# Effect of Board Certification on Antihypertensive Treatment Intensification in Patients With Diabetes Mellitus

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# Effect of Board Certification on Antihypertensive Treatment Intensification in Patients With Diabetes Mellitus

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***Background***—Regular recertification is mandatory to maintain board certification status in all specialties. However, the evidence that physicians' performance decreases with time since initial certification is limited. We therefore carried out a study to determine whether the frequency of antihypertensive treatment intensification for diabetic patients changes with time since their physicians' last board certification.

***Methods and Results***—In this retrospective cohort study, we analyzed treatment of 8127 hypertensive patients with diabetes mellitus treated by 301 internists at primary care practices affiliated with 2 large academic hospitals. Patient visits with documented blood pressure ≥130/85 mm Hg between January 1, 2000, and August 31, 2005, were studied. The association between the number of years since the physician's last board certification and the probability of pharmacological antihypertensive treatment intensification at a given visit was analyzed. Frequency of treatment intensification decreased from 26.7% for physicians who were board certified the previous year to 6.9% for physicians who were board certified 31 years before the visit. Treatment intensification rate was 22.5% for physicians certified ≤10 years ago versus 16.9% for physicians last certified >10 years ago ($P<0.0001$). Multivariable analysis adjusted for patient and visit characteristics and physician age showed that for every decade since the physician's last board certification, the probability of treatment intensification decreased by 21.3% ($P=0.0097$).

***Conclusion***—Physician intensification of pharmacological therapy for blood pressure levels above the recommended treatment goals decreases with time since the last board certification. This finding supports the current policy of mandatory recertification. (***Circulation*. 2008;117:623-628.**)

**Key Words:** certification ■ diabetes mellitus ■ hypertension ■ pharmacology ■ standards

Hypertension is the most common treatable cardiovascular risk factor.[1] Most hypertensive patients do not have their blood pressure under control.[2,3] The reasons for inadequate blood pressure control in these patients are not well understood.

## Clinical Perspective p 628

A physician's board certification status is regarded by many as an indicator of his or her fund of knowledge.[4] Several investigations have shown that physicians who are board certified in their specialty have better process measures and outcomes of care than those who are not.[5–7] Many hospital and health maintenance organizations take board certification into account when hiring physicians.[8,9]

Originally, all board certifications were permanent. Since 2006, all 24 specialty boards of the American Board of Medical Specialties issue time-limited certificates that require physicians to retake the examination within 6 to 10 years to maintain certification.[10] However, quantitative studies that offer evidence in support of recertification are lacking.[4]

We recently developed and validated a technique that allows us to computationally analyze the text of physician notes in the electronic medical record to identify documentation of antihypertensive treatment intensification.[11] Frequency of treatment intensification when faced with an abnormal finding (eg, elevated blood pressure or blood glucose level) is an emerging measure of quality of care[12,13] that has been promoted as "tightly linked" to outcomes of care.[14] Higher frequency of treatment intensification has been associated with improved outcomes in treatment of hypertension and hyperglycemia,[15–17] and interventions aimed at increasing frequency of antihyperglycemic treatment intensification lead to improved blood glucose control.[18] Elevated blood pressure is one of the major risk factors for macrovascular and microvascular complications in diabetic patients.[19–24] Treatment of hypertension decreases these risks[25–29] and is highly cost-effective.[30] Nevertheless, many diabetic patients have blood pressure above the currently recommended treatment goals.[31,32]

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We performed this retrospective study of >8000 hypertensive diabetic patients to examine the association between the time since the last board certification of the patient's physician and the frequency of antihypertensive treatment intensification.

## Methods

### Study Cohort

We conducted a retrospective cohort study of diabetic patients followed up by internists at the Massachusetts General Hospital and Brigham and Women's Hospital between January 1, 2000, and August 31, 2005. Patients were included in the analysis if they were at least 18 years of age, had a documented diagnosis of diabetes mellitus, and had at least 1 encounter with an attending internist during the study period at which elevated blood pressure was recorded. Diagnosis of diabetes mellitus was ascertained by analyzing the text of physician notes in the electronic medical record as previously described.[33] Patients who had at least 1 encounter with an endocrinologist during the study period that addressed diabetes mellitus (as ascertained by billing data and computerized analysis of the text of the notes) were excluded. The institutional review board at Partners HealthCare System approved the study, and the need for written informed consent was waived.

