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Dementia Neurology Deserts and Long-Term Care Insurance Claims Experience in the United States: How Does Limited Supply of Neurology Specialists Correlate with Claims Experience Data?

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Dementia Neurology Deserts and Long-Term Care Insurance Claims Experience in the United States

How Does Limited Supply of Neurologists Correlate with Claims Experience Data?

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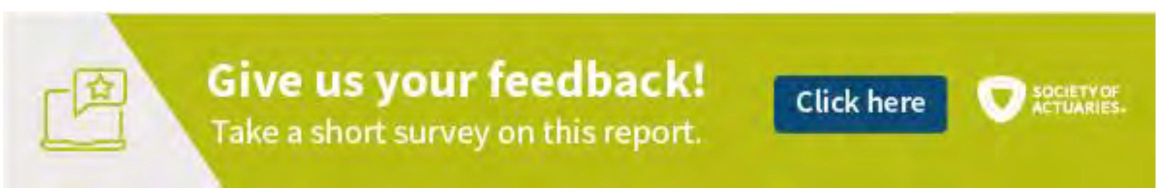

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Executive Summary

Alzheimer's Disease and Related Dementias (ADRD) constitute a plurality of historical long-term care insurance (LTC, LTCI) claims. These insurance benefits are paid to individuals who are severely cognitively impaired. LTCI actuaries are interested in understanding the driver of past claim patterns in order to predict how future LTCI claims will emerge. Because ADRD is such a prominent cause of claim, we see value in exploring drivers of claims that stretch beyond typical predictive parameters such as age, sex, and other demographic attributes or benefit types. This study is unique as it combines long term care insurance actuarial analysis, neurology, and real-world predictive analytics.

Dementia is one of the top growing public health problems in the world. It impacts both developing and developed countries. It is estimated by global reports that there are approximately 50 million people living with dementia globally, and this number is expected to increase to 152 million by 2050. The annual global total cost of dementia is estimated at US $1 trillion in 2018, a figure expected to double by 2030[18].

If the global cost of dementia care were a country, it would represent the 18th largest economy[18]. According to the Alzheimer's Association, in the United States, every 65 seconds someone in the United States is diagnosed with the disease. Dementia is the 6th leading cause of mortality in the United States and kills more people annually than breast cancer and prostate cancer combined[1].

Increased life expectancy and reduced fertility have shaped the demographics of society into a predominantly older and aging population. Given this phenomenon of population aging, there also exists a rise in neurological and cognitive conditions such as dementia, stroke, and epilepsy. We chose to focus specifically on neurologists in this paper given the U.S. population's aging and the diseases this type of medical specialist diagnoses and treats. In 2015, it was estimated that about 1 in 3 Medicare beneficiaries had at least one office visit for a neurological condition[17]. Among all dementia care specialists, neurologists were the most likely to diagnose patients with a specific type of dementia[7].

Despite the enormity of dementia from both the population health and cost perspectives noted above, there is a growing shortage of dementia care specialists, including neurologists. By 2025, there will likely be a large number of ADRD patients facing a shortage of neurologists and the wait times for new and follow up neurologist appointments are projected to grow significantly from the wait time of about 30 days in 2012 [9]. Specific geographic locations are expected to have a relatively high number of dementia cases and a relatively low number of neurologists - known as *dementia neurology deserts*.

Severe irreversible cognitive impairment from dementia is a benefit eligibility trigger in LTCI. In 2020, carriers reported that approximately 50-70% of incoming claim applications are attributed to cognitive conditions.

This paper describes the results of our analysis into how the supply of neurology specialists for diagnosis and care of ADRD, as captured by Alzheimer's Disease and Related Disorders Neurology Desert Index (ANDI) scores, relates to historical LTCI cognitive claims. We explore whether there is any relationship between geographic distribution of neurology specialists (and demand for access to these specialists across geographic locations) and LTCI cognitive claims incidence.

