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RESEARCH ARTICLE

External Determinants of Veterans' Utilization of VA Health Care

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Objective. Veterans' utilization of Veterans Affairs (VA) health care is likely influenced by community factors external to the VA, including Medicaid eligibility and unemployment, although such factors are rarely considered in models predicting such utilization. We measured the sensitivity of VA utilization to changes in such community factors (hereafter, "external determinants"), including the 2014 Medicaid expansion following the Affordable Care Act.

Data Sources/Study Setting. We merged VA health care enrollment and utilization data with area-level data on Medicaid policy, unemployment, employer-sponsored insurance, housing prices, and non-VA physician availability (2008–2014).

Study Design. For veterans aged 18–64 and ≥65, we estimated the sensitivity of annual individual VA health care utilization, measured by the cost ($) of care received, to changes in external determinants using longitudinal regression models controlling for individual fixed effects.

Principal Findings. All external determinants were associated with small but significant changes in VA health care utilization. In states that expanded Medicaid in 2014, this expansion was associated with 9.1 percent ($826 million) reduction in VA utilization among those aged 18–64; sizable changes occurred in all services used (inpatient, outpatient, and prescription drugs).

Conclusions. Changes in alternative insurance coverage and other external determinants may affect VA health care spending. Policy makers should consider these factors in allocating VA resources to meet local demand.

Key Words. Veterans, health care utilization, economic conditions, unemployment, Medicaid, insurance coverage

The Department of Veterans Affairs (VA) must "anticipate and proactively prepare for the needs" (Department of Veterans Affairs 2010) of veterans to provide timely and adequate health care services for this population. The importance of appropriately aligning resource availability with demand for

health care services in the VA was recently underscored by revelations of long waiting times in accessing VA care (VA Office of Inspector General 2014) and the subsequent passage of the Veterans' Access to Care through Choice, Accountability, and Transparency Act of 2014 (VACAA) to facilitate use of non-VA services for eligible veterans who live more than 40 miles from a VA facility or must wait 30 days or more for VA care (Congressional Budget Office 2014). The number of veterans eligible and enrolled to receive any of the full spectrum of health care services provided by the VA has increased from 7.3 million in 2008 to 8.5 million in 2014 (Office of Strategic Planning and Analysis [OSPA] 2015); furthermore, this population has become younger (Office of Strategic Planning and Analysis [OSPA] 2015). As most veterans live and work in community settings, the choice to use VA health care services is likely influenced by factors internal and external to the VA; for instance, Medicaid expansion in 2014, as part of the Affordable Care Act (ACA), was associated with 25 percent reduction in uninsurance among veterans aged 18–64 (Haley et al. 2016). In step with the demographic changes in the veteran population, a better understanding of the internal and external factors that influence the choice of VA health care services is important for VA's continued ability to meet veterans' health care needs at national and local levels.

VA policy makers routinely use models of VA health care demand to forecast budgets and allocate resources (RAND 2005, 2008). These models do not include factors external to the VA (hereafter called "external determinants"), such as alternative insurance (Medicaid, employer-sponsored coverage), unemployment, and non-VA provider availability. Other studies of demand for VA health care services recognized the role of alternative insurance coverage; however, until recently, this literature was largely limited to

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examining subgroups of veterans with dual health insurance coverage, most often elderly veterans with Medicare (Carey et al. 2008; Shen et al. 2008; Hendricks et al. 2010). It largely excluded working-age veterans, who, apart from eligibility for VA services, are more commonly covered by employer-sponsored commercial insurance (34 percent in 2010) or uninsured (37 percent; Bernard and Selden 2016). Recent studies have begun to examine the role of unemployment and Medicaid coverage, and their temporal fluctuations, in VA utilization among veterans of all ages (Wong and Liu 2013; Wong et al. 2014a, 2015; Frakt, Hanchate, and Pizer 2015).

Our study advances the understanding of the external determinants of VA health care utilization among all age groups in several important ways. First, we developed a model that comprehensively examines a range of external determinants covering alternative insurance coverage (Medicaid, employer-sponsored insurance), economic changes (unemployment, housing prices), and non-VA physician availability. Second, no previous study has, to our knowledge, examined the changes in VA health care utilization following the 2014 Medicaid expansion under ACA (Congressional Budget Office 2005, 2010; Kizer 2012; Vandenberg et al. 2013). Third, our model incorporates improvements in study design aimed at reducing confounding changes in VA utilization; in particular, our estimation approach only utilizes individual-level longitudinal ("within-individual") changes in VA utilization to estimate sensitivity to changes in external determinants (Cameron and Trivedi 2005). Compared to previous studies based on longitudinal changes at aggregate (clinic or area) levels, our approach eliminates potential confounding arising from compositional changes within area-level groups arising from factors such as relocation or death (Frakt, Hanchate, and Pizer 2015).

We obtained estimates of sensitivity of VA utilization overall at the national level, and for regions and veteran subgroups of interest by merging individual-level annual data on VA health care utilization among all veterans enrolled for VA health care from 2008 to 2014 with area-level measures of external determinants. Based on standard economic models of health care demand, we hypothesized the following: Increases in local unemployment would reduce earnings and insurance coverage, thereby increasing VA utilization; expansion of insurance coverage, either Medicaid or employer-sponsored private insurance, or increases in non-VA physician availability would reduce VA health care utilization; and increases in area-level housing prices could have two countervailing effects, one inducing lower VA utilization among property-owning veterans who benefit from increased wealth, and the

other increasing VA utilization among veterans who experience increases in housing rental costs (Phelps 2003; Flanagan and Schwartz 2013).

