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WAITING TIMES AND AMBULATORY CARE SENSITIVE CONDITION HOSPITALIZATIONS

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Abstract

Long waits for health care are hypothesized to cause negative health outcomes due to delays in diagnosis and treatment. This study uses administrative sources to examine the relationship between time spent waiting for outpatient care and the risk of hospitalization for an ambulatory care sensitive condition (ACSC).

Data on the number of days until the next available appointment were extracted from Veteran Affairs (VA) medical centers. Two methodological issues arose. First, the endogeneity of wait times with individual health status due to medical triage was overcome by developing an exogenous wait time. Second, selection bias due to unobserved case mix differences was minimized by separating the sample selection period in time from the period when wait times and outcomes were measured.

Exogenous facility-level wait time was the main variable of interest in stacked probit regression models that predicted the probability of ACSC hospitalization in each month of a six-month period. Veterans who visited a VA medical center with facility-level wait times of between 34.5 days and 44.99 days had a significantly higher probability of experiencing an ACSC hospitalization compared to veterans who visited a VA medical center with facility-level wait times of less than 22.50 days.

There is a weak significant association between an exogenous measure of wait times and the probability of experiencing an ACSC hospitalization among geriatric veterans. Further research is needed to replicate these findings in other populations and among those with different clinical histories. Similarly, future work should consider the potential effect of selection bias.

Key Words: access to care, ACSC hospitalization, wait times

1.0 Background

The Institute of Medicine's Committee on the Quality of Health Care in America (2004) highlighted reducing delays as one of six aims for improving the quality of America's health care system. The main reason to reduce delays is because long waits for healthcare are assumed to negatively affect health outcomes due to delays in diagnosis and treatment (IOM 2004; Kenagy, Berwick, and Shore 1999). Despite the declared importance of ensuring timely access to care, little research has actually examined the empirical association between waiting for outpatient care and health outcomes.

The lack of research on the consequences of waiting for outpatient care may be due to the scarcity of administrative data on wait times in American health care systems. The Veterans Affairs (VA) health care system is an important exception because each month it automatically extracts data from its outpatient scheduling system on how long veterans are waiting for appointments. This data collection effort was implemented as a response to a VA policy goal that by 1998, 90% of veterans seeking care would be seen in both primary and specialty care within 30 days of the appointment request (U.S. GAO 2001).

Using these data on waiting times until the next available appointment, we recently examined the association between waiting for outpatient care in the VA and mortality among veterans who had visited a geriatric outpatient clinic in federal fiscal year (FFY) 2001 (October 2000-September 2001). Veterans who visited medical centers with facility-level wait times of 31 days or more were 21% more likely to die in a six month follow-up period compared to veterans who visited facilities with wait times of less than 31 days (Prentice and Pizer, forthcoming). This article extends the limited work on how wait times affect health outcomes by examining the association between waiting for outpatient care and experiencing a hospitalization due to an

ambulatory care sensitive condition (ACSC), also known as a potentially preventable hospitalization.[2]

ACSC hospitalizations are an ideal outcome to examine the consequences of waiting for outpatient care because these hospitalizations can be avoided if patients are receiving *timely* and effective outpatient care. Appropriate outpatient care prevents the onset of certain conditions, controls the chronic disease to prevent progression or controls an acute episode of the disease (Culler, Parchman, and Przybylski 1998). For example, suppose a diabetic patient has an ulcer on his toe that is not healing and he cannot get a podiatry appointment quickly. He may be at increased risk of gangrene and being hospitalized for a lower-extremity amputation (AHRQ 2001). Common ACSCs among adults include asthma, diabetes, hypertension, congestive heart failure, and chronic obstructive pulmonary disease (Culler, Parchman, and Przybylski 1998; AHRQ 2001).

This article is the first to test the assumption that long waits for outpatient care increase the risk of experiencing an ACSC hospitalization. It also examines the two main methodological challenges that arise when examining the relationship between waiting for outpatient care and ACSC hospitalization: 1) the endogeneity of wait times with individual health status due to medical triage and 2) potential selection bias that may occur if facilities with relatively long wait times attract fewer severely ill patients because very sick patients go elsewhere for their care versus waiting.

2.0 Methods

2.1 Study Population

The study population included VA patients age 65 or older who visited at least one of three types of geriatric outpatient clinics during the 2001 federal fiscal year (FFY; October, 2000

to September, 2001). The three types of geriatric outpatient clinics are 1) geriatric primary care, 2) geriatric clinic and 3) geriatric evaluation and management. Appointments at geriatric outpatient clinics are focused on preventing, evaluating and managing illnesses and conditions that are specifically associated with aging (e.g. incontinence), and feature providers who are trained in the management of these conditions (VHA 2004). This sample was ideal for examining whether long wait times were associated with negative health outcomes. Since these patients are older and more frail than the general population they ought to be particularly sensitive to variation in the timeliness of access to medical care.