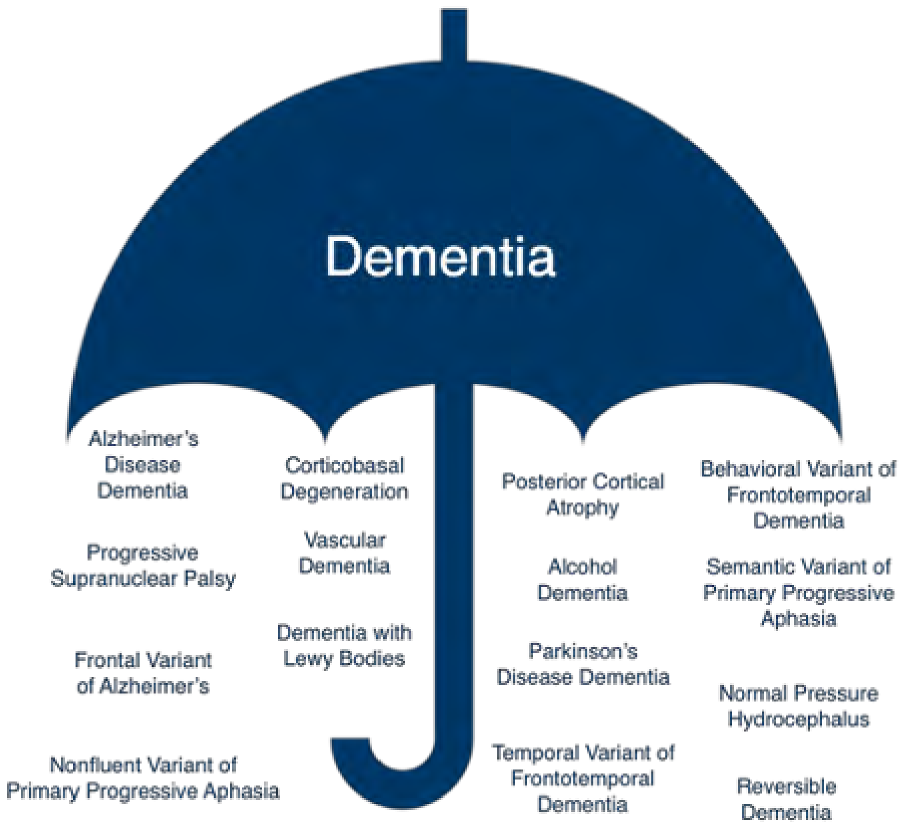
We found the following key results.

- There is a positive, modest correlation (10%) between dementia neurology deserts and historical retrospective LTCI claims from 2000-2017. We developed a methodology to correlate the neurological dataset with actuarial LTCI claims using a cognitive incidence rate relativity score described further in the research below.
- There is a positive correlation (38%) between the 2012 demand of neurologists by geographic location and the historical incidence of LTCI claims from years 2000-2017. This correlation provides an intuitive validation of results that we would expect to see and provides more confidence in our results given that the two datasets were collected independently.
- Traditional parameters used by actuaries to assess cost and utilization in LTCI such as gender, claim duration, and age were not meaningful predictors of the variability in cognitive claim incidence rates across geographic locations in the United States. This finding has various implications for actuaries across insurance product lines that use these attributes for reserving purposes.

What is Dementia?

DEMENTIA AND AGING ARE NOT THE SAME

Dementia is a category of symptoms and behaviors that negatively impact daily life and activities of daily living. Dementia can be caused by a variety of illnesses spanning from stroke, Parkinson's disease, infection, or neurodegeneration of cells[1]. Dementia is an umbrella category, just like cancer is an umbrella category[21]. There are many types of dementia just like there are many types of cancer. Alzheimer's disease and dementia are not the same. Alzheimer's disease is one type of dementia among more than fifteen different types[1,27]. From a risk management perspective, each type of dementia has its own morbidity, mortality, and utilization profile[27].



Understanding the subtype of dementia is as important as identifying the type of cancer. Possible benefits of identifying the specific subtype of dementia include prompt evaluation of treatable or recoverable causes of cognitive impairment[6,22]. For example, 10-20% of all new cases of cognitive impairment have a treatable component due to undiagnosed sleep apnea, untreated depression, or polypharmacy (taking too many medications)[5]. More about reversible conditions will be discussed below.

