ORIGINAL RESEARCH

The Impact of Medication-Based Risk Adjustment on the Association Between Veteran Health Outcomes and Dual Health System Use

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BACKGROUND: Veterans commonly receive care from both Veterans Health Administration (VA) and non-VA sources (i.e., dual use). A major challenge in comparing health outcomes between dual users and VA-predominant users is applying an accurate method of risk adjustment.

OBJECTIVE: To determine how different comorbidity indices affect the association between patterns of dual use and health outcomes.

DESIGN: Retrospective cohort.

PARTICIPANTS: A total of 316,775 community-dwelling Veterans (≥65 years) with type 2 diabetes who were enrolled in VA and fee-for-service Medicare from 2008 to 2010.

METHODS: We determined the associations between dual use and death or diabetes-related hospitalization in FY 2010 using multivariable models incorporating claims-based (Elixhauser) or medication-based (RxRisk-V) risk adjustment. Dual use was classified using four previously identified groups of health services users: 1) VA-predominant, 2) VA + Medicare visits and labs, 3) VA + Medicare test strips, and 4) VA + Medicare medications.

KEY RESULTS: Controlling for Elixhauser comorbidities, dual-use groups 2–4 had significantly decreased odds of death or hospitalization compared to VA-predominant users. Controlling for RxRisk-V comorbidities, groups 2–4 had increased odds of death compared to VA-predominant users, but variable odds of hospitalization, with group 2 having increased odds (OR 1.06, CI 1.04–1.09), while groups 3 (OR 0.96, CI 0.94–0.99) and 4 (OR 0.93, CI 0.89–0.97) had decreased odds.

CONCLUSIONS: The method of risk adjustment drastically influences the direction of effect in health outcomes

among dual users of VA and Medicare. These findings underscore the need for standardized and reliable risk adjustment methods that are not susceptible to measurement differences across different health systems.

KEY WORDS: Veterans; Medicare; outcomes; diabetes; health services research.

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INTRODUCTION

Beneficiaries of the Veterans Health Administration (VA) are commonly enrolled in other health insurance plans and receive care outside VA (i.e., dual use).^{1–6} As of 2015, 80% of VA-enrolled Veterans were also enrolled in non-VA health insurance plans, with greater than 95% of Veterans aged 65 and older also enrolled in Medicare.¹ Although dual use may improve Veterans' access to care, it has also been associated with fragmentation of care,^{7–9} increased healthcare utilization,¹⁰ and worse health outcomes.^{11–20}

An essential component for an accurate determination of the relationship between dual use and health outcomes is the application of a risk adjustment method that accurately captures all conditions treated within VA and/or Medicare. Prior studies suggest there is systematic under-coding of medical comorbidities within VA compared to Medicare,^{21–23} leading to incomplete identification of comorbidities in Veterans who are reliant on VA for care. This is due, in part, to differential financial incentives in the assignment of International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes within Medicare versus VA, as billing in Medicare is augmented through accurate and complete documentation of claims.²³ Claims-based risk adjustment indices (i.e., Charlson²⁴ and Elixhauser²⁵) likely result in underrepresentation of the true burden of disease among Veterans who receive the bulk of their care within VA, leading to biased estimates of the true relationship between dual use and health outcomes.

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Alternative risk adjustment measures that use medication claims and are not subject to such coding discrepancies have been developed and validated, but have not been previously applied to dual use research.^{26–28}

As increasing numbers of Veterans receive care outside VA,^{29, 30} developing a better understanding of the impact of dual health system use on health outcomes—one that accurately adjusts for Veterans' true burden of comorbid disease and accounts for the different ways in which Veterans access healthcare services across systems—is essential. We previously established a typology of four distinct groups of Veterans, representing the most common naturally occurring patterns in which Veterans used diabetes health services (outpatient visits, laboratory tests, test strips, and medications) within VA and Medicare.¹⁰ Within this typology, we discovered significant differences among groups, including socio-demographic factors, Medicaid eligibility, and volume of health services used, yet the relationship between these patterns of dual use and health outcomes remains unknown.