### Study Measurements

We used 129 and 84 mm Hg as the recommended treatment goals of systolic blood pressure (SBP) and diastolic blood pressure (DBP), respectively, in accordance with the guidelines published before the beginning of the study period.[34] Only encounters with documented blood pressures were used in the analysis. Treatment intensification was defined as initiation of a new or an increase in the dose of an existing antihypertensive medication.[15] We conservatively classified a change from one antihypertensive medication to another as treatment intensification because no validated means of comparing dose strengths between different antihypertensive drugs currently exists.

Treatment intensification rate was defined as the ratio of the number of encounters with documented elevated blood pressure and treatment intensification to the total number of encounters with documented elevated blood pressure. Number of years since last board certification was calculated as the difference between the year of the visit and the last year in which the physician passed the Internal Medicine Board Certification examination before the year of the encounter. Encounters for which no previous Internal Medicine Board Certification year was available were excluded from analysis. For each encounter in the data set, we also computed the following variables. SBP and DBP were identified from the blood pressure reading with the lowest mean arterial pressure reported in the note. If a blood pressure range was reported (eg, 140 to 150/70 to 80 mm Hg), the lowest limits for both SBP and DBP were used. Mean SBP for the last 2 visits and mean DBP for the last 2 visits were calculated as the mean of the SBPs and DBPs, respectively, from 2 previous encounters identified as above. If only 1 previous encounter was identified, the blood pressure from that encounter was used; if no previous encounters were identified, the blood pressure from the current encounter was imputed. The number of acute conditions addressed was defined as the number of *International Classification of Diseases*, 9th edition, clinical modification (ICD-9-CM) billing codes associated with the encounter that represented an acute complaint (most commonly acute pain or infection). Number of diabetes issues addressed was defined as the number of ICD-9-CM diabetes billing codes (250.xx) associated with the encounter. Number of chronic conditions addressed was defined as the number of billing codes that represented conditions that were not self-limiting but created persistent health consequences lasting for years.[35] Depression diagnosis was based on at least 2 billing codes associated with depression within a year before the visit. Patient's health insurance status was categorized as underinsured if any of the patient's insurances included Medicaid or FreeCare (a health insurance program in Massachusetts for individuals with incomes <400% of the federal poverty level who do not qualify for Medicaid), as no coverage if the patient had only Medicare without supplemental insurance or no insurance, and insured in all other cases. Cardiology/nephrology visit was set to 1 if the patient was recorded to have had a visit to either a nephrologist or a cardiologist within 6 months before the current visit. We identified the physician who wrote the note as the patient's primary care provider if he or she had the largest number of visits by this patient over the study period.

### Data Sources

Demographic and health insurance information, laboratory data, billing codes, and the text of physician notes were obtained from the Research Partners Data Registry. This registry is a large data warehouse that serves as a central clinical data repository for participating hospitals and clinics within the Partners HealthCare System, an integrated healthcare delivery network in eastern Massachusetts that includes Massachusetts General Hospital and Brigham and Women's Hospital. Blood pressure values and antihypertensive treatment intensification were computationally abstracted from the text of physician notes in the electronic medical record through the use of specially designed software as previously described.[11] The sensitivity and specificity of this method are 91% and 96%, respectively, for identification of blood pressure values and 84% and 95% for identification of antihypertensive treatment intensification. Physician specialty was identified with a combination of self-reported specialty data available from the Massachusetts Board of Registration in Medicine and the specialty of the clinic where the physician practiced. Year of board certification was obtained from the American Board of Internal Medicine.