2.2 Waiting Time Data

We hypothesized that individuals who wait longer for medical care are at an increased risk of experiencing an ACSC hospitalization. Thus, the main explanatory variable of interest was the wait until the next available appointment at a VA facility. The VA keeps monthly data on the average number of days between the request for an appointment and when the appointment is actually scheduled. Services in the VA can be provided at a parent station, such as a medical center, or a sub-station, such as a community-based outpatient clinic, which organizationally operates under a parent station. Wait times are kept for each type of clinic appointment (e.g. urology, primary care, and laboratory) within a parent station and for all clinic appointments at sub-stations under a parent station. To create a performance measure for tracking wait times, the VA aggregates wait times by appointment type at the parent station level on a monthly basis using a weighted average (Baar 2005b).[3]

Although there are data available on all types of appointments, past performance measures in the VA have focused on the wait times for 49 types of appointments. These 49 clinic appointment types were chosen because they are 1) appointment types with high volumes,

2) appointment types that cover 93% of office-based patient-provider interactions in the VA (versus other services, such as labs or telephone consultations) and 3) appointment types that represent all major sub-specialties of medicine (e.g. mental health, orthopedics) (Baar 2005a). As in our previous work (Prentice and Pizer, forthcoming), our wait time measure is based on these 49 appointment types in addition to appointments in a geriatric clinic or for geriatric evaluation and management because the study population was based on visiting a geriatric outpatient clinic (49 +2 =51 appointment types). Note that geriatric primary care was already included as one of the 49 appointment types.

2.3 Individual Level Wait Times

Data are available on the date, the facility and the appointment type used by each patient in the study population. Thus, it was tempting to calculate a wait time measure based on services each individual actually used in 2001 and to associate this measure with health outcomes. This approach is problematic, however, because unobserved individual health status differences are likely to affect individual wait times as well as outcomes due to the medical triage effect. In many medical practices, providers identify those who are in poorer health when calling to request an appointment and schedule these patients with appointments first (Murray and Berwick). In the VA context, medical providers may identify those who are in the poorest health when calling to request an appointment and refer these patients to clinics with the shortest waits.

The top panel of Table 1 illustrates this problem. It shows the mean, median and interquartile range of waits times that were calculated for July, August and September based on the appointment types an individual actually used in each of those months by whether or not the individual experienced an ACSC hospitalization in that month.[4] Individuals with an ACSC hospitalization had consistently shorter individualized wait times. The mean and median wait

times among individuals who did not have an ACSC hospitalization were between 2 and 3 days longer than the mean and median wait times among individuals who had an ACSC hospitalization. Thus, if our wait time measure were based on services individuals actually used, it would appear that waiting for health care had a positive effect on the probability of experiencing an ACSC hospitalization.

The endogeneity of unobserved individual health status with wait times and health outcomes confounds any attempt to study the effect of wait times on outcomes. Although statistical controls for observable differences in health status will reduce the severity of this problem, we are not able to measure health status precisely enough to eliminate it. Consequently, to properly isolate the effect of waiting on outcomes we calculated a wait time that is exogenous to the individual (not affected by prior individual health status).

2.4 Exogenous Wait Time Measure

To calculate wait times that were exogenous to the individual we set out to construct a wait time that would apply to the same "representative" patient at each parent station, eliminating the simultaneous effect of unmeasured prior individual health status on both wait time and outcome. An example of this exogenous wait time calculation is given in Table 2. We computed the proportion of each type of clinic appointment used by the entire sample between October 2000 and March 2001 (the sample selection period discussed below).[5] For each month, this proportion was multiplied by the wait in days for each type of appointment at a parent station, and these products were summed for all appointment types in the parent station. Multiplying the wait time for an appointment type by its proportion in the whole sample gives greater weight to the wait times of appointment types that were used more frequently by the entire sample.

There were two adjustments made to the general calculation just described. First, if no appointments were requested as next available within a month for a certain type of clinic appointment, the wait time is missing. As in our previous work, we imputed wait times that were missing with zero under the assumption that if no next available appointments were requested, individuals could use these services right away.[6] We confirmed this assumption by 1) finding recorded utilization at these clinic appointments in FY 2001 or 2) finding that a type of clinic appointment was missing in one month but had a wait time in other months implying this type of service did not have next available appointments scheduled each month. However, due to a large amount of missing wait times, we excluded appointment types for opioid substitution, speech pathology, radiation therapy treatment, recreational therapy services and intensive substance abuse treatment for a final total of 46 appointment types (51-5=46). These clinic types were missing 20% or more of their wait time data and would require a large amount of zeroes to be imputed.

The second adjustment was made to the proportions if a parent station did not use all 46 clinic stops. The appointment types parent stations rely on may differ. For example, the same services provided under Women's Clinic at Station X would be coded under primary care at Station Y and Station Y may not use the Women's Clinic code. If parent stations did not use some appointment types, the national proportions of these appointment types were equally distributed among the appointment types a parent station did use (See Table 2 for a detailed example). Thus, the proportions added up to 1 for each parent station in each month. All individuals who visited the same parent station were assigned the same exogenous wait time for that station in each month.

The bottom panel of Table 1 shows the mean, median and interquartile range of exogenous wait times that were calculated for July, August and September by whether or not the individual experienced an ACSC hospitalization in that month. In contrast to the top panel in Table 1, there is little difference in the mean and median wait times of individuals who experienced an ACSC versus individuals who did not.