Thus, our primary aims for this study were, first, to adapt a novel, medication-based risk adjustment index for use in dual use research that is not susceptible to coding discrepancies between VA and Medicare; second, to determine whether different patterns of dual use for diabetes care are associated with adverse health outcomes; and third, to evaluate the impact of using different risk adjustment indices on our study's conclusions.

METHODS

Study Design and Data Sources

We conducted a retrospective cohort study using linked national administrative data from VA and the Centers for Medicare and Medicaid Services (CMS) from fiscal years (FY) 2008–2010 (October 1, 2007 to September 30, 2010). This study was approved by the institutional review board of the VA Pittsburgh Healthcare System.

VA data included Medical SAS (Statistical Analysis System) datasets for patient sociodemographic characteristics and inpatient, emergency department, and outpatient claims; Pharmacy Benefits Management (PBM) data for dispensed outpatient prescriptions and durable medical equipment (DME); and the Vital Status File to determine mortality. CMS data included denominator files for Medicare and Medicaid enrollment and sociodemographic variables; inpatient, outpatient, and carrier (i.e., non-institutional claims) files for inpatient, outpatient, and emergency department claims; and Part D and DME files for dispensed outpatient prescriptions and medical supplies, respectively, that were incorporated into the medication-based risk index.

Study Cohort

We previously identified a national cohort of Veterans aged 65 and older with type 2 diabetes documented in FY 2008, who had at least one outpatient visit within VA, received a diabetes medication in FY 2009, and were enrolled in Medicare Part A, B, or D in FY 2008–2009.¹⁰ This cohort excluded those enrolled in a Medicare HMO over this time period (due to limited claims data) or with a continuous hospital or nursing home stay of greater than 30 days, as this would disrupt their normal outpatient receipt of diabetes care.^{31–34}

Outcome Measures

Our primary outcomes were all-cause mortality and a diabetes-related hospitalization or emergency department (ED) visit in FY 2010. We examined outcomes in FY 2010, as data from FY 2008–2009 were used to establish our baseline typology of diabetes health service use. To determine rates of all-cause mortality, we used VA vital status data to identify Veterans with a documented date of death in FY 2010. We identified hospitalizations or ED visits at a VA or Medicare facility associated with a primary diagnosis code for a diabetes-related condition, including acute complications (hypoglycemia, sepsis, cellulitis, etc.) and previously defined microvascular and macrovascular complications (diabetic nephropathy, stroke, ischemic heart disease, etc.).^{35, 36}

Independent Variable

Our primary independent variable was the pattern of VA and Medicare diabetes-specific health services use (outpatient visits, laboratory tests, test strips, and medications), characterized by membership in one of four subgroups identified in our previously established typology of VA and Medicare dual use.¹⁰ Specifically, Veterans in group 1 (VA-predominant users) had a high probability of VA use and low probability of Medicare use across all diabetes health services. Veterans in groups 2 (VA + Medicare visit and laboratory users), 3 (VA + Medicare test strip users), and 4 (VA + Medicare prescription users) had a high probability of VA and Medicare dual use, but differed in the specific VA and Medicare health services used. For example, Veterans in group 3 received test strips exclusively through Medicare, whereas Veterans in group 4 received their medications predominantly through Medicare.¹⁰

Covariates

We generated sociodemographic variables for age, sex, and race/ethnicity. As a proxy for socioeconomic status, we determined each Veteran's Medicaid enrollment status; we also assessed VA priority group membership, which governs copays and is determined based on income, service-connected medical conditions, and era of service.³⁷

Risk Adjustment

We applied both claims-based (Elixhauser) and medication-based risk adjustment indices (RxRisk-V). The Elixhauser Comorbidity Index is an unweighted index of 30 comorbid conditions identified using ICD-9 administrative claims from both VA and Medicare.²⁵ The RxRisk-V Index includes 45 comorbid conditions identified from pharmacy use, with different assigned weights that are used to generate an overall comorbidity score (Online Appendix Table 1).²⁸ This index has been validated to predict mortality and cost of care using VA pharmacy records, which include medications and related supplies.^{28–30} Given our focus on dual use, we adapted this measure to also include Medicare pharmacy claims and DME. We incorporated all Part D medications also used in VA and classified all relevant Part D medications not typically used within VA into one of the 45 categories. Two members of the research team (TR and JN) independently classified each Part D medication not previously incorporated into the RxRisk-V Index, with any disagreement between reviewers reconciled by research group consensus. Additionally, we searched the CMS Part B DME file and incorporated supplies that were previously incorporated into the RxRisk-V Index, because they are dispensed as drugs within VA (e.g., glucose test strips, urinary catheters). Given the nature of our cohort, we excluded diabetes as a comorbidity from both RxRisk-V and Elixhauser.

