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An Algorithm to Characterize a Dementia Population by Disease Subtype

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Abstract

Purpose: Identification of Alzheimer's disease and related dementias (ADRD) subtypes is important for pharmacologic treatment and care planning, yet inaccuracies in dementia diagnoses make ADRD subtypes hard to identify and characterize.

The objectives of this study were to: 1) develop a method to categorize ADRD cases by subtype and 2) characterize and compare the ADRD subtype populations by demographic and other characteristics.

Methods: We identified cases of ADRD occurring during 2008-2014 from the OptumLabs Database using diagnosis codes and anti-dementia medication fills. We developed a categorization algorithm that made use of temporal sequencing of diagnoses and provider type.

Results: We identified 36,838 individuals with ADRD. After application of our algorithm, the largest proportion of cases were non-specific dementia (41.2%), followed by individuals with anti-dementia medication but no ADRD diagnosis (15.6%). Individuals with Alzheimer's disease formed 10.2% of cases. Individuals with vascular dementia had the greatest burden of comorbid disease. Initial documentation of dementia occurred primarily in the office setting (35.1%).

Discussion: Our algorithm identified six dementia subtypes and three additional categories representing unique diagnostic patterns in the data. Differences and similarities between groups provided support for the approach and offered unique insight into ADRD subtype characteristics.

Keywords

Alzheimer's Disease; Dementia Subtype; Algorithm; Administrative Claims Data; Characterization

INTRODUCTION

Alzheimer's disease and related dementia (ADRD) diagnoses are poorly documented and under-diagnosed at the earliest stages of disease presentation.^{1,2} Diagnosing dementia can be a challenging process and prone to misclassification as disease recognition relies on variable factors such as cognitive history, diagnostic tests, and clinical judgment.^{3,4} Numerous factors affect receipt and accuracy of the diagnosis and further specification of dementia subtype.⁵ Definitive diagnosis relies on autopsy and more conclusive tests (e.g. spinal fluid, genetics, or positron emission tomography scanning) are invasive and can be cost-prohibitive. Identification and diagnosis of dementia can occur in a variety of care settings representing differing dementia diagnostic and coding practices by provider type.⁵⁻⁷ Identification of the dementia subtype would facilitate research on risk factors and outcomes by type, yet inaccuracies in dementia diagnoses can make ADRD subtypes hard to define, identify, and characterize.^{5,8}

Individuals with ADRD have a high comorbidity burden and are vulnerable to greater risk of complications due to inadequate or mismanaged treatments as cognition and function decline.⁹ Understanding the characteristics of the ADRD population by subtype at diagnosis can ultimately inform targeted interventions to enhance diagnosis and individualize treatment.¹⁰ Past efforts to study ADRD subtypes using administrative claims data have resulted in variable estimates on disease prevalence, utilization, and costs, mainly due to differences in methodology and case definitions.¹⁰⁻¹⁵ In addition to variation due to methodology, our prior work has provided evidence suggesting that individuals may receive multiple conflicting diagnoses, sometimes even on the same day.¹⁶ Thus, our objectives were to: 1) develop a systematic method to categorize patients by ADRD subtype at the time of earliest recorded dementia diagnosis and 2) characterize and compare the ADRD subtype populations by demographics, comorbidities, and diagnosis setting and provider type.

METHODS

Launched by the Global CEO Initiative on Alzheimer's Disease and OptumLabs®, this work is part of Project INSIGHT, designed to use big data to better understand ADRD and bring new evidence and innovation to improve care and accelerate the path to a cure. The initiative is focused on three of the biggest challenges in ADRD: disease prediction, disease progression and care delivery. The incident ADRD cohort described here was created as part of a project to create a claims-based predictive model for diagnosing ADRD earlier and more accurately.

Database

We used the OptumLabs Data Warehouse (OLDW), which includes de-identified claims data for privately insured and Medicare Advantage enrollees in a large, private, U.S. health plan.¹⁷ The database contains longitudinal health information on enrollees, representing a diverse mixture of ages, ethnicities and geographical regions across the United States and is broadly representative of the general commercial/Medicare Advantage market in the geographic area where it operates.¹⁷ The health plan provides comprehensive insurance coverage for physician, hospital, and prescription-drug services. In the OLDW, anyone 89 years is

assigned an age of 89 years to maintain patient confidentiality. Since this study involved analysis of pre-existing, de-identified data, it was determined exempt by the University of Maryland, Baltimore's Institutional Review Board.