METHODS

Data Sources

We used VA's Assistant Deputy Under Secretary for Health for Policy and Planning (ADUSH-PP) Enrollment and Vital Status files for information on VA health care coverage (VA Information Resource Center 2013). We obtained individual-level data on cost of utilization of inpatient care, outpatient care, and outpatient prescription drugs provided or paid for by the VA and received from providers within and outside the VA (from Managerial Cost Accounting System extracts and Medical SAS Datasets; Gidwani, Hong, and Murrell 2015; Phibbs, Barnett, and Fan 2015; U.S. Department of Veterans Affairs Information Resource Center 2015a, b, c). We used multiple sources of area-level data on external determinants: American Community Survey (U.S. Census Bureau 2017) Medicaid Eligibility Data (Urban Institute 2015; Kaiser Family Foundation 2016) Medical Expenditure Panel Survey (Agency for Healthcare Research and Quality 2015) Area Health Resources File (Health Resources and Services Administration 2015) and Housing Price Index data(Federal Housing Finance Agency 2015). In addition, to adjust for regional differences in cost of living, and their changes over time, we used Consumer Price Index-All Urban and Regional Price Parity measures (Bureau of Economic Analysis 2015; Bureau of Labor Statistics 2017).

Study Population

We used the ADUSH Enrollment File for fiscal years (FY; beginning October 1) 2008–2014 to identify 11,412,576 veterans, aged 18 and older, who had either received or were eligible and enrolled to receive VA health care during 2008–2014 (see Appendix SA2 for chart of study cohort derivation). As this is a lifetime benefit, we used enrollee death status data to ascertain the individual longitudinal period of VA health care coverage until 2014 (U.S. Department of Veterans Affairs 2017a, b). We examined individual health care utilization annually, treating a (fiscal) year as the unit of time; there were 62,449,133 person-year utilization records overall. Because our estimation approach is based on longitudinal change in health care utilization, we excluded veterans (1) without coverage in two or more years, (2) who relocated across counties

during 2008–2014 as relocations can confound our treatment of external determinants as exogenous factors, (3) with missing information on key measures, and (4) from 738 counties where any year to year change in number of non-VA physicians exceeded ±25 percent. The final dataset included 46,390,458 person-year VA utilization records from 8,016,250 veterans.

Outcomes

Our primary outcome was *VA health care utilization*, measured by the cost of all acute inpatient care, outpatient care, and pharmacy use provided by the VA for each individual annually, and adjusted for inflation using the Consumer Price Index (with 2010 as the base year). We also examined four components of overall utilization: (1) acute inpatient care, (2) outpatient care, (3) pharmacy use, each obtained within the VA, and (4) all care obtained from non-VA providers and covered by the VA.

External Determinants

Our choice of external determinants is conceptually based on the basic economic model of individual health care demand that indicates that use of health care services is affected by out-of-pocket costs, health care insurance, household income and wealth, travel costs, and quality of care (Phelps 2003). Economic changes and public policy affect access to private or public insurance (Phelps 2003; Levy and Meltzer 2008; Ruhm 2015). In the context of VA health care utilization, previous models have examined the influence of dual coverage (particularly Medicare and Medicaid), unemployment, housing prices, and Medicaid expansion (Wong et al. 2014a, 2015; Frakt, Hanchate, and Pizer 2015). Housing price changes have potentially different effects on household financial status and, indirectly, on VA utilization: Increases in housing prices represent a financial gain for homeowners, but likely a financial loss for renters due to a likely increase in rents. The net effect of housing price changes depends on the relative share of homeowners and renters. We include two potentially important determinants not previously examined. First, employer-sponsored coverage provides an alternative to VA health care for a large proportion of Veterans (Office of Strategic Planning and Analysis [OSPA] 2015). Second, increased proximity to non-VA physicians may reduce travel costs for Veterans with dual insurance coverage (Fortney et al. 2005).

Overall, our model examined five external determinants. *Medicaid eligibility* (%) measures the proportion of a standardized population—stratified by

age—that would be eligible for Medicaid coverage based on eligibility criteria in each state each year. Following prior work, we derived this measure by applying eligibility criteria for each state and year to a reference population cohort so as to measure "generosity" of Medicaid eligibility policy without influence of state-level differences in demographic, health status, and socioeconomic conditions (Currie and Gruber 1996; Frakt, Hanchate, and Pizer 2015; Golberstein and Gonzales 2015). Additional details are provided in Appendix SA4.

State-level annual data on *employer-sponsored coverage* was measured by the proportion of employees eligible for health insurance in private firms that offer health insurance (Agency for Healthcare Research and Quality 2015). *Unemployment ratio* is a state-level annual indicator of the proportion of veterans aged 18–64 who are not employed (U.S. Census Bureau 2017). *Housing Price Index* is a state-level annual measure of seasonally adjusted changes in housing prices (with 1991 as base year) (Federal Housing Finance Agency 2015). *Non-VA physician availability* is measured by the number of active non-Federal physicians per 1,000 population and reported at the county-level annually (Health Resources and Services Administration 2015). To adjust VA utilization costs for regional differences in cost of living, we included the Regional Price Parity, an annual state-level index of price level, as a covariate.