Statistical Analysis

We calculated descriptive statistics for all sociodemographic variables for the overall cohort and by subgroup of VA and Medicare diabetes health services use. We determined the mean number of medical comorbidities separately considering VA and VA + Medicare claims overall and for each subgroup using the RxRisk-V and Elixhauser Comorbidity indices.

We compared differences in prevalence of outcomes between subgroups using chi-square tests. We used logistic regression to determine the independent association between subgroups and our primary outcomes, using Veterans in group 1 (VA-predominant users) as the reference. We conducted unadjusted analyses and analyses controlling for sociodemographic characteristics and medical comorbidities. To evaluate the effect of using different risk adjustment measures, we conducted separate models with 1) the Elixhauser Comorbidity Index using VA claims only, 2) the Elixhauser Comorbidity Index using VA and Medicare claims (to evaluate the impact of known coding discrepancies between VA and Medicare on outcomes), and 3) the RxRisk-V Index using VA and Medicare pharmacy claims. In a post hoc sensitivity analysis, risk adjustment was also performed using the Charlson Comorbidity Index,²⁴ a weighted index of 19 conditions, using VA and Medicare ICD-9 diagnoses.

All statistical tests were two-sided, with a *p* value of <0.05 considered statistically significant. All analyses were performed using SAS version 9.3 software (SAS Institute Inc., Cary, NC).

RESULTS

Study Sample

The cohort included 316,775 dually enrolled Veterans aged 65 or older with type 2 diabetes. Among the overall cohort, 53.9% of Veterans were classified in group 1 (VA-predominant users), 17.2% were in group 2 (VA + Medicare visits and labs), 21.8% were in group 3 (VA + Medicare test strips), and 7.0% were in group 4 (VA + Medicare Medications; Table 1).

Comorbidities

The mean number of Elixhauser comorbidities differed among groups. Compared to group 1, dual-use groups 2, 3, and 4 had fewer documented Elixhauser comorbidities using only VA claims, but a greater number of documented comorbidities when adding Medicare claims (Table 2). Mean RxRisk-V comorbidities were similar in the overall cohort and across groups when using VA prescription claims alone versus VA and Medicare claims, with the exception of group 4, given their known reliance on Medicare medications.

Health-Related Outcomes

There were significant differences across all groups in the incidence of all-cause mortality and in having a diabetes-related hospitalization or ED visit in FY 2010 (Table 3). In adjusted analyses controlling for sociodemographic factors and comorbidities, the odds of death were inconsistent using claims-based versus medication-based risk adjustment (Table 4). Controlling for sociodemographic factors and Elixhauser comorbidities documented within VA, Veterans in groups 2–4 all had significantly increased odds of death (OR 1.10, 1.12, and 1.24, respectively) compared to Veterans in group 1 (VA-predominant users). In contrast, when incorporating Medicare Elixhauser comorbidities, Veterans in groups 2–4 had significantly decreased odds of death (OR 0.88, 0.88, and 0.89, respectively). When controlling instead for RxRisk-V comorbidities documented within VA and Medicare, Veterans in groups 2 (OR 1.08, CI 1.03–1.13) and 3 (OR, 1.09, CI 1.05–1.14) had significantly increased odds of death in comparison to Veterans in group 1. Veterans in group 4 had increased odds of death (OR 1.03, CI 0.97–1.09), although this was not statistically significant.