In addition, correctly identifying the dementia subtype prevents prescription of medications that may worsen cognitive impairment and allows patients to participate in clinical trials that include possibly slowing the disease or participating in research at clinical expert centers to access pharmacologic or nonpharmacologic therapies[23]. For patients with multiple medical comorbidities, identifying dementia subtypes may help manage other chronic medical conditions that can worsen cognitive function[8]. For example, recognizing dementia in a patient with diabetes may allow care management teams to focus on blood glucose management with a care partner instead of expecting the patient to self-manage the disease alone[6]. New medications are on the horizon for the management of possible behavioral symptoms associated with ADRD but require an accurate diagnosis of dementia.

PRE-DEMENTIA AND IDENTIFYING MILD COGNITIVE IMPAIRMENT

The earliest stages of dementia start during a phase called "preclinical." On objective brain imaging studies (MRI or PET) during this stage, patients may have structural changes but not yet exhibit clinical symptoms[1]. Some individuals may stay in the preclinical phase without ever developing symptoms of dementia. Researchers have ascribed this to possible higher cognitive reserve in some individuals versus others. Many biotechnology companies are developing tools and biomarkers to detect this early preclinical stage in patients. However, they have had varied success in accuracy.

The next stage after preclinical is called mild cognitive impairment (MCI). These patients have subtle changes in memory and thinking[14]. Usually, these symptoms have been noticed by others around them, either family members or friends who are concerned about the person's brain health and cognition. Patients are generally able to perform their activities of daily living, but there are also structural changes noted on MRI, PET, or other biomarker modalities. In longitudinal studies, 38% of patients with MCI go on to develop dementia in five years[1].

RISK FACTORS FOR DEVELOPING DEMENTIA

Age is the single biggest risk factor for developing dementia. The risk of developing dementia increases significantly with age; 3% of people between 65-74, 17% of people between 75-84, and 32% of people 85 and above have dementia[1].

Genetics also plays a role. There are both risk genes and deterministic genes. Risk genes may increase the likelihood of developing dementia but will not guarantee it happens. One such example is the apolipoprotein E- ε4 gene (APOE4). The more copies one has of this gene, the higher the risk. Around 60% of people affected by Alzheimer's disease have at least one copy of this allele. People who have two copies of this allele have three to five times more risk of developing dementia. Deterministic genes can cause early onset Alzheimer's disease (EOAD) or familiar Alzheimer's disease (FAD). In these cases, symptoms may develop before age 65. Three common genes associated with deterministic risk include amyloid precursor protein (APP), presenilin-1 (PS-1) and presenilin-2 (PS-2)[1].

Gender plays a role in dementia risk as well. Research has demonstrated that more than two thirds of cases are women, and women live with more severe symptoms than men[11,21].

Lastly, modifiable lifestyle related risk factors such as smoking, obesity, diabetes type II, and depression are among a list of others listed in Table 1 that have all been associated with increased risk of developing dementia[21]. The relative risk indicates that people with those lifestyle factors are more likely to develop Alzheimer's Dementia than those without. The population attributable risk indicates the percentage of cases from the cited study, attributable to a given lifestyle factor.

Table 1

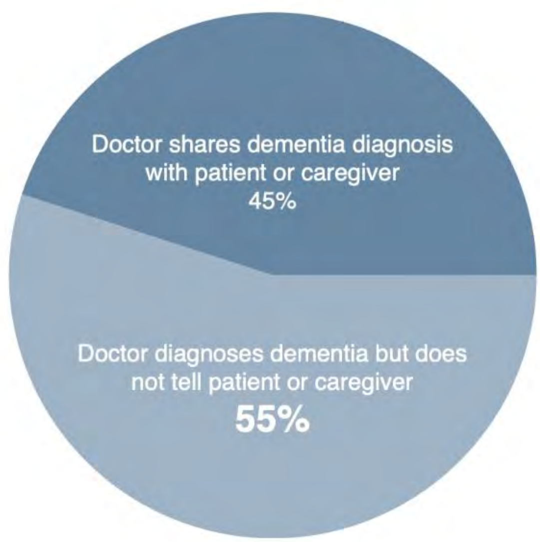
RELATIVE RISK OF LIFESTYLE FACTORS INCREASING RISK FOR DEMENTIA[21]

