Background—There is concern that performance measures, patient ratings of their care, and pay-for-performance programs may penalize healthcare providers of patients with multiple chronic coexisting conditions. We examined the impact of coexisting conditions on the quality of care for hypertension and patient perception of overall quality of their health care.

Methods and Results—We classified 141,609 veterans with hypertension into 4 condition groups: those with hypertension-concordant (diabetes mellitus, ischemic heart disease, dyslipidemia) and/or -discordant (arthritis, depression, chronic obstructive pulmonary disease) conditions or neither. We measured blood pressure control at the index visit, overall good quality of care for hypertension, including a follow-up interval, and patient ratings of satisfaction with their care. Associations between condition type and number of coexisting conditions on receipt of overall good quality of care were assessed with logistic regression. The relationship between patient assessment and objective measures of quality was assessed. Of the cohort, 49.5% had concordant-only comorbidities, 8.7% had discordant-only comorbidities, 25.9% had both, and 16.0% had none. Odds of receiving overall good quality after adjustment for age were higher for those with concordant comorbidities (odds ratio, 1.78; 95% confidence interval, 1.70 to 1.87), discordant comorbidities (odds ratio, 1.32; 95% confidence interval, 1.23 to 1.41), or both (odds ratio, 2.25; 95% confidence interval, 2.13 to 2.38) compared with neither. Findings did not change after adjustment for illness severity and/or number of primary care and specialty care visits. Patient assessment of quality did not vary by the presence of coexisting conditions and was not related to objective ratings of quality of care.

Conclusions—Contrary to expectations, patients with greater complexity had higher odds of receiving high-quality care for hypertension. Subjective ratings of care did not vary with the presence or absence of comorbid conditions. Our findings should be reassuring to those who care for the most medically complex patients and are concerned that they will be penalized by performance measures or patient ratings of their care. (Circulation. 2009;119:2978-2985.)

Key Words: comorbidity ■ hypertension ■ physician incentive plans ■ process assessment (health care) ■ quality indicators, health care
pothesis, Turner and colleagues found that a higher number of unrelated conditions decreases the likelihood that the patient will receive appropriate care for uncontrolled hypertension.

In addition to concerns about the impact of patient complexity on performance measures, healthcare providers also were concerned that with increasing numbers of comorbid conditions, patient ratings of their care may suffer. The reason is that “high-quality” care may come with a burden of large numbers of medications and healthcare use that lower the satisfaction of patients overall. An evaluation of clinical practice guideline adherence found that a hypothetical older adult with 5 common comorbidities would be prescribed at least 12 medications. In addition, because evidenced-based guidelines focus on single disease processes and fail to account for patients with multiple comorbidities, the potential risks and benefits of such therapy, particularly in elderly patients, are unclear. We are not aware of studies assessing how patient perceptions of the quality of their care are affected by the presence of concordant and/or discordant conditions.

Thus, it is possible that healthcare providers may be penalized by both performance measures and patient ratings of their care if these measures do not account for the extra effort and complexity in caring for patients with comorbid diseases, especially patients with discordant conditions. The goal of this analysis was to determine the impact of different types of coexisting chronic diseases on the measured quality of care for hypertension and patient perceptions of quality and to assess how these measures vary with the presence of hypertension-concordant and hypertension-discordant clinical conditions.

Methods

Study Setting and Study Population

We identified veterans with hypertension who received primary care in fiscal year (FY) 2005 in 8 Veterans Affairs (VA) facilities in 3 states. We used VA Decision Support System clinics to identify primary care encounters. Veterans were defined as having hypertension if they had any of the following documented in either FY 2004 or 2005 in the VA National Patient Care Database or the VA fee-basis files: 2 outpatient diagnosis codes or 1 inpatient diagnosis code indicating hypertension (International Classification of Diseases, ninth revision, clinical modification codes 401 to 405) or at least 2 elevated blood pressure readings (defined as systolic reading \( \geq 140 \) mm Hg or diastolic reading \( \geq 90 \) mm Hg) at least 4 weeks apart.