Controlling for sociodemographic factors and Elixhauser comorbidities documented within VA, Veterans in groups 2 and 4 had significantly increased odds of having a diabetes-related hospitalization/ED visit (OR 1.04 and 1.06, respectively), whereas Veterans in group 3 had significantly decreased odds (OR 0.96; Table 4). Incorporating Medicare comorbidities resulted in Veterans in groups 2–4 all having significantly decreased odds of hospitalizations/ED visits compared to group 1 (OR 0.87, 0.80, and 0.82, respectively). When controlling instead for RxRisk-V comorbidities, Veterans in group 2 had significantly increased odds of having a diabetes-related hospitalization or ED visit (OR 1.06, CI 1.04–1.09). In

Table 1 Characteristics of Veterans with Diabetes by VA and Medicare Health Service Dual-Use Group

Characteristic	Overall	Group 1 (VA-predominant)	Group 2 (VA + Medicare visits and labs)	Group 3 (VA + Medicare test strips)	Group 4 (VA + Medicare prescriptions)
N (%)	316,775 (100)	170,750 (53.9)	54,606 (17.2)	69,158 (21.8)	22,261 (7.0)
Age in years, median (IQR)	74 (69–80)	72 (68–78)	75 (70–80)	77 (72–82)	76 (71–81)
Male sex (%)	98.7	98.5	98.9	98.9	98.9
Race/ethnicity (%)					
Non-Hispanic white	83.0	77.6	86.8	91.0	90.7
Black	10.0	13.5	7.5	4.9	4.6
Hispanic	5.0	6.7	3.8	2.6	2.8
Other/missing	2.0	2.3	1.9	1.5	2.0
Medicaid-eligible (%)	5.3	6.0	3.5	2.1	14.7
VA priority group (%) [*]					
1	16.4	18.7	19.9	11.7	4.6
2–6	47.8	56	38.5	36	43.8
7–8	35.9	25.4	41.6	52.2	51.6

^{*}Each Veteran is assigned to one of eight priority groups (PG) upon VA enrollment based upon service-connected illnesses, era of service, and socioeconomic status determined by means testing. A Veteran's priority group determines their level of copays. Priority groups are condensed for presentation based upon similarity of copays between groups; however, groups were incorporated separately in all analyses

contrast, Veterans in groups 3 (OR 0.96, CI 0.94–0.99) and 4 (OR 0.93, CI 0.89–0.97) had significantly decreased odds, consistent in direction with results using Elixhauser comorbidities.

The same results were obtained when using the Charlson Index instead of Elixhauser for comorbidity adjustment—namely, the direction of effect for both outcomes was opposite when using each method of adjustment.

DISCUSSION

This study in a national cohort of Veterans with diabetes who were dually enrolled in VA and Medicare yielded two key findings. First, we found that applying different risk adjustment indices drastically influenced outcomes. Second, we discovered significant differences in health outcomes among Veterans with different patterns of VA and Medicare dual use, emphasizing that dual use should not be considered as a single construct. Veterans use health services from VA and Medicare

in diverse ways, and taken together, our findings underscore the importance of more precisely defining and analyzing these patterns to accurately measure whether dual use of health services impacts health outcomes. Our results are important not only for dual use research, but for any policy and outcomes research that compares care between VA and non-VA health-care systems.

Our results were highly sensitive to both the method and source of claims for risk adjustment, highlighting an important analytic challenge. Among dual users, VA ICD-9 claims capture only 33% of a Veteran's total illness burden, whereas Medicare ICD-9 claims capture 80%.²³ This discrepancy makes VA-predominant users appear less sick than dual users and is exemplified by the differing number of comorbid conditions and conflicting direction of effect we observed when adjusting using VA-only versus VA and Medicare Elixhauser claims. Our findings highlight the need to give careful consideration to the method of risk adjustment when interpreting the results of prior studies that applied ICD-9 claims-based measures of risk adjustment, as the results may be biased against VA.

