Published in final edited form as:

Jt Comm J Qual Patient Saf. 2010 April ; 36(4): 164–172.

When tight blood pressure control is not for everyone: a model for performance measurement in hypertension

Michael A. Steinman, MD¹ and Mary K. Goldstein, MD²

¹ Division of Geriatrics, San Francisco VA Medical Center and the University of California, San Francisco

² Geriatrics Research Education and Clinical Center, VA Palo Alto Health Care System and Stanford University

Abstract

Background—Many patients with hypertension have legitimate reasons to forego standard blood pressure targets yet are nonetheless included in performance measurement systems. An approach to performance measurement that incorporates clinical reasoning was developed to determine which patients to include in a performance measure for blood pressure control.

Design—A 10-member multispecialty advisory panel refined a taxonomy of situations in which the balance of benefits and harms of anti-hypertensive treatment do not clearly favor tight blood pressure control (blood pressure < 140/90).

Results—The panel identified several broad categories of reasons that could reasonably exempt a patient from performance measurement for blood pressure control. These included (1) patients who have suffered adverse effects from multiple classes of antihypertensive medications; (2) patients already taking ≥ 4 antihypertensive medications; (3) patients with terminal disease, moderate to severe dementia, or other conditions that overwhelmingly dominate the patient's clinical status; and (4) other patient factors, including comfort care orientation and poor medication adherence despite attempts to remedy adherence difficulties. Several general principles also emerged. Performance measurement should focus on patients for whom the benefits of treatment clearly outweigh the harms and incorporate a longitudinal approach whereby clinicians are given a reasonable period of time to intervene on their patients with high blood pressure. In addition, the criteria for exempting a patient from performance measurement should be more strict in patients at higher risk of adverse health outcomes from hypertension, and more lenient for patients at lower risk.

Conclusions—Incorporating “real world” clinical principles and judgment into performance measurement systems may improve targeting of care and, by accounting for patient case-mix, allow for better comparison of performance between institutions.

Introduction

Algorithms have been used widely in medicine since the mid-1970s, first as a heuristic for guiding clinical judgment, later to summarize clinical practice guidelines, and, more recently, to measure performance.^{1,2} As this progression has occurred, the subtleties of clinical care have sometimes failed to keep up.^{3–5} This problem has been particularly acute

Corresponding author: Michael Steinman, MD, San Francisco VA Medical Center, 4150 Clement St, Box 181-G, San Francisco, CA 94121, (t) 415.221.4810 x3677, (f) 415.750.6641, mike.steinman@ucsf.edu.

Disclosures: None.

for performance measurement systems that focus on tight control of easily quantifiable clinical outcomes, such as blood pressure and glycosylated hemoglobin (A1C). A typical approach for these quality measures has been to identify all patients in an institution with the disease and then measure the percent of those with blood pressure or hemoglobin A1C above a prespecified target level. To accommodate situations in which there are clinically defensible reasons for patients not meeting targets, performance goals are typically set well below 100%. Such reasons include elevated blood pressure or blood sugar despite aggressive medical management and patients for whom standard treatment targets are not appropriate on the basis of adverse effects of treatment or goals of care.^{6–8}

Including all patients with a disease simplifies implementation of performance measures but results in several potential problems. Performance goals are often set arbitrarily, without grounding in evidence, and frequently increase from year to year on the contestable assumption that more control represents better care. Such systems can also incentivize physicians to overtreat patients to boost their scores (and associated performance pay) on performance measures.⁴ In addition, this approach may penalize physicians whose panels contain a high percentage of patients in whom treatment is more difficult or less appropriate.

In this article, we propose a new method for measuring performance which improves on the limitations of existing measurement approaches. The central tenet of our approach is a clinically based algorithm to identify patients for whom close blood pressure control is clearly appropriate. These patients should be included in a performance measure. Conversely, patients for whom tight blood pressure control is likely to provide relatively little net benefit (or even net harm) are exempted from the measure (Figure 1, page 000). Such an approach does not imply that all patients in the latter category should go untreated. Rather, this approach recognizes that a sufficient number of these patients have legitimate reasons to forego aggressive treatment such that strongly incentivizing treatment through performance measurement is not desirable. Thus, potential benefits of our approach are encouraging clinician efforts where the yield is greatest, reducing incentives to overtreat patients in whom the harms of therapy may exceed the benefits, and facilitating comparisons of performance across providers and institutions by accounting for patient case-mix.

To develop this approach, we convened a multispecialty expert panel to refine an algorithm for a blood pressure performance measure grounded in the concepts articulated above. In this article, we present the final product of these discussions.

Methods

In consultation with colleagues and with a review of the relevant literature, in spring 2007, we decided on general principles for the algorithm and created a draft version. In May 2007, we convened a multispecialty advisory panel to provide formal feedback and refine the algorithm.

The panel (as identified in the Acknowledgments section) consisted of three general internists, three geriatricians, two cardiologists, and two nephrologists, all affiliated with academic medical centers, the Department of Veterans Affairs (VA) health care system, and/or community-based practice. Most of the panelists convened in person at two sites in Northern California, which were linked by video conference. Two panelists from other regions of the United States joined the meeting by telephone.

