A Clinically Guided Approach for Improving Performance Measurement for Hypertension

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Background: Performance measures often fail to account for legitimate reasons why patients do not achieve recommended treatment targets.

Methods: We tested a novel performance measurement system for blood pressure (BP) control that was designed to mimic clinical reasoning. This clinically guided approach focuses on (1) exempting patients for whom tight BP control may not be appropriate or feasible and (2) assessing BP over time. Trained abstractors conducted structured chart reviews of 201 adults with hypertension in 2 VA health care systems. Results were compared with traditional methods of performance measurement.

Results: Among 201 veterans, 183 (91%) were male, and the mean age was 71 ± 11 years. Using the clinically guided approach, 61 patients (30%) were exempted from performance measurement. The most common reasons for exemption were inadequate opportunity to manage BP (35 patients, 17%) and the use of 4 or more antihypertensive medications (19 patients, 9%). Among patients eligible for performance measurement, there was little agreement on the presence of controlled versus uncontrolled BP when comparing the most recent BP (the traditional approach) with an integrated assessment of BP control (κ 0.14). After accounting for clinically guided exemptions and methods of BP assessment, only 15 of 72 patients (21%) whose last BP was ≥ 140/90 mm Hg were classified as problematic by the clinically guided approach.

Conclusions: Many patients have legitimate reasons for not achieving tight BP control, and the methods used for BP assessment have marked effects on whether a patient is classified as having adequate or inadequate BP control.

Key Words: quality of health care, quality indicators, health care, hypertension, physician's prescribing practices

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Hypertension is a central focus of many performance measurement systems. However, despite the ubiquity of performance measures that evaluate blood pressure (BP) control, substantial debate remains over the best ways to evaluate quality.[1,2]

Many performance measures use a relatively straightforward approach of evaluating BPs in all patients with a diagnosis of hypertension and assessing whether the most recent reading is above or below 140/90 mm Hg. This approach has several important flaws. It does not differentiate between patients for whom tight BP control is strongly indicated and for patients in whom such treatment may yield limited benefits or even net harm.[3] Such patients may be unevenly distributed among different physicians according to their panel case mix. In addition, reliance on the most recent BP reading does not account for the lability of BPs and the fact that many conditions that lead to medical appointments, such as acute infections, pain, or disease flares may transiently elevate the patient's BP.[4] These problems can mistakenly identify patients as receiving suboptimal hypertension care, leading to inaccurate results, poor credibility among clinicians, and misalignment of efforts to improve the quality of care.

To address these deficiencies, we convened a multidisciplinary expert panel to help develop a clinically sensible model of performance measurement for BP control. The resulting approach, which we term the "clinically guided approach," has been described elsewhere and has 2 key foci.[5] First, it uses an algorithm that replicates clinical decision

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making to exclude patients for whom aggressive treatment to standard BP targets may not be strongly indicated (Box). The model does not suggest that the excluded patients should not be treated, but rather than there is enough uncertainty about the net benefit of treatment that physicians should not be penalized for failing to maintain their patients' BP below 140/90 mm Hg. Second, we developed an integrated approach to measure BP control (Box). This approach aims to identify patients' BPs over time in a manner that is not overly influenced by a spuriously elevated recent reading or by readings taken when the patient was acutely ill. In this paper, we describe the application of the clinically guided approach to performance measurement in a general adult population of veterans with hypertension.

Box: Clinically Guided Approach to Performance Measurement for Blood Pressure Control

