© Health Research and Educational Trust

DOI: 10.1111/1475-6773.12995

SPECIAL ISSUE: LINKING VA AND NON-VA DATA TO ADDRESS US VETERAN HEALTH SERVICES ISSUES

Empirical-Based Typology of Health Care Utilization by Medicare Eligible Veterans

Mary Vaughan Sarrazin , Gary E. Rosenthal, and Carolyn L. Turvey

Objective. Up to 70 percent of patients who receive care through Veterans Health Administration (VHA) facilities also receive care from non-VA providers. Using applied classification techniques, this study sought to improve understanding of how elderly VA patients use VA services and complementary use of non-VA care.

Methods. The study included 1,721,900 veterans age 65 and older who were enrolled in VA and Medicare during 2013 with at least one VA encounter during 2013. Outpatient and inpatient encounters and medications received in VA were classified, and mutually exclusive patient subsets distinguished by patterns of VA service use were derived empirically using latent class analysis (LCA). Patient characteristics and complementary use of non-VA care were compared by patient subset.

Results. Five patterns of VA service use were identified that were distinguished by quantity of VA medical and specialty services, medication complexity, and mental health services. Low VA Medical users tend to be healthier and rely on non-VA services, while High VA users have multiple high cost illnesses and concentrate their care in the VA.

Conclusions. VA patients distinguished by patterns of VA service use differ in illness burden and the use of non-VA services. This information may be useful for framing efforts to optimize access to care and care coordination for elderly VA patients.

Key Words. Administrative data uses, access/demand/utilization of services, chronic disease, Medicare, VA Health Care System

An estimated 40–70 percent of patients who receive care through Veterans Health Administration (VHA) facilities also receive care from non-VA community providers (Hynes et al. 2007; Liu et al. 2010, 2011a; U.S. Department of Veterans Affairs 2011; Humensky et al. 2012). This proportion is likely to grow in light of the 2014 Veterans Choice Act, which stipulates specific conditions under which VA will pay for care received in the community. Moreover,

the proportion of Veterans who qualify for Medicare, a major contributor to dual use, will grow as the Veteran population ages.

Although the VA provides a comprehensive array of services, including acute medical and surgical care, primary care, mental health services, prescription medications, and other specialty care, dual use of VA and non-VA services may increase access to important services for many veterans. However, dual use also complicates efforts to coordinate health services and optimize outcomes, potentially leading to duplication of services (Trivedi et al. 2012), care fragmentation (Hynes et al. 2007; Shen et al. 2008), and worse health outcomes (Wolinsky et al. 2006, 2007; Jia et al. 2007).

In the VA, coordination of care occurs by nurse care managers functioning in teams in VA primary care clinics. However, efforts to coordinate care for VA patients are complicated by the fact that substantial portions of VA patients receive care outside the VA, and dual use is growing. These issues are particularly important for elderly veterans, given the availability of Medicare to most patients age 65 and older and the substantial morbidity in elderly populations.

Understanding how veterans access different services within the VA and private sector is important for policy planning and allocation of resources on a national level as well as providing a framework around which efforts to coordinate care can be implemented on the patient level. To address this gap, the current study used VA administrative data for patients age 65 and older to empirically derive a typology of VA patient service utilization using latent class analysis (LCA; Collins and Lanza 2010). LCA is a probabilistic method of cluster analysis that reduces a complex array of multivariate data to a format that is parsimonious and easy to comprehend. Using LCA, we grouped VA patients into similar classes based on their VA utilization patterns. We subsequently examined patient characteristics and patterns of utilization of non-VA services within each class defined to reveal insights into how Veterans complement VA care with care in the community.

Address correspondence to Mary Vaughan Sarrazin, Ph.D., Iowa City VA Health Care System (152), 601 Highway 6 West, Iowa City, IA 52246, and also Department of Internal Medicine, University of Iowa, Iowa City, IA; e-mail: Mary-Vaughan-Sarrazin@uiowa.edu. Gary E. Rosenthal, M.D., F.A.C.P., is with the Department of Internal Medicine, Wake Forest School of Medicine, Winston-Salem, NC. Carolyn L. Turvey, Ph.D., is with the Comprehensive Access and Delivery Research and Evaluation (CADRE), Iowa City VA Health Care System, Iowa City, IA, and Department of Psychiatry, University of Iowa, Iowa City, IA.

METHODS

Data

Sources included administrative records pertaining to services received during 2013 through the VHA, and outside the VHA through Medicare. Information pertaining to VA encounters were obtained from VA's Medical SAS (MedSAS) datasets which contain national administrative data on VA patient inpatient and outpatient encounters (VIREC 2015a, b). Medications received through VA pharmacies were identified from Managerial Cost Accounting National extracts (Phibbs, Barnett, and Fan 2015). Medicare enrollment details, Part A (hospital insurance) and Part B (medical insurance) fee for service claims submitted by non-VA providers for reimbursement for hospital inpatient, hospital outpatient, and clinician office services provided to VA patients were obtained from the VA Information Resource Center (VIREC). Medicare records are available through an Information Exchange Agreement between the VA and the Centers for Medicare and Medicaid Services (CMS), which allows VIREC to maintain a repository of Medicare claims for VA patients who receive care through the VA and are also eligible for Medicare (U.S. Department of Veterans Affairs 2015, 2016).