2.5 Sample Selection

A second way that unobserved prior health status could affect both waiting times and outcomes is through sample selection. If, for example, facilities with relatively long wait times attract fewer severely ill patients (because they choose to go elsewhere rather than wait), then long wait times could be associated with relatively favorable outcomes because of unobserved and uncontrolled casemix differences. One way to address this problem is to separate in time the selection of the sample and the measurement of outcomes.[7] For example, if the sample were selected five years ago and the outcome were measured today, we could study the effect of recent waiting times on outcomes without worrying that sample selection might be correlated with either one. Waiting times might have been related to sample selection five years ago, but the distribution of waiting times would have changed enough over time to break any link between selection and current waiting time, leaving the relationship between current waiting time and outcome to be measured free of bias. Unlike in the example, our data does not allow us to select the sample five years before the outcome. Nonetheless, we were able to separate by three months the selection of the study sample (October 2000-March 2001) from the computation of wait times and the assessment of outcomes (July-December 2001). Wait times changed in this amount of time. The correlation between average parent station wait times

during the first third of the year (January – March) and the last half (July – December) was only 0.58.

Therefore, the study population consisted of patients who 1) visited a geriatric outpatient clinic between October 2000 and March 2001 and 2) survived through June 30, 2001. Patients could only enter the sample through March 31, 2001. Starting in July 2001, our measure of wait time was the facility-level exogenous wait time for each month between July and December 2001. For each patient we calculated the probability of experiencing an ACSC hospitalization in each month between July and December 2001 as the outcome (see details under *Analyses*). Individuals who visited more than one parent station during the sample selection period were excluded (n=982; 3%) because these individuals had more than one facility-level wait time. The final sample size is 33,538.

2.6 Outcome

The outcome of interest is experiencing an ACSC hospitalization. The dates and ICD-9 codes of all inpatient hospitalizations between July and December 2001 were extracted from the VA National Patient Care Database (NPCD) and the Medicare MedPAR file. We used AHRQ methodology to determine which hospitalizations were potentially preventable and excluded hospitalizations for pediatric conditions (e.g. pediatric asthma). Please refer to AHRQ (2001) for a complete description of the methodology used to determine ACSC hospitalizations.

2.7 Risk Adjustment

Since prior individual health status can confound the relationship between waiting for health care and outcomes, we account for multiple measures of prior individual health status following similar models in the literature (Berlowitz et al. 1997; Mukamel, and Spector 2000; Porell et al. 1998; Selim et al. 2002) and our previous work (Prentice and Pizer, forthcoming).[8]

Explanatory variables include age, gender, principal diagnoses and the Charlson index as a measure of the number and seriousness of co-morbid conditions (Charlson et al. 1987; Deyo, Cherkin, and Ciol 1992).[9] Diagnosis codes from VA inpatient encounters in the 365 days prior to the date of each patient's first geriatric clinic visit were grouped according to the classification system developed by Rosen et al. (2000). Some of the diagnosis categories developed by Rosen et al. (2000) overlap with diagnosis categories used in the Charlson index. We estimated models that only included either the Charlson index or the diagnosis categories as a test for collinearity. Results were similar so both measures were included in the models presented.

Models also included whether or not an individual experienced an ACSC hospitalization in the 365 days before the beginning of the sample selection period (October 2000) (AHRQ 2001). This variable reflects variation in self-care among patients as well as the effects of past outpatient care. In addition, it isolates the population who are at greatest risk for experiencing a preventable hospitalization because those who have experienced an ACSC hospitalization in the past are known to have conditions that would make them susceptible to experiencing future ACSC hospitalizations. This variable has a significant effect in the models, and the other explanatory variables have similar associations with ACSC hospitalization regardless of whether previous ACSC hospitalization is excluded or included. Thus, the models presented include this variable.

We used duration analyses to predict the odds of experiencing an ACSC hospitalization in each month between July and December 2001 (see *Analyses* for details). As time passes, individuals may be at greater risk of experiencing an ACSC hospitalization due to failing health. To control for this we included a variable that counts up the number of observations for each

person. For example, the variable was 1 for the July observation, 2 for the August observation, and so on.

Finally, to control for differences in case mix between facilities, a historical three-month average ACSC hospitalization rate (October through December 2000) per facility was included as an explanatory variable. Facilities that generally treated patients with a greater burden of illness would be expected to have higher ACSC hospitalization rates.

2.8 Analyses

Data were analyzed using STATA 9.0 (Statacorp 2005). We report the coefficients and marginal effects from a stacked heteroskedastic probit model that predicts the probability of experiencing an ACSC hospitalization.

Each individual had one observation for each month he or she was alive between July and December 2001. Individuals who died were censored in the month that they died. For example, an individual who lived through December 31, 2001 would have six observations. However, an individual who died on August 15, 2001 would have one observation for July and one observation for August. The probability of experiencing an ACSC hospitalization was predicted in each month with a model that included the individual-level risk adjustment variables, a lagged facility-level ACSC hospitalization rate and a facility-level wait time. Facility-level wait time changed each month and was therefore a time varying covariate. All other covariates were time invariant.