Criterion	Description
Part I: Criteria for exclusion from performance measurement system for blood pressure control	
Insufficient opportunity to manage hypertension	Less than 2 nonacute visits to medically focused outpatient clinics in the past year, or <1 nonacute visit to these clinics 1–2 y prior Acute visits defined as visits for acute pain or acute infection or visits within 1 wk before or 2 wk after hospitalization
Adverse effects of treatment	Adverse events attributed to antihypertensive treatment for ≥ 3 antihypertensive drugs classes (for lower-risk patients) or all major antihypertensive drug classes (for higher-risk patients)*; or Symptomatic orthostatic hypotension with the use of 2 separate antihypertensive medication classes; or Diastolic blood pressure <65 mm Hg and systolic blood pressure >140 mm Hg
Preexisting antihypertensive medication use	Patient is already prescribed ≥ 4 antihypertensive medications at effective doses from ≥ 4 different drug classes
Competing or clinically dominant comorbidities	Terminal or end-stage noncardiovascular disease with limited life expectancy; or Dementia; or Enrollment in hospice; or Uncontrolled severe mental illness or substance abuse
Other patient factors	Patient desires a palliative approach and an emphasis on comfort over life prolongation; or Patient is reluctant to take medications to treat hypertension and education and/or discussion with the patient about the benefits of treating hypertension is documented in the medical record; or Patient has poor adherence to medications and education and/or discussion with the patient about adherence strategies and/or preferences is documented
Part II: Integrated measure of blood pressure control	
Blood pressure control	Patients were classified as having controlled blood pressure if Blood pressure was <140/90 mm Hg at ≥ 50% of nonacute visits over the past year or Blood pressure was <140/90 mm Hg at the most recent nonacute visit Patients not meeting these criteria were considered to have uncontrolled blood pressure

*Lower-risk patients are patients without established coronary heart disease or risk equivalents (cerebrovascular disease, peripheral vascular disease, heart failure, chronic renal insufficiency, or diabetes) and with blood pressure <160/100 mm Hg. Higher-risk patients are those with established coronary heart disease or risk equivalents, or with blood pressure ≥ 160/100 mm Hg.

METHODS

Sample

We identified a stratified random sample of 500 patients in the San Francisco and Palo Alto VA Health Care Systems in 2009 with an encounter diagnosis of hypertension in the previous 2 years, among whom we randomly selected 201 veterans, aged 21 years and older. Each of the 2 VA health care systems include hospital-based clinics and community-based outpatient clinics, stretching from the far northern part of California to the central coast and inland areas of the state. The sample size was powered to estimate the frequency of exemptions within a 95% confidence range of ±7% given an expected proportion of exemptions of 15%–40%.

Chart Review

Trained research assistants reviewed patient charts using a standardized chart abstraction form and guide. Information was abstracted from free-text clinic notes and structured elements of VA's electronic health record including the computerized pharmacy profile (comprising all medications filled in VA pharmacies), problem list, demographic information, allergies, laboratory results, and vital signs. Up to 6 free-text clinic notes in the 2 years before February 1, 2009, were reviewed in reverse chronological order, including the most recent visit (of any type) and other recent visits to primary care and/or medicine subspecialty clinics. One feature of the BP measurement algorithm is distinguishing visits associated with acute illness from nonacute visits. We defined acute visits as those that addressed an acute infection or new onset or newly worsened pain, or visits that occurred within 1 week before or 2 weeks after hospitalization.

TABLE 1. Subject Characteristics

Characteristics	N (%) (n = 201)
Age (y)	
21–64	76 (38)
65–74	49 (24)
75 and older	76 (38)
Male sex	183 (91)
Race	
White	96 (48)
Black	11 (5)
Other	12 (6)
Declined to answer or unknown	82 (41)
Comorbid conditions	
Ischemic heart disease	47 (23)
Cerebrovascular disease	6 (3)
Heart failure	8 (4)
Diabetes	79 (40)
Chronic renal insufficiency	13 (7)
Peripheral vascular disease	12 (6)
Any secondary prevention disease*	116 (58)
No. antihypertensive medications at effective doses	
0	33 (16)
1	53 (26)
2	50 (25)
3	46 (23)
4	12 (6)
5 or more	8 (3)
Most recent BP (mm Hg), by category†	
SBP<140 and DBP<90	129 (64)
SBP 140–159 or DBP 90–99	56 (28)
SBP ≥ 160 or DBP ≥ 100	16 (8)
No. eligible visits in past year (median, interquartile range)‡	3 (2.4)
VA site	
San Francisco region	63 (31)
Palo Alto region	138 (69)
Location of primary care provider	
Hospital-based clinic	107 (53)
Community-based clinic	91 (45)
Other or unclear	3 (1)

Some percentages do not add to 100% because of rounding.
*Includes 1 or more of the conditions listed in the "comorbid conditions" section of the table.
†Most recent BP recorded in medical record.
‡See Methods section for definition of "eligible visits."
BP indicates blood pressure; DBP, diastolic blood pressure, in units of mm Hg; SBP, systolic blood pressure.