This initiative began in 1998 to establish a VA system of records and to acquire, merge, and maintain VA and Medicare beneficiary utilization data. The repository represents all individuals who have used health care services from the VHA since 1992, enrolled in the VHA, or are eligible for VHA health care services through compensation or pension benefits. The repository is updated annually through a process by which VHA submits to CMS an updated list of social security numbers (SSN) for individuals newly eligible for VHA care. Prior to release, VIREC assigns unique scrambled social security numbers to the Medicare claims that are consistent with scrambled social security numbers provided in other VA national patient-level data, to allow merging CMS claims with VA health care records.

Patients

We identified 2,304,251 patients age 65 or older who used VA in 2013 who were also enrolled in Medicare Part A for at least 1 month in 2013. Patients were excluded if they were enrolled in a Medicare managed care plan at any time during 2013 (due to incomplete capture of claims for Medicare managed care enrollees), leaving 1,721,900 unique patients (Figure 1).

Figure 1: Summary of Cohort Selection Criteria

Service Use

Outpatient services received in VA clinics were categorized using a multi-step process, building on an established algorithm developed by Burgess et al. (2011). First, visits to physicians, physician assistants, nurse practitioners, and nonphysician mental health providers were identified; visits not in one of these provider categories were excluded. We then categorized provider types and CPT codes associated with each visit. Provider types included primary care (internal medicine, family practice, and geriatric medicine), mental health (psychiatrist, psychologist, mental health social workers), diagnostic radiology, other specialty care (medical subspecialists and surgical specialties), and rehabilitative therapists (physical, occupational, respiratory therapists). Physician assistants and nurse practitioners were considered primary care providers unless another specialty was noted. CPT categories included psychiatry services, evaluation and management (E and M) visits, diagnostic radiology, and rehabilitative therapy. Finally, each visit was categorized based on a

combination of provider type and CPT category as follows: Mental health visits included all visits with a psychiatry CPT code or visits with a mental health provider and a concurrent E and M CPT code; primary care included visits to a primary care physician with an E and M CPT code; specialty care included visits to all other physician specialties with a E and M CPT code. Visits with a diagnostic radiology CPT code or visits to a diagnostic radiologist were considered diagnostic radiology; visits with a physical, rehabilitative, or occupational therapist were considered rehabilitative therapy. We applied the same multi-step algorithm of Burgess et al. (2011) to Medicare Part A and Part B claims to identify the use of hospital outpatient or clinician office services outside the VA by patients age 65 and older.

Acute inpatient admissions in VA and non-VA hospitals during FY2013 were identified in the VA MedSAS Files and Medicare (Part A) Provider Analysis and Review (MedPAR) files, respectively. Finally, medications received through the VA were categorized using a modification of the VA Drug Class variable to identify 25 different classes of drugs. In addition, patients who received any psychiatric medication were identified. Psychiatric medications were defined primarily as tricyclic anti-depressants, selective serotonin uptake inhibitors, serotonin norepinephrine reuptake inhibitors, anti-psychotics, central nervous system stimulants, benzodiazepines, and miscellaneous sedatives and hypnotics used to treat anxiety and depression. We did not confirm that these drugs were taken for a psychiatric diagnosis; thus, this list may include occasional use of some medications for nonpsychiatric purposes.

Latent Class Models

Latent class analysis models were developed to reflect VA service use only and included 1,721,900 patients age 65 and older who used any VA services during FY2013. Prior to generating latent class models, we inspected the distribution of each VA service variable and categorized service use into two to four levels. The number of primary care visits and number of unique drug classes were both categorized into four levels (categories were 0, 1, 2–3, and 4 or more for primary care visits, 0–4, 5–9, 10–14, and 15 or more for drug classes). Specialty physician visits and mental health visits were categorized into three levels (0, 1, and 2 or more specialty visits; 0, 1–2, and 3 or more mental health visits). Receipt of rehabilitative therapy, diagnostic radiology, inpatient admission, and psychiatric medication was dichotomized to reflect none or any. In sensitivity analyses, we modified the category cutoffs.

Latent class models were generated using PROC LCA with *SAS* and were estimated using maximum-likelihood estimation (Lanza et al. 2007). Because the optimal number of classes is not known in advance, it is often necessary in LCA to estimate the optimal number of classes underlying the data. This was performed by comparing the fit of models with increasing numbers of classes on the basis of interpretability and meaning of classes, latent class separation, model entropy, and the Bayesian Information Criteria (BIC). Latent Class separation refers to the certainty with which patients can be assigned to a single class using the mean posterior probability of class membership (Collins and Lanza 2010). Thus, in a five-class LCA model, each patient has five posterior probabilities (indicating the probability of belonging to each of the five classes, given the observed service use). When there is good class separation, patients have a large probability of membership in a single class, with low probabilities for the remaining latent classes. Entropy is a single score that summarizes the certainty in patient classification (Collins et al. 1993). Entropy ranges from 0 to 1, with 1 indicating perfect separation between classes. The BIC reflects the degree to which the model fits the underlying data (Dziak et al. 2012).