Since there were multiple observations per person, observations within individuals are not independent of one another. To account for this we calculated robust standard errors, clustering on individuals. Similarly, observations for individuals who visited the same facilities are likely not independent from one another. Facilities with fewer observations had greater

residual variance. To account for this we used a heteroskedastic probit model specifying that the variance of the disturbance term is a function of the natural log of the number of observations per facility (Greene 1993). This model explained the heteroskedasticity well.

We tested several different functional forms of the wait time including a linear form, categories based on deciles and categories based on quintiles. The deciles gave the most detailed understanding of the relationship between facility-level wait times and the probability of experiencing an ACSC hospitalization. We categorized the facility-level wait times into less than 22.5 days, 22.50-25.99 days, 26.00-28.99 days, 29.00-31.49 days, 31.50-34.49 days, 34.50-37.49 days, 37.50-40.99 days, 41.00-44.99 days, 45.00-48.99 days, and greater than or equal to 49 days.

3.0 Results

Eighty-six of the 152 VA medical centers with wait time data had patients who visited a geriatric outpatient clinic at only one parent station between October 2000 and March 2001. The median facility-level wait time between July and December 2001 was 32.9 days. Twenty-five percent of the facilities had wait times less than or equal to 25.9 and twenty-five percent of the facilities had wait times that were greater than or equal to 42.8 days.

The first column in Table 3 gives health status statistics for the geriatric sample, which is elderly and in generally poor health. Ninety-six percent of the sample was male and the mean age was 78 years. About a third of the patients had endocrine disease, neurological disease, psychiatric disease, or sensory disease, and about 20% of the sample had cancer and/or pulmonary disease. Eighty-two percent of the sample had been diagnosed with heart disease. The average patient in the sample was diagnosed with 2.79 of these disease categories, and the mean rating on the Charlson comorbidity index was 0.77. Five percent of the sample had

experienced a preventable hospitalization in the previous federal fiscal year. Three percent of the sample died during the six-month outcome period between July and December 2001 and five percent of the sample (n=1803) experienced at least one ACSC hospitalization in the six-month outcome period. Seventeen percent of those experiencing an ACSC hospitalization had more than one ACSC hospitalization (n=371) during the outcome period.

The remaining columns of Table 3 show individual health status characteristics by the facility-level six month average wait times broken into five categories. As discussed above, unobserved health status may affect the relationship between waiting for care and ACSC hospitalization if facilities with very long waits have healthier patients overall because individuals in poorer health go outside of the VA for care, and exclude themselves from the sample. We attempted to control for potential selection bias by separating the sample selection period from the wait time and outcome measure period in time. However, as seen in Table 3 it does not appear that selection bias was completely eliminated. This table compares descriptive statistics on health status measures for the overall sample to the health status characteristics of individuals who visited facilities where the average six month wait was <26 days, 26-31.49 days, 31.50-37.49 days, 37.50-44.99 days and >=45 days. The effect is most notable for individuals who visited facilities with an average wait time of 45 days or more. These individuals are healthier than the overall sample. For example, about 25% of the veterans who visited facilities with an average wait time of 45 days or more had a neurological disease or psychiatric disease, compared to about 31% of veterans across the whole sample with each of these diseases. Similarly, veterans who visited facilities with an average wait time of 45 days were diagnosed with a mean of 2.51 diseases compared to 2.79 for the entire sample and only 3.6% of the veterans who visited facilities with an average wait time of 45 days or more experienced a

previous ACSC hospitalization compared to 5.1% in the overall sample. Veterans who visit facilities with an average wait time of less than 45 days do not appear consistently healthier than the overall sample.

Table 4 shows the coefficients, marginal effects and *p*-values for the stacked heteroskedastic probit model explaining the probability of experiencing an ACSC hospitalization in each month between July and December 2001. The probability of experiencing an ACSC hospitalization was significantly increased for veterans who visited a facility with wait times between 34.50 and 44.99 days compared to veterans who visited a facility with wait times of less than 22.5 days. The probability of experiencing an ACSC hospitalization increased by 0.24 percentage points for facility-level waits between 34.50 and 37.49 days, 0.27 points for facility-level waits between 37.50 and 40.99 days and 0.19 points for facility-level waits between 41.00 and 44.99 days (Table 4; Column 2). Veterans who visited a facility with wait times greater than or equal to 45 days did not significantly differ in their probability of being hospitalized for an ACSC compared to veterans who visited facilities with wait times of less than 22.5 days. This is likely due to the remaining selection bias in the sample that is demonstrated in Table 3.