Chart Review Measures

Blood Pressure

Chart reviewers abstracted BP readings from clinic notes, including results entered as free text and templated results from VA's vital signs package that were populated into the note. In situations where BP readings in notes were missing or unclear, we cross-checked the data from the electronic vital signs package. When BP was assessed more than once during a clinic visit, we used the reading with the lowest mean arterial pressure.

Comorbid Conditions

Comorbid conditions were considered to be present if they were listed on the electronic problem list or noted within the free text of clinic notes. "Rule-out" diagnoses were not counted.

TABLE 2. Exclusions From Performance Measurement

Reason	N (%) n = 201
Insufficient opportunity to manage hypertension*	35 (17)
Preexisting use of ≥ 4 antihypertensive medications	19 (9)
Competing or clinically dominant comorbidities	6 (3)
Adverse effects of treatment	0 (0)
Other patient factors	9 (4)
Any exclusion	61 (30)

Some patients had more than 1 reason for exclusion.
*This criterion also includes "no clinical diagnosis of hypertension," but no patients met this criterion.

Adverse Effects of Antihypertensive Treatment

Adverse effects were assessed using the structured allergy/adverse drug effects field and from the free text of reviewed clinic notes, and defined as any adverse effects that the patient or physician attributed to an antihypertensive drug.

Current Antihypertensive Medication Use

The patient's current regimen of antihypertensive medications was defined using a hierarchical system of evidence. First, we used the medication list embedded in the most recent primary care or subspecialty clinic note (including information imported automatically from the VA pharmacy profile, structured information on use of non-VA medications, and free-text notations). If a medication list was not recorded in the most recent eligible note, we reviewed other eligible notes in reverse chronological order up to 6 months back. If the medication data were still lacking, we used information from the patient's VA pharmacy profile present at the time the chart was abstracted, including active medications and those that had expired within the past 3 months. We modified the medication list if the assessment and plan indicated medication changes in the most recent visit. To determine whether a given antihypertensive drug was given at an effective dose, we assessed whether the prescribed dose fell within the range of lowest to highest recommended doses cited in a pharmacy reference text.[6]

Competing or Clinically Dominant Comorbidities

Using criteria similar to those used to define comorbid conditions, we assessed the presence of dementia, cancer of the liver, bile ducts, or the pancreas (cancers with highly limited life expectancy), and documented life expectancy of <12 months (or equivalent). Similarly, we evaluated for the presence of *poorly controlled* mental illness or substance abuse, defined as the documentation of mental illness or substance abuse with substantially impaired current social or occupational functioning that is not receiving a stable intervention, or that is interfering with medication use or follow-up.

Other Patient Factors

Using a review of free-text clinic notes as described above, we assessed (1) the documentation of express patient wishes to focus on comfort care rather than life-prolonging