After model development, we compared the use of specific types of health services inside versus outside the VA across LCA classes as identified in VA and Medicare claims. We also compared patient characteristics across LCA classes, including demographics (age, sex, race, ethnicity, rural residence, enrollment in Medicare Part D or Medicaid per Medicare enrollment files, VA Means Test category) and illness burden. Race and ethnicity were defined using the race code developed by the Research Triangle Institute (RTI) that is available on the CMS Beneficiary Summary File and has excellent agreement with self-reported race (Bonito et al. 2008). Rural residence was defined based on the VA Office of Rural Health designation which incorporates Rural–Urban Commuting Areas (RUCA; U.S. Department of Agriculture 2015). Distance to nearest VAMC and nearest primary care were calculated using straight line distance between patient residence (based on longitude and latitude coordinates) and the longitude and latitude coordinates of the nearest VAMC or primary care clinic as identified on the VA Station Tracking (VAST) database. Illness burden was measured by the Medicare Hierarchical Condition Category (HCC) software, which identifies 79 mutually exclusive medical conditions by ICD-9-CM code. Conditions are additive, so that more HCC conditions means a greater disease burden. In addition, we identified and tallied for each patient the presence of 15 specific HCC conditions identified by Medicare as requiring chronic or special needs

(Research Triangle Institute 2008). In order to obtain a full assessment of patient illness burden regardless of where services were obtained, we used diagnoses present on *either* VA or Medicare claims during the year to identify HCC conditions.

RESULTS

We chose the five-class model of VA utilization as the optimal solution. While the six- and seven-class models had modestly lower (i.e., better) BIC values, the five-class model had the best entropy (0.77) and was the most parsimonious model with good fit. Moreover, most patients could easily be assigned to a single class based on posterior probabilities, and class provided meaningful interpretations.

Overall, the five classes representing different patterns of VA service use were distinguished by level of medical services, number of prescription medication classes filled, and mental health service use (Table 1). The LCA classes were given the following descriptive labels based on observed VA utilization: (1) Low VA medical use with *minimal* VA medication and mental health use (representing an expected 43 percent of patients based on posterior probabilities from the LCA model; 45.4 percent based on assigning patients to the most probable class); (2) Low VA medical users with *significant* VA medication and mental health use (12.7 percent mean posterior probability); (3) Moderate VA medical use with *minimal* VA medication and mental health use (23.1 percent); (4) Moderate VA medical use with *significant* VA medication and mental health use (10.5 percent); and (5) High use of all VA services including inpatient hospitalizations (10.8 percent). The five-class LCA solution provided good agreement between latent class membership based on the posterior probabilities of class membership, and based on assignment of patients to most likely class (Table 1). For example, the LCA model estimated that 10.8 percent of patients are high users of all services; 10.5 percent of patients were assigned to the “High VA Medical User” class based on their conditional response probability. The largest group of patients, “Low VA Medical Users with Minimal VA Medication and Mental Health Use,” represents 43.0 percent of the entire patient sample based on prior probabilities and 45.4 percent based on assignment of patients to the most likely class.

Table 2 shows VA services used by patients in each of the five classes. Use of VA primary care, specialty care, inpatient acute care, and diagnostic radiology services was very small for the two classes labeled “Low Medical

Table 1: Latent Class Model Results: Agreement of Class Assignment Based on Estimated Posterior Probabilities and Based on Assignment of Patients to the Most Likely Class

Assigned Class	Mean Posterior Probability After Assignment to Class						
	Based on Estimated Posterior Probabilities	Based on Assignment to Most Likely Class	Low VA Users— Minimal Medications and Mental Health	Low VA Users— Significant Medications and Mental Health	Moderate Users— Minimal Medications and Mental Health	Moderate Users —Significant Medications and Mental Health	High Users All Services
Low medical users— minimal Rx and MH	43.0%	45.4%	.89	.04	.07	0	0
Low medical users— significant Rx and MH	12.7%	11.6%	.03	.82	.03	.12	.00
Moderate users— minimal Rx and MH	23.1%	21.9%	.10	.03	.83	.01	.03
Moderate users— significant Rx and MH	10.5%	10.6%	0	.09	.06	.76	.09
High users—all services	10.8%	10.5%	0	.00	.05	.08	.87

Notes: Bolded numbers represent the probability that the LCA model assigns patients to the correct class (e.g., 89% of “Low users with minimal medication and mental health services” are assigned to the correct class based on the LCA model).

Table 2: Use of Services by Type of Service for Five Categories of Patients Defined by Latent Class Analysis

	<i>Low VA Users</i>		<i>Moderate VA Medical Users</i>		
	<i>(a) Minimal Medications and Mental Health</i>	<i>(b) Significant Medications and Mental Health</i>	<i>(c) Minimal Medications and Mental Health</i>	<i>(d) Significant Medications and Mental Health</i>	<i>(e) High Users of All VA Services</i>
Overall % of patients	45%	12%	22%	11%	10%
Number of patients	781,065	199,953	376,275	183,171	181,436
<i>Medical services</i>					
Primary care ≥ 2 visits	24%	37%	73%	71%	88%
Subset with ≥ 4 visits	<1%	1%	26%	28%	65%
Specialty care ≥ 2 visits	3%	3%	42%	38%	71%
Any ER visit	1%	1%	12%	11%	52%
Any inpatient admission	<1%	<1%	5%	7%	66%
Diagnostic radiology ≥ 2	1%	1%	38%	36%	84%
Any rehab therapy	5%	9%	33%	39%	61%
<i>Rx and mental health</i>					
Mental health ≥ 1 visit	7%	38%	21%	64%	61%
Subset with ≥ 3 visits	1%	20%	7%	41%	34%
Any psychiatric medication	<1%	96%	<1%	99%	60%
Drug classes: 10 or more	2%	28%	35%	72%	98%

Users.” However, *Low Medical Users* were further distinguished by the level of mental health and pharmacy services. Twenty percent (20 percent) of *Low VA Medical Users with Significant VA Medication and Mental Health Use* had 3 or more VA mental health visits, 96 percent received a psychiatric medication through the VA, and 28 percent received 10 or more categories of medications through the VA. In contrast, *Low VA Medical Users with Minimal VA Medication and Mental Health Use* received very few of these services. Overall, the two groups of “Moderate VA Medical Users” incurred more VA medical services compared to *Low VA Medical Users*, including more VA primary care visits, specialty physician visits, rehabilitative services, and diagnostic radiology compared to either group of lower VA users. However, they are also distinguished by the use of the VA for mental health and pharmacy services. Finally, 65 percent of patients in the *High VA User* group had 4 or more VA primary care visits during the year, and 71 percent had 2 or more specialty physician visits. High VA users also had significant use of VA diagnostic radiology, rehabilitative therapy, and prescription drugs.