ADRD Case Identification

We based our case definition on prior studies, but with clinical input broadened it to include individuals with mild cognitive impairment (MCI) and anti-dementia medication use, as well as specialty of provider.^{3,5,16,18,19} Individuals 18 years of age with an ADRD diagnosis between January 1, 2011 and June 30, 2014 were eligible for study inclusion. ADRD was defined as an inpatient or outpatient ICD-9-CM code for Alzheimer's disease (AD; 331.0), mild cognitive impairment (MCI; 331.83), Lewy-body associated dementia (LBD; 331.82), frontotemporal dementia (FTD; 331.10, 331.11, 331.19), vascular dementia (VD; 290.40, 290.41, 290.42, 290.43), or non-specific dementias (NSD; 290.00, 290.10, 290.11, 290.12, 290.13, 290.20, 290.21, 290.30, 290.80, 290.90, 294.10, 294.11, 294.20, 294.21, 797.00). Anti-dementia prescriptions (tacrine, donepezil, rivastigmine, galantamine, memantine/donepezil) were also used as proxy to identify ADRD cases.

Eligible claimants were required to have continuous enrollment in medical and pharmacy coverage for 36 months prior to the first identified dementia diagnosis (index date) and 6 months post-index date. The 36 month period pre-index date had to be 'clean' with no dementia diagnoses or anti-dementia prescriptions. At least one subsequent ADRD diagnosis within the post-index 6-month period was required to increase specificity of the ADRD case definition (e.g., exclude "rule-out" diagnoses) and further classify ADRD subtypes/groups. Individuals with a diagnosis of nutritional deficiencies (ICD-9-CM codes: 266.2x, 266.9x) or alcohol or substance dependency (ICD-9-CM codes: 291.xx, 303.xx, 305.0x, 571.0x, 571.2x, 571.3x) within 90 days of the index diagnosis or those with a hospice claim within 6 months to the index diagnosis were excluded.

ADRD Subtype Designation

To categorize ADRD individuals by subtype, we developed an algorithm informed by previous methods, existing case definitions, and clinical input.^{3,10,18,20} The algorithm was based on the initial diagnosis, the temporal sequence of dementia diagnoses during the follow up period, and diagnosing provider type(s). The algorithm was instrumental when there were two or more conflicting diagnoses or when there was only one diagnosis and a confirming prescription for an anti-dementia medication. Specialists (particularly geriatricians, neurologists, neuro-psychiatrists, psychologists and geriatric psychologists) have been shown to identify cases with a higher sensitivity compared to primary care and other physicians; thus, specialist diagnosis was a component of the algorithm.^{5,21,22} ADRD categories were established based on the six subtypes: AD, MCI, LBD, FTD, VD, NSD. Individuals with no ADRD diagnosis but with anti-dementia prescription fills were assigned to a drug-only category. Examination of the data prompted development of two new dementia categories, multiple dementia diagnoses (Multi) and multiple dementia diagnoses by specialists (Multi-S), to account for cases with conflicting diagnoses unresolved by the categorization rules.

The algorithm comprised a set of rules applied to cases with conflicting diagnoses: (1) if index and subsequent diagnoses were a single subtype + drug, then categorized as the subtype; (2) if index and subsequent diagnoses were a subtype + MCI, then categorized as the subtype; (3) If a specialist diagnosis was received, then group as specialist-defined subtype; (4) if index and subsequent diagnoses were an AD + VD, then categorized as AD; (5) if there were >1 claims with an AD diagnosis, then categorized as AD; (6) if index and subsequent diagnoses were conflicting, given by non-specialists, and not grouped by the above rules, categorized as Multi; (7) if index and subsequent diagnoses were conflicting, given by specialists, and not grouped by the above rules, categorized as Multi-S.

Covariates

Comorbidities were selected based on those previously reported to be associated with dementia.⁹ We searched all claim types for ICD-9-CM codes representing diagnoses of interest during the year preceding the index date. Comorbidities identified during this period were considered present at index date.

We extracted care setting and provider information from the index diagnosis claim. Care settings were grouped as: emergency department, office visit, pharmacy, inpatient, outpatient, long-term care, and other settings. Similarly, we created groups of provider types: family practitioner, hospital-based provider, neurologist, psychiatrist, psychologist, and unknown.

Analyses

Summary statistics were calculated for demographic, comorbidity, care setting and provider type characteristics overall and by ADRD category.