Other explanatory variables to control for facility-level case mix and individual health status generally have the expected association with the probability of experiencing an ACSC hospitalization (Table 4). There is a significant positive association between the lagged facility-level ACSC hospitalization rate and the probability of experiencing an ACSC hospitalization. Females had a significantly lower probability of experiencing an ACSC hospitalization than males. Age and the Charlson index of comorbidity both had a significant positive association with the probability of being hospitalized for an ACSC. Veterans who were previously hospitalized for an ACSC condition were almost 2 percentage points more likely to be

hospitalized for an ACSC condition in the outcome period. Veterans who had a diagnosis of endocrine disease or pulmonary disease in the prior year had significantly higher probabilities of experiencing an ACSC hospitalization compared to veterans who were not diagnosed with each of these diseases. Finally, the time effect is significant with a positive association between the number of months since the beginning of the outcome period and the probability of experiencing an ACSC hospitalization (marginal effect=0.03 points; P=0.036).

4.0 Discussion

Generally these results show a weak positive association between visiting facilities with longer wait times and the probability of experiencing an ACSC hospitalization even when controlling for prior individual health status. The association is significant for geriatric veterans who visited facilities with wait times between 34.50 days and 44.99 days compared to geriatric veterans who visited facilities with wait times of less than 22.5 days. These results are consistent with our previous work that found a significant positive association between visiting facilities with longer waits for outpatient care and risk-adjusted mortality among the same population of veterans (Prentice and Pizer, forthcoming).

However, the marginal effects for the significant wait time categories are generally small. The largest marginal effect was 0.27 percentage points for facility-level waits between 37.50 and 40.99 days compared to veterans who visit facilities with wait times of less than 22.5 days. Our sample is all individuals who visited a geriatric outpatient clinic in 2001. Thus, individuals in the sample could have a wide range of clinical conditions and the effect of wait times on the likelihood of experiencing an ACSC hospitalization may be stronger for some clinical conditions versus other clinical conditions. Future research should examine the relationship between waiting for care and health outcomes among populations that are more narrowly clinically defined and

where the ongoing timely management of the condition is hypothesized to prevent more serious health outcomes (e.g. diabetes).

The relationship between waiting for care and ACSC hospitalization does not remain significant after 45 days (although >=49 days is significant at $P<0.10$). We believe this is due to the sample selection bias that occurs because only the healthiest individuals can afford to wait for care at facilities with very long waits. We tried to minimize this selection bias by separating in time the sample selection period from the wait time and outcome period. However, individuals who visited facilities with a six month average wait of 45 days or more were healthier than the overall sample (Table 3; last column) so we do not think we eliminated selection bias. In future research, we hope to formally model the process by which veterans choose among VA and non-VA options. If we are successful, we will be able to more fully correct future estimates for selection bias.

Finally, further research is needed on the mechanisms through which wait times negatively affect health. The assumed mechanism is that delays in diagnosis and treatment as a result of waiting for health care cause poorer health outcomes (IOM 2004; Kenagy, Berwick, and Shore 1999). However, wait times in this study may also be a proxy for poor quality of care at certain facilities. Facilities that have consistently long waits may be poorly managed in other ways, and this poor management may affect patient health, such as through patient safety errors. Furthermore, we cannot rule out that poor management has adverse effects on patient health and simultaneously results in inaccurate reporting of waiting times. If such inaccuracies systematically lead to longer reported waits, our results could be attributable purely to management, not to waiting.

Nonetheless, if delays in diagnosis and treatment from waiting for health care negatively affect health, the health of individuals could improve if U.S. health care systems begin to monitor wait times and implement policies to decrease them where needed. Some strategies for shortening wait times are already known and can be implemented through appropriate health care policy. For example, several studies have found that wait times can be shortened by implementing the Advanced Clinic Access model (Gordon and Chin 2004; Murray et al. 2003; Van Deusen Lukas et al. 2004). The Advanced Clinic Access model changes how appointments are scheduled, analyzing the supply of appointments relative to the demand for appointments and changing scheduling procedures so that demand is met. After clearing the backlog of patients waiting for appointments, facilities then attempt to see patients the same day appointments are requested. Since all physicians have open slots in their schedule, patients see their regular physician, eliminating recheck appointments that result when a patient goes to a different clinician because of a long wait to see their regular clinician (Murray and Berwick 2003). The results of this study strengthen the case for broad implementation of interventions such as Advanced Clinic Access as well as for more extensive monitoring of waiting times throughout the American health care delivery system.

References

AHRQ Quality Indicators-Guide to Prevention Quality Indictors: Hospital Admission for Ambulatory Care Sensitive Conditions. Rockville, MD: Agency for Healthcare Research and Quality; 2001. AHRQ Pub No. 02-R0203.

Baar, B. 2005a. "New Patient Montitor: Data Definitions". Veteran Health Administration Support Services Center.

Baar, B. 2005b. "Next Available Detail Data: Data Definitions". Veterans Health Administration Support Services Center.

Berlowitz, D. R., G. H. Brandeis, J. Anderson, W. Du, and H. Brand. 1997. "Effect of Pressure Ulcers on the Survival of Long-Term Care Residents." *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences* 52(2):M106-M10.

Charlson, M. E., P. Pompei, K. L. Ales, and C. R. MacKenzie. 1987. "A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation." *Journal of Chronic Disease* 40(5):373-83.

Culler, S. D., M. L. Parchman, and M. Przybylski. 1998. "Factors Related to Potentially Preventable Hospitalizations Among Elderly." *Medical Care* 36(6):804-17.