In additional sensitivity analyses, we evaluated the robustness of the final LCA model to alternative categorizations of VA health services. For example, we collapsed the number of primary care visits and unique drug classes into three categories rather than the four categories used in our primary model (i.e., 0–1, 2–3, and 4 or more primary care visits; and 0–4, 5–9, and 10 or more drug classes). The resulting model had slightly lower entropy than our primary model (entropy = 0.75 vs. 0.77) but resulted in identical interpretations of the resulting categories, with generally similar proportions of patients categorized as Low VA Users with Minimal Medications and Mental Health, Low VA Users with Significant Medications and Mental Health, Moderate Users with Minimal Medications and Mental Health, Moderate Users with Significant Medications and Mental Health, and High Users all services (49, 15, 20, 8, and 9 percent of patients, respectively). Further collapsing primary care and drug classes into two categories or expanding to five categories also resulted in categories with identical interpretation, but slightly modified proportions of patients in each category and slightly lower entropy.

High VA users were more likely to live in urban centers and live closer to VA medical centers, on average, than patients who used fewer services. They were also less likely to be non-Hispanic White compared to other groups and more likely to be enrolled in Medicaid (Table 3). *Low VA Medical Users* lived, on average, farther from the nearest VA medical center. The mean number of medical conditions identified by Medicare HCC model, and number of conditions representing chronic or special needs were similar for *Low VA users with minimal VA medications and mental health* (column a) and *Moderate VA users with minimal VA medications and mental health* (column c), suggesting roughly similar illness burden for the two groups despite the difference in the use of VA care. *Low VA users with significant VA medications and mental health* (column b) have a slightly greater number of HCC conditions—possibly reflecting the increased burden associated with mental illness. Not surprisingly, *High VA users* had the most medical conditions, including conditions representing chronic or special needs.

Interesting patterns of complementary dual use between VA and Medicare services are revealed corresponding to the first four patient LCA classes of VA Utilization (Table 4). The mean of total number of primary care visits (i.e., VA and non-VA combined) is generally similar across the four LCA classes of low and moderate VA medical users, with the mean total primary care visits during FY2013 ranging from 3.51 to 3.73 across the four classes. While low and moderate VA users experienced roughly similar total numbers of primary and specialty service visits, moderate VA users have a greater

Table 3: Demographic Characteristics of Patients in Five Service Use Categories Defined by Latent Class Analysis*

	<i>Low VA Users</i>		<i>Moderate VA Medical Users</i>		
	<i>(a) Minimal Medications and Mental Health</i>	<i>(b) Significant Medications and Mental Health</i>	<i>(c) Minimal Medications and Mental Health</i>	<i>(d) Significant Medications and Mental Health</i>	<i>(e) High Users of All VA Services</i>
Overall % of patients	45%	12%	22%	11%	10%
<i>Demographics</i>					
65–74	50.6%	61.1%	59.5%	72.2%	60.2%
75–84	33.0%	24.8%	28.1%	19.00%	26.8%
85+	16.4%	14.2%	12.5%	8.8%	13.0%
Mean age (SD)	75.3 (8.1)	73.6 (8.3)	74.0 (7.8)	71.8 (7.4)	73.9 (7.9)
Female	1.6%	2.1%	2.0%	2.6%	2.3%
<i>Race and ethnicity</i>					
Non-Hispanic white	87.1%	86.0%	77.9%	79.6%	76.4%
Black	7.4%	8.0%	14.6%	12.4%	16.2%
Hispanic	3.2%	4.0%	5.2%	5.8%	5.6%
Other non-white	1.6%	1.3%	1.7%	1.6%	1.4%
Missing	0.7%	0.7%	0.6%	0.6%	0.4%
% Enrolled in Medicare Part D	24.1%	22.2%	16.7%	17.2%	17.3%
% Enrolled in Medicaid	3.9%	5.4%	6.2%	6.8%	9.6%
<i>Eligibility category</i>					
Service connected disability >50%	18%	39%	28%	53%	43%
Service connected disability 0–50%	22%	15%	20%	13%	14%
Not service connected	59%	46%	52%	34%	43%
<i>Geography</i>					
Mean miles to nearest VAMC (SD)	45.1 (48.6)	45.6 (49.6)	41.4 (47.2)	42.0 (46.2)	37.2 (45.1)
Mean miles to nearest VA Primary Care	12.6 (16.5)	12.6 (17.1)	12.3 (16.2)	12.2 (16.2)	11.7 (15.4)
Urban residence	56%	56%	57%	57%	59%
<i>Illness burden</i>					
Total number of HCC conditions	1.71 (2.02)	2.03 (2.17)	1.81 (1.86)	2.23 (2.07)	3.72 (2.52)
% with ≥4 HCC conditions	15%	19%	14%	20%	45%
Mean number of severe or disabling chronic conditions	1.33 (1.39)	1.65 (1.50)	1.43 (1.30)	1.85 (1.47)	2.64 (1.56)
% with any severe or disabling chronic condition	66%	75%	74%	83%	94%

*All patient characteristics are significantly related to LCA class membership using statistical criterion, $p < .01$.