### Statistical Analysis

Summary statistics were constructed by using frequencies and proportions for categorical data and by using means, SD, medians, and ranges for continuous variables. A 2-sided $t$ test was used to analyze the difference between the treatment intensification rate by physicians who were last board certified >10 versus <10 years before the visit. To determine the association between the time since the last board certification and the probability of treatment intensification, we constructed a hierarchical multiple logistic model using GLIMMIX procedure to correct for clustering within individual physicians and patients.[36,37] This model adjusted for the patient's current and past blood pressures, demographic characteristics, diagnosis of depression, number of acute and chronic issues addressed during the visit, recent encounter with a specialist (cardiologist or nephrologist), physician age, and relationship with the physician (primary care provider versus coverage). A value of $P=0.05$ obtained with a type III test was used as the threshold to establish significance of association of the primary analysis variable (number of years since the last board certification) with the probability of treatment intensification in the model. A value of $P=0.0025$ with Bonferroni correction of the type III test was used to establish significance of association of other variables with the probability of treatment intensification.

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

### Blood Pressure Control and Treatment Intensification in Diabetic Patients

We identified 21 912 adult patients with a documented diagnosis of diabetes mellitus who had at least 1 outpatient visit at either hospital during the study period and were not treated by an endocrinologist or a diabetologist. Of these patients, 11 835 had at least 1 note by an internist in the electronic medical record. Among these, 8127 patients had least 1 documented elevated blood pressure and were included in the study.

The median age of the study patients was 64 years; 56.2% were women; and 60.3% were white (Table 1). Most patients

**Table 1. Patient Characteristics**

| Variable | Value |
|---|---|
| Study patients, n | 8127 |
| Age,* y, mean (SD) | 64.1 (14.0) |
| Women, n (%) | 4567 (56.2) |
| Ethnicity, n (%) | |
| White | 4904 (60.3) |
| Black | 1326 (16.3) |
| Hispanic | 1145 (14.1) |
| Other (includes unknown) | 752 (9.3) |
| English is the primary language, n (%) | 6786 (83.5) |
| CAD,† n (%) | 2024 (24.9) |
| Health insurance, n (%)* | |
| Insured | 5397 (65.7) |
| Underinsured‡ | 2466 (30.3) |
| No prescription coverage§ | 264 (3.2) |

CAD indicates coronary artery disease.

*At the end of the study period.

†At least 2 billing codes representing CAD on record before the end of the study period.

‡Includes Medicaid and FreeCare, a program that provides fully or partially (depending on the income) subsidized health care in Massachusetts.

§Includes Medicare without supplemental insurance and patients with no reported insurance.

spoke English as their primary language, and most had insurance medication coverage.

Of 91 710 encounters of the study patients with documented blood pressure, 53 909 (58.8%) recorded elevated blood pressure (≥130/85 mm Hg), and 31 956 (34.8%) recorded blood pressure ≥140/90 mm Hg. The average SBP and DBP recorded during a study visit were 132 and 75 mm Hg, respectively. Only 10 837 encounters (20.1%) with documented elevated blood pressure recorded antihypertensive treatment intensification.

## Relationship Between Board Certification and Treatment Intensification

The patients in the study had encounters with 301 internists (Table 2). Median age of the patients' physicians was 41 years; slightly more than a quarter were board certified before 1990, when the American Board of Internal Medicine began issuing time-limited certificates. On average, study patients' physicians were last board certified 11.7 years before the study encounter. Of the 33 584 encounters with physicians who were last certified after 1989, 2855 (8.5%) were with physicians whose certificates had lapsed. Overall, 57.5% study encounters (30 999) were with physicians whose last board certification was ≤10 years before the encounter, and 42.5% encounters (22 910) were with physicians whose last board certification was >10 years before the encounter.

**Table 2. Provider Characteristics**

| Variable | Value |
|---|---|
| Study providers, n | 301 |
| Age,* y, mean (SD) | 43.2 (9.7) |
| Years since graduation from medical school, mean (SD), n * | 15.4 (9.8) |
| Years since last board certification,* n, mean (SD) | 9.9 (9.6) |
| Providers last board certified before 1990, n (%) | 83 (27.6) |

*At the end of the study period.