Subgroups

We examined the sensitivity of VA health care utilization to external determinants separately for the 26 states that implemented ACA Medicaid expansion (by March 2014), versus the other states (Kaiser Family Foundation 2014b). A veteran's *priority status*, ranging from priority 1 (highest priority with greatest access to VA care) to priority 8 (lowest priority and access), assigned based on qualifying eligibility criteria (including extent of service-connected disabilities and income), affects access to VA care, in terms of timeliness of receipt of VA health care services and out-of-pocket costs. We estimated VA utilization models separately for three priority groups: priority 1 to 4 (eligibility from service-connected disabilities), priority 5 (eligibility from income below VA-determined threshold), and priority 6 to 8 (eligibility from other disability and income criteria) (U.S. Department of Veterans Affairs 2015). Due to incomplete enrollee-level data on race and ethnicity, we used ZIP code–level census data and characterized all veterans by the proportion of non-Hispanic whites in the ZIP code of their residence. We followed a similar approach for

socioeconomic status and assigned ZIP code median household income to all veterans.

Analysis

Our core analysis focused on the estimation of the association between external determinants and longitudinal individual-level changes in VA health care utilization. We estimated a linear longitudinal regression model of annual change in utilization as a function of annual changes in the external determinants with individual fixed effects; this specification was preferred over random effects as estimation is based only on within-individual changes over time and is not confounded by unobserved cross-sectional differences across individuals (Cameron and Trivedi 2005). We included the state-level index of price changes and, to capture secular changes in determinants of VA health care utilization, indicators of year. At the individual level, we only included indicator of age categories (9 and 5 categories for 18–64 and 65+ age-groups, respectively). Data on health status are not available for the entire study population as about 30 percent of veterans enrolled for VA health care have not sought care in the VA. However, our model specification (using individual fixed effects) adjusts for individual differences in health status that did not vary over time (chronic conditions). Our preferred estimation model permitted time-varying association between VA utilization and Medicaid eligibility by interacting Medicaid eligibility with year indicators. We estimated the model separately for the 18–64 and 65 and older age groups, as two external determinants are inapplicable for the older group (unemployment ratio and employer-sponsored coverage). We repeated the analysis for the study population stratified by residence in states that expanded Medicaid in 2014 versus other states. We also estimated the model for the secondary outcomes of VA utilization components (inpatient, outpatient, pharmacy, and non-VA providers) and for subgroups by priority status (ZIP code), minority status, and (ZIP code) income.

Due to differences in the units of measurement of the outcomes and external determinants, we report the model estimates in terms of marginal changes; specifically, we report the percentage change in VA health care utilization associated with a 10 percent annual increase in the value of an external determinant, holding all other external determinants and covariates constant (elasticity; Wong and Liu 2013).

In addition, we projected overall change in per capita and aggregate VA health care utilization between 2013 and 2014, by applying the model estimates to observed changes in external determinants.

Sensitivity Analysis

As area-level external determinants are likely to be correlated, we examined the sensitivity of model estimates to inclusion/exclusion of individual external determinants. Because a sizable proportion of veterans have no history of VA health care use, we also estimated the models for the subgroups of veterans who used VA care in the base year (2008) and those who used VA care in any study year (2008–2014). We also examined sensitivity of model estimates to exclusion of individual years. As our state-level measure of Medicaid eligibility is imputed for some years (2009–2011, 2013) we also estimated the model without data for these years. We did not include comorbidities in the main VA utilization models as data on comorbidities are available only from VA utilization data and not for care obtained outside VA. Consequently, a switch to VA health care may lead to all newly documented diagnoses being treated as newly diagnosed conditions even if previously diagnosed outside VA, thereby leading to underestimation of the impact of the underlying external factor change that motivated the switch to VA health care. To illustrate, consider an increase in VA unemployment in some areas leading some Veterans to switch from non-VA to VA health care coverage. The switch to use of VA services leads to identification of comorbidities not previously documented in VA data; these will be treated as "newly" identified comorbidities in our estimation models, even though a proportion of these are likely to have been diagnosed outside VA. If the model estimate of the coefficient for diabetes is $1,000, then this model attributes $1,000 of increased VA spending to the "newly" documented diabetes diagnosis, even though the underlying cause of this increase is the external factor change, thereby leading to the underestimation of its impact. We performed two sensitivity analyses to examine this issue. We performed two sensitivity analyses to examine this issue. First, we estimated variants of the main model with comorbidity measures included and performed secondary analyses to assess the extent of potential confounding. Second, we identified the subgroup of Veterans who used VA health care in all 7 years of the study period (2008–2014)—as comorbidities for this group are more likely to be completely documented in VA data—and compared the model estimates with and without comorbidity measures included.

RESULTS

Our study included 8.0 million veterans enrolled for VA health care services observed longitudinally for an average of 5.2 years between 2008 and 2014 (Table 1). Stratified by age, 4.6 million veterans were included in the 18–64 age cohort and 4.2 million in the age 65+ cohort. More of the younger veterans (35 percent) were in higher priority groups (priority 1 to 4) for which eligibility is based on service-related disability, while more of the older veterans (48 percent) were in lower priority groups (priority 7 to 8) based on income-related eligibility. A greater proportion of older veterans (71 percent) resided in ZIP codes with a low proportion of minorities, compared to younger veterans (64 percent).