Several weeks before the meeting date, panelists received a draft algorithm prepared by the authors and were invited to contribute comments and suggestions. At the meeting, we used discussion probes to solicit comments on the algorithm and on general principles that should underlie performance measurement for blood pressure control. At various points, we

attempted to elicit group consensus on various parts of the algorithm, although we did not conduct a formal vote. After the meeting, we reviewed a transcript of the proceedings, synthesized panelist comments, and revised the algorithm accordingly. Finally, we resubmitted the revised version to panelists for further comment, on the basis of which we finalized the algorithm. Through this process, the panel reached a general consensus on the algorithm, and our final product was heavily influenced by their input. However, because the panel was conceived as having an advisory rather than final decision-making role, we did not seek their formal endorsement of the final version.

Findings

General Approach to Performance Measurement in Hypertension

The expert panel commented on general issues in performance measurement for chronic diseases. First, the panel affirmed that performance measurement might optimally focus on patients with the greatest likelihood of deriving benefit from treatment. Focusing broadly on all patients regardless of an individual's disease-associated health risks can divert attention from patients with the greatest potential to benefit. On a related note, the panel noted that drug therapy for hypertension involves a balance of potential benefits and harms and recommended that performance measures exclude patients expected to derive uncertain or only slight net benefit from treatment. This approach would remove the incentive to treat patients for whom the harms of therapy may outweigh the benefits.^{4,5,7,9} These principles were incorporated into the performance measure by excluding patients with uncertain or limited benefit from tight blood pressure control and by tailoring the algorithm to each patient's risk of adverse outcomes from untreated hypertension.

While noting the problems of overinclusive performance measurement systems, the panel also expressed caution about excessively liberalizing exclusions. Allowing physicians to easily "opt-out" their patients from performance measurement may lead to abuse. In addition, patient-centered decision making requires patient understanding of the harms of foregoing treatment for hypertension. These principles were incorporated into the performance measure by requiring documentation of clinician attempts to discuss, educate, and (preferably) remediate problems with patient adherence and refusal of therapy before they would be considered grounds for exempting a patient from performance measurement.

Of particular note, a foundation for this performance measurement system was the recognition that patients excluded from performance measurement are not by definition inappropriate to treat. A substantial proportion of excluded patients likely can and should be treated. Rather, the guiding principle for the exclusion criteria explained in this article is that they identify groups of patients for whom there is a reasonable uncertainty that aggressive blood pressure control is a clinical imperative. Treatment decisions for such patients should be left to the treating physician and patient and should not be subject to the potentially counterproductive incentives and judgments of a performance measurement system.

Finally, the panel noted that chronic disease treatment was better evaluated as a longitudinal process than as performance at a single point in time.¹⁰ Allowing a finite period of time after diagnosis to optimize disease management allows clinicians to try different interventions and to temporarily defer advancing management of one disease in the face of other pressing issues.^{3,11} This principle was incorporated into the performance measure by use of a one-year look-back period.

Algorithm for Performance Measurement for Blood Pressure Control

The algorithm for performance measurement for blood pressure control, shown in Figure 2 (page 000), is explained in terms of each of its steps. Specific criteria for operationalizing

each branch point are shown in Table 1 (page 000), and Sidebar 1 (page 000) shows examples of how the algorithm would be operationalized for sample patients.

1. Does the Patient Have Hypertension, and Is There Sufficient Opportunity to Manage That Hypertension?—Treatment of blood pressure is rarely an emergency.

Pressing issues at a given visit can result in appropriate deferral of hypertension care, and treatment plans often involve incremental recommendations for lifestyle change and medication use.^{12–14} However, the expert panel warned that an overly permissive approach might encourage prolonged inaction in controlling blood pressure.¹⁵ Thus, the consensus of the panel was that clinicians should be allowed up to, but not more than, one year after their initial contact with a patient to get that patient's blood pressure under control. In the algorithm, this is operationalized as requiring evidence of an office visit more than one year before the most recent visit (a so-called anchoring visit).

2. What Is the Expected Benefit from Treatment of Hypertension?—The expert panel noted that it was important to identify each patient's expected benefit from treatment of hypertension—for two reasons. First, performance measures should focus on patients with clear net benefit from tight blood pressure control.⁴ Second, the degree of expected benefit from tight blood pressure control should modify the criteria for excluding a patient from the performance measure. For example, patients with much to gain from blood pressure control should be more difficult to exclude, even in the presence of a relative contraindication. Later sections of this article discuss how these exclusions are operationalized.

We considered three domains in constructing a simple risk stratification tool. First, we considered the patient's blood pressure because the likelihood of adverse outcomes increases substantially as blood pressure increases.¹⁶ Second, we considered whether the patient was being treated in the context of primary or secondary prevention, the latter defined as end-organ damage from hypertension or a concurrent disease state placing the patient at high risk of developing end-organ damage. Third, we considered patient age. When the panel met, subgroup analysis of large randomized trials and observational studies suggested that treating hypertension may increase mortality after approximately age 85 years.^{17,18} Shortly after, results of a major trial were released that demonstrated mortality benefit for controlling blood pressure in persons of age 80 years and older.¹⁹ Although exclusion criteria and blood pressure targets for this trial limit its generalizability to the entire population of the old-old, the results were sufficiently compelling that we removed patient age as a criterion despite the panel's recommendation that age be considered in assessing expected benefit.