Deyo, R. A., D. C. Cherkin, and M. A. Ciol. 1992. "Adapting a Clinical Comorbidity Index for Use with ICD-9-CM Administrative Databases." *Journal of Clinical Epidemiology* 45(6):613-19.

Gordon, P. and M. Chin. 2004. "Achieving a New Standard in Priamry Care For Low-Income Populations: Case Studies of Redesign and Change Through a Learning Collaborative". pp. 17. New York: The Commonwealth Fund.

Greene, W. H. 1993. Econometric Analysis, 2nd edition. Upper Saddle River: Prentice Hall.

Institute of Medicine (IOM): The Committee on the Quality of Health Care in America. 2004. "Crossing the Quality Chasm: A New Health System for the 21st Century". Washington D.C.: Institute of Medicine

Kazis L.E., X. S. Ren, A. Lee, K. Skinner, W. Rogers, J. Clark, D.R. Miller. 1999. "Health Status in VA Patients: Results from the Veterans Health Study." *American Journal of Medical Quality* 14(1):28-38.

Kenagy, J. W., D. M. Berwick, and M. F. Shore. 1999. "Service Quality in Health Care." *Journal of the American Medical Association* 281(7):661-65.

Mukamel, D. B. and W. D. Spector. 2000. "Nursing Home Costs and Risk-Adjusted Outcome Measures of Quality." *Medical Care* 38(1):78-89.

Murray, M. and D. M. Berwick. 2003. “Advanced Access: Reducing Waiting and Delays in Primary Care.” *Journal of the American Medical Association* 289:1035-40.

Murray, M., T. Bodenheimer, D. Rittenhouse, and K. Grumbach. 2003. “Improving Timely Access to Primary Care: Case Studies of the Advanced Access Model.” *Journal of the American Medical Association* 289(8):1042-46.

Porell, F., F. G. Caro, A. Silva, and M. Monane. 1998. “A Longitudinal Analysis of Nursing Home Outcomes.” *Health Services Research* 33(4):835-65.

Prentice, J. C. and S. D. Pizer. “Delayed Access to Health Care and Mortality.” *Health Services Research* In press.

Rosen, A., J. Wu, B. H. Chang, D. Berlowitz, A. Ash, and M. Moskowitz. 2000. "Does Diagnostic Information Contribute to Predicting Functional Decline in Long-Term Care?" *Medical Care* 38(6):647-59.

Selim, A. J., D. R. Berlowitz, G. Fincke, A. K. Rosen, X. S. Ren, C. L. Christiansen, Z. Cong, A. Lee, and L. Kazis. 2002. “Risk-Adjusted Mortality Rates as a Potential Outcome Indicator for Outpatient Quality Assessments.” *Medical Care* 40(3):237-45.

StataCorp. 2005. *STATA* (release 9.0) statistical software. College Station, TX. StataCorp.

United States Government Accounting Office (U.S. GAO). 2001. “More National Action Needed to Reduce Waiting Times, but Some Clinics Have Made Progress”. United States General Accounting Office. GAO-01-953.

VanDeusen Lukas, C., M. Meterko, D. Mohr, and M. N. Seibert. 2004. “The Implementation and Effectiveness of Advanced Clinic Access”. Health Services Research and Development Management Decision and Research Center. Boston: Office of Research and Development, Department of Veteran Affairs.

Veterans Health Administration (VHA); Decision Support Office (2004). Summary of Active Stop Codes; Reference I. [accessed on January 15, 2005] Available at http://vaww.dss.med.va.gov/programdocs/pd_oident.asp

Table 1: Individualized Wait Time versus Exogenous Wait Time Measure by PQI Status (July-September)

Individualized Wait Time	July ACSC Hospitalization		August ACSC Hospitalization		September ACSC Hospitalization	
	Yes	No	Yes	No	Yes	No
	(n=14,783)*		(n=15,338)		(n=13,679)	
Mean	34.77	37.73	35.69	38.78	34.36	36.88
Median	29.40	31.79	32.27	35.18	28.37	29.78
Interquartile Range	18.62-44.56	19.36-48.97	16.98-45.11	21.70-47.49	17.61-43.69	18.79-47.65
Exogenous Wait Time	(n=33,082)		(n=33,271)		(n=33,111)	
Mean	36.60	36.39	36.73	36.88	34.27	34.49
Median	36.03	36.03	35.84	37.82	34.31	32.17
Interquartile Range	30.26-43.13	30.26-43.13	30.58-43.49	30.01-45.55	27.79-41.80	27.57-43.03

*There were 33,538 people in the sample. However, not everyone had an outpatient visit to one of the 46 clinic stops in July, August or September. July and August had one (August) or two (July) parent stations that reported no wait time data at all and were treated as missing. As well, some individuals died in July, August and September and these individuals were censored.