Table 4: VA and Private Sector Service Use by VA Patients Age 65 and Older Enrolled in Medicare

	<i>Low VA Users</i>		<i>Moderate VA Medical Users</i>		
	<i>(a) Minimal Medications and Mental Health</i>	<i>(b) Significant Medications and Mental Health</i>	<i>(c) Minimal Medications and Mental Health</i>	<i>(d) Significant Medications and Mental Health</i>	<i>(e) High Users of All VA Services</i>
% of all patients	45%	12%	22%	11%	10%
Mean number of primary care visits (SD)					
VA	1.11	1.34	2.62	2.68	5.1
Medicare	2.40	2.13	0.99	1.05	0.5
Total primary care visits	3.51	3.47	3.61	3.73	5.6
% Reliance on VA	32%	39%	73%	72%	92%
Mean number of specialty care visits (SD)					
VA	0.20	0.20	1.71	1.59	4.0
Medicare	3.40	3.00	1.50	1.51	0.71
Total specialty care visits	3.6	3.2	3.21	3.1	4.71
% Reliance on VA	6%	6%	53%	51%	85%
Mean number of mental health visits (SD)					
VA	0.18	1.95	0.77	4.66	4.30
Medicare	0.10	0.22	0.05	.016	0.07
Total mental health	0.28	2.17	0.82	4.82	4.37
% Reliance on VA	64%	90%	94%	97%	98%
Mean number of rehabilitative and physical therapy services					
VA	0.11	0.22	0.98	1.40	2.69
Medicare	1.94	1.80	0.95	1.02	0.53
Total rehabilitative services	2.05	2.02	1.93	2.42	3.22
% Reliance on VA	5%	11%	51%	58%	84%
Mean number of inpatient episodes of care					
VA	0	0	0.06	0.09	1.19
Medicare	0.30	0.38	0.23	0.30	0.40
Total inpatient stays	0.30	0.38	0.29	0.39	1.59
% Reliance on VA	0%	0%	21%	23%	75%
Mean number of ED visits					
VA	0.01	0.01	0.21	0.20	1.42
Medicare	0.27	1.63	1.00	1.42	1.47
Total ER visits	0.28	1.64	1.21	1.62	2.89
% Reliance on VA	4%	1%	17%	12%	49%

reliance on the VA for these visits. For example, among *Low VA users with minimal VA medications and mental health services*, 32 percent of total primary care visits occurred through the VA (i.e., on average, 1.11 of 3.51 total primary care visits occur in the VA)—compared to 73 percent among moderate VA users.

Patients in the high VA user class rely substantially on the VA for all services, with the exception of emergency room visits. For all classes, patients received the majority of mental health services through the VA.

DISCUSSION

This study provides a comprehensive typology of VA health system use by applying latent class analysis to administrative utilization data from the VA health system. We successfully identified five unique classes of VA patients distinguished by low, moderate, and high VA service use, with further distinctions based on their use of VA mental health and pharmacy services. These parameters suggest that the use of VA care by veterans is determined by medical acuity as well as the need for mental health or pharmacy services. Specifically, we classified more than half of all elderly VA patients as low users of VA medical and specialty services, with the majority of Low users also using few VA mental health and pharmacy services. Moderate users of VA medical services comprised about one-third of all elderly VA patients, and nearly two-thirds of moderate users also used relatively few VA mental health and pharmacy services. Approximately 10 percent of elderly VA patients were categorized as high users, meaning that they incurred substantial use of all VA medical, mental health, and pharmacy services, as well as acute inpatient and emergency care.

We also demonstrated that the reliance on VA services relative to Medicare services differed substantially within each of the five patient classes. Surprisingly, Low VA users and Moderate VA users had relatively similar illness burden and total health service utilization, but differed substantially in the degree to which they relied on the VA for care. Like previous studies (Weeks, Mahar, and Wright 2005; Liu et al. 2009), our study found that veterans who needed mental health service typically seek those services within the VA. Reliance on the VA was highest for patients with the greatest disease burden.

Multiple prior studies have investigated dual use, particularly among the elderly with Medicare coverage. Liu et al. (2010b) found that over 30 percent of Medicare-eligible VA primary care patients also received primary care through Medicare, and over 60 percent received specialty care through Medicare. Moreover, the proportion of VA patients who rely on the VA for care has decreased over time, especially for specialty care (Liu et al. 2011b).

A few prior studies have used LCA to classify individuals on the basis of service use, although few that focused specifically on VA patients. Hastings

et al. (2010) identified five categories of ED patients based on the use of primary care, specialty care, ED visits, and hospitalization during the 12 months prior to the index ED encounter. Other studies used LCA models to investigate services used by caregivers (Beeber, Thorpe, and Clipp 2008; Hong 2010) and to describe the demand for health services among elderly patients (Deb and Triveki 2002). Prior applications of LCA to veteran patients have focused on risk profiling (Funderburk et al. 2008; Cho et al. 2017), psychiatric comorbidity patterns (Cadigan, Klanecky, and Martens 2017; Richardson et al. 2017), and service utilization among veterans with diabetes (Radomski et al. 2016).