Lifestyle factors	Relative Risk	Population Attributable Risk
Midlife obesity	+60%	2.0%
Diabetes Type II	+46%	2.9%
Midlife hypertension	+61%	5.1%
Smoking	+59%	13.9%
Depression	+90%	10.6%
Low education	+59%	19.1%

Current Issues with Evaluating and Diagnosing Dementia as they Relate to Long Term Care Risk

POOR DISCLOSURE TO PATIENTS REPRESENTS UNACCOUNTED RISK FOR CARRIERS

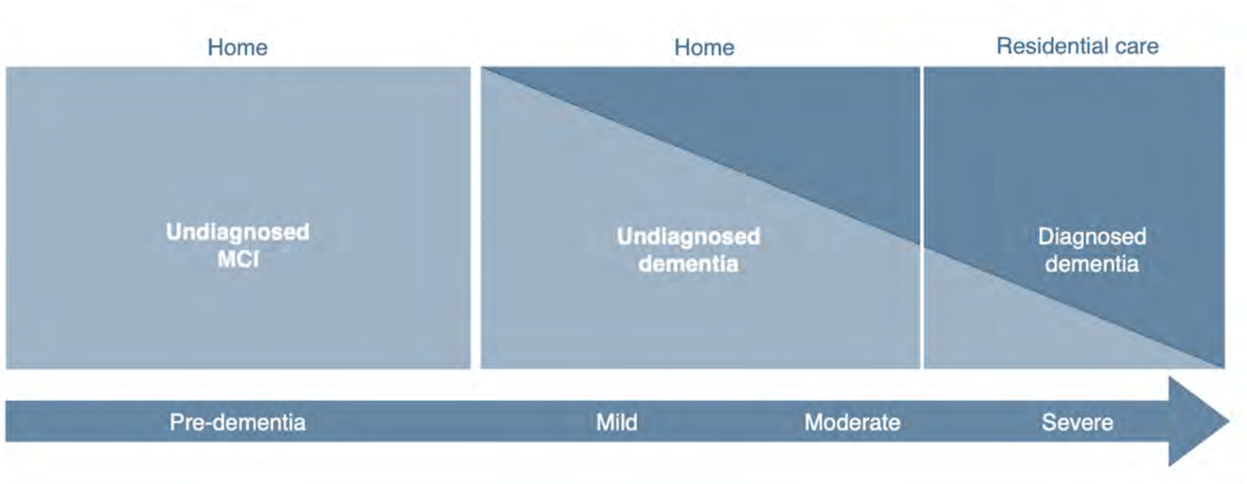
Physicians often have the responsibility of delivering bad news. In the 1960s, research studies showed that 9 out of 10 physicians did not disclose a cancer diagnosis due to fear of causing unnecessary anxiety or suicidal ideation during a time when cancer therapies were limited. In 2015, the Alzheimer's Association reported that physicians routinely disclose a diagnosis of dementia to patients and families only 45% of the time[2]. Disclosure rates were even lower at 27% for patients diagnosed with other types of dementia[2]. This was again because many physicians believed that there was no point to disclosure due to lack of therapeutic options available.



The lack of clinical disclosure by physicians also appears as poor documentation in the electronic medical record[23]. For insurance coverage, this represents unaccounted risk during underwriting and claims adjudication which rely on attending physician statements or medical record review to verify a clinical condition. Appendix D includes more detail on professionals who diagnose and treat dementia.

THE UNDIAGNOSED AND MISDIAGNOSED

Further complicating poor disclosure are undiagnosed cases. Community-based research studies have shown that approximately 50% of cases with ADRD are never diagnosed by a physician[2,19]. The illustrative figure below highlights how the undiagnosed population mainly accounts for community dwelling (home-based) patients. By the time patients make it to residential/facility care, the majority of patients have been diagnosed by a clinician, however there are still patients who are undiagnosed[19]. For insurance carriers, claims arising from the community regardless of cognitive or non-cognitive status warrant further investigation to determine cognitive impairment. For actuaries this may be important for identifying risk, as cognitive claims last longer and cost more over time, thus requiring more reserving over the long term.