RESULTS

There were 565,292 individuals with a diagnosis of ADRD or a prescription fill for an anti-dementia medication between 2011-2014. Of these, 64,811 (11%) met age and continuous enrollment criteria, and had no diagnosis of ADRD during the 36-month look-back period. Exclusion criteria eliminated 10,845 individuals, leaving 53,966 cases. After applying the case definition for ADRD diagnosis confirmation, an additional 17,128 individuals were excluded, leaving 36,838 individuals in the final cohort.

Application of our categorization algorithm resulted in changes from the initial to final (categorized) ADRD subtype (Figure 1). Individuals initially diagnosed with MCI were more likely to end up with a final MCI categorization (86% of initial) while those initially diagnosed with LBD, VD, or drug only were less likely to receive a corresponding final categorization (66%, 64%, and 65%, respectively). Individuals who initially received an anti-dementia medication were more likely to end up in the NSD category than any other initial diagnostic group.

Individuals in the NSD subtype comprised the greatest proportion (41.2%) of the cohort, followed by drug only (15.6%), MCI (15.3%), AD (10.2%), Multi (8.5%), VD (4.1%), Multi-S (4.1%), LBD (0.6%), and FTD (0.4%) (Table 1). The largest proportion of

individuals belonged to the 75 to 84 age group followed by the over 85 and 65-75 age groups. In comparison to other ADRD categories, individuals in the MCI and FTD categories were younger (mean age 68.5, standard deviation (SD) 14.5 and 69.0 (SD 12.8) respectively) versus NSD and Multi (78.4 (SD 9.6) and 81.1 (SD 5.9), respectively). Geographic distribution of the ADRD cohort reflects the market share of the health plan by census region, with largest proportions in the South (41.8%) and Midwest (34.8%). The ADRD categories were predominately female with the exception for LBD (42.6% female). Medicare Advantage was the predominant insurer among the entire cohort (73.7%) with the remainder insured by commercial insurance, however, MCI and FTD categories had a lower percentage of Medicare Advantage beneficiaries (54.6% and 56.2%, respectively).

Overall, the most prevalent comorbidities were hypertension (83.8%), hyperlipidemia (76.3%), arthritis (55.3%), and ischemic heart disease (38.1%)(Table2). Prevalence of comorbidities differed by ADRD category. Individuals in the VD category had the greatest burden of comorbid diseases compared to the other categories. Parkinson's disease was highest among individuals with a LBD diagnosis (49.0%) compared to other categories (3.8% - 15.7%). Bipolar/manic disorder was most prevalent in FTD (10.5% versus <4.1% in other subtypes).

Across ADRD categories, the initial documentation of dementia occurred primarily in the office setting (35.1%)(Figure 2). A stand-alone pharmacy claim for an anti-dementia medication was the second most common setting in which a dementia diagnosis was identified (24.1%). Index diagnoses occurring in an emergency department, inpatient, outpatient, or long-term care setting accounted for about one-third of the ADRD cohort. More than half of individuals with AD, MCI, LBD, and FTD were initially diagnosed at an office visit compared to other categories (0% - 44.3%). Those in the VD category had the highest percentage of index diagnosis in a long term setting (23.4%) followed by the Multi (16.5%) and NSD (13.7) categories. The Multi-S category had the highest percentage of index diagnoses in an inpatient setting (21.9%) followed by the Multi (18.1%), VD (18.0%), NSD (15.7%) and FTD (11.8%) categories. The AD group had the second highest proportion of index diagnoses based on a pharmacy claim (17.3%), while MCI had the lowest (4.9%).

Family practice physicians were the most common provider type for the index diagnosis overall and were responsible for 33.2%-60.4% of the AD, VD, NSD, drug only, and Multi groups (Figure 3). Neurologists were the predominant provider type at initial diagnosis of MCI, LBD, FTD, and Multi-S (33.8-59.2%). Neurologist and psychiatrists made up one-third of the initial diagnoses among those in the VD category (17.7% and 13.4% respectively).

DISCUSSION

We created a novel algorithm to identify known dementia diagnostic subtypes using sequential diagnoses, prescription drug use and provider specialty. In the process, we identified three additional diagnostic categories (Drug only, Multi, Multi-S) that have not been previously described. We also characterized all the subtype populations at the time of

earliest available dementia record. Our results highlight important differences and similarities between subtypes that support the algorithm's ability to discern among different dementia categories.