Overall, these findings have multiple important implications for the management of elderly VA patients with dual use of community services. Importantly, this study demonstrates that VA patients are largely delineated by use of medical services, pharmacy, and mental health services, suggesting that activities of clinical primary care teams can be targeted to specific patient subsets. For example, mental health services are a common reason to seek care from the VA, even among patients with few medical needs or patients whose medical needs are addressed through providers outside the VA. Thus, one could argue that facilitating the provision of mental health services within the VA for these patients is important, yet coordinating other care that is largely delivered outside the VA may be more challenging and possibly even duplicate coordination efforts of primary care teams outside the VA. Similarly, many patients opt to receive medications through the VA yet may not receive the majority of their care through the VA. Having access to pharmacy management and medication reconciliation strategies may be important for managing these patients, particularly for patients whose VA medical records are incomplete due to not including documentation of services obtained outside the VA. In addition, assessing VA's performance on patient outcomes is incomplete and potentially misleading if care received outside the VA is not also considered. For example, within the VA, adoption of medical home features has been shown to be associated with lower rates of avoidable hospitalizations (Yoon et al. 2013). However, these results do not account for hospitalizations occurring outside the VA, which account for the majority of inpatient admissions among VA patients. Thus, changes in the use of non-VA hospitals for inpatient care may distort perceived benefits of PACT within the VA and obscure overall costs to the federal government.

Second, the finding that high users of VA services rely on the VA for the vast majority of their care highlights the important role of the VA as a safety net for veterans, particularly veterans who are most burdened by illness and

require substantial health services. Coordination of care for these patients occurs primarily within the VA system, but is nevertheless complex due to the diverse services and medications used by these patients. In additional analysis, we determined that, although high VA users represent only 10 percent of all VA patients, they account for 90 percent of all inpatient admissions to VA hospitals and nearly half of all specialty care visits. Thus, careful management of this relative small portion of VA patients may have a tremendous impact on overall VA health services utilization.

Finally, this study also identifies categories of patients for whom information in VA medical records may be missing important information about medical services utilization that is received outside the VA. In our study, more than 40 percent of elderly VA patients use relatively few VA services, with the majority of care received outside the VA for those patients. While VA providers may have a rough understanding that a large proportion of elderly VA patients use relatively few services, they may be unaware of the degree to which such patients use services outside the VA. Failure to recognize total illness burden and the use of other health services has important implications for the provision of care and allocating resources to meet the needs of aging veterans. For example, Ried et al. (2007) identified 25 percent more VA patients with a history of stroke using Medicare and VA records combined, compared to using VA records only. This study provides information regarding the potential that VA data do not capture all services for specific classes of patients, types of services that are most likely missing, and categories of patients for whom VA medical records likely represents all services.

This study has limitations. First, evaluating service use using administrative data sources from different health care providers or payers is challenging. Burgess et al. (2011) describe in detail the nuances and complexities of evaluating service use in administrative data from different administrative data sources. With Medicare data, diagnosis and procedure codes are often recorded to maximize reimbursement, while in the VA reimbursement is not relevant. Nevertheless, VA providers are increasingly pressured to capture complete data for their patients as such data are used for performance and workload measures. Our study built on the system developed by Burgess et al. (2011) for classifying individual services in VA data sources, which was demonstrated to have good negative and predictive values for classifying primary and specialty services. Second, our typology of VA service use included patients age 65 and older only and therefore may not be generalizable to younger veterans. Third, the cutoffs we used to define levels of VA service utilization were admittedly somewhat arbitrary. We conducted sensitivity

analysis to determine whether the cutoffs used to define levels of primary care, specialty care, and other services impacted results substantially. We found that the interpretation of LCA classes identified was remarkably similar regardless of the specific cutoffs, but the proportion of patients identified as low, moderate, or high users of VA services varied modestly depending on the cutoffs. We did not perceive substantial impact of these analyses on our conclusions. Fourth, we conducted the LCA analysis on VA data only. Future studies will use this analysis for combined VA and Medicare data. Fifth, our analysis did not reflect medications received through Medicare. Nevertheless, Medicare enrollment data indicated that the majority of VA patients (nearly 80 percent) in our cohort were never enrolled in Part D during the observation period, with reasonably similar Part D enrollment across the five classes of VA patients (ranging from 76 to 83 percent). Finally, our study did not include fee-based VA care, which is care provided in non-VA facilities that is paid by the VA. Inclusion of outpatient fee-based care is problematic because VA data files for outpatient fee-based care generally contain fewer details regarding specific types of services provided. We did, however, conduct additional analysis in which fee-based inpatient admissions were included in our analysis, and results were very similar.

VA serves an important role in the care of elderly veterans. It is a central provider of mental health care, its pharmacy benefits are highly valued, and veterans with high need for health services and accompanying acute care seek most of their services at VA relative to non-VA care. Nevertheless, most elderly veterans also receive care outside the VA. While the use of non-VA care will likely increase with the Veterans Choice Act, combined VA and community care, in one form or another, has been common in the VA for decades. Such care requires effective coordination of care, user-friendly health information exchange platforms, and protocols for transitions between VA and the community. Since 1998, the VA Information Resource Center and Centers for Medicare and Medicaid Services (CMS) have made linked VA-Medicare claims and enrollment information available to VA researchers, clinicians, and policymakers to better understand care received outside the VA for veterans dually eligible for VA and Medicare services. This linking of data provides an opportunity to gain clinical insight into the needs of elderly veterans and potential missed opportunities for care coordination. Moreover, by linking data over multiple years, future research may evaluate the impact that policy changes, such as changes in pharmacy benefits or the availability of inpatient and specialty services has on access to care and the use of services outside the VA.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: Drs. Vaughan Sarrazin and Turvey are Core Investigators in the Comprehensive Access & Delivery Research and Evaluation (CADRE) Center Iowa City VA Health Care System, which is funded through the Department of Veterans Affairs, Veterans Health Administration, Health Services Research and Development Service.