We extracted blood pressure readings for the cohort from a data warehouse, a repository of clinical and demographic information for patients receiving care at medical centers and community-based outpatient clinics. We excluded patients with a limited life expectancy and those who died during the study period or the follow-up period.

We assigned each patient in the study cohort an index date using the date of the last blood pressure reading in FY 2005. For those patients who did not have their blood pressure recorded in FY 2005, we used their last outpatient visit in FY 2005 as their index date.

Hypertension-Concordant and -Discordant Conditions

Using diagnosis and procedures codes plus laboratory and pharmacy data, we identified chronic conditions that were concordant and discordant with hypertension. The concordant conditions of diabetes, dyslipidemia, and ischemic heart disease were selected because their pathophysiological risk profiles are similar to that of hypertension. The discordant conditions of arthritis, chronic obstructive pulmonary disease, and depression were chosen because these conditions are not related to either hypertension disease development or management. Concordant and discordant conditions were identified in the 2-year period before the patient’s index date, and patients were categorized into 4 mutually exclusive groups: (1) no other comorbid chronic conditions (among the 6 studied), (2) only hypertension-discordant conditions, (3) only hypertension-concordant conditions, and (4) both hypertension-concordant and -discordant conditions. We required 2 outpatient diagnosis codes or 1 inpatient diagnosis code for the coexisting study conditions.

Outcomes

We used the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) guidelines to identify the proportion of patients having controlled hypertension at index, defined as having a blood pressure reading of \(<140/90\) mm Hg. Because FY 2005 VA performance assessment did not use the JNC 7 guideline of blood pressure \(<130/80\) mm Hg for patients with coexisting diabetes, we did not use the guideline to define controlled hypertension for this study. For those patients with uncontrolled hypertension at index, we examined a 6-month follow-up period to ascertain whether medication adjustments were made by the patient’s healthcare provider regardless of blood pressure achieved or whether the patient’s last blood pressure reading was at goal (appropriate follow-up). For those patients who did not have a reading in FY 2005, we looked for blood pressure recordings 6 months from their last outpatient encounter. For those with readings during the follow-up period, we used their first reading to determine hypertension status (controlled or uncontrolled). For those patients with blood pressure readings that were not at goal, we assessed whether they received appropriate care during the time remaining in the follow-up period (Figure 1).

We designated patients as being on an antihypertensive medication at the time of their index date in FY 2005 if they had evidence of a prescription filled in the 100 days before the index date. We computed the average daily dosage of a medication to examine medication dosage changes during the follow-up interval. The average daily dosage was computed using the following formula: (quantity of medication/days supplied) \( \times \) numeric dosage. To remove questionable data, we set limits on the minimum and maximum average daily dosages on the basis of the prescribing instructions for each drug.

To quantify the overall level of appropriate hypertension quality of care provided for patients with hypertension, we summed the number of patients who met the JNC 7 blood pressure guideline at the FY 2005 index date and the number of patients who received appropriate care during the 6-month follow-up period. Fulfillment of either of these criteria is called “overall good quality” in the following discussion.

We assessed patients’ responses about satisfaction with outpatient care from the Survey of Health Experiences of Patients, a questionnaire administered via mail by the VA Office of Quality and Performance. The methods used in the survey have been described previously. We analyzed the Likert scale responses to the survey question, “Overall, how would you rate the quality of care you received during the past 2 months?” We dichotomized the responses as either patient-reported positive quality (very good and excellent responses) or patient-reported negative quality (poor, fair, and good responses). The overall outpatient response rate for the Survey of Health Experiences of Patients questionnaire is 70.3%. The patients who responded had similar demographic characteristics, illness burden, and healthcare use compared with those who did not respond or were not surveyed.