Table 2 Mean Number of Comorbid Conditions using Elixhauser and RxRisk-V Indices by VA and Medicare Health Service Dual-Use Group

Method of comorbidity assessment	Overall	Group 1 (VA-predominant)	Group 2 (VA + Medicare visits and labs)	Group 3 (VA + Medicare test strips)	Group 4 (VA + Medicare prescriptions)
Elixhauser Index, mean (SD) [*]					
VA claims only	1.3 (1.3)	1.5 (1.4)	1.2 (1.2)	0.9 (1.1)	0.8 (0.8)
VA + Medicare claims	2.1 (1.6)	1.8 (1.5)	2.5 (1.7)	2.3 (1.7)	2.6 (1.8)
RxRisk-V Index, mean (SD) [†]					
VA prescriptions only	5.6 (2.7)	6.0 (2.7)	5.6 (2.6)	5.1 (2.3)	4.1 (2.7)
VA + Medicare prescriptions	5.9 (2.7)	6.0 (2.7)	5.8 (2.6)	5.3 (2.4)	6.6 (2.7)

^{*}The Elixhauser Comorbidity Index comprises 30 comorbid conditions identified using ICD-9 codes from administrative claims; we excluded diabetes as a comorbid condition in this cohort

[†]The RxRisk-V Index comprises 45 comorbid conditions identified using pharmacy claims; we excluded diabetes as a comorbid condition in this cohort

Table 3 Comparison of Mortality and Diabetes-Related Hospitalizations or ED Visits by VA and Medicare Health Service Dual-Use Group

Outcome measure	Overall	Dual-use group			
		Group 1 (VA-predominant)	Group 2 (VA + Medicare visits and labs)	Group 3 (VA + Medicare test strips)	Group 4 (VA + Medicare prescriptions)
Mortality (%)*	5.8	5.3	6.2	6.4	7.2
Hospitalization or ED visit (%) [†]	17.0	17.2	17.8	15.8	17.7

* $P < 0.001$ (chi-square)[†]Diabetes-specific hospitalizations or ED visits within VA or Medicare

When using the RxRisk-V Index, we discovered that dual use is associated with increased odds of death. These results are generally consistent with prior studies that examined dual use and mortality, and found greater risk in individuals with dual use.^{11, 12, 16–18} Comparison with these studies is challenging, however, given their binary classification scheme for dual use and inconsistent risk adjustment methods. For example, Wolinsky and colleagues risk adjusted based upon self-reports of comorbidities contained in a pre-existing database,¹² while Wright and colleagues controlled for the presence of 11 comorbidities by variably extracting claims from VA and Medicare (9 comorbidities from VA and 4 comorbidities from Medicare).¹¹

Our findings, coupled with the inconsistent risk adjustment measures applied in other studies, underscore the importance of establishing a standardized and reliable risk adjustment method for studies examining the use of VA and non-VA care. As dual use continues to grow, accurate risk adjustment will be essential to further our understanding of its association with health outcomes. In applying the RxRisk-V Index, we have demonstrated that it is possible to control for medical comorbidities using prescription medications in a way that is not prone to bias in the ascertainment of VA and Medicare administrative claims. Furthermore, The RxRisk-V Index will allow comorbidity-based risk adjustment for individuals enrolled in Medicare Advantage plans, who have been routinely excluded

from analyses due to a lack of available data for adequate risk adjustment using traditional claims-based indices.^{10, 31, 32}

We also discovered variations in outcomes between dual-use groups with regard to hospitalizations when adjusting for risk using the RxRisk-V Index. This is in contrast to prior work by Ajmera and colleagues, which demonstrated no difference when comparing dual users as a single group to Veterans who rely on VA care.³⁸ Our categorization of Veterans into groups based upon their patterns of diabetes health service use allowed us to more precisely characterize dual users and identify key differences in health outcomes. These findings raise important questions, however, regarding the potential mechanisms through which variations in dual use affect health outcomes. Dual users may receive varying degrees of care coordination based upon their health service use. Furthermore, dual users who rely primarily on non-VA care may receive care in non-VA facilities that lack the advanced electronic medical record and decision-support tools within VA, leading to adverse health events. Future research aimed at identifying the root cause of these differences is essential for informing policymakers how to most effectively target policies and interventions toward those dual users most at risk of adverse health outcomes.