This work was supported by the VA VISN 23 Patient Aligned Care Teams (PACT) Demonstration Laboratory, VA Office of Patient Care Services. Support for VA/CMS Data provided by the Department of Veterans Affairs, VA Health Services Research and Development Service, VA Information Resource Center (Project Numbers SDR 02-237 and 98-004), Hines, IL. This work was supported using resources and facilities at the VA Informatics and Computing Infrastructure (VINCI), VA HSR RES 13-457, Salt Lake City, UT.

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

Disclosure: None.

Disclaimer: None.

REFERENCES

- Beeber, A. S., J. M. Thorpe, and E. C. Clipp. 2008. "Community-Based Service Use by Elders with Dementia and Their Caregivers: A Latent Class Analysis." *Nursing Research* 57 (5): 312–21.
- Bonito, A. J., C. Bann, C. Eicheldinger, and L. Carpenter. 2008. "Creation of New Race-Ethnicity Codes and Socioeconomic Status (SES) Indicators for Medicare Beneficiaries." RTI International report for the Agency for Healthcare Research and Quality (AHRQ) and the Centers for Medicare and Medicaid Services (CMS) under CMS contract No 500-00-0024. Available at <http://www.ahrq.gov/research/findings/final-reports/medicareindicators/index.html>
- Burgess, J. F., M. L. Maciejewski, C. L. Bryson, M. Chapko, J. Fortney, M. Perkins, N. D. Sharp, and C. F. Liu. 2011. "Importance of Health Sector Context for Evaluation Utilization Patterns across Sectors." *Journal of Health Economics* 20 (2): 239–51.
- Cadigan, J. M., A. K. Klanecky, and M. P. Martens. 2017. "An Examination of Alcohol Risk Profiles and Co-Occurring Mental Health Symptoms among OEF/OIF Veterans." *Addictive Behaviors* 70: 54–60.
- Cho, J., E. M. Stock, I. C. Liao, J. E. Zeber, B. K. Ahmedani, R. Basu, C. C. Quinn, and L. A. Copeland. 2017. "Multiple Chronic Condition Profiles and Survival among

- Oldest-Old Male Patients with Hip Fracture." *Archives of Gerontology and Geriatrics* 74: 184–90.
- Collins, L. M., and S. T. Lanza. 2010. *Latent Class and Latent Transition Analysis: With Applications in the Social, Behavioral, and Health Sciences*. Hoboken, NJ: John Wiley & Sons Inc.
- Collins, L. M., P. L. Fidler, S. E. Wugalter, and J. L. Long. 1993. "Goodness-of-Fit Testing for Latent Class Models." *Multivariate Behavioral Research* 28: 375–89.
- Deb, P., and P. K. Triveki. 2002. "The Structure of Demand for Health Care: Latent Class Versus Two-Part Models." *Journal of Health Economics* 21: 601–25.
- Dziak, J. J., D. L. Coffman, S. T. Lanza, and R. Li. 2012. "Sensitivity and Specificity of Information Criteria: Technical Report Series #12-119." Methodology Center and College of Health and Human Development, Penn State, State College, PA [accessed on January 2, 2018]. Available at <https://methodology.psu.edu/media/techreports/12-119.pdf>
- Funderburk, J. S., S. A. Maisto, D. E. Sugarman, and M. Wade. 2008. "The Covariation of Multiple Risk Factors in Primary Care: A Latent Class Analysis." *Journal of Behavioral Medicine* 31: 525–35.
- Hastings, S. N., C. Horney, L. R. Landerman, L. L. Sanders, M. B. Hocker, and K. E. Schmader. 2010. "Exploring Patterns of Health Service Use in Older Emergency Department Patients." *Academic Emergency Medicine* 17 (10): 1086–92.
- Hong, S. I. 2010. "Understanding Patterns of Service Utilization among Informal Caregivers of Community Older Adults." *Gerontologist* 50 (1): 87–99.
- Humensky, J., H. Caretta, K. deGroot, M. M. Brown, E. Tarlov, and D. M. Hynes. 2012. "Service Utilization of Veterans Dually Eligible for VA and Medicare Fee-for-Service: 1999–2004." *Medicare & Medicaid Research Review* 2 (3): E1–E22.
- Hynes, D. M., K. Koelling, K. Stroupe, N. Arnold, K. Mallin, M. W. Sohn, F. M. Weaver, L. Manheim, and L. Kok. 2007. "Veterans' Access to and Use of Medicare and Veterans Affairs Health Care." *Medical Care* 45: 214–23.
- Jia, H., Y. Zheng, D. M. Reker, D. C. Cowper, S. S. Wu, W. B. Vogel, G. C. Young, and P. W. Duncan. 2007. "Multiple System Utilization and Mortality for Veterans with Stroke." *Stroke: A Journal of Cerebral Circulation* 38: 355–60.
- Lanza, S. T., L. M. Collins, D. R. Lemmon, and J. L. Schafer. 2007. "PROC LCA: A SAS Procedure for Latent Class Analysis." *Structural Equation Modeling* 14 (4): 671–94.
- Liu, C. F., C. Bolkan, D. Chan, E. M. Yano, L. V. Rubenstein, and E. F. Chaney. 2009. "Dual Use of VA and Non-VA Services among Primary Care Patients with Depression." *Journal of General Internal Medicine* 24 (3): 305–11.
- Liu, C. F., M. Chapko, C. L. Bryson, J. E. Burgess, J. C. Fortnery, M. Perkins, S. M. Sharp, and M. L. Maciejewski. 2010. "Use of Outpatient Care in Veterans Health Administration and Medicare among Veterans Receiving Primary Care in Community Based and Hospital Outpatient Clinics." *Health Services Research* 45 (5): 2368–85.
- Liu, J. H., W. G. Manning, J. F. Burgess, P. L. Hebert, C. L. Bryson, J. Fortney, M. Perkins, N. D. Sharp, and M. L. Maciejewski. 2011a. "Reliance on Veterans Affairs Outpatient Care by Medicare-Eligible Veterans." *Medical Care* 49: 911–7.