IDENTIFYING DELIRIUM AND REVERSIBLE DEMENTIA CASES IN CLINICAL PRACTICE

Prior to providing a patient with a diagnosis of irreversible dementia, the American Academy of Neurology and the American Psychiatric Association consider it best practice and part of evidence-based guidelines to rule out treatable conditions. Research focused on quality metrics for primary care physicians has demonstrated that only 41% of patients with cognitive impairment are screened for depression (which is a frequent mimicker of dementia), and only 15% receive lab screening to check for recoverable causes for dementia (such as metabolic disorder, vitamin deficiency, hearing/vision impairment, sleep apnea, or medication side effects)[4]. It is estimated in clinical literature that at least 10-25% of initial cases presenting as cognitive impairment, have some type of treatable component to the disease[1,4].

Generally, insurance carriers today assume the clinical provider has ruled out reversible cases of cognitive impairment prior to administering neuropsychological testing such as the Mini-Mental Status Exam (MMSE) or the Montreal Cognitive Assessment (MOCA) during the benefit eligibility assessment. Furthermore, more modern cognitive assessments performed on mobile devices or using wearable technology may result in a high degree of false positive diagnoses as these workflows may not rule out treatable conditions prior to testing.

In dementia specialist centers, neurologists spend a large portion of the clinical workup ruling out treatable conditions before administering neuropsychological testing and diagnosing cognitive impairment[1,4]. Furthermore, it is important to also note many neuropsychological tests are validated in highly controlled settings with small cohorts of patients who are not representative of LTCI insurance claimants.

Currently there are a limited number of expert Alzheimer's Disease Research Centers that use state of the art biomarkers, imaging, and diagnostic techniques. Most patients who have access to these centers do so through referral from their primary care physician or neurologist.

Figure 2

NATIONAL INSTITUTES OF HEALTH (NIH) FUNDED ALZHEIMER'S DISEASE RESEARCH CENTERS IN THE UNITED STATES

SHORTAGE OF NEUROLOGISTS GLOBALLY AND IN THE UNITED STATES

In 2004, the World Health Organization and the World Federation of Neurology reported that there were 85,318 neurologists globally in 106 countries—only 25% of the world population had access to more than one neurologist per 100,000 people[25] The American Academy of Neurology (AAN) in 2012 estimated active supply of neurologists to be 16,366 adult and child neurologists in the United States. By 2025, neurology supply estimates were projected to be 18,060[9]. Geriatric or behavioral neurologists are estimated to be even fewer, with estimates ranging between 600-1,000 of these specialty neurologists in total across the United States. Roughly 615 medical students apply for neurology training positions every year[9].

AAN research calculations for demand of neurologists take into consideration wait times, difficulty associated with recruiting a specialist to a specific geographic area, epidemiologic patterns within an aging patient population, primary care referral patterns, and physician practices that were no longer able to accept Medicaid beneficiaries. In 2012, the average wait time to see a general neurologist across the United States for a new patient visit was 30 days[9]. Today, wait times to see a geriatric neurologist are six to nine months across major academic medical centers.

In a study by the AAN, a microsimulation model evaluated neurology specialist demand by considering prevalence of neurological conditions associated with a growing aging population in each state along with expanding healthcare insurance enrollment under the Patient Protection and Affordable Care Act (ACA). The AAN study estimated in 2012, there was an overall 11% shortfall of neurologists, meaning the neurology workforce could have used an additional 11% of trained neurologists to meet the demand at that time. By 2025, the shortfall is expected to increase to 19% across the United States, with specific geographic regions being more in need of specialist neurological care than others[9].