3. Adverse Effects of Treatment—Adverse effects from antihypertensive medications, such as indistinct feelings of “dizziness,” may be difficult to measure or describe precisely. Despite the difficulty of quantifying such symptoms, the panel recommended that adverse effects be taken seriously and that patients be empowered to decide when a symptom is bothersome enough to discontinue or change medications.^{20–22} However, in clinical practice nuanced approaches to managing adverse reactions can be useful. It may be appropriate to suspend use of a medication temporarily and then to restart it later if drug withdrawal did not improve the symptoms (suggesting they had another cause). Alternatively, patients with reaction to one antihypertensive drug may tolerate other drug types, and several medications should be tried before a provider abandons hope of finding a tolerable therapy.

The panel recommended that the algorithm account for the patient's risk factor profile in deciding when serial intolerance to antihypertensive drugs would be sufficient to exempt a patient from performance measurement. For a patient with lower expected benefit from

treatment, the panel suggested that it was reasonable to defer further therapeutic trials after the patient failed to tolerate antihypertensive medications from three separate classes. For patients at high risk, all major antihypertensive drug classes should be tried. The exception to this general rule was documented orthostatic hypotension, which if present for two antihypertensive medication classes would be sufficient to exempt the patient from further therapeutic trials of blood pressure lowering (on the basis of the severity of this side effect and its likely recurrence across multiple drug classes).

Finally, the panel noted that patients with ischemic heart disease and low diastolic pressure may have poor outcomes.^{23,24} We concluded that all patients with hypertension and low diastolic blood pressure (defined somewhat arbitrarily at < 65 mm Hg) should be excluded from the performance measure because the presence of wide pulse pressure is often an indicator of underlying ischemic heart disease even if it has not been formally diagnosed.

4. Preexisting Antihypertensive Medication Use—Clinical trial evidence is derived mostly from studies that used one to three antihypertensive medications, and scant data exist about the benefits of adding additional drugs.^{24–26} Despite potential pitfalls of intensifying therapy in patients already on multiple drugs, the expert panel acknowledged some key mistakes that physicians may make in this setting. Physicians may prescribe two or more drugs from the same drug class, use suboptimal doses of medications, or fail to use medications that can overcome pseudoresistance (for example, failing to include a diuretic in the medication regimen).²⁵ In addition, physicians may fail to inquire about problems with adherence.²⁷ Thus, in clinical practice clinicians should go beyond counting the number of drugs to ensure that the patient has been adequately treated on the “right” drugs at effective doses and has been given tools to facilitate drug adherence and lifestyle modifications. Moreover, patients with treatment-resistant hypertension should often be referred to a hypertension specialist.²⁵

Fine-tuned clinical practice is difficult to perfectly operationalize in a decision tree such as our algorithm. Thus, for the purpose of simplifying these considerations, as a general rule the panel concluded that patients taking medications at therapeutic doses from four or more antihypertensive drug classes could reasonably be excluded from performance measurement on the grounds that there is limited evidence that adding a fifth or sixth antihypertensive drug would yield consistently meaningful net benefit. There was disagreement about whether alpha-1 adrenergic blockers (for example, terazosin) should be considered among these four drug classes, but most panelists felt that they should count toward the limit.

5. Competing or Clinically Dominant Comorbidities—Other urgent or acute clinical conditions can legitimately take priority over hypertension treatment at a single visit or series of visits. However, in most cases the clinician should eventually make time to address the patient’s hypertension. In addition, many comorbid conditions (for example, heart failure or renal insufficiency), are exacerbated by uncontrolled blood pressure, heightening the urgency and importance of controlling blood pressure.

There are several exceptions to this general rule. First, the expert panel felt that patients with terminal disease states or end-stage non-cardiovascular disease should be exempted from performance measurement for blood pressure control. This exemption reflects differing treatment priorities and goals of care in many such patients, the persistent need to prioritize the clinically dominant illness, and/or the expectation that the patient may not live long enough to reap the benefits of hypertension treatment.¹ As with other exemptions in this algorithm, this does not imply that treating blood pressure in patients with terminal illness is always inappropriate but is intended to acknowledge that foregoing aggressive blood pressure control is a legitimate clinical decision in many patients near the end of their lives.

Second, the panel felt that patients with dementia should be exempted. As with the exception just noted, hypertension treatment is appropriate in many patients with dementia and may slow progression of cognitive decline.^{28,29} However, the panel felt that goals of care and prognosis are sufficiently heterogeneous in this population that this exemption is essential to avoid incentivizing potentially inappropriate treatment.

Third, the panel felt that patients with uncontrolled severe mental illness or substance abuse should be exempted. This issue prompted much discussion in the panel, which highlighted the importance of not providing inferior hypertension care to the mentally ill or substance abusers. However, the panel acknowledged that hypertension management usually cannot be a priority in patients whose uncontrolled severe mental illness or substance abuse makes them unable to function in their daily lives or to engage in medical care. The key distinction is thus the presence of *uncontrolled* severe psychiatric or addictive illness (as contrasted to stable, controlled disease), with the patient returning to inclusion after the illness has become controlled. It is difficult by computerized clinical data to distinguish whether a patient's psychiatric illness or substance abuse is controlled or uncontrolled. Nonetheless, the panel's dominant opinion was that given the high lifetime prevalence of these diseases and the history of discrimination against persons with them, it was important to err on the side of including them in the hypertension performance measure.