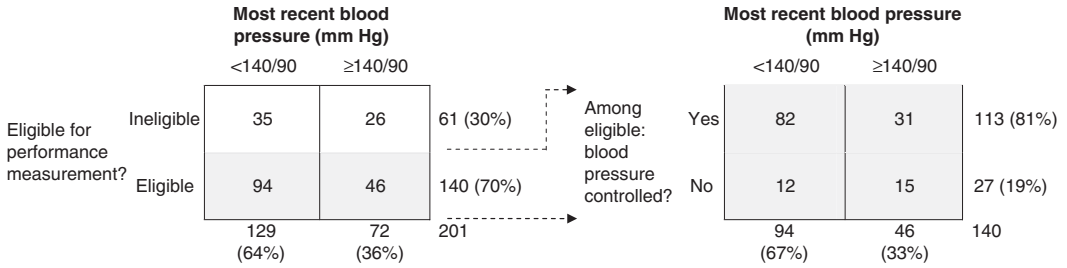

FIGURE 1. Comparison of most recent blood pressure (BP) versus eligibility for performance measurement and an integrated measure of BP control. The results on the left show the association between eligibility for performance measurement and the most recent BP. The results on the right show the association between the integrated measure of BP control and the most recent BP, among patients eligible for performance measurement. Eligibility for performance measurement is based on exclusions described in Table 2.

treatment and (2) evidence of long-term and persistent nonadherence to or reluctance to take antihypertensive medications or medications in general, *plus* evidence of discussion, patient education, or other intervention to address these issues.

Two research assistants independently reviewed 60 charts to assess interrater reliability. Kappa for the presence of one or more exemptions was 0.86, indicating excellent agreement.

Automated Version Using Structured Data From Electronic Records

We also developed an automated version of the performance measurement approach using structured data elements available in the VA Sierra Pacific Network data warehouse (details provided in online Appendix 1, Supplemental Digital Content 1, http://links.lww.com/MLR/A265).

Alternate Versions of the Clinically Guided Approach

We repeated our analyses using alternate versions of the clinically guided approach. First, given concern about excusing health systems from their responsibility to follow up patients in a timely manner, we omitted the criterion of "insufficient opportunity to manage hypertension." Second, we did not exempt patients using 4 or more antihypertensive medications, but instead considered this as a marker of "controlled BP" in the integrated measure of BP control (as such patients are receiving aggressive management of their hypertension). Third, in our integrated measure of BP control, we removed the criterion that a BP of <140/90 mm Hg on the most recent nonacute visit would define the patient as having controlled BP even if the majority of prior visits had pressures $\geq$ 140/90 mm Hg. This modification was made to prevent a spuriously low recent reading from overriding a longstanding history of elevated BPs. Instituting the above changes resulted in some patients having no nonacute visits in the past year at which BP could be assessed. For these patients, we based our assessment of BP control on the most recent BP available in the electronic medical record (from any setting).

Analyses

We used logistic regression to identify the bivariate associations between the patient and the health system characteristics and exemptions from the performance measurement algorithm. Because the bivariate analyses yielded few meaningful associations, we did not conduct multivariable analyses. Analyses were performed using SAS 9.2 (SAS Institute, Cary, NC). This study was approved by the Research and Development committees at the San Francisco and Palo Alto VA Medical Centers, and by the institutional review boards at the University of California, San Francisco and Stanford University.

RESULTS

Chart review information was collected on 201 patients (Table 1). The mean age was 71 (±11) years, 183 (91%) were male patients, and the mean BP on the most recent reading was 136 (±16) mm Hg systolic and 75 (±10) mm Hg diastolic. Patient characteristics were similar across hospital-based and community-based clinics (details in online Appendix 3, Supplemental Digital Content 1, http://links.lww.com/MLR/A265).

Subjects Exempted From Performance Measurement

Overall, 61 patients (30%) would be exempted from performance measurement using the clinically guided approach (Table 2). The most common reasons for exemption included inadequate opportunity to manage BP (17% of patients) and a preexisting use of 4 of more antihypertensive medications at effective doses (9% of patients). The proportion of exempted patients did not vary significantly by age, with exemption in 27/71 (38%) subjects aged 18–64 years, 13/51 (25%) subjects aged 65–74 years, and 21/79 (27%) subjects aged 75 years and older ($P = 0.14$ in test for trend). Similarly, the frequency of exemptions did not vary between patients with or without cardiovascular disease or risk equivalents ($P = 0.58$), between hospital-based and community-based clinics ($P = 0.97$), or between the 2 health systems in our study ($P = 0.71$; details in online Appendix 3, Supplemental Digital Content 1, http://links.lww.com/MLR/A265).