Between 2008 and 2014, average annual VA health care utilization ($) per veteran ranged between $3,853 and $4,619 among both 18–64 and 65+

Table 1: VA Enrollee Population, 2008–2014

	Age 18–64	*Age 65+*	*All*
N	4,593,485	4,157,308	8,016,250
Mean years of follow-up	5.3	5.1	5.2
Mean age, years	48.7	73.3	59.9
Female, %	9.9%	2.1%	6.5%
Priority category			
1 to 4	35%	27%	30%
5 to 6	26%	25%	26%
7 to 8	37%	48%	43%
Missing	2%	<1%	1%
% residing in			
Low minority % areas	58%	71%	64%
Moderate minority % areas	27%	20%	24%
High minority % areas	15%	9%	12%
% residing in			
Low-income areas	26%	26%	26%
Moderate-income areas	55%	56%	55%
High-income areas	19%	18%	19%

Note: As all veterans are observed multiple years, we used the observed value during the first observed year. Some individuals who aged into 65+ category are studied in both age cohorts; therefore, the number of veterans in "All" column is smaller than the total from the two age groups. Distribution of veteran population by race/ethnicity and individual median income was based on the ZIP code–level data from American Community Surveys 2007–2011. Minority veterans were defined as those who were not non-Hispanic white; based on the proportion of veteran population who were minority, ZIP codes were grouped as low (<20%), moderate (20% to 50%), and high (>50%). To categorize ZIP codes by median income, we obtained the ratio between median income and federal poverty level threshold for a family of four ($23,021 in 2011) and grouped ZIP codes as low income (income ratio <=133%), moderate income (133% to 200%), and high income (>200%).

groups (Table 2). There was considerable longitudinal variation in the external determinants. Among veterans aged 18–64, average Medicaid eligibility experienced a gradual increase through 2013, followed by a 33 percent increase (8.2–10.9 percent) from 2013 to 2014. Among veterans aged 65 and older, Medicaid eligibility increased gradually, with the largest increase (15 percent) between 2010 and 2011. Among both age groups, the housing price index decreased between 2008 and 2011, and increased afterward; and average non-VA physician availability gradually increased from 2008 through 2014. The state-level proportion of unemployed veterans (aged 18–64) increased between 2008 (22.3 percent) and 2011 (25.6 percent), and then remained largely unchanged through 2014. Employer-sponsored coverage for private-sector employees was largely stable through 2013, but experienced a 3.3 percent decrease (77.9–75.4 percent) from 2013 to 2014. Between 2013 and

Table 2: Longitudinal Trends in VA Health Care Utilization and External Determinants, 2008–2014

(a) Age 18–64

Year	*Average VA Health Care Utilization (2010 $)*	*% Medicaid Eligible*	*Housing Price Index*	*No. of MDs/1,000 Population*	*Veterans' Unemployment Ratio*	*% with Employer-Sponsored Insurance Coverage*
2008	$4,132	7.1%	189.2	2.52	22.3%	78.1%
2009	$4,483	7.1%	181.8	2.53	23.8%	79.4%
2010	$4,489	7.3%	173.0	2.55	24.7%	78.0%
2011	$4,415	8.0%	168.9	2.56	25.6%	78.0%
2012	$4,083	8.1%	178.2	2.57	25.3%	77.8%
2013	$3,853	8.2%	192.2	2.61	25.6%	77.9%
2014	$3,940	10.9%	203.9	2.64	24.9%	75.4%

(b) Age 65 and Older

Year	*Average VA Health Care Utilization (2010 $)*	*% Medicaid Eligible*	*Housing Price Index*	*No. of MDs/1,000 Population*
2008	$4,256	9.6%	189.1	2.49
2009	$4,619	9.9%	181.5	2.50
2010	$4,617	10.2%	172.8	2.51
2011	$4,560	11.7%	168.9	2.51
2012	$4,230	11.7%	177.7	2.53
2013	$4,004	11.7%	191.2	2.54
2014	$4,086	11.7%	202.4	2.56

Note: For area-level measures (external determinants), we have reported the population-weighted averages; for instance, unemployment ratio is the state-level average with states weighted by the proportion of all veterans (aged 18–64) belong to the state in each year.

2014, for 18- to 64-year-old veterans, the population eligible for Medicaid increased by 54 percent (9.1–14.0 percent) in the expansion states and by 8.1 percent (7.4–8.0 percent) in the nonexpansion states; trends in other external determinants were similar among expansion and nonexpansion states (Table S1). We observed no appreciable increase among the 65+ population in either expansion or nonexpansion states.

In estimating the association between VA health care utilization and external determinants, our preferred model specification allowed for time (year)-varying association with Medicaid eligibility, but a stable association for other determinants (Table 3). We found that, for veterans aged 18–64, a 10 percent increase in Medicaid eligibility was associated with a small but significant decrease in VA health care utilization in 2014 (−0.31 percent) and 2013 (−0.09 percent); but in earlier years, there was either no associated change (2011–2012) or an increase in utilization (2008–2010). Utilization was positively associated with an increase in housing price index (0.92 percent), non-VA physician availability (1.20 percent), and unemployment ratio (0.65 percent). A 10 percent increase in employer-sponsored coverage was also associated with a decrease in utilization (−1.40 percent). These estimates differed between Medicaid expansion and nonexpansion states. In 2014, a 10 percent increase in Medicaid eligibility was associated with a sizable decrease in VA utilization in expansion states (−1.63 percent), but no significant change in nonexpansion states. An increase in employer-sponsored coverage was associated with a decrease in VA utilization in expansion states (−2.89 percent), but an increase in nonexpansion states (1.02 percent).