These considerations for competing or clinically dominant comorbidities were operationalized by exempting patients with terminal or end-stage non-cardiovascular disease, patients enrolled in hospice, patients with documented dementia, and patients with uncontrolled severe mental illness or substance abuse.

6. Other Patient Factors—The panel affirmed the importance of respecting patient preferences and goals of care, particularly when the patient is knowledgeable of the risks and benefits of their decisions. The most obvious of such preferences and goals are patients with a palliative care and/or comfort care orientation. Aggressive hypertension control may be appropriate in some such patients, but there is enough doubt in enough patients that the entire group should be exempted from the performance measure.

Patients who are reluctant to accept medical interventions present a more difficult problem. The higher the risk of untreated hypertension, the more the physician should work with the patient to facilitate their use of antihypertensive medications. However, the decision of whether to follow physician recommendations ultimately belongs to the patient.³⁰

The algorithm operationalizes these considerations by exempting patients who refuse or have poor adherence to aggressive antihypertensive management if (and only if) there is accompanying documentation that the clinician engaged the patient in discussion of the benefits of therapy or (where relevant) adherence strategies. For patients with lower expected benefit, the operationalization requires documentation during only one episode of care; for patients with higher expected benefit, at least two separate discussions are required to be documented to exempt the patient. The panel considered mandating periodic reassessment by the physician but ultimately declined to identify a specific time frame under which these questions should be readdressed.

Defining the Decision Blood Pressure (Is the Blood Pressure Controlled or Uncontrolled?)

Blood pressure is highly variable within individuals.^{16,31} Thus, the representativeness of the measured blood pressure at a given visit should be viewed through the lens of prior probability. For example, if blood pressure at the last several visits was controlled, clinical

experience suggests that it would be premature to act on a high blood pressure at the current visit unless it is very high. If blood pressure at the last several visits was high, a high blood pressure at the current visit should be cause for concern. Finally, if blood pressure at the last several visits was variable, sometimes high, and sometimes not, the panel felt that there was only equivocal appropriateness to intensifying antihypertensive therapy. For such patients, there is no clear consensus for defining when to intensify therapy. As a result, as a starting point the panel suggested a rough “rule of thumb” whereby a patient’s blood pressure should be considered controlled if more than half of visits in the past year had documented blood pressure below 140/90. In addition, for purposes of performance measurement, a patient’s hypertension would also be considered controlled if the most recent visit showed blood pressure under the 140/90 threshold.

In considering which visits to include in this count, blood pressures from visits for acute pain or acute illness, to the emergency room, or occurring in close proximity to hospitalizations should not be treated as a measure of that patient’s tonic blood pressure. In addition, several panelists voiced concern about including self-reported home blood pressure measurements in a performance measure because machines may be miscalibrated, some patients may misreport readings, and most clinical trial data are based on blood pressures taken in a clinical setting.^{32,33} Thus, although panelists strongly endorsed the clinical benefits of home blood pressure monitoring, several members affirmed that performance measurement should rely largely on readings in clinical settings.

In clinical practice, recommended treatment thresholds for blood pressure vary according to underlying comorbidities and different guidelines; for example, < 140/90 for uncomplicated hypertension, or < 130/80 for diabetes. However, a single threshold has typically been used for performance measurement and, for purposes of simplicity, was also adopted for the system discussed in this article. However, future adaptations of this system may wish to revisit this issue and consider blood pressure measurements more tailored to patients’ clinical situations.

Discussion

In this article, we introduce a model that emulates clinical decision-making to determine which patients should be included in a performance measure for tight blood pressure control. This approach has several advantages over existing methods of performance measurement. First, it incentivizes physicians to control blood pressure in patients for whom control is clearly appropriate, while reducing the incentive to overtreat patients for whom control is not clearly warranted. Second, this approach helps adjust for patient case-mix to better compare performance across institutions, clinics, or individual providers. Third, by replicating the clinical decision-making process, this method may achieve greater physician acceptance than existing methods of performance measurement.

Implementing any performance measurement system into clinical settings presents major challenges. Our algorithm is no exception. Many of the subtleties of clinical care are not captured in computable clinical data, nor are they universally recorded in the medical record.¹⁴ Although these limitations apply to our proposed system, we believe that the decision nodes in our algorithm can be implemented with a reasonable degree of fidelity. A robust clinical information system, such as is present in the VA health care system, allows for direct or proxy measurement of many of the decision criteria in our algorithm (Sidebar 2, page 000). Medical record review will likely improve on this further. Although time-consuming, precedent for widespread medical record review has been set by the VA’s External Peer Review Program, which reviews tens of thousands of medical records each year in the United States for performance measurement.³⁴ Although implementation in

electronic clinical information systems is feasible, it requires testing and refinement. We are in the process of implementing the performance measurement algorithm using electronic structured clinical data from the VA's VistA system and will compare results obtained using electronic data with results obtained with chart review.