Analysis

We examined the proportion of hypertensive patients with blood pressure controlled at index, who received appropriate care in the 6-month follow-up period, and who achieved overall good quality by...
chronic condition category. We used logistic regression to determine the impact of type and number of study conditions on the likelihood of having blood pressure controlled at index and of receiving appropriate follow-up care and overall good quality of care for hypertension. We calculated the odds ratios (ORs) from a model adjusted only for age, a model adjusted for age and illness burden, and a model that also included the number of primary care and specialty care visits during the year before the patient’s index date. Confidence intervals (CIs) for control at index and appropriate follow-up were calculated on the basis of a type I error of 0.05. CIs for overall good quality were calculated on the basis of a type I error of 0.025 because it is a compound event. Diagnosis-relevant specialty care visits were determined (ie, visits to the pulmonary clinic were counted as specialty encounters if the patient had coexisting chronic obstructive pulmonary disease but not counted as specialty visits in the absence of chronic obstructive pulmonary disease). We used Diagnostic Cost Group Relative Risk Scores to represent patients’ illness burden. Each model accounted for clustering of patients by facility. We conducted a sensitivity analysis to assess the impact of using shorter follow-up intervals (3 and 4 months compared with 6 months). We used χ² analyses to evaluate the relationship between patient perceptions of quality and objective ratings of receipt of good quality across the condition groups and number of coexisting conditions. All analyses were conducted with SAS version 9.1.3 (SAS Institute Inc, Cary, NC). This study was approved by the Institutional Review Board at Baylor College of Medicine and the Michael E. DeBakey VA Research and Development Committee.

The authors had full access to and take full responsibility for the integrity of the data. All authors have read and agree to the manuscript as written.

Results
Of the 141,609 hypertensive patients in the cohort (Figure 2), 22,595 (16.0%) had no other comorbid conditions, 70,098 (49.5%) had concordant-only conditions, 12,283 (8.7%) had discordant-only conditions, and 36,633 (25.9%) had both types of conditions (Table 1). As expected, illness burden, assessed with the Diagnostic Cost Group Relative Risk Score, varied according to comorbidity group. Those with no other coexisting chronic conditions had the lowest mean score (0.94), and the group with both types of conditions had the highest mean score (1.70; P<0.001). Hypertensive patients had on average 3.7 primary care visits and 0.8 diagnosis-related specialty care visit in the year before entry into the cohort. Mean prior primary care and specialty care use was lowest in the group with no other comorbid conditions (3.0 and 0.1 visits, respectively) and was highest in the group with both types of comorbidities (4.6 and 2.0 visits, respectively; P<0.001).

The number and proportion of hypertensive patients receiving appropriate quality of care are shown in Table 2. The number of hypertensive patients with blood pressure controlled at index was 12,956 (57.3%) for those with no other comorbid conditions, 45,334 (64.7%) for those with concordant-only conditions, 7742 (63.0%) for those with discordant-only conditions, and 25,339 (69.2%) for those with both concordant and discordant conditions (P<0.001). Among those who did not have blood pressure controlled at index, the proportion of patients with appropriate follow-up within 6 months ranged from 53.7% for those with no other comorbid conditions to 69.0% for those with both types of conditions (P<0.001). The proportion of patients with overall good quality (blood pressure controlled at index, medication change, or subsequent reading indicating control within 6 months) varied by condition type, with 80.2% of hypertensive patients with no other comorbid conditions studied having overall good quality and 90.4% with both types of conditions achieving overall good quality (P<0.001). Of the 49,049 patients with uncontrolled blood pressure at index, 27.3% did not receive treatment intensification or have a blood pressure reading in the follow-up period. These patients were classified as having poor quality of care.