Among veterans aged 65 or older, an increase in Medicaid eligibility in 2014 was associated with a decrease in VA utilization in Medicaid expansion states (−0.77 percent) but an increase in VA utilization in Medicaid nonexpansion states (1.81 percent); this pattern was also found in 2011–2013. Estimates for other external determinants were qualitatively similar between Medicaid expansion and nonexpansion states. Across all states, an increase in housing price index was associated with an increase in utilization (2.24 percent) and an increase in non-VA physician availability was also associated with an increase (2.47 percent) in utilization.

Sensitivity analyses indicated that model estimates were robust to alternative specifications (1) excluding each external determinant from the full model (Table S2a), (2) including only veterans with VA utilization in 2008 (Table S2b) and in 2008–2014 (Table S2c), (3) excluding data from each individual year (Table S2d), and (4) including data for only the years (2008, 2012

Table 3: VA Health Care Utilization Model Estimates: Outcome Change Associated with 10% Increase in External Factor

	% Change in VA Health Care Utilization Associated with 10% Increase in External Determinant		
External Determinant	*All States*	*Medicaid Expansion States*	*Medicaid Nonexpansion States*
A. Age 18–64			
Medicaid eligibility			
2014	**−0.31% [−0.38%, −0.23%]**	**−1.63% [−1.80%, −1.46%]**	−0.08% [−0.20%, 0.05%]
2013	**−0.09% [−0.16%, −0.03%]**	**−0.65% [−0.76%, −0.54%]**	**0.12% [0.03%, 0.20%]**
2012	0.002% [−0.04%, 0.09%]	**−0.39% [−0.51%, −0.28%]**	0.08% [−0.008%, 0.17%]
2011	0.03% [−0.05%, 0.09%]	**−0.34% [−0.46%, −0.23%]**	**0.11% [0.02%, 0.21%]**
2010	**0.25% [0.18%, 0.32%]**	0.01% [−0.10%, 0.12%]	**0.31% [0.21%, 0.40%]**
2009	**0.83% [0.74%, 0.92%]**	**0.61% [0.48%, 0.74%]**	**1.01% [0.88%, 1.14%]**
2008	**1.60% [1.49%, 1.71%]**	**1.40% [1.24%, 1.56%]**	**1.98% [1.81%, 2.15%]**
Housing price index	**0.92% [0.65%, 1.20%]**	**0.60% [0.24%, 0.95%]**	0.41% [−0.11%, 0.93%]
No. of MDs per 1,000 population	**1.20% [0.95%, 1.44%]**	**1.06% [0.69%, 1.44%]**	**1.08% [0.77%, 1.39%]**
Veteran unemployment ratio	**0.65% [0.32%, 0.98%]**	**1.46% [0.99%, 1.93%]**	**0.88% [0.39%, 1.36%]**
Employer-sponsored coverage	**−1.40% [−1.97%, −0.83%]**	**−2.89% [−3.82%, −1.96%]**	**1.02% [0.24%, 1.79%]**
B. Age 65+			
Medicaid eligibility			
2014	−0.06% [−0.36%, 0.23%]	**−0.77% [−1.10%, −0.44%]**	**1.81% [0.98%, 2.64%]**
2013	0.29% [−0.03%, 0.61%]	−0.34% [−0.70%, 0.02%]	**1.96% [1.05%, 2.87%]**
2012	−0.04% [−0.38%, 0.31%]	**−0.62% [−1.01%, −0.23%]**	**1.47% [0.50%, 2.45%]**
2011	−0..26% [−0.61%, 0.09%]	**−0.79% [−1.19%, −0.39%]**	**1.47% [0.47%, 2.48%]**
2010	−0.03% [−0.03%, 0.20%]	−0.11% [−0.38%, 0.15%]	0.12% [−0.45%, 0.68%]
2009	−0.009% [−0.28%, 0.26%]	−0.02% [−0.50%, 0.10%]	0.05% [−0.73%, 0.83%]
2008	−0.46% [−0.79%, −0.13%]	**−0.54% [−0.91%, −0.17%]**	−0.81% [−1.90%, 0.27%]
Housing price index	**2.24% [1.89%, 2.59%]**	**1.84% [1.39%, 2.29%]**	**2.29% [1.69%, 2.90%]**
No. of MDs per 1,000 population	**2.47% [2.21%, 2.73%]**	**2.80% [2.42%, 3.18%]**	**1.75% [1.39%, 2.11%]**

Note: Estimates with 95% confidence interval not including zero are in bold font.

and 2014) for which actual detailed Medicaid eligibility data were available (Table S2e).