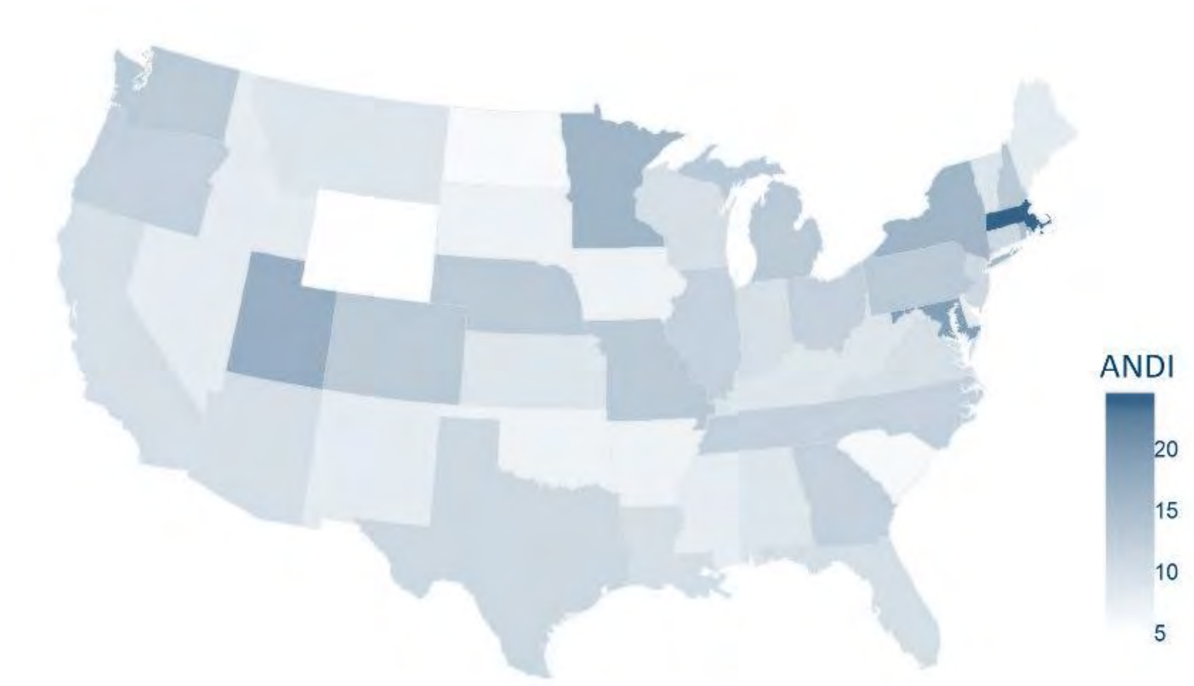
ALZHEIMER'S AND OTHER RELATED DEMENTIA NEUROLOGY DESERTS INDEX SCORE

In prior research it has been well established that the number of neurologists in a particular geographical area influences utilization of this speciality[17]. In 2020, a retrospective cross-sectional study evaluated the geographic distribution of neurologists and the utilization of neurologists across specific geographic regions. A 20% national sample of the 2015 Fee-for-Service Medicare population estimated that on average 23.5% of Medicare patients accessed neurological services. This estimate ranged between 20.6%-27% depending on the geographical distribution of neurologists among hospital referral regions (regional health markets for tertiary care)[17]. Furthermore, after considering the prevalence of various neurological diseases across U.S. states, more than 50% of the overall weighted increase in patients seen by neurologists in the highest neurologist density compared to the lowest neurologist density was comprised mainly of patients with dementia (ranking the highest in overall difference) followed by other neurological conditions including stroke, back pain, and gait abnormality[17]. This result indicates that the supply of neurologists may influence access to neurologist care differentially for specific health and neurological conditions.

In 2017, Neurocern, a neuroinformatics and predictive analytics company developed an ADRD Neurology Desert index (ANDI) score, defined as the ratio of general adult neurologists to ADRD population. General adult neurologists were used as opposed to behavioral or geriatric neurologists as the geographic distribution of this latter group is not readily available. Neurocern's researchers identified states with the lowest projected ratio of adult neurologists per 10,000 ADRD cases in 2025. Twenty states with low ANDI scores (5 to 9) were identified as "dementia neurology deserts", indicating a significant shortfall between an available neurology workforce that provides neurological care delivery and the prevalence of ADRD patients in those states. Per capita scores were calculated to account for states with low population counts. To calculate this scoring index, data was used from the Centers of Medicare, Alzheimer's Association, and the American Academy of Neurology. To account for the undiagnosed population, estimated prevalence of ADRD cases were doubled. It was also assumed that 90% of projected neurologists would be adult neurologists as compared to pediatric neurologists. Altogether, the 20 most severe desert states represent a projected ADRD population of 2,068,000 people by 2025 with a wide range of state budgets dedicated toward long term care support services, Medicaid, and public-private partnerships. The top 20 ANDI scores are listed in Appendix A. Figure 2 illustrates through a heat map which states have high ANDI scores (darker areas), where neurologists are in greater supply statewide, and the 'neurology deserts' in the lighter areas where neurologists are in relatively lower supply statewide. Wyoming has the fewest adult neurologists per 10,000 persons with ADRD. It is important to note that although telehealth services may be provided in certain geographic regions with a low supply of neurologists, prior to the COVID-19 pandemic, telehealth neurology services have mainly been utilized for stroke care and not for dementia care services[15].