Assessments of BP Control

Figure 1 shows the correspondence between subjects' most recent BP and how these subjects' BP control would be classified when measured using the integrated approach.

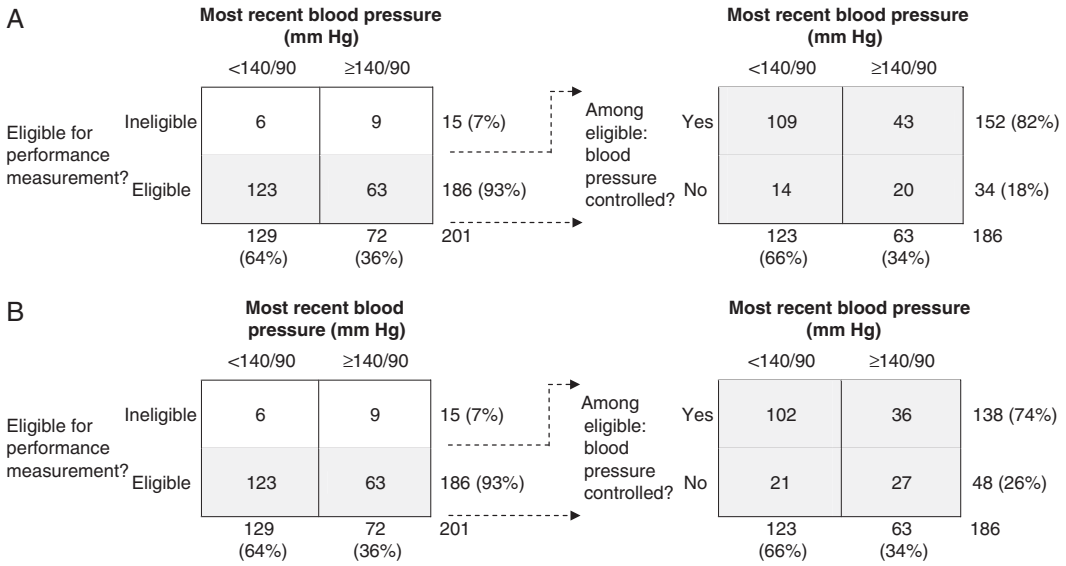

FIGURE 2. Results from alternate approaches to determining eligibility for performance measurement and defining blood pressure (BP) control. The figure replicates the format from Figure 1. A, Results from modified criteria, whereby eligibility is not impacted by the number of opportunities to manage BP or the number of BP medications taken, and whereby the integrated measure of BP control considers patients controlled if they are taking ≥ 4 antihypertensive medications (regardless of actual BP). B, The criteria further modified, incorporating the revisions used in (A) and excluding the criterion that defines patients as having controlled BP if their most recent eligible BP is <140/90 mm Hg. The most recent BP (from any source) is not necessarily the same as the most recent eligible BP, as the latter is obtained only from eligible clinics where the patient was seen for a nonacute condition.

Among 140 patients who would be eligible for performance measurement under the clinically guided approach, these 2 methods provided concordant results for 69% of patients, agreeing that 82 of 140 patients (59%) had controlled BP and 15 (11%) had uncontrolled BP. Kappa was 0.14, indicating poor agreement beyond that which would be expected by chance. Disagreements were more pronounced when we considered all patients, regardless of whether or not they would be excluded from performance measurement by the clinically guided approach. Overall, only 15 of 72 patients (21%) whose last BP was $\geq 140/90$ mm Hg would be classified as problematic after accounting for exemptions and BP control over time.