We found that inclusion of comorbidity indicators in the estimation models leads to differences in estimates of VA utilization changes associated with external factors in the models with all Veterans; but in the models limited to Veterans using VA services in all study years, estimates with and without comorbidity measures were concordant. Due to concerns that these estimates may be influenced by confounding arising from comorbidity data available only from VA utilization data, we present here models without comorbidity measures. However, the Appendix (section SA5) includes all estimates, additional secondary evidence, and discussion of our rationale.

Based on estimates of sensitivity of VA utilization to these changes, we calculated the breakdown of the change in per capita and aggregate VA health care utilization between 2013 and 2014 by each of the external determinants (Table 4 and Table S4); the confidence interval of these estimates is proportionate with that for the corresponding elasticity estimates in Table 3. Among those aged 18–64, increased Medicaid eligibility was associated with a $39 reduction in per capita VA utilization ($181 million aggregate), but among Medicaid expansion states, the corresponding figure was a per capita utilization decrease of $363 ($833 million aggregate), amounting to a 9.1 percent reduction in VA utilization (in this age group among the expansion states). Among the nonexpansion states, there was virtually no change in VA utilization associated with Medicaid eligibility change. Increases in the housing price index and reduction in the proportion of employees with employer-sponsored coverage were associated with per capita VA utilization increases of $22 (99 million aggregate) and $17 ($79 million), respectively. Among older veterans, the increase in housing price index was associated with a $53 ($220 million aggregate) increase in utilization. Overall, the net impact of external determinants was a utilization decrease of $636 million in Medicaid expansion states and a $95 million utilization increase in Medicaid nonexpansion states, amounting to 3.5 percent and 0.6 percent changes in overall VA utilization in the respective group of states.

Examination by type of VA health care service among all veterans indicates that, between 2013 and 2014, an increase in Medicaid eligibility in the Medicaid expansion states was associated with the largest decrease in all components of VA health care utilization: outpatient care (−$399 million; −3.8 percent); inpatient care (−$213 million; −4.2 percent); pharmacy use (−$97 million; −4.5 percent), and VA-paid care from non-VA providers (−$71 million; −5.8 percent; Table 5 and Tables S3 and S5).

Table 4: Model-Predicted Change in Per Capita VA Health Care Utilization from 2013 to 2014 Associated with External Determinants

A. All States

	Change in Per Capita VA Health Care Utilization between 2013 and 2014 (2010$)		
External Determinants	*Age 18–64*	*Age 65+*	*Total*
Medicaid eligibility	−$39.3	$0.2	−$39.1
Housing price index	$21.6	$52.9	$74.5
No. of MDs per 1,000 census population	$5.3	$7.9	$13.2
Veteran unemployment ratio	−$6.8	NA	−$6.8
% employees with ESI	$17.3	NA	$17.3
Total net change	−$2.0	$61.0	$59.0

B. Medicaid Expansion States

	Associated Change in Per Capita VA Health Care Utilization between 2013 and 2014 (2010$)		
External Factor	*Age 18–64*	*Age 65+*	*Total*
Medicaid eligibility	−$362.6	$2.8	−$359.8
Housing price index	$15.2	$48.7	$63.9
No. of MDs per 1,000 census population	$6.2	$13.4	$19.5
Veteran unemployment ratio	−$24.6	NA	−$24.6
% employees with ESI	$30.1	NA	$30.1
Total net change	−$335.7	$64.8	−$270.9

C. Medicaid Nonexpansion States

	Associated Change in Per Capita VA Health Care Utilization between 2013 and 2014 (2010$)		
External Factor	*Age 18–64*	*Age 65+*	*Total*
Medicaid eligibility	−$2.2	−$6.4	−$8.5
Housing price index	$8.8	$51.4	$60.2
No. of MDs per 1,000 census population	$4.9	$6.1	$10.9
Veteran unemployment ratio	−$2.6	NA	−$2.6
% employees with ESI	−$13.9	NA	−$13.9
Total net change	−$5.0	$51.1	$46.1

Note: We calculated the marginal change in VA health care utilization ($, 2010) associated with the observed change in external factor, holding all other factors constant. Besides the change in the external factor between 2008 and 2014, this calculation used (a) demand model estimate of % change in utilization associated with 1% change in each external factor and (b) 2008 VA health care utilization.

Estimates of sensitivity of VA utilization to external determinants varied across subgroups by priority status, (zip code) income, and race/ethnicity

Table 5: Model-Predicted Change in Per Capita VA Health Care Utilization from 2013 to 2014 Associated with External Determinants by Type of Service: Medicaid Expansion States: Age 18–64

	Associated Change in Per Capita VA Health Care Utilization			
External Factor	*Inpatient*	*Outpatient*	*Prescription Medications*	*Non-VA Providers*
Medicaid eligibility	−$92.8	−$173.4	−$42.0	−$31.1
Housing price index	$18.4	$41.7	$5.6	$31.4
No. of MDs per 1,000 census population	$23.5	$1.6	$0.1	−$0.7
Veteran unemployment ratio	$1.0	−$22.2	−$3.3	−$4.3
% employees with ESI	$13.2	$10.6	$1.4	$1.9
Total net change	−$36.7	−$141.7	−$38.2	−$2.9

(Table S6). In particular, in Medicaid expansion states and across priority status groups, utilization changes with respect to Medicaid eligibility and employer-sponsored coverage were larger among priority groups whose eligibility is not based on service-connected disability. In Medicaid nonexpansion states, significant change in VA utilization associated with Medicaid eligibility change was noted only for veterans with higher income and lower priority categories.