Figure 2

HEAT MAP OF ANDI SCORES BY STATE



Light areas ('deserts') indicate fewer neurologists per capita

In this subsequent actuarial research, we considered whether we would find higher cognitive impairment claims incidence among ANDI desert states where neurologist supply is low relative to the ADRD population. Geographic variation in primary care physician practice patterns for dementia patients has been previously reported[12]. Furthermore, we expected that neurologist supply relative to the ADRD population could have an impact on the average LTC length of claim in these dementia neurology deserts. This impact may be due to factors such as the timing of dementia diagnosis, the specificity of dementia type diagnosis, the rate of identifying and managing treatable conditions contributing to cognitive impairment, and dementia care treatment patterns. These factors all have the potential to influence the timing of LTC claim incidence and patient mortality, which in turn could affect the LTC length of claim.

Methods

MILLIMAN DATA AND ANDI SCORE

To understand historical claims data, ANDI scores were combined with Milliman's *Long-Term Care Guidelines (Guidelines)* research. In the *Guidelines*, data represents claims from the years 2000 – 2017, with certain data contributors providing claims for certain subsets of that experience window. There have been seven editions of the *Guidelines*, starting in 1992 up to the most recent edition of 2017. The 2017 version of the *Guidelines* is based primarily on claims from around 2005 to 2014. The final product is based on observed data and incorporates the collective judgment of Milliman LTC actuaries on the future level of morbidity. Each update of the *Guidelines* considers recent claim data, along with past analysis and research. The 2017 *Guidelines* are based directly on 800,000 claims representing nearly $50 billion of incurred claims and 49 million life years of exposure. In addition to the insured data analyzed, other research and industry studies are considered and have an indirect influence on the *Guidelines*.

For this study, we grouped claims by policyholder state of issue, as we did not have a resident state concurrent with each claim. To the extent that policyholders migrate among states between the date of issue and the date of claim, the analysis does not detect such migration.

Certain contributors to the *Guidelines* provide diagnosis (or a similar cause of claim) associated with each claim. For the data with this indicator, we grouped these claims as shown in Table 2.

Table 2
GROUPING OF LTCI CAUSES OF CLAIM

Cause of claim	Grouping
Nervous System	Cognitive
Mental	Cognitive
Alzheimer's	Cognitive
Stroke	Cognitive
Arthritis	Non-Cognitive
Cancer	Non-Cognitive
Circulatory	Non-Cognitive
Diabetes	Non-Cognitive
Digestive System	Non-Cognitive
Endocrine System	Non-Cognitive
Genitourinary System	Non-Cognitive
Injury	Non-Cognitive
Respiratory	Non-Cognitive
Missing	Other
Other	Other

We removed the 'Other' and 'Missing' causes of claims (approximately 20,000) from our analysis altogether, noting that all companies did not provide the same level of detail.

In total, this analysis relies on approximately 77,000 cognitive claims and 89,000 non-cognitive claims. The state with the least number of cognitive claims is Alaska, with 107 cognitive claims and 95 non-cognitive claims. The median number of cognitive claims in the dataset, across all states, is 1,162 and the median number of non-cognitive claims is 1,086.

LTCI HISTORICAL CLAIMS EXPERIENCE DATA

We calculated the cognitive incidence rate relativity (CIRR) across U.S. states. We sum the number of cognitive (and non-cognitive) LTCI claims for policies issued in a given state (we refer to 'issue state' as 'state' throughout this report) and compare those to the **total** expected LTCI claims in that state, over the same time period. We refer to this ratio (actual cognitive claims / total expected