In analyses adjusted for age alone and age and illness burden, blood pressure control at index was positively asso-
associated with having chronic comorbid conditions (Table 2). Hypertensive patients having both types of conditions were significantly more likely to be controlled at index than patients with no other comorbid conditions after adjustment for patient age (model 1) (OR, 1.61; 95% CI, 1.56 to 1.67). The adjusted odds of receiving appropriate follow-up within 6 months were higher for those with concordant and both condition types compared with those with no other comorbid conditions (OR, 1.64; 95% CI, 1.57 to 1.73; and OR, 1.91; 95% CI, 1.80 to 2.02, respectively). Compared with those with no other comorbid conditions, receipt of overall good quality was highest for those with both types of conditions (OR, 2.25; 95% CI, 2.13 to 2.38). Analyses examining the frequency of comorbid conditions demonstrated that the odds of receiving quality care increased as the number of conditions increased.

Our findings did not change after additional adjustment for illness burden (model 2). Adjustment for the number of primary care and specialty care visits in 1 year before the patient’s index date did not change the patient’s likelihood of having blood pressure controlled at index, appropriate follow-up, and overall good quality (data available on request).

To address the question of whether the 6-month follow-up window explained the majority of the results, we conducted a sensitivity analysis substituting 3-month and 4-month follow-up time periods for the 6-month time window. Regardless of the length of follow-up, we found similar results, suggesting that the choice of a 6-month follow-up window was not solely responsible for the findings.

**Patient’s Perceptions of Quality**

To explore the relationship between patient assessment of the receipt of good quality and performance measures, we assessed the perceptions of quality among a subset of 4432 patients in the cohort. Of these, 74.6% of the responses were either “excellent” or “very good.” We found that the proportion of patients with these responses was similar among patients with and without measured overall good quality of care (74.7% and 74.0%, respectively; \( \chi^2 = 0.13; P = 0.72 \)). The results were similar across conditions groups, number of coexisting conditions, age groups, and Diagnostic Cost Group Relative Risk Score groups. Our findings did not change when we added those patients with the response “good” as an indicator of patient-reported positive quality (data not shown). We also evaluated responses to the additional survey question, “All things considered, how satisfied are you with your health care in the VA?” to ensure that our findings were robust to other dimensions of patient views of their care. This alternative measure of patient satisfaction did not yield different findings (data not shown).

**Discussion**

We assessed the quality of care for hypertension (objective measure) and patient perceptions of quality (subjective measure) and evaluated how these 2 dimensions of quality varied with the presence of hypertension-concordant and hypertension-discordant clinical conditions. A strikingly high 90% of the patients with hypertension who had both types of conditions received overall good quality of care. Patients with both concordant and discordant types of conditions were almost twice as likely as those without any such conditions to receive appropriate overall quality of care for hypertension. In marked contrast to other studies conducted solely in a non-VA setting,\textsuperscript{6,7} we found that as the number of chronic conditions increased, so did the odds of receiving appropriate overall care for hypertension. Our findings extend those of another report that found that quality of care increased as a patient’s number of comorbidities increased. That study used a simple count of comorbid conditions (rather than assessing the nature of the relationship between specific types of conditions) and did not assess data on patient experience of care.\textsuperscript{10}
Interestingly, despite the high quality of care as measured objectively, we did not find a relationship between provision of guideline-recommended care and the subjective measure of patient perception of quality. The reason may be that practice guidelines do not capture other nuances of clinical care delivered.22,23 In addition, consumers’ conceptualization of quality of care may differ from the way it is measured and reported,24 although few studies address this important topic.

Several factors may hinder the provision of guideline-recommended care in a patient with multiple comorbidities. Comorbid conditions complicate treatment plans and patient compliance.12 Other factors include lack of physician and/or patient acceptance of guidelines, variation in patient preferences, and competing demands that limit the number of problems that can be addressed during a single office visit.25–28 Other studies have suggested that strict guideline adherence in patients with multiple comorbidities may lead to unintended consequences and contribute to higher rates of adverse health outcomes. For example, studies indicate that as the number of daily medications that a patient is prescribed increases, medication adherence decreases.29–32 Thus, an older adult who is prescribed numerous medications in accordance with clinical practice guidelines may be less adherent to