Our work builds on a robust literature for performance measurement, including several techniques that are complementary to ours. Hayward, Pogach, and others have convincingly argued for performance measurement systems that consider the degree to which an outcome measure is controlled and weigh the results accordingly.^{4,9,35} This approach could easily be added to our proposed algorithm; for example, a performance score could be worse for a patient with blood pressure 190/110 than a patient with blood pressure 142/80, rather than considering both patients "uncontrolled" with no further distinction. Kerr and others have advanced the idea of "tightly linked" performance measurement, in which treating physicians are given credit for taking steps to improve disease management even for patients who have not yet achieved the target outcome measure.^{10,13} This concept could expand our approach by giving physicians credit for actively intensifying a patient's antihypertensive therapy and lifestyle counselling even if that patient's blood pressure has not yet fallen to below 140/90. This approach has particular appeal insofar as it replicates the evidence base from which hypertension guidelines are derived.^{9,36}

The problems that we have identified with traditional methods of measuring performance should not diminish the potential benefits of using performance measurement to improve hypertension care.³⁷ Rather, our goal is to build a smarter way of measuring performance that can achieve these ends while minimizing unintended consequences. In this light, it is important to reaffirm that physicians should not ignore hypertension in patients excluded from the algorithm. The algorithm is designed to identify broad groups of patients for whom tight blood pressure control may not be warranted. It is not designed to replace clinical judgment about the appropriateness of blood pressure management strategies for individual patients. In doing so, it conforms to the conceptualization of performance measures as *standards* (for example, identifying that patients are receiving at least minimally acceptable care) rather than as *guidelines*, which describe optimal, individualized care. Finally, it is important to note that our algorithm has not been formally validated and is intended as a starting point—rather than the final product—for a new perspective on performance measurement for hypertension.

The history of performance measurement includes many unintended consequences, incentivizing use of interventions for patients in whom they are not warranted, and distracting from important yet unmeasured aspects of clinical care.³⁸ To maximize benefits and minimize harms, the next generation of performance measures needs to better determine which patients will benefit from interventions, to assess the degree of this benefit, and to acknowledge the incremental manner with which clinical interventions are often provided. The algorithm we introduce represents a small step toward this goal. As such, it should be construed not as a complete product but as a model that can be refined and adapted for performance measurement in hypertension and other clinical conditions.

Sidebar 1. Case Examples of Operationalization of the Algorithm

Case 1

A 60-year-old man transferred care to his local clinic three months ago and has since had two primary care visits. He has hypertension and osteoarthritis and is amenable to drug treatment of these conditions. On initial presentation, his blood pressure was 160/92. He was started on hydrochlorothiazide 25 mg daily and dietary sodium restriction. At his second visit, his blood pressure was 152/90, and lisinopril was added.

Algorithm—This patient would not be considered eligible for performance measurement because he has not yet had sufficient contact with his new primary care provider to establish good blood pressure control (Step 1).

Case 2

A 78-year-old woman has been regularly followed by her primary care physician for many years. She has hypertension, diabetes, coronary artery disease, osteoarthritis, and chronic obstructive pulmonary disease. Her blood pressure has been stable at 155/80 during the last several visits. She has reported feeling nonspecifically “dizzy” on hydrochlorothiazide and lisinopril, but formal orthostatic maneuvers failed to elicit postural blood pressure changes. Her only antihypertensive medication at present is amlodipine 10 mg daily.

Algorithm—This patient would be considered eligible for performance measurement. She receives ongoing care (Step 1), and her history of diabetes and heart disease gives her high expected benefit from tight blood pressure control (Step 2). Although she had symptoms of dizziness on two classes of antihypertensive medications, she does not have documented postural blood pressure changes, and other drug classes could be tried in an attempt to control her blood pressure without causing symptoms (Step 3). She is not taking four or more antihypertensive medications (Step 4), and she does not have competing or clinically dominant comorbidities (Step 5) or other factors that would make her ineligible for the measure (Step 6). Her blood pressure is serially above recommended targets, so she would be considered to have uncontrolled blood pressure.

Case 3

A 58-year-old man receives regular care at his local Department of Veterans Affairs (VA) medical center. He is healthy but has difficult-to-control blood pressure and is currently taking diltiazem SR (sustained release) 360 mg daily, hydrochlorothiazide 25 mg daily, lisinopril 40 mg daily, and atenolol 50 mg daily. He has had six visits in the past year, with blood pressures of approximately 145/90 (including his most recent visit).

Algorithm—This patient would not be considered eligible for performance measurement. He receives regular care (Step 1) and does not have side effects to multiple medication types (Step 3). However, he is already taking antihypertensive medications from four different drug classes at therapeutic doses (Step 4) and thus would be considered exempt on the basis of limited evidence that adding more antihypertensive medications would provide substantial clinical benefit and hence the need to individualize treatment choices. If this patient were taking only three such medications, he would be eligible for performance measurement.