Alternate Approaches

We tested alternate versions of the clinically guided approach. Dropping the exemption for patients taking 4 or more antihypertensive drugs (and instead considering such patients to have adequately managed BP) reduced the number of exempted patients from 61 (30%) to 47 (23%). Dropping the exemption for patients with limited health system contact further reduced the number of patients exempted to 15 (7%). However, the overall percentage of eligible patients whose BP would be considered controlled (18%) did not differ substantially from the original version (19%) (Fig. 2A). In further sensitivity analyses, we modified our definition of BP control to not automatically consider BP controlled if the most recent eligible reading was <140/90 mm Hg. This change increased the number of patients considered to have uncontrolled BP from 34 (18%) to 48 (26%) (Fig. 2B).

Automated Implementation of the Clinically Guided Approach

To assess whether the clinically guided approach could be automated, we compared results from the chart review with an automated approach using structured data elements available in the electronic health record of VA. Concordance between the 2 methods was limited. Compared with the chart review, the automated approach correctly identified 23 of 61 patients who should be exempted from performance measurement (sensitivity 38%). The specificity was 79% (111/140). Overall, no sections of the algorithm were sufficiently robust to serve as an effective screening mechanism to substantially reduce the number of charts that could be assessed by manual review (details in online Appendix 2, Supplemental Digital Content 1, http://links.lww.com/MLR/A265).

DISCUSSION

In this study, nearly 1 in 3 patients with hypertension would be exempted from BP performance measurement on the basis of the clinically guided criteria. Roughly half of these exemptions were due to insufficient opportunity for clinicians to manage the patient's BP. The other half of the exemptions were due to patient-centered factors that explain failure to achieve standard BP targets. In addition, the choice of methods for defining whether the patients had achieved their target BP had major impacts on which patients would

be considered to have their BP controlled or uncontrolled. Overall, only 21% of patients whose last BP was $\geq$140/90 mm Hg would be deemed problematic by the clinically guided approach, that is, eligible for performance assessment and defined as having uncontrolled BP. Together, these results highlight a major discordance between clinically sensible approaches to measuring BP control and the relatively simplistic measures commonly used in practice.

The clinically guided approach tested in this paper highlights several unintended adverse consequences of common and simplistic systems of performance measurement. First, current performance measures encourage BP control for many patients who are unlikely to benefit substantially, encouraging overtreatment. For example, recent work in VA has demonstrated that 93% of veterans with diabetes received appropriate hypertension care, yet 10% or more may be overtreated, putting them at unnecessary risk of harm.[7] Others have found that exemptions to performance measurement are reasonably common for a variety of common conditions.[8–11] Simple measures that do not account for clinically based exemptions may be a reasonable proxy for health system performance if the overall achievement of BP targets is low. However, as the performance improves, exemptions may apply to an increasing number of patients with uncontrolled BP, raising concerns of overtreatment and misplaced resources.[2,8–12]

Another unintended consequence of traditional performance measurement is penalizing clinicians who provide care for an especially challenging mix of patients.[13] Although we had an insufficient sample size to test our approach across different types of providers and care systems, it is likely that clinics serving large numbers of frail older adults would have a higher number of exemptions.[13,14] However, older age itself was not associated with an increased rate of exemptions, and other research suggests that multimorbidity does not automatically confer a disadvantage for performance measurement.[15,16] More broadly, in the setting of typical panel sizes, errors in measurement and random variation in case mix can lead to erroneously high or low assessments of quality for individual clinicians. Thus, although our algorithm may help incentivize appropriate care, we do not recommend that it be used as a definitive measure to evaluate the quality of care provided by individual clinicians.

The other focus of this study—the impact of different approaches to define BP control—poses even bigger challenge to traditional methods of hypertension performance measurement. Agreement between the most recent BP (commonly used in performance measurement) and an integrated measure designed to approximate the patient's "true" resting BP was only slightly greater than predicted by chance. These results are consistent with other studies, which have found that single BP measurements poorly predict actual BP control.[11,17,18] Our study both confirms and extends this work by focusing on BP measurements taken during nonacute internal medicine settings, thus automatically excluding readings that are likely to be aberrant due to acute illness or pain.