AD is typically regarded as the most common form of dementia, yet it accounted for only 10% of our cohort.^{23,24} This discrepancy is likely due to two factors: use of administrative claims data and our categorization algorithm. Diagnosis of dementia relies on variable factors such as cognitive history, diagnostic tests, and clinical judgment.^{4,5} In the absence of a detailed neurologic evaluation, providers may assign a non-specific dementia code.^{5,25} Many of these cases might truly be AD. Thus, while these ICD-9-CM codes do not accurately represent the underlying etiology, they do represent the current state of dementia diagnosis as determined by claims. In alignment with previous administrative claims-based dementia studies, a significant proportion of our cohort (41%) fell into the NSD category.^{3,5,10}

Results on initial and final ADRD subtypes suggests that diagnoses often differ, meaning that characterization of ADRD subtypes can't be predicted based on single diagnoses. The categorization scheme we used is unique, which makes comparisons with other administrative claims studies difficult. Cho et al (2014) used a simple categorization scheme and reported higher prevalence of AD (31.9%) compared to our study (10.2%), but focused on only three subtypes of dementia (AD, VD, NSD), which explains the higher prevalence estimate for AD.³ Goodman's study (2017) did not create mutually exclusive subtype categories and reported prevalence of 43.5% for any diagnosis code for AD.¹⁰ Population-based studies have reported a wide range of estimates for prevalence of MCI (5%-37%).^{5,25-27} Our estimate, based strictly on claims data (15.3%) falls within this range.

We observed differences in provider type and place of service at diagnosis between ADRD subtypes suggestive of different pathways to diagnosis by subtype. Individuals in MCI, LBD, and FTD categories were most often diagnosed initially by a neurologist. Observed cognitive difficulties or behavioral disturbances among younger individuals such as those with MCI, LBD, and FTD may have caused greater concern and precipitated a visit to a specialist. In contrast, individuals in the NSD and Multi categories were most often diagnosed by a general or family practitioner and these diagnoses often happened in a long-term care or inpatient setting. Differentiating a specific dementia subtype may not have been a priority in these settings.

A significant proportion of individuals received anti-dementia medication but no corresponding diagnosis. We also observed dementia-related prescription fills before receipt of a dementia diagnosis for more than 10% of AD, LBD, NSD, and multi subtypes, with the greatest proportion of initial fills observed in AD (17%). Given increased follow-up time, we may have observed a diagnosis at a later date for those individuals that did not have one. Nonetheless, lack of a dementia diagnosis prior to treatment is consistent with well-documented issue of under-coding of dementia in clinical practice.^{1,28}

Differences were observed between ADRD categories in demographic and comorbidity profiles. While it is expected that dementia-related diseases will be most often observed in

an aging population, there is limited information in the literature on younger patients less than 65 years of age. Prior studies have often excluded younger individuals from prevalence estimates, yet we observed that 8.5% of individuals diagnosed with MCI were under the age of 45, suggesting that age ranges for prevalence studies should be expanded.²⁷ The younger age range for the FTD aligns with evidence that FTD is typically seen at an earlier age than most of the other dementia types.^{10,29} This is also true of the MCI subtype which converts to dementia with an annual incidence of 10% and represents the earliest record of cognitive symptoms leading to AD.^{30,31}

As would be expected, comorbidities related to cardiovascular diseases (e.g., stroke/TIA, hypertension, diabetes, heart failure, atrial fibrillation) were prominent in VD.³² Difficulty in differentiating FTD from other psychiatric disease has been reported in multiple case studies, which may explain the higher prevalence of bipolar or manic disorders in this group.^{33,34} LBD had high prevalence of Parkinson's disease (49%) which is not surprising since both diseases have similar clinical presentations are believed to stem from a similar neurodegenerative disorder.³⁵

This study has limitations that should be considered. The primary limitation is use of administrative claims data to identify dementia cases. Given the well-documented under- and mis-diagnosis of dementia, these data may not represent the true prevalence of ADRD subtypes.^{36–39} Nonetheless, only a small percentage of individuals undergo diagnostic testing to ascertain dementia subtype, so these data represent what is known from the viewpoint of the administrative record. Furthermore, our categorization algorithm identified unique subtypes that differed from each other in substantial ways, suggesting that they represented different groups of people, at least in time. Our study relied primarily on data from Medicare Advantage enrollees, thus this algorithm should be validated in Medicare fee for service claims. Data from 2015 suggest that Medicare Advantage enrollees differ from Medicare fee for service beneficiaries in that they are somewhat older with a higher proportion of individuals with income less than \$20,000/year.⁴⁰