Table 2: Example of Exogenous Wait Time Calculation*

	Oct.-March (Sample Selection Period)			**July Wait Times**		**August Wait Times**	
Appointment Type	*Station 1* # of appointments	*Station 2* # of appointments	National proportion of appointments	*Station 1* Wait in days	*Station 2* Wait in days	*Station 1* Wait in days	*Station 2* Wait in days
Primary Care	18	13	0.37	20.8	36.5	15.2	34.2
Psychology	8	13	0.25	33.2	Missing	20.9	10.0
Optometry	12	10	0.26	25.5	27.4	23.8	28.4
Women's Clinic	10	----	0.12	21.2	----	22.5	----
			Wait Time Calculation	(0.37*20.8)+ (0.25*33.2)+ (0.26*25.5)+ (0.12*21.2)= **25.17**	(0.41*36.5)+ (0.29*00.0)+ (0.30*27.4)= **23.19**	(0.37*15.2)+ (0.25*33.2)+ (0.26*25.5)+ (0.12*21.2)= **20.02**	(0.41*34.2)+ (0.29*10.0)+ (0.30*28.4)= **25.44**

*Suppose there were only four appointment types: 1) primary care visits, 2) psychology 3) optometry and 4) women's clinic and two parent stations. The total number of appointments during the sample selection period was 84. Overall, 37% of the appointments were in primary care, 25% were in psychology, 26% were in optometry and 12% were in Women's clinic, even though these proportions actually differ by individual station (e.g. the proportions are 38% for primary care, 17% for psychology, 26% for optometry and 22% for the Women's Clinic for station 1).

The wait time for station 1 in July is: (0.37*20.8) + (0.25*33.2)+(0.26*25.5)+(0.12*21.2)=25.17 days. Since this parent station uses all clinic appointment types and has no missing wait times, the wait time is constructed by multiplying the wait in days for each appointment type by the national proportion of appointments associated with each clinic type. Similarly, August wait times are calculated by multiplying the August wait times for each appointment type by the national proportion of each appointment type.

The wait time for station 2 in July is: (0.41*36.5)+(0.29*0.00)+(0.30*27.4)=23.19 days. For psychology appointments, the wait time was imputed with 0 because the wait time for this appointment type was missing in the July data. This indicates no next available appointments were scheduled for psychology in July. Since there is a wait time for psychology in August, it was assumed that there was no waiting for psychology appointments in July and patients could get in right away.

However, there are no appointments or wait times for women's clinic in either July or August for the Women's Clinic for Station 2. Therefore, station 2 is assumed not to use Women's clinic and the 12% of appointments that are attributed nationally to the Women's Clinic is redistributed evenly among the other 3 appointment types so the proportions add up to 1. The proportions for Station 2 for primary care are 0.41 (versus 0.37 nationally), for psychology 0.29 (versus 0.25 nationally) and for optometry 0.30 (versus 0.26 nationally).

Table 3: Difference in Health Status of Individuals Visiting Facilities By Average Facility-Level Wait Time (n=33,538 people)*

	Overall Sample	Wait time <26 days*		Wait time 26.00-31.49 days		Wait time 31.50-37.49 days		Wait time 37.50-44.99 days		Wait time >=45 days	
Health status	Percent or Mean	Percent or Mean	Diff^	Percent or Mean	Diff	Percent or Mean	Diff	Percent or Mean	Diff	Percent or Mean	Diff
Age	78.37	78.93	-0.56	78.15	0.22	77.96	0.41	78.42	-0.05	78.69	-0.32
Charlson Index score	0.77	0.95	-0.18	0.84	-0.07	0.71	0.06	0.79	-0.02	0.62	0.15
Cancer†	19.90	22.26	-2.36	20.96	-1.06	20.01	-0.11	21.52	-1.62	16.02	3.88
Endocrine disease	31.51	31.85	-0.34	32.32	-0.81	30.68	0.83	34.33	-2.82	29.41	2.1
Heart disease	82.42	79.32	3.1	80.18	2.24	86.22	-3.8	83.2	-0.78	82.77	-0.35
Neurological disease	31.40	38.92	-7.52	29.44	1.96	34.35	-2.95	31.84	-0.44	25.69	5.71
Psychiatric disease	31.75	34.13	-2.38	33.15	-1.4	33.42	-1.67	33.98	-2.23	25.49	6.26
Pulmonary disease	20.13	19.6	0.53	20.17	-0.04	21.48	-1.35	20.89	-0.76	18.57	1.56
Sensory disease	32.82	33.73	-0.91	38.25	-5.43	30.08	2.74	32.57	0.25	28.66	4.16
Muscular disease	12.24	14.18	-1.94	11.05	1.19	9.41	2.83	15.8	-3.56	13.13	-0.89
Other disease	16.88	22.37	-5.49	18.26	-1.38	16.94	-0.06	17.01	-0.13	11.6	5.28
# of disease categories	2.79	2.96	-0.17	2.84	-0.05	2.83	-0.04	2.91	-0.12	2.51	0.28
Previous ACSC hospitalization^	5.10	5.92	-0.82	4.83	0.27	5.52	-0.42	6.48	-1.38	3.63	1.47

*Facility level wait times were averaged together between July and December 2001. Facilities were then categorized into groups with six month average wait times of less than 26 days, 26.00-31.49 days, 31.50-37.49 days, 37.50-44.99 days and >=45.00 days. These categories are the wait time quintiles when wait time is tabulated in each month between July and December and not averaged together over the six month outcome period (See Table 4).