- . 2011b. "Reliance on Veterans Affairs Outpatient Care by Medicare-Eligible Veterans." *Medical Care* 49 (10): 911–7.
- Phibbs, C. S., P. B. Barnett, and A. Fan. 2015. *Research Guide to the Managerial Cost Accounting National Cost Extracts. Guidebook*. Menlo Park, CA: VA Palo Alto, Health Economics Resource Center.
- Radomski, T. R., X. Zhao, C. T. Thorpe, J. M. Thorpe, C. B. Good, M. K. Mor, M. J. Fine, and W. F. Gellad. 2016. "VA and Medicare Utilization among Dually Enrolled Veterans with Type 2 Diabetes: A Latent Class Analysis." *Journal of General Internal Medicine* 31 (5): 524–31.
- Research Triangle Institute. 2008. "RTI Analysis of Special Needs Plan Chronic Condition Panel: Final Report." North Carolina: Research Triangle Park.
- Richardson, J. D., F. Ketcheson, L. King, P. Schnaider, M. Marlborough, A. Thompson, and J. D. Elhai. 2017. "Psychiatric Comorbidity Pattern in Treatment-Seeking Veterans." *Psychiatry Research* 258: 488–93.
- Ried, L. D., R. Cameon, H. Jia, K. Findley, M. S. Hinojosa, X. Wang, and M. J. Tueth. 2007. "Identifying Veterans with Acute Strokes with High-Specificity ICD-9 Algorithm with VA Automated Records and Medicare Claims Data: A More Complete Picture." *Journal of Rehabilitation Research and Development* 44 (5): 665–73.
- Shen, Y., P. A. Findley, M. Maney, L. Pogach, S. Crystal, M. Rajan, and T. W. Findley. 2008. "Department of Veterans Affairs-Medicare Dual Beneficiaries with Stroke: Where Do They Get Care?" *Journal of Rehabilitation Research and Development* 45 (1): 43–51.
- Trivedi, A. N., R. C. Grebla, L. Jiang, J. Yoon, V. Mor, and K. W. Kizer. 2012. "Duplicate Federal Payments for Dual Enrollees in Medicare Advantage Plans and the Veterans Affairs Health Care System." *Journal of the American Medical Association* 308 (1): 67–72.
- U.S. Department of Agriculture. 2015. *Rural-Urban Commuting Area Codes*. Washington DC: Economic Research Service [accessed on August 20, 2017]. Available at <http://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx>
- U.S. Department of Veterans Affairs. 2011. *2011 Survey of Veteran Enrollees' Health and Reliance upon VA*. Washington, DC: Veterans Health Administration.
- U.S. Department of Veterans Affairs. 2015. "System of Records Notice 97VA10P1: Consolidated Data Information System-VA." 76 FR 25409. May 4, 2011.
- U.S. Department of Veterans Affairs. 2016. "VHA Directive 1153: Access to Centers for Medicare and Medicaid Services (CMS) and United States Renal Data System (USRDS) Data for Veterans Health Administration (VHA) Users within the Department of Veterans Affairs (VA) Information Technology (IT) Systems."
- VIReC. 2015a. *VIReC Research User Guide: Fiscal Year 2014 VHA Medical SAS Inpatient Datasets*, 2d Edition. Hines, IL: U.S. Department of Veterans Affairs Health Services Research & Development Service, VA Information Resource Center.
- VIReC. 2015b. *VIReC Research User Guide: Fiscal Year 2014 VHA Medical SAS Outpatient Datasets and Inpatient Encounters Dataset*. Hines, IL: U.S. Department of Veterans Affairs Health Services Research and Development Service, VA Information Resource Center.

- Weeks, W. B., P. J. Mahar, and S. M. Wright. 2005. "Utilization of VA and Medicare Services by Medicare-Eligible Veterans: The Impact of Additional Access Points in a Rural Setting." *Journal of Healthcare Management and American College of Healthcare Executives* 50 (2): 95–106.
- Wolinsky, F. D., H. An, L. Liu, T. R. Miller, and G. E. Rosenthal. 2006. "Dual Use of Medicare and the Veterans Health Administration: Are There Adverse Health Outcomes?" *BMC Health Services Research* 6: 131.
- . 2007. "Exploring the Association of Dual Use of the VHA and Medicare with Mortality: Separating the Contributions of Inpatient and Outpatient Services." *BMC Health Services Research* 7: 70.
- Yoon, J., D. E. Rose, I. Canelo, A. S. Upadhyay, G. Schectman, R. Stark, L. Rubenstein, and E. M. Yano. 2013. "Medical Home Features of VHA Primary Care Clinics and Avoidable Hospitalizations." *Journal of General Internal Medicine* 28 (9): 1188–94.

SUPPORTING INFORMATION

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

Appendix SA1: Author Matrix.