In conclusion, we created a novel algorithm, using only claims data, to predict final ADRD diagnostic subtypes. The approach incorporated sequential diagnoses, use of anti-dementia drugs, and provider specialty designation. Using this algorithm, we identified six dementia diagnostic subtypes and three additional categories representing unique diagnostic patterns in the data. Differences and similarities between groups provided support for the approach and offered unique insight into ADRD subtype characteristics. Further research is needed to validate the algorithm with medical records data.

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Figure 1. Categorization into Alzheimer's Disease and Related Dementia Subtypes by Initial Diagnosis, n=36,838

Note. Alzheimer's disease (n=3,748); Mild cognitive impairment (n=5,648); Lewy-body dementia (n=204); Fronto-temporal dementia (n=153); Vascular dementia (n=1,520); Non-specific dementia (n=15,166); Drug only n=5,736; multiple dementia diagnoses by non-specialists (n=3,147); multiple dementia diagnoses by specialists (n=1,516); other – this category combines two or more other subtypes when cell sizes were too small to pass OptumLab's cell suppression limit

Figure 2. Place of Service at Index Diagnosis by Dementia Subtype

Note. Alzheimer's disease (n=3,748); Mild cognitive impairment (n=5,648); Lewy-body dementia (n=204); Fronto-temporal dementia (n=153); Vascular dementia (n=1,520); Non-specific dementia (n=15,166); Drug only n=5,736; multiple dementia diagnoses by non-specialists (n=3,147); multiple dementia diagnoses by specialists (n=1,516); RX- pharmacy claim; LTC – Long-term care; ED- Emergency department; Combined- combination of all other unspecified categories due to cell size limitations; Other – all other point of service categories (e.g. laboratory, radiology)

Figure 3. Provider Type at Index Diagnosis by Dementia Subtype

Note. Alzheimer's disease (n=3,748); Mild cognitive impairment (n=5,648); Lewy-body dementia (n=204); Frontotemporal dementia (n=153); Vascular dementia (n=1,520); Non-specific dementia (n=15,166); Drug only n=5,736; multiple dementia diagnoses by non-specialists (n=3,147); multiple dementia diagnoses by specialists (n=1,516)

Table 1.
Demographics of the Alzheimer's Disease and Related Dementia Cohort at Index Diagnosis by Subtype, n=36,838

	All*	AD	MCI	LBD	FTD	VD	NSD	Drug Only	Multi	Multi-s
N (%)	36,838 (100%)	3,748 (10.2%)	5,648 (15.3%)	204 (0.6%)	153 (0.4%)	1,520 (4.1%)	15,166 (41.2%)	5,736 (15.6%)	3,147 (8.5%)	1,516 (4.1%)
Age, mean(sd)	76.4 (11.0)	78.1 (8.5)	68.5 (14.5)	75.5 (9.3)	69.0 (12.8)	76.1 (9.9)	78.4 (9.6)	75.2 (11.0)	81.1 (5.9)	77.7 (7.7)
Age (%)										
18-44	2.5	<1	8.5	<5.4	<7.2	1.1	1.6	2.7	<1	<1
45-64	11.5	7.2	27.7	11.3	30.1	13.5	7.6	13.3	3.1	8.4
65-74	21.0	21.3	25.8	29.4	28.8	25.0	18.4	24.1	13.1	26.1
75-84	38.9	44.5	28.1	42.6	26.1	38.6	39.5	41.8	41.3	43.7
85+	26.1	26.1	10.0	>11.3	>7.8	21.8	32.9	18.1	>42	>21
Gender (%)										
Female	61.8	62.3	57.3	42.6	50.3	60.7	64.0	59.8	65.8	59.8
Census Region (%)										
Midwest	34.8	30.0	31.5	33.8	28.8	32.2	37.9	29.0	40.3	41.4
Northeast	11.7	11.9	12.2	12.7	9.8	15.7	12.3	7.4	12.5	13.3
South	41.8	46.0	42.9	38.2	47.1	43.0	38.2	51.2	36.7	37.4
West	11.7	12.2	13.4	15.2	14.4	9.1	11.6	12.5	10.4	7.8
Insurance Type (%)										
Commercial	26.3	24.1	45.4	29.4	43.8	22.5	20.7	30.2	16.7	23.9
Medicare Advantage	73.7	75.9	54.6	70.6	56.2	77.5	79.3	69.8	83.3	76.1

* Represents the full ADRD cohort; AD- Alzheimer's disease; MCI- Mild Cognitive Impairment; LBD- Lewy-body dementia; FTD- Frontotemporal dementia; VD - Vascular dementia; NSD- Non-specific dementia; Multi - multiple dementia diagnoses by non-specialists; Multi-s - multiple dementia diagnoses by specialists

Table 2.