Sidebar 2. Implementation in a Robust Clinical Information System: The Case of the Department of Veterans Affairs (VA)

Integrated health systems with robust clinical information systems can supply much of the information required by the performance measurement algorithm. The VA's VistA electronic medical record system includes each of several key data elements and provides an excellent example for how the algorithm might be implemented. Key data elements in the VA system include the following:

1. **Diagnoses.** Diagnostic information is available as ICD-9 (*The International Classification of Diseases*, 9th Revision, Clinical Modification) codes assigned to all outpatient encounters and hospitalizations, which can be used to risk-stratify patients into high- and low-risk groups, identify patients with exclusionary

conditions such as dementia, and differentiate acute from nonacute visits (for example, encounter codes for acute infectious illnesses suggest an acute visit).

2. **Vital Signs.** Blood pressures taken by clinic nursing staff are entered into a blood pressure data element in VistA, with additional capability for physicians to enter blood pressures obtained manually during the office encounter.
3. **Medication Information.** The VA's clinical pharmacy records all past and present medications dispensed to patients. A supplemental section of the electronic pharmacy package allows clinicians to enter information on medications that patients obtain from non-VA sources; entry of non-VA medication is strongly encouraged to maintain a complete record of the patients' current medications.
4. **Terminal Conditions:** Encounter codes associated with hospice visits can identify patients enrolled in hospice.

Other data elements used in the algorithm are more difficult to obtain from computerized clinical data. For example, one of the exclusion criteria is uncontrolled severe mental illness. Diagnosis codes can identify patients with mental illness but cannot reliably differentiate the extent to which a patient's disease is controlled at a particular point in time. In this setting, proxy measures may be used, such as defining patients as uncontrolled for a three-month period before and after psychiatric hospitalization. Finally, other data elements cannot at present be extracted from structured clinical data in VistA, such as patient refusal of medications or physician counseling and education. However, VistA employs clinical reminders for selected interventions. To clear these reminders, physicians must complete a brief, checkbox-based form noting that the service has been provided or why it is not appropriate for the patient. Factors such as counseling and patient attitudes could easily be documented on such a reminder form in a manner that allows for automated data extraction. Research is currently underway on methods for additional information extraction from free-text progress notes and other reports.

Acknowledgments

Support

This work was supported in part by a Research Career Development Transition Award (01-013) from the VA HSR&D Service and a career development award (K23 AG030999) from the National Institutes of Health and the American Federation for Aging Research (Dr. Steinman) and is related to work supported by VA HSR&D IMV 04-062 (Dr. Goldstein). The sponsor had no impact on the research process, drafting of the manuscript, or decision to submit the manuscript for publication. Views expressed are those of the authors and not necessarily those of the Department of Veterans Affairs or other affiliated institutions.

The authors thank the following persons who served on the expert panel and otherwise contributed to the development of the algorithm:

Kenneth Covinsky, MD, MPH

Brian Hoffman, MD

Ann O'Hare, MD

Lars Osterberg, MD

Nancy Plauth, MD

Peter Pompeii, MD

Peter Rudd, MD

Colman Ryan, MD

Michael Shlipak, MD

Theodore Steinman, MD

Paul Varosy, MD

Louise Walter, MD

The authors affirm that they had access to all of the expert panel data and had authority over manuscript preparation and the decision to submit the manuscript for publication.

References

1. Walter LC, et al. Pitfalls of converting practice guidelines into quality measures: Lessons learned from a VA performance measure. *JAMA* May 26;2004 291:2466–2470. [PubMed: 15161897]
2. O'Malley AS, et al. Clinical practice guidelines and performance indicators as related—but often misunderstood—tools. *Jt Comm J Qual Saf Mar*;2004 30:163–171. [PubMed: 15032073]
3. Kerr EA, et al. Avoiding pitfalls in chronic disease quality measurement: A case for the next generation of technical quality measures. *Am J Manag Care Nov*;2001 7:1033–1043. [PubMed: 11725807]
4. Hayward RA. Performance measurement in search of a path. *N Engl J Med Mar 1*;2007 356:951–953. [PubMed: 17329704]
5. Walter LC, Eng C, Covinsky KE. Screening mammography for frail older women: What are the burdens? *J Gen Intern Med Nov*;2001 16:779–784. [PubMed: 11722693]
6. Ardery G, et al. Explicit and implicit evaluation of physician adherence to hypertension guidelines. *J Clin Hypertens (Greenwich) Feb*;2007 9:113–119. [PubMed: 17268216]
7. Walter LC, Covinsky KE. Cancer screening in elderly patients: a framework for individualized decision making. *JAMA Jun 6*;2001 285:2750–2756. [PubMed: 11386931]
8. Kerr EA, et al. The role of clinical uncertainty in treatment decisions for diabetic patients with uncontrolled blood pressure. *Ann Intern Med May 20*;2008 148:717–727. [PubMed: 18490685]
9. Hayward RA. All-or-nothing treatment targets make bad performance measures. *Am J Manag Care Mar*;2007 13:126–128. [PubMed: 17335355]
10. Kerr EA, et al. Building a better quality measure: Are some patients with 'poor quality' actually getting good care? *Med Care Oct*;2003 41:1173–1182. [PubMed: 14515113]
11. Phillips LS, Twombly JG. It's time to overcome clinical inertia. *Ann Intern Med May 20*;2008 148:783–785. [PubMed: 18490691]
12. Safford MM, et al. Reasons for not intensifying medications: Differentiating "clinical inertia" from appropriate care. *J Gen Intern Med Dec*;2007 22:1648–1655. [PubMed: 17957346]
13. Rodondi N, et al. Therapy modifications in response to poorly controlled hypertension, dyslipidemia, and diabetes mellitus. *Ann Intern Med Apr 4*;2006 144:475–484. [PubMed: 16585661]
14. Asch SM, et al. A new approach for measuring quality of care for women with hypertension. *Arch Intern Med May 28*;2001 161:1329–1335. [PubMed: 11371262]
15. Berlowitz DR, et al. Inadequate management of blood pressure in a hypertensive population. *N Engl J Med Dec 31*;1998 339:1957–1963. [PubMed: 9869666]
16. Chobanian AV, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. *JAMA May 21*;2003 289:2560–2572. Epub May 14, 2003 May 14. Erratum in: *JAMA* 290:197, Jul. 9, 2003. [PubMed: 12748199]
17. Oates DJ, et al. Blood pressure and survival in the oldest old. *J Am Geriatr Soc Mar*;2007 55:383–388. [PubMed: 17341240]
18. Staessen JA, et al. Subgroup and Per-Protocol Analysis of the Randomized European Trial on Isolated Systolic Hypertension in the Elderly. *Arch Intern Med Aug 10–24*;1998 158:1681–1691. [PubMed: 9701103]