In addition to the superior nature of an integrated approach in measuring BP control, others have identified substantial problems with assessing BP control as a dichotomous outcome (ie, above or below a given target, such as 140/90 mm Hg).[11,19,20] In addition to creating unstable measures, the general principle of dividing BPs into "controlled" or "uncontrolled" diverges from the clinical benefit associated with BP reduction, which is much more closely linked to the initial BP, the degree of reduction, and the underlying patient risk rather than the achievement of a dichotomous, one-size-fits-all target.[3,21]

There is no single optimal way to construct a performance measurement system, and so we tested several alternative versions of our system using modified criteria in areas where the original version is most likely to provoke disagreement. One change—dropping the exemption for patients with insufficient opportunities for follow-up—halved the number of patients who would be exempted from performance measurement, and modifying the way patients taking 4 or more antihypertensive medications were treated further reduced the number of patients exempted. Although these changes had a major impact on the number of patients exempted, the overall impact on measured performance was relatively minor, in part because a sizable majority of patients were already eligible for performance measurement under the original approach. In contrast, the method of defining BP control—in particular, whether or not to automatically consider a patient controlled if his or her last BP was <140/90 mm Hg—had bigger impacts on the assessment of quality. The choice of which approach is preferable depends on the perspective of the user. On the one hand, not giving preferential treatment to the most recent eligible reading likely presents a better measure of BP control over time. On the other, this criterion replicates clinical decision making, as few would fault clinicians for failing to intensify antihypertensive therapy if recent values were within normal limits (even if they had consistently been elevated in earlier visits).

Our findings suggest several lessons for improving the quality of performance measurement for hypertension and other chronic conditions. Our inability to robustly automate our performance measurement approach highlights the difficulty of implementing patient-centered exemptions using standard data elements in electronic health data.[22,23] However, several principles of our approach are feasible for implementation on a broad scale.[11] For example, clinical reminder systems could prompt clinicians to identify reasons for not achieving guideline-recommended targets, which could help identify patients who might be appropriate to exempt from performance measurement.[10,24]

More importantly, identifying reasons for not achieving targets could be linked to interventions to address the underlying issues. For example, many patients whose BP remains elevated while prescribed 4 or more antihypertensive medications may have undiagnosed adherence difficulties or other causes of resistant hypertension.[25,26] Clicking this reason (4 or more antihypertensives already prescribed) on a computerized reminder or a clinical decision support system could generate recommendations, for example, a reminder to inquire about adherence, or better yet a display of adherence data from pharmacy records and options to refer the patient to local adherence support systems.[27]

It is important to ensure that exemptions be targeted with reasonable accuracy to avoid disincentivizing care for broad groups of patients who might benefit. In addition, the best performance measurement systems incorporate other principles complementary to our approach. For example, tightly linked measures—where performance is defined in part by the clinician's actions to treat elevated biomarkers (such as BP or lipid levels) rather than focusing only on the biomarker itself—may help align incentives to improve clinicians' performance.[28,29] Other approaches that focus on processes of care, such as appropriate history taking, lifestyle interventions, and addressing reversible causes of disease, can be useful, although difficult to implement.[22,30]

Our study has several limitations. First, we collected data from 2 VA health care systems, and it is uncertain how our findings generalize to other health care environments. Second, although pilot testing suggests that our methods were robust, our chart review protocol may have missed some exemptions. Third, although our sample size was sufficiently powered to estimate the overall frequency of exemptions with a reasonable degree of precision, we did not have sufficient power to precisely estimate the frequency of each of the specific exemptions.

In conclusion, a clinically guided approach to performance measurement for hypertension generates substantially different patient ratings than simplistic forms of assessment. This discrepancy highlights the limitations of traditional forms of performance measurement and the promise of clinically guided approaches to increase credibility, better align incentives, and improve care. There are substantial challenges to implementing our approach, and its wholesale adoption on a widespread basis is likely not feasible in the current health care environment. However, the principles embedded within this system point to a series of concrete steps that can improve not only the accuracy of performance measurement in a clinically meaningful manner, but can lead to specific interventions to improve the quality of care.

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