DISCUSSION

Our study of the determinants of VA health care utilization during 2008–2014 has three principal findings. First, utilization of VA health care is sensitive to changes in external determinants. Consistent with expectations, expanded alternative health insurance coverage, in the form of Medicaid expansion or expansion of employer-sponsored coverage, was associated with a reduction in VA health care utilization in 2013–2014, while increases in unemployment were associated with an increase in VA utilization. Second, during 2008–2014, the largest change in VA utilization associated with external determinants occurred between 2013 and 2014 following a 55 percent increase in Medicaid eligibility in the 26 Medicaid expansion states. Among veterans aged 18–64, this increase in Medicaid eligibility was associated with a 9.1 percent reduction in overall VA health care utilization in these states. These reductions occurred for all types of VA-covered health care services provided at VA facilities or by

non-VA providers. To our knowledge, this is the first study to examine the association between ACA Medicaid expansion in 2014 and VA health care utilization. Third, net change in overall VA demand from all external determinants was small, due in part to offsetting changes associated with different determinants; however, changes are larger for specific target groups of veterans.

We found that sensitivity of VA utilization to Medicaid eligibility varied over time. In particular, among veterans aged 18–64, increases in Medicaid eligibility were associated with decreases in VA utilization in Medicaid expansion states, and no change in nonexpansion states, during 2011–2014; but during 2008–2009, the associated change was an increase in VA utilization in both expansion and nonexpansion states. This unexpected positive association during 2008–2009 may be due to the severe recession that occurred during this period, leading to widespread loss of jobs (Holahan et al. 2011; Cawley, Moriya, and Simon 2015). Modest increases in Medicaid eligibility in some states may have been insufficient to neutralize the increase in VA health care utilization among veterans adversely affected by the recession. Previous studies found that Medicaid expansion was associated with a decrease in enrollment for VA health care, indicating larger decreases in VA utilization across all veterans (Wong et al. 2014b; Frakt, Hanchate, and Pizer 2015).

During the 2011–2014 postrecession period, we find that while Medicaid expansions were associated with reductions in VA utilization in the expansion states, they were most often associated with increases in VA utilization in the nonexpansion states. We conjecture that this unexpected association may involve other systematic differences, including structural factors, not captured in our model. One explanation is that Medicaid eligibility has been more limited in nonexpansion states than the expansion states. Even when eligible, there may be systematic differences in take-up of Medicaid; using data from 2005 to 2010, one study indicated systematically lower take-up rates in nonexpansion states compared to expansion states (Sommers et al. 2012; Kaiser Family Foundation 2014a). As a result, the modest Medicaid expansions in the nonexpansion states were likely insufficient to reduce demand for VA services.

Differences in sensitivity of VA utilization to external determinants between Medicaid expansion and nonexpansion states are not limited to changes in Medicaid eligibility. In particular, among veterans 18–64, a 10 percent increase in employer-sponsored coverage was associated with 2.89 percent reduction in VA utilization in the expansion states, but 1.02 percent increase in the nonexpansion states. We conjecture that this difference in

change may again be associated with systematic structural differences in non-expansion states, including those noted above, which are not captured in our model.

Our study indicated that a 10 percent increase in unemployment ratio was associated with a 0.65 percent increase in overall VA utilization. These are consistent with previous findings, despite differences in the unemployment measure used; prior studies used the unemployment rate in the general population (Wong and Liu 2013; Wong et al. 2014a, 2015; Frakt, Hanchate, and Pizer 2015). One study found that a 1 percentage point increase in county-level unemployment rate (equivalent to an approximately 20 percent increase) was associated with a 1.0 to 1.3 percent increase in VA outpatient visits among veterans aged 18–64 during 2004–2012 (Wong et al. 2014a). In contrast, inpatient care utilization was not associated with changes in the overall unemployment rate (Wong et al. 2015).

Our estimates indicate that increases in housing prices are associated with increases in VA utilization, with substantially higher sensitivity among those aged 65 and older (2.24 percent) than among those 18–64 (0.92 percent). Increased housing prices represent gains for homeowners but increase in rents for renters; our estimate of a positive net change in VA utilization suggests larger influence of a rental effect, consistent with evidence of lower incomes among Veterans (Bernard and Selden 2016).

Contrary to our expectation, increases in non-VA physician availability were associated with increased VA utilization. While our hypothesis was based on patient perspective and preferences, with more non-VA physicians indicating easier access to non-VA care, another plausible explanation is that areas with higher availability of physicians may apply to both VA and non-VA settings, driven more by location preferences among physicians.