19. Beckett NS, et al. Treatment of hypertension in patients 80 years of age or older. *N Engl J Med* May 1;2008 358:1887–1898. [PubMed: 18378519]
20. Lewis DK, Robinson J, Wilkinson E. Factors involved in deciding to start preventive treatment: Qualitative study of clinicians' and lay people's attitudes. *BMJ* Oct 11;2003 327:841. [PubMed: 14551099]
21. Benson J, Britten N. What effects do patients feel from their antihypertensive tablets and how do they react to them? Qualitative analysis of interviews with patients. *Fam Pract* Feb;2006 23:80–87. [PubMed: 16107491]
22. Fraenkel L, et al. Treatment options in knee osteoarthritis: The patient's perspective. *Arch Intern Med* Jun 28;2004 164:1299–1304. [PubMed: 15226163]
23. Messerli FH, et al. Dogma disputed: Can aggressively lowering blood pressure in hypertensive patients with coronary artery disease be dangerous? *Ann Intern Med* Jun 20;2006 144:884–893. [PubMed: 16785477]
24. Chaudhry SI, Krumholz HM, Foody JM. Systolic hypertension in older persons. *JAMA* Sep 1;2004 292:1074–1080. [PubMed: 15339901]
25. Moser M, Setaro JF. Clinical Practice: Resistant or difficult-to-control hypertension. *N Engl J Med* Jul 27;2006 355:385–392. [PubMed: 16870917]
26. Kapoor JR, et al. Systolic hypertension in older persons: how aggressive should treatment be? *Prog Cardiovasc Dis* May-Jun;2006 48:397–406. [PubMed: 16714159]
27. Vrijens B, et al. Adherence to prescribed antihypertensive drug treatments: Longitudinal study of electronically compiled dosing histories. *BMJ* May 17;2008 336:1114–1117. [PubMed: 18480115]
28. Guo Z, et al. Occurrence and progression of dementia in a community population aged 75 years and older: Relationship of antihypertensive medication use. *Arch Neurol* Aug;1999 56:991–996. [PubMed: 10448805]
29. Bellew KM, et al. Hypertension and the rate of cognitive decline in patients with dementia of the Alzheimer type. *Alzheimer Dis Assoc Disord* Oct-Dec;2004 18:208–213. [PubMed: 15592132]
30. Benson J, Britten N. Patients' decisions about whether or not to take antihypertensive drugs: qualitative study. *BMJ* Oct 19;2002 325:873. [PubMed: 12386041]
31. Pickering TG, Shimbo D, Haas D. Ambulatory blood-pressure monitoring. *N Engl J Med* Jun 1;2006 354:2368–2374. [PubMed: 16738273]
32. Bachmann LM, et al. To what extent can we trust home blood pressure measurement? A randomized, controlled trial. *J Clin Hypertens (Greenwich)* Nov-Dec;2002 4:405–407. 412. [PubMed: 12461302]
33. Nordmann A, et al. Comparison of self-reported home blood pressure measurements with automatically stored values and ambulatory blood pressure. *Blood Press* 2000;9(4):200–205. [PubMed: 11055472]
34. Jha AK, et al. Effect of the transformation of the Veterans Affairs Health Care System on the quality of care. *N Engl J Med* May 29;2003 348:2218–2227. [PubMed: 12773650]
35. Pogach LM, Rajan M, Aron DC. Comparison of weighted performance measurement and dichotomous thresholds for glycemic control in the Veterans Health Administration. *Diabetes Care* Feb;2006 29:241–246. [PubMed: 16443867]
36. Hayward RA, Hofer TP, Vijan S. Narrative review: Lack of evidence for recommended low-density lipoprotein treatment targets: a solvable problem. *Ann Intern Med* Oct 3;2006 145:520–530. [PubMed: 17015870]
37. Asch SM, et al. Comparison of quality of care for patients in the Veterans Health Administration and patients in a national sample. *Ann Intern Med* Dec 21;2004 141:938–945. [PubMed: 15611491]
38. Petersen LA, et al. Does pay-for-performance improve the quality of health care? *Ann Intern Med* Aug 15;2006 145:265–272. [PubMed: 16908917]