^Difference=(Overall sample percent/mean-percent or mean for each average wait time category). Positive numbers indicate individuals visiting facilities with that average wait time are healthier than the overall sample. Negative numbers indicate these individuals are less healthy than the overall sample.

†Patients diagnosed with each of the diseases within a year before his or her first geriatric clinic were categorized as yes.

^Patients who had an ACSC hospitalization between Oct. 1, 2000 and Sept. 31, 2001 were categorized as yes.

Table 4: Coefficients, Marginal Effects, and P-values of a Heteroskedastic Stacked Probit Model Predicting ACSC hospitalization, 2001 (n=197,588 person months; 33,538 people)

Independent Variables	Coefficient	Marginal Effect	*P* value
Facility wait time in days (ref=<22.5 days)			
22.50-25.99 days	0.0478	0.00130	0.177
26.00-28.99 days	0.0514	0.00140	0.130
29.00-31.49 days	0.0558	0.00153	0.105
31.50-34.49 days	0.0489	0.00133	0.149
34.50-37.49 days	0.0850	0.00240	0.012
37.50-40.99 days	0.0948	0.00271	0.007
41.00-44.99 days	0.0697	0.00194	0.049
45.00-48.99 days	0.0406	0.00109	0.248
>=49 days	0.0677	0.00188	0.082
Facility average ACSC hospitalization rate per 1000‡	0.0070	0.00018	<0.001
Female (ref=male)	-0.1227	-0.00272	0.025
Age	0.0086	0.00022	<0.001
Previous ACSC hospitalization (ref=no)†	0.4298	0.01882	<0.001
Charlson Index	0.0262	0.00067	<0.001
Cancer (ref=no)*	-0.0554	-0.00136	0.090
Endocrine disease (ref=no)	0.0993	0.00269	0.002
Heart disease (ref=no)	0.0325	0.00081	0.369
Neurological disease (ref=no)	0.0549	0.00145	0.083
Psychiatric disease (ref=no)	-0.0076	-0.00019	0.813
Pulmonary disease (ref=no)	0.2494	0.00794	<0.001
Sensory disease (ref=no)	-0.0621	-0.00155	0.057
Other disease (ref=no)	0.0405	0.00108	0.253
Number of disease categories	0.0337	0.00087	0.188
Count of observations per person[@]	0.0095	0.00025	0.036
Natural log of number of observations per clinic	-0.0138	-0.00076	0.003
Likelihood ratio test of heteroskedacity	χ^2=8.66, degrees of freedom=1; *P*=0.003		

^Standard errors were adjusted for clustering by individuals.

‡ ACSC hospitalization rates in each facility between October and December 2000 were averaged together.

†Patients who had an ACSC hospitalization between Oct. 1, 2000 and Sept. 31, 2001 were categorized as yes.

*Patients diagnosed with each of the diseases within a year before his or her first geriatric clinic in FY2001 were categorized as yes. Muscular disease was dropped due to collinearity with the other disease categories.

[@]This variable counted up the number of observations for each person. For example, the variable was 1 for the July observation, 2 for the August observation, etc.

Notes

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2. Hospitalizations that potentially could have been prevented through appropriate outpatient care have been referred to as "ambulatory care sensitive," "preventable," "avoidable," or "prevention quality indicators" (Culler, Parchman, and Przybylski 1998; AHRQ 2001). We use the term ACSC hospitalization throughout this paper.

3. For ease of presentation, "facility" and "parent station" are used interchangeably throughout the paper to refer to a VA parent station.

4. Note this is still not the actual time individual patients waited for appointments. The VA averages together the individual wait times and reports an average wait for the entire parent station for each appointment type. We averaged together this parent station level wait time for all clinic appointments used by each individual.

5. Only 37% of the clinic visits in the entire sample were to a geriatric outpatient clinic. Thus, the sample used a wide range of health care services beyond geriatric outpatient clinics.

6. In the final sample, 12% of the clinic appointments were imputed with 0.

7. The standard correction for selection bias involves estimating a first stage selection model and explicitly accounting for the expected value of the disturbance term from that model in the second stage equation of interest. Because we do not have veterans in our sample who chose not to come to a VA medical center for care, we cannot take this approach.

8. Our previous work examining the relationship between wait times and mortality included the same explanatory variables to risk-adjust for prior individual health status presented in this paper. However, the mortality models also included whether or not a patient had a 50% or more service-connected disability (e.g. a condition or disability that the VA has determined was incurred or aggravated by military service). We ran models predicting ACSC hospitalization that included service-connected disability. In these models, service-connected disability had no significant effect. It was excluded in the final models because of the loss of observations due to missing values on service-connected disability.

9. Following previous work (e.g. Selim et al, 2002), the Deyo et al. (1992) translation of the original Charlson index that identifies conditions by ICD-9-CM codes was used. Conditions were weighted using the original Charlson weighting system (Charlson et al, 1987).