Table 1. Characteristics of the Hypertension Cohort by Chronic Condition Group, FY 2005

<table>
<thead>
<tr>
<th>Chronic Condition Group</th>
<th>All (N=141 609)</th>
<th>No Other Comorbid Conditions (n=22 595)</th>
<th>Discordant Only* (n=12 283)</th>
<th>Concordant Only† (n=70 098)</th>
<th>Both (n=36 633)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comorbidities, mean (SD), n</td>
<td>1.6 (1.1)</td>
<td>0</td>
<td>1.2 (0.4)</td>
<td>1.7 (0.7)</td>
<td>2.8 (0.8)</td>
</tr>
<tr>
<td>Type of comorbidity, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthritis</td>
<td>20.8</td>
<td>NA</td>
<td>60.5</td>
<td>NA</td>
<td>60.2</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disorder</td>
<td>12.0</td>
<td>NA</td>
<td>32.7</td>
<td>NA</td>
<td>35.6</td>
</tr>
<tr>
<td>Depression</td>
<td>7.5</td>
<td>NA</td>
<td>22.6</td>
<td>NA</td>
<td>21.4</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>32.4</td>
<td>NA</td>
<td>NA</td>
<td>44.0</td>
<td>40.9</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>68.4</td>
<td>NA</td>
<td>NA</td>
<td>90.9</td>
<td>90.4</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>23.6</td>
<td>NA</td>
<td>NA</td>
<td>30.3</td>
<td>33.2</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>63.4 (12.4)</td>
<td>58.9 (14.5)</td>
<td>61.2 (13.9)</td>
<td>64.7 (11.6)</td>
<td>64.4 (11.4)</td>
</tr>
<tr>
<td>Age group, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;55 y</td>
<td>23.3</td>
<td>39.1</td>
<td>33.5</td>
<td>18.5</td>
<td>19.2</td>
</tr>
<tr>
<td>55–64 y</td>
<td>29.7</td>
<td>26.2</td>
<td>26.9</td>
<td>30.0</td>
<td>32.1</td>
</tr>
<tr>
<td>65–74 y</td>
<td>25.1</td>
<td>16.6</td>
<td>18.0</td>
<td>28.6</td>
<td>26.2</td>
</tr>
<tr>
<td>≥75 y</td>
<td>22.0</td>
<td>18.1</td>
<td>21.7</td>
<td>23.0</td>
<td>22.5</td>
</tr>
<tr>
<td>Diagnostic cost group relative risk score, mean (SD)</td>
<td>1.22 (1.85)</td>
<td>0.94 (1.42)</td>
<td>1.44 (1.89)</td>
<td>1.02 (1.60)</td>
<td>1.70 (2.34)</td>
</tr>
<tr>
<td>Diagnostic cost group relative risk score group, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.50</td>
<td>46.9</td>
<td>55.0</td>
<td>37.5</td>
<td>53.2</td>
<td>32.9</td>
</tr>
<tr>
<td>0.50–0.99</td>
<td>19.8</td>
<td>17.4</td>
<td>20.7</td>
<td>19.5</td>
<td>21.6</td>
</tr>
<tr>
<td>1.00–1.99</td>
<td>16.0</td>
<td>14.6</td>
<td>19.7</td>
<td>13.9</td>
<td>19.7</td>
</tr>
<tr>
<td>≥2.00</td>
<td>17.4</td>
<td>13.1</td>
<td>22.2</td>
<td>13.4</td>
<td>25.9</td>
</tr>
<tr>
<td>Outpatient primary care visits to VA in 1 y prior, mean (SD), n</td>
<td>3.7 (3.3)</td>
<td>3.0 (2.7)</td>
<td>3.9 (3.4)</td>
<td>3.5 (3.0)</td>
<td>4.6 (3.8)</td>
</tr>
<tr>
<td>Outpatient specialty care visits to VA in 1 y prior, mean (SD), n</td>
<td>0.8 (2.7)</td>
<td>0.1 (0.5)</td>
<td>1.6 (3.7)</td>
<td>0.3 (1.2)</td>
<td>2.0 (4.2)</td>
</tr>
<tr>
<td>Indicator of hypertension, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP ≥140/90 mm Hg‡</td>
<td>70.3</td>
<td>73.5</td>
<td>80.2</td>
<td>66.0</td>
<td>73.3</td>
</tr>
<tr>
<td>ICD-9-CM diagnosis code§</td>
<td>84.4</td>
<td>72.5</td>
<td>70.5</td>
<td>89.1</td>
<td>87.3</td>
</tr>
<tr>
<td>Met both indicators</td>
<td>54.7</td>
<td>46.0</td>
<td>50.7</td>
<td>55.1</td>
<td>60.6</td>
</tr>
<tr>
<td>Only met BP criterion</td>
<td>15.6</td>
<td>27.5</td>
<td>29.5</td>
<td>10.9</td>
<td>12.7</td>
</tr>
<tr>
<td>Only ICD-9-CM code</td>
<td>29.7</td>
<td>26.5</td>
<td>19.8</td>
<td>34.0</td>
<td>26.7</td>
</tr>
</tbody>
</table>