Figure 1. Traditional and New Approaches to Performance Measurement for Blood Pressure
 Figure 1a shows a traditional approach, in which all patients with hypertension (represented as circles in the box) as included in the performance measure, whether tight blood pressure control is clearly appropriate (white circles) or not (colored circles). Figure 1b shows the new approach, in which patients for whom tight blood pressure control is not clearly appropriate, are excluded from the denominator of the performance measure.

Figure 2. Algorithm for Performance Measurement for Blood Pressure Control

The algorithm for performance measurement for blood pressure control includes several steps, each of which is explained in the text. BP, blood pressure.

Table 1

Description of Decision Nodes*

1. Does the patient have hypertension, and is there sufficient opportunity to manage that hypertension?	<p><i>To be eligible for the performance measure, the patient must have:</i></p> <ul style="list-style-type: none"> - A formal diagnosis of hypertension; and - ≥ “Anchoring visit” to outpatient clinics during 1 to 2 years prior to most recent visit <ul style="list-style-type: none"> • where visits do not include visits for acute pain or acute infection or visits to the emergency room; and - ≥ 2 visits to medically-focused outpatient clinics in the past year <ul style="list-style-type: none"> • where visits do not include visits for acute pain or acute infection, visits to the emergency room, or visits within 1 week before or 2 weeks after hospitalization.
2. What is the expected benefit from treatment of hypertension?	<p><i>Define patient into one of two risk groups:</i></p> <ul style="list-style-type: none"> - Lower expected benefit group <ul style="list-style-type: none"> • Primary prevention and BP < 160/100 - Higher expected benefit group <ul style="list-style-type: none"> • Secondary prevention with any elevated blood pressure <ul style="list-style-type: none"> - Secondary prevention includes cardiovascular disease equivalents, including coronary artery disease, cerebrovascular disease, peripheral vascular disease, heart failure, chronic renal insufficiency, or diabetes • Primary prevention and BP ≥ 160/100 <p><i>[See bottom of table for defining the decision blood pressure]</i></p>
3. Adverse effects of treatment	<p><i>The patient should be exempted from the performance measure if:</i></p> <ul style="list-style-type: none"> • For the lower expected benefit group: <ul style="list-style-type: none"> - non-specific or specific symptoms attributed to antihypertensive treatment and patient has tried medications from ≥ antihypertensive drug classes; • For the higher expected benefit group: <ul style="list-style-type: none"> - nonspecific or specific symptoms attributed to antihypertensive treatment and patient has tried medications from all antihypertensive drug classes - or - • Symptomatic orthostatic hypotension documented with the use of 2 separate antihypertensive medication classes - or - • Diastolic blood pressure < 65 (with or without documented ischemic heart disease) and systolic blood pressure > 140.
4. Pre-existing antihypertensive medication use	<p><i>The patient should be exempted from the performance measure if:</i></p> <p>The patient is prescribed ≥ antihypertensive medications from ≥ different drug classes at effective doses.</p>

5. Competing or clinically dominant comorbidities	<p><i>The patient should be exempted from the performance measure in the presence of:</i></p> <ul style="list-style-type: none"> • Terminal or end-stage non-cardiovascular disease with limited life expectancy <ul style="list-style-type: none"> – e.g., end-stage chronic obstructive pulmonary disease, end-stage liver disease, etc. • Enrollment in hospice • Dementia • Uncontrolled severe mental illness or substance abuse
6. Other patient factors	<p><i>The patient should be exempted from the performance measure if:</i></p> <ul style="list-style-type: none"> - Patient desires a palliative approach and an emphasis on comfort over life prolongation <ul style="list-style-type: none"> - or - - Patient is reluctant to take medications to treat hypertension, <i>and</i> education and/or discussion with the patient about the benefits of treating hypertension is documented in the medical record <ul style="list-style-type: none"> • If lower benefit group, documentation of education and/or discussion once ever • If higher benefit group, documentation of education and/or discussion twice ever or once in past year - or - - Patient has poor adherence to medications <i>and</i> education and/or discussion with the patient about adherence strategies and/or preferences is documented in the chart (particularly for higher-risk patients)
Defining the decision blood pressure: Is the blood pressure controlled or uncontrolled?	<p><i>To determine the decision blood pressure:</i></p> <ul style="list-style-type: none"> - Determine the proportion of nonacute visits over the last year at which blood pressure was $\geq 140/90$. <ul style="list-style-type: none"> • If this proportion is $\geq 50\%$, classify the patient as uncontrolled. If $< 50\%$, classify the patient as controlled. - or - - If the patient's last non-acute visit had blood pressure $< 140/90$, classify the patient as controlled. <p>Among patients with uncontrolled blood pressure, their "actual" blood pressure for performance measurement purposes should be the mean blood pressure from all non-acute visits over the past year.</p>

* BP, blood pressure.