Prevalence of Select Comorbidities in Alzheimer's Disease and Related Dementia Cohort 12-Months prior to Index Diagnosis by Subtype, n=36,838

	All	AD	MCI	LBD	FTD	VD	NSD	Drug	Multi	Multi-s
N (%)	36,838 (100%)	3,748 (10.2%)	5,648 (15.3%)	204 (0.6%)	153 (0.4%)	1,520 (4.1%)	15,166 (41.2%)	5,736 (15.6%)	3,147 (8.5%)	1,516 (4.1%)
Comorbidities [†] (%)										
Anemia	19.5	19.1	15.7	16.2	15.0	25.6	21.3	17.6	20.0	18.0
Anxiety	17.2	14.2	20.6	14.7	20.3	19.9	17.6	15.2	15.1	18.7
Arthritis	55.3	54.6	51.3	51.0	48.4	58.2	57.1	54.9	55.4	54.5
Atrial fibrillation	20.5	18.5	14.4	17.2	16.3	28.0	23.4	16.5	23.8	20.5
BMD	3.2	1.8	3.8	*	10.5	4.1	3.3	3.3	2.2	3.4
CKD	31.1	28.4	23.1	29.9	19.0	41.8	35.2	25.8	35.0	29.9
CLD	10.1	8.0	8.8	11.8	11.1	17.3	11.5	6.9	10.7	10.8
COPD	28.2	26.9	22.2	24.5	17.7	35.3	31.0	25.8	29.1	27.0
Delirium	5.8	4.4	3.2	*	*	10.1	6.9	2.9	9.5	7.5
Depression	28.2	22.8	30.1	29.4	33.3	35.9	29.0	26.0	26.9	28.8
Diabetes	37.0	33.8	30.3	37.3	32.7	48.3	39.2	37.0	37.2	36.0
Epilepsy/seizures	4.8	3.3	6.6	*	*	8.4	4.8	3.3	4.3	4.4
Heart failure	22.8	19.7	13.8	21.6	15.7	33.1	27.5	17.2	26.4	20.9
Hyperlipidemia	76.3	79.2	75.3	78.4	80.4	81.7	74.4	80.6	71.9	79.1
Hypertension	83.8	85.4	73.3	82.8	76.5	91.6	86.3	83.1	87.1	83.7
IHD	38.1	38.7	30.9	35.3	30.1	50.7	40.2	35.4	38.7	39.6
OSA	22.1	18.1	30.5	30.9	26.8	24.4	20.3	23.7	16.3	20.2
Other psychosis	13.3	10.4	8.7	12.3	12.4	18.6	15.7	8.6	17.8	17.3
Parkinson's disease	5.2	4.6	5.2	49.0	15.7	3.8	4.6	4.5	7.1	6.5
Stroke/TIA	33.8	32.0	30.8	35.8	28.8	59.5	33.4	29.9	35.9	37.9
TBI	15.4	12.7	13.7	15.2	16.3	19.3	17.2	11.4	18.7	15.5

[†] Illustrates the top comorbidities by prevalence within each ADRD category 1 year prior to the index date; AD- Alzheimer's disease; MCI- Mild Cognitive Impairment; LBD- Lewy-body dementia; Frontotemporal dementia; VD - Vascular dementia; NSD- Non-specific dementia; Multi - multiple dementia diagnoses by non-specialists; Multi-s - multiple dementia diagnoses by specialists; BMD - Bipolar and Manic Disorders; CKD - Chronic Kidney Disease; CLD - Chronic Liver Disease; COPD - Chronic Obstructive Pulmonary Disease; IHD - Ischemic Heart Disease; OSA - Obstructive Sleep Apnea; TIA - Transient Ischemic Attack; TBI - Traumatic Brain Injury;

* Cell size limited by OptumLabs