia	1.37 (0.80–2.33)	0.42 (0.19–0.92)	0.65 (0.26–1.61)	1.17 (0.66–2.08)
Coronary artery disease	1.96 (1.16–3.29)	0.52 (0.21–1.29)	1.62 (0.74–3.57)	1.38 (0.79–2.40)
Cerebrovascular disease	0.88 (0.40–1.92)	1.00 (0.21–4.74)	2.17 (0.63–7.47)	0.85 (0.33–2.21)
Asthma/chronic obstructive pulmonary disease	Not included	1.93 (0.78–4.76)	1.66 (0.64–4.30)	Not included
Interaction factor age × sex	Not included	0.98 (0.94–1.02)	0.97 (0.91–1.02)	Not included
<b>Organizational factors</b>				
Specialist care	3.40 (2.00–5.80)	0.40 (0.20–0.80)	0.62 (0.34–1.13)	0.57 (0.32–1.01)
Care by diabetes facility	2.37 (1.56–3.61)	1.41 (0.71–2.81)	1.13 (0.57–2.24)	1.15 (0.72–1.84)
Type of practice (partnership)	1.14 (0.61–2.13)	1.58 (0.75–3.34)	2.17 (0.94–5.00)	1.01 (0.58–1.78)
Size of practice	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
<b>Location of practice</b>				
Urban	1.00	1.00	1.00	1.00
Semirural	0.88 (0.30–2.61)	2.43 (0.40–14.97)	1.37 (0.20–9.34)	1.09 (0.45–2.65)
Rural	0.88 (0.42–1.85)	0.75 (0.31–1.80)	0.68 (0.30–1.54)	0.58 (0.29–1.15)
<b>Physician factors</b>				
Sex (male)	0.30 (0.12–0.71)	0.90 (0.35–2.30)	0.53 (0.17–1.62)	0.81 (0.40–1.66)
<b>Work experience (years)</b>				
≤10	1.00	1.00	1.00	1.00
10–20	0.46 (0.23–0.91)	1.03 (0.47–2.24)	0.60 (0.26–1.38)	0.99 (0.52–1.88)
>20	0.61 (0.31–1.21)	1.34 (0.59–3.02)	1.02 (0.42–2.51)	0.78 (0.42–1.44)
Dispensing doctor	1.72 (0.83–3.55)	0.72 (0.30–1.73)	1.18 (0.50–2.79)	1.14 (0.57–2.25)

Data are odds ratio (95% CI).

general practitioners with 10–20 years of work experience.

Patients receiving care from a specialist and patients with hyperlipidemia were more likely to be treated with an ACE inhibitor than with no treatment, whereas smokers had a significantly higher chance of not being treated (Table 2, model 2A). Older patients were somewhat more likely to receive other antihypertensive treatments than ACE inhibitors, such as diuretics (Table 2, model 2B). Duration of diabetes and HbA<sub>1c</sub> were not significantly associated with hypertension treatment.

Older patients were less likely to achieve the target level of ≤135/85 mmHg (Table 2, model 3). No other factors were significantly related to achievement of the target level. In the multivariate model analyzing the continuous values of diastolic and systolic blood pressures, older age of the patients was significantly associated with a lower diastolic blood

pressure and a higher systolic blood pressure (data not shown).

The deviance tests of random intercept were highly significant in all of the models ( $\chi^2 = 100.5$  for blood pressure registration,  $P < 0.001$ ;  $\chi^2 = 173.3$  for treatment of hypertension,  $P < 0.001$ ;  $\chi^2 = 19.9$  for blood pressure target level,  $P < 0.001$ ), indicating that there remained significant differences between general practitioners after controlling for the effect of the included physician, practice, and patient characteristics.

**CONCLUSIONS**— Our study shows that registration of blood pressure in primary care was adequate in 73% of the patients with type 2 diabetes. The proportion of these patients with a blood pressure ≤135/85 mmHg was 20%, and 24% were <140/90 mmHg. The need for improvement is seen when our results are compared with the goals set by the Diabe-

tes Physician Recognition Program Comparison, which state that in 97% of adult patients a blood pressure should be taken once a year and that the proportion of adult patients with a blood pressure <140/90 mmHg should be 65% (21). In several clinical trial settings, however, stringent target levels were reached in only 50–60% of the patients, and it has been suggested that in routine diabetes practice it is more realistic to aim for 75% of patients to be <160/95 mmHg (22). In our study population, this level was reached in 66% of the subjects.

The lack of achievement of blood pressure target levels was largely due to a lack of systolic blood pressure control in this elderly population. There were, however, no patients in this population combining high systolic blood pressure levels with a low diastolic blood pressure. Many hypertensive patients could have had their treatment intensified. The percent-

age of patients not receiving antihypertensives was 32%, which is comparable with the range of 27–43% found in other studies (2,4). In addition, almost half of the patients received only monotherapy for their hypertension. It seems that physicians are willing to accept a higher systolic blood pressure than put forward by the treatment guidelines (23). A survey among primary care physicians in the U.S. also showed that they were more likely to start or intensify treatment for a mildly elevated diastolic blood pressure than for a mildly elevated systolic blood pressure (24).