We recognize several limitations of the study. First, in the selection of external determinants to examine, our goal was to extend the current models by adding two additional determinants: employer-sponsored coverage and provider availability. There are other factors not examined here, including indicators of quality and other public benefits. ACA reform included a coverage mandate and expansion of subsidized coverage through exchanges that we could not examine. However, as we only included veterans enrolled in VA by 2013, our estimates are not influenced by veterans newly enrolled for VA health care in 2014 in response to the mandate. Second, correlation among measured external factors may affect some estimates, although sensitivity analyses indicated that our estimates are robust to exclusion of individual determinants. Third, data for our measure of Medicaid eligibility, available

for 2008, 2012, and 2014, were imputed for the other years. Limiting model estimation to only these years yielded similar estimates to those using data for all years. Fourth, we did not examine the role of area-level adequacy of VA physician availability, but this may limit the extent to which VA utilization can increase in response to changes in external factors. Fifth, except for unemployment, measures of the other external determinants were not based on veteran-specific experience, due to limitations of data. Also, our main estimates did not adjust for comorbidities, as these data were only available for VA discharge data. Our extensive sensitivity analysis found considerable secondary evidence suggestive of potential confounding from including comorbidities identified only in VA data. Also, the sensitivity analysis for the subgroup of Veterans with continuous documented VA health care use (2008–2014) indicated concordant estimates from models with and without comorbidity measures. Finally, although we have combined all services used, pattern of demand for services may vary across different patient groups; in particular, patients may have differing preferences for VA and non-VA services by type of care.

The study findings point to several implications. First, the VA is a large, integrated delivery system with a budget fixed every year by Congress. Agency and congressional leaders have to forecast budget needs and VA managers must allocate limited resources to facilities based on expected demand. Our findings inform both processes by improving the national budget forecast and by identifying factors that influence variations in local demand. The external factor effects we measure characterize the alternative sources of care for veterans and govern how local demand will respond to increases or shortages in staffing. Failure to account for these effects can lead to inequities in access to care across facilities. Second, our findings indicate that a sizable proportion of Veterans are moving in and out of VA health care, which may affect continuity of patient care. This may also result in duplication of services across multiple providers. Better ways to handle patient hand-offs and track patient care across providers need to be developed. Third, current data sources are limited in providing a comprehensive understanding of the health profile and health services utilization of Veterans. The *Survey of Veteran Enrollees' Health and Use of Health Care*, an annual survey by the VA, provides broad evidence on changes in alternative coverage and VA health care, but it has several limitations in design and measures to examine shifts in VA and non-VA health care utilization. A promising approach is to merge VA discharge data with all-payer data that are being developed in many states that permits longitudinal examination

of coverage changes and utilization of health care services by clinical groups (APCD Council 2017).

In conclusion, our findings indicate that area-level changes in external determinants are associated with sizable changes in VA utilization. Accounting for these factors in VA's models of budget and resource projections will enhance VA's and the federal government's ability to forecast and meet the demand for VA health care services. In light of VA's ongoing efforts to better accommodate demand for health care services, our findings of a sharp decrease in VA utilization in the Medicaid expansion states in 2014 points to considerable easing of demand in these states. However, reversal of the Medicaid expansion—currently under discussion by policy makers (McDonough and Jones 2016; Sommers and Epstein 2017; Wilensky 2017)—may lead to an equally sharp increase in demand for VA services.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information section at the end of the article:

Appendix SA1: Author Matrix.

Appendix SA2: Derivation of Analytic Data.

Appendix SA3: Data Sources for External Factors.

Appendix SA4: Medicaid Eligibility Measure: Additional Details.

Table S1a: Longitudinal Trends in Health Care Utilization and External Factors, 2008–2014: Medicaid Expansion States.

Table S1b: Longitudinal Trends in Health Care Utilization and External Factors, 2008–2014: Medicaid Non-Expansion States.

Table S1c: Correlation among External Determinants.

Table S2a: Sensitivity of Model Estimates to Combination of External Determinants: Outcome Change Associated with 10% Increase in External Factor.

Table S2b: Additional Sensitivity Analysis: Subpopulation of VHA Users in 2008 (Baseline Year).

Table S2c: Additional Sensitivity Analysis: Subpopulation Who Used Some VA Care during 2008–2014.

Table S2d: Sensitivity of Model Estimates to Exclusion of Individual Year Data: Outcome Change Associated with 10% Increase in External Factor.

Table S2e: Additional Sensitivity Analysis: Data Limited to 2008, 2012, and 2014.

Table S3: VA Health Care Utilization Model Estimates by Type of Care: Outcome Change Associated with 10% Increase in External Factor.

Table S4: Model Predicted Change in Aggregate VA Health Care Utilization from 2013 to 2014 Associated with External Determinants.

Table S5: Model Predicted Change in Aggregate VA Health Care Utilization from 2013 to 2014 Associated with External Determinants by Type of Service: Medicaid Expansion States: Age 18–64.

Table S6a: Model Predicted Impact by Subpopulations: Medicaid Expansion States: Outcome Change Associated with 10% Increase in External Factor.

Table S6b: Model Predicted Impact by Subpopulations: Medicaid Non-Expansion States: Outcome Change Associated with 10% Increase in External Factor.

Appendix SA5: VA Utilization and Comorbidities.

Table S7a: Prevalence of Chronic Conditions Identified in VA Utilization Records, 2008 and 2014.

Table S7b: Prevalence of Chronic Conditions Identified by Number of Years of VA Health Care Use.

Table S7c: State-Level Correlation between Chronic Condition Prevalence and VA Use.

Table S7d: VA Health Care Utilization Model Estimates with VA-Data Comorbidities Included as Covariates.

Table S7e: Direction and Magnitude of Year-to-Year Change in External Factor, 2008–2014.

Table S7f: Direction and Magnitude of Year-to-Year Change in Medicaid Eligibility, 2008–2014.

Table S7g: VA Health Care Utilization Model Estimates: Subgroup with VA Utilization in All Years (2008–2014).