VA is currently implementing programs that have the potential to expand access to non-VA care, and our findings may

Table 4 Odds Ratios of Death or Having a Diabetes-Related Hospitalization/ED Visit by Subgroup of VA and Medicare Health Service Utilization, Determined Using Various Risk Adjustment Indices

Outcome measures and methods of adjustment	Group 2 (VA + Medicare visits and labs)*		Group 3 (VA + Medicare test strips)*		Group 4 (VA + Medicare prescriptions)*	
	OR	95% CI	OR	95% CI	OR	95% CI
Death						
Unadjusted	1.18	(1.14–1.23)	1.23	(1.18–1.27)	1.38	(1.31–1.46)
Adjusted for sociodemographic factors [†]	1.01	(0.97–1.06)	0.94	(0.91–0.98)	1.06	(1.00–1.12)
Adjusted for sociodemographic factors and comorbidities:						
Elixhauser (VA claims) [‡]	1.10	(1.06–1.15)	1.12	(1.07–1.17)	1.24	(1.17–1.32)
Elixhauser (VA + Medicare claims) [‡]	0.88	(0.84–0.92)	0.88	(0.84–0.92)	0.89	(0.84–0.95)
RxRisk-V (VA + Medicare prescriptions)	1.08	(1.03–1.13)	1.09	(1.05–1.14)	1.03	(0.97–1.09)
Hospitalization or ED visit						
Unadjusted	1.04	(1.02–1.07)	0.90	(0.88–0.92)	1.04	(1.00–1.07)
Adjusted for sociodemographic factors [†]	1.00	(0.98–1.03)	0.83	(0.81–0.85)	0.91	(0.88–0.95)
Adjusted for sociodemographic factors and comorbidities:						
Elixhauser (VA claims) [‡]	1.04	(1.01–1.07)	0.96	(0.94–0.99)	1.06	(1.02–1.11)
Elixhauser (VA + Medicare claims) [‡]	0.87	(0.85–0.90)	0.80	(0.78–0.82)	0.82	(0.79–0.85)
RxRisk-V (VA + Medicare prescriptions)	1.06	(1.04–1.09)	0.96	(0.94–0.99)	0.93	(0.89–0.97)

*Group 1 (VA-predominant users) is the comparison group for all analyses

[†]Sociodemographic factors: age, race, gender, Medicaid eligibility, VA priority group[‡]Models that adjust for Elixhauser comorbidities also control for diabetes complications and the presence of serious mental illness

serve as a cautionary note to both VA and non-VA health systems and providers engaged in the dual care of Veterans through such initiatives. Through the Veterans Choice Program, increasing numbers of Veterans are receiving care both within VA and in private facilities. VA has also prioritized the establishment of “high-performance networks,” where VA medical centers will partner with private health systems to best meet the comprehensive health needs of VA enrollees.³⁹ These forms of dual use differ slightly from VA/Medicare dual use, given that VA remains the single payer; nonetheless, our results emphasize the importance that must be placed on care coordination by both VA and non-VA healthcare systems. Our findings are also applicable to the growing number of non-VA integrated healthcare delivery and finance systems that seek to measure the outcomes associated with patients who receive care from providers both within and outside their integrated system and thus may be subject to differing ICD-9 coding practices.⁴⁰

This study has important limitations. First, these data only consider dual use of diabetes-specific health services and do not consider Veterans’ overall receipt of care from VA and non-VA sources. Our approach may serve as a template, however, to characterize Veterans’ comprehensive use of dual health systems or the use of other disease-specific services. Second, our data are from fiscal years 2008–2010, and therefore our findings may not be representative of outcomes related to more recent patterns of dual use that may have emerged as a result of policy changes. Third, while the RxRisk-V measure has been previously validated in predicting mortality,^{27, 28} to our knowledge, this is the first application of this measure evaluating dual use of VA and non-VA care. Nevertheless, given the limitations of other commonly applied risk adjustment schemes, we believe that the RxRisk-V Index may be superior. Studies aimed at more rigorously evaluating the measure in dual-use cohorts are ongoing.

CONCLUSION

The method of risk adjustment drastically influences the assessment of health outcomes among Veterans with different patterns of VA and Medicare dual use. By using the RxRisk-V index, we were able to apply a risk adjustment index not susceptible to coding discrepancies and to highlight key differences in outcomes between dual-use groups. Our findings have broad implications for policy and outcomes research, and make the case for adoption of a standardized and reliable risk adjustment scheme to ensure the validity of future research examining VA and non-VA care.

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Compliance with Ethical Standards:

Conflict of Interest: The authors declare that they have no conflicts of interest.

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