Of the hypertension patients treated with medication, less than half received treatment with an ACE inhibitor. Contraindications or documented lack of patient compliance could account for only a very small percentage of this. The use of angiotensin II antagonists, which may be considered an alternative in case of side effects from ACE inhibitors, was relatively small.

Assessing the relative influence of specific physician and practice characteristics in relation to patient factors is important for the development of targeted interventions to improve the quality of care (15). Our study showed that several patient-related factors are associated with the quality of hypertension management. Type 2 diabetic patients with risk factors, such as being overweight and having a cardiovascular comorbidity, had a better blood pressure registration than that of patients without these additional risk factors. From the point of view that stringent blood pressure control is especially needed in a high-risk population, this could reflect an efficient way of dealing with time pressures experienced in general practice (25). The choice of treatment was also influenced by patient factors. Older hypertensive diabetic patients were more likely to receive other antihypertensives, such as diuretics, instead of ACE inhibitors. This preference for diuretics in older patients has also been described for hypertension treatment in general (26). Finally, hypertensive patients who smoked were more likely to receive no treatment. It is not clear whether this is partly a patient compliance problem. Patients who cannot be persuaded to stop smoking might also be less motivated to take preventive medication.

Controlling for patient- and practice-related factors, there was a significant

influence of the physician on the management activities, i.e., blood pressure registration and hypertension treatment. Female physicians showed better blood pressure registrations, as did physicians with <10 years of work experience. Previous studies (11,15) have also shown a positive relation between female physicians and quality-of-care aspects. Regarding the choice of treatment, we could not identify specific general practitioner characteristics that were related to better treatment, but the deviance test showed that there remained significant differences between general practitioners after controlling for the effect of the included physician, practice, and patient characteristics. There may be other characteristics, e.g., personal beliefs about optimal treatment, which may further explain differences between general practitioners. Although Pelligrini et al. (16) showed that physician beliefs about blood pressure management in diabetic patients were not related to blood pressure control, there may be relevant differences in beliefs about the choice of treatment. These could be related to differences in the general practitioners' preference for following a specific guideline. Most guidelines recommend ACE inhibitors as first-choice drugs, but the Dutch guidelines for general practitioners recommend diuretics in patients without microalbuminuria. Also, target levels recommended in the various guidelines range from 130/80 to 150/85 mmHg (17).

Patients visiting the diabetes facility had a better registration of their blood pressure, but this did not appear to lead to better treatment of hypertension or better achievement of target levels. This is probably due to the fact that the diabetes facility in our study region advises the general practitioners mainly about blood glucose-lowering treatment and only reports the blood pressure measurements to the general practitioner. More active recommendations are probably needed to trigger changes in hypertension treatment. General practitioners may be helped by having an alerting system for patients with consistent suboptimal blood pressure recordings (27).

Specialist care was positively associated with better registration of blood pressure and treatment of hypertension with ACE inhibitors but had no detectable influence on the achievement of target levels. Despite our adjustment for age,

sex, and comorbidity of the patients, there may be other patient-related factors explaining why blood pressure levels of patients referred to a specialist are more difficult to control.

The population of general practitioners included in our study was typical for our region, including a relatively large proportion of single-handed, male, dispensing general practitioners. This is a potential limitation for drawing conclusions about the quality of hypertension management in general, but it does not hamper the analysis of factors influencing this quality. A similar restriction should be noted for the patient population because patients with heart failure were excluded. This subpopulation is more likely to have a rigorous monitoring of blood pressure and treatment with ACE inhibitors and  $\beta$ -blocking agents. The prevalence of heart failure in type 2 diabetes has been estimated at 12% (28).

Another limitation of the study is its reliance on review of medical records. This source reflects the clinical information considered relevant by the general practitioner, but may result in an underestimation of the quality of care (29). Physicians usually record issues like smoking habits and being overweight more often when present than when absent, but they were found to be quite accurate in recording physical examinations and blood pressures (29,30). Underestimates are expected in the recording of other conditions, such as hyperlipidemia. Assessment of blood pressure levels was limited to patients who had a blood pressure recorded in the last year. Among the 115 patients who did have earlier blood pressure measurements, 80% did not reach the target level, suggesting that our estimates regarding achievement of blood pressure target levels were not much affected by lack of blood pressure registration. As for the registration of drug treatment, 95% of the general practitioners in the Netherlands prescribe electronically and their prescriptions are automatically recorded in the electronic medical records. Only initial drug prescriptions from specialists are usually not recorded in the medical files of the general practitioner. Commonly, specialists' prescriptions intended for chronic use are repeated by the general practitioners and will subsequently appear in their medical records.

We used blood pressure measure-

ments as recorded in the medical records. These are measured by a variety of methods and individuals. Some may be more affected by white coat hypertension than others. This could lead to an overestimation of the number of patients classified as having hypertension.

We conclude that hypertension management in type 2 diabetic patients in primary care is suboptimal. Characteristics of the general practitioners as well as additional care provided by a diabetes facility or a specialist are associated with either better registration or better treatment of blood pressure, but blood pressure outcomes are not as clearly related to these factors. Interventions aimed at achieving better process-of-care goals could be targeted at certain general practitioners. To achieve better outcomes of care, however, support should be given in general to intensify the treatment of hypertension, focusing especially on systolic blood pressure. In addition, extra attention is needed for hypertensive patients who smoke.

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