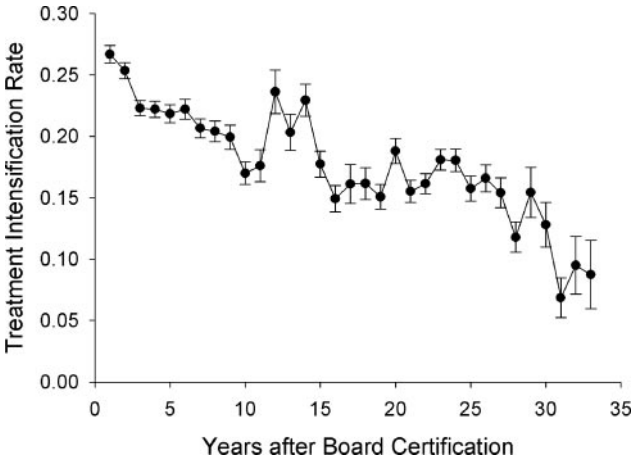


**Figure 1.** Relationship between treatment intensification rate and time since the physician's last board certification. The number of years between the physician's last board certification in internal medicine and the year of the visit was plotted vs the average frequency of antihypertensive treatment intensification for all encounters with documented elevated blood pressure. Only data points with at least 100 encounters were used for the plot. Wisps indicate 95% confidence intervals.

In univariate analysis, per-provider rate of treatment intensification decreased as the time from the physician's last board certification increased (Figure 1). This trend held for both the physicians who were ≤10 years away from the last certification and for the physicians whose last certification was >10 years before the visit. Treatment intensification rate was the highest at 26.7% for physicians who passed the examination the year before the visit (3846 encounters with 103 individual physicians) and lowest at 6.9% for physicians who passed the examination 31 years ago (248 encounters with 6 individual physicians). On average, treatment intensification rate was 22.5% for physicians who passed the examination ≤10 years before the encounter and 16.9% for physicians who passed the examination >10 years before the encounter ($P<0.0001$). Similar differences were found for every year of the study when analyzed separately (data not shown).

In a multivariable analysis of the probability of antihypertensive treatment intensification at a given visit that adjusted for patient, provider, and visit characteristics (Figure 2), every decade since the physician's last board certification was associated with a 21.3% drop in the probability of treatment intensification ($P=0.0097$). The association of provider age and probability of treatment intensification, which was highly significant when the time since last board certification was not included in the model, lost its significance when it was (data not shown). The association of board certification with the probability of treatment intensification remained significant ($P=0.03$) in the subset of 30 999 patient visits with physicians who were last certified <11 years ago (and thus held time-limited certificates). Among other variables included in the model, past and present blood pressures, nature of physician-patient relationship (primary care pro-

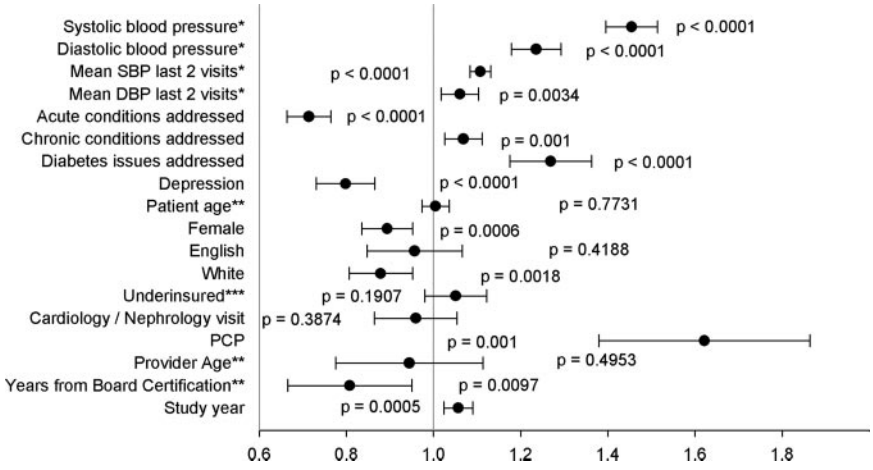


**Figure 2.** Effect of patient, visit, and provider factors on treatment intensification. Circles indicate odds ratios for antihypertensive treatment intensification at a given visit; wisps indicate 95% confidence intervals. PCP indicates primary care provider. *For every 10 mm Hg; **for every 10 years; ***for patients with no prescription coverage vs patients with prescription coverage other than Medicaid.