ICD-9-CM indicates International Classification of Diseases, 9th revision, clinical modification; BP, blood pressure.
*Discordant-only conditions include arthritis (rheumatoid and osteoarthritis), chronic obstructive pulmonary disease, and depression.
†Concordant-only conditions include diabetes, ischemic heart disease, and dyslipidemia.
‡At least 2 elevated blood pressure readings (defined as systolic reading ≥140 mm Hg or diastolic reading ≥90 mm Hg) recorded at least 4 weeks apart in FY 2004 or 2005.
§Two outpatient diagnosis codes or 1 inpatient diagnosis code indicating hypertension (ICD-9-CM codes 401 to 405) in FY 2004 or 2005.
his or her prescribed regimen, leading to poorer health outcomes. Alternatively, taking numerous medications as may be required with strict adherence to clinical practice guidelines may lead to unintended consequences in older patients such as increased adverse drug reaction–related hospitalizations.33,34

Contrary to our expectations, we did not find that increasing numbers of comorbid conditions reduced the overall quality of care for hypertension. We determined that our findings were not solely explained by confounding caused by the number of primary care visits, subspecialty care visits, or our choice of a 6-month compared with a shorter follow-up window. Indeed, care delivered in the VA for single conditions is of higher quality generally than non-VA care,36 this may have lessened our ability to demonstrate variation in the care delivered to patients in our cohort.

### Conclusions

The proportion of guideline-recommended care provided to patients with multiple comorbidities and the impact of such care on overall quality for these patients are of particular concern to healthcare providers. We found that hypertensive patients with the most complex medical conditions were more likely than those without such conditions to have higher overall quality of care for hypertension. Interestingly, we did not find a relationship between good quality and higher (or lower) patient perception of quality, regardless of the presence or absence of various types of comorbid conditions. This relationship was not due to confounding by primary care or specialty care visits. Therefore, healthcare providers appear to be identifying patients at highest risk and focusing their
efforts on hypertension control in this group without a significant association with patient ratings of their care.

Our results should be reassuring for policy makers who have faced criticism that performance measures, public reporting, and pay-for-performance initiatives may penalize healthcare providers of patients with multiple coexisting chronic conditions. Our findings suggest that performance measurement programs will not necessarily penalize those providers who care for the most medically complex patients.

Acknowledgment
We thank the VA Office of Quality and Performance for providing access to the Survey of Health Experiences of Patients data presented in this article.

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Disclosures
None.

References
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Will Hypertension Performance Measures Used for Pay-for-Performance Programs Penalize Those Who Care for Medically Complex Patients?
Laura A. Petersen, LeChauncy D. Woodard, Louise M. Henderson, Tracy H. Urech and Kenneth Pietz

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