vider versus coverage), and the number of acute conditions addressed during the visit had a particularly strong effect on the probability of treatment intensification. No significant relationship existed between the probability of treatment intensification and either physician age or the time since the physician graduated from medical school (data not shown). A separate model that included the institution where the patient was seen (Massachusetts General Hospital versus Brigham and Women's Hospital) did not show any effect of the institution on the probability of treatment intensification.

## Discussion

In this large retrospective cohort study of treatment of hypertension in diabetic patients, we have demonstrated a quantitative relationship between board certification and an important process measure of quality of care of hypertension: frequency of treatment intensification. Independently from the patient's blood pressure during the visit and other patient and visit characteristics, the probability of treatment intensification progressively decreased nearly 4-fold as the number of years since the physician's last board certification increased. Given that a strong relationship between treatment intensification and blood pressure levels has been demonstrated in both observational and interventional studies,[15,17,18] this finding indicates that the time since the last board certification could have an effect on the blood pressure of the physician's patients.

This association can be explained by several possible mechanisms. One is provider age. The time since the last board certification would generally be longer for older physicians, and other studies have shown that physician performance decreases with the increasing number of years in practice or physician age.[38] However, in our analysis, physician age did not have a significant effect on the probability of treatment intensification once the time since the physician's last board certification was included in the model.

A more likely reason for the relationship between the time since board certification and the frequency of treatment intensification is the educational efforts many physicians engage in before taking the examination. Physicians report extensive self-education in preparation for the test[39]; multiple preparation courses run by commercial and academic institutions testify to the substantial instruction many examinees receive. Because current treatment goals for patients with diabetes mellitus are included in the examination curriculum, it is likely that they are reviewed during the preparation for the examination and are then adopted in clinical practice.

Our study has confirmed that the probability of antihypertensive treatment intensification can be affected by many patient and visit characteristics. Not surprisingly, patients with higher blood pressure were more likely and patients who presented with acute issues or were seen by a covering physician were less likely to have their treatment intensified. Depressed patients also were less likely to have their treatment intensified, possibly because of decreased patient motivation leading to lower treatment adherence that has been previously reported in association with depression.[40,41] Encounters with white and female patients had lower probability of treatment intensification. Although it is possible that the physicians considered lower cardiovascular risk of these groups, a documented diagnosis of coronary artery disease did not affect the probability of treatment intensification (data not shown), making this explanation less likely. The probability of antihypertensive treatment intensification was higher during visits when other diabetes or chronic disease issues were addressed; it is possible that physician visits may fall into several different patterns, including some in which chronic conditions (eg, hypertension) are addressed and some (eg, urgent care visits) when they are generally not.

A distinctive feature of this study is that data acquisition from narrative medical documents was carried out automatically by custom-designed and validated software. Consequently, extraction of the relevant information from nearly 100 000 physician notes, a process that typically would have taken months of work by highly trained personnel, was completed in $<1$ hour. Broader implementation of this technique could be used for real-time quality-of-care surveillance of individual providers across large practices and healthcare networks. Availability of those data could, in turn, make possible individualized feedback to physicians based on their behavior and adjusted for their patient population, an approach that has already been shown to increase the frequency of treatment intensification and to improve outcomes in diabetes mellitus.[42]

Our study has a number of strengths. First, it included several thousand ethnically diverse patients from 2 large

hospitals that serve patients from all socioeconomic strata. To the best of our knowledge, it is the first study that analyzed a quantitative relationship between the length of time since the last board certification and quality of care. Our finding of a significant decrease in the frequency of antihypertensive treatment intensification offers support for the current policies of mandatory recertification. Finally, our study focused on care delivered in primary care practices because this is currently the predominant mode of care for diabetic patients and is set to become even more common in the future as the number of diabetic patients grows.

Our study has several limitations. It was restricted in scope to the patients of internists affiliated with academic hospitals in eastern Massachusetts. This could limit its generalizability to other patient and physician populations. This retrospective study relied on documentation of relevant findings in the electronic medical record. If the accuracy of this documentation varied with the rate of treatment intensification, the study findings could be biased. Many diabetic patients did not have sufficient information in the electronic medical record (primarily notes) to be included in the study. This lack of information was likely due to the gradual rollout of the electronic medical record throughout Partners HealthCare during the study. The rollout took place at one clinic at a time, and entering notes in the electronic medical record was mandatory for all clinic physicians after the rollout. Therefore, it is unlikely that the missing information led to a bias in the study results. The main outcome of the study, antihypertensive treatment intensification, was abstracted from the electronic medical record through the use of computerized analysis of the physician notes. The sensitivity of this technology was 84%[11]; if the episodes of treatment intensification that the tool did not detect were unevenly distributed with respect to the board certification status, our study findings could be invalid. We were unable to directly compare doses between different medications and conservatively treated any medication change as treatment intensification; this could have biased our results. As in any retrospective study, the nature of the relationship between the predictor (board certification) and outcome (treatment intensification rate) variables is only associative rather than causal. This association could be explained by other factors, including physician comfort with documentation of the office visit related to physician age or time since the completion of training. However, neither physician age nor the time since medical school graduation was significantly associated with the probability of treatment intensification in multivariable analysis. We did not have information about patient adherence to medical regimen, which could have affected the probability of treatment intensification. However, physician surveys showed that patient nonadherence is cited as the reason for not intensifying treatment $<10\%$ of the time[43]; therefore, it is unlikely that inclusion of patient adherence information would alter our findings. Finally, the study could not account for some of the other factors that could potentially significantly affect the probability of pharmacological treatment intensification, including nonpharmacological antihypertensive interventions or the number of medications the patient was taking.

## Conclusions

We have demonstrated that frequency of antihypertensive treatment intensification, a process measure known to be linked to clinical outcomes, decreases as the time since the physician's last board certification increases. These findings offer quantitative evidence in support of mandatory recertification. Because physician education related to the board certification examinations is the most likely explanation for these results, the study provides indirect evidence that more intensive educational efforts could help to improve the quality of care delivered by physicians. To ensure continuing improvement in the standards of health care, we should aim for nothing less.

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## Disclosures

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## CLINICAL PERSPECTIVE

Hypertension is the most common treatable cardiovascular risk factor. Nevertheless, blood pressure of most patients with hypertension remains above recommended treatment targets. The reasons for this are not fully understood, but low frequency of antihypertensive treatment intensification is thought to be a contributing factor. The low frequency of treatment intensification may be due to physicians' lack of knowledge about treatment goals. Board certification status is commonly regarded as an indicator of the physician's fund of knowledge. Recertification every 10 years is required for internists to maintain certification, but it is unknown whether physicians whose last certification was more than a decade ago are less likely to practice consistently with guidelines. We conducted a retrospective cohort study of 8127 hypertensive diabetic patients to determine the relationship between the time since their internist's last board certification and the frequency with which their internist intensified antihypertensive treatment in response to elevated blood pressure. Frequency of treatment intensification decreased progressively from 26.7% for physicians who were board certified the previous year to 6.9% for physicians who were board certified 31 years before the visit. The treatment intensification rate was 22.5% for physicians certified $\leq$10 years ago versus 16.9% for physicians last certified $>$10 years ago. Multivariable analysis adjusted for patient and visit characteristics and physician age showed that for every decade since the physician's last board certification, the probability of treatment intensification decreased by 21.3%. These findings support the current policy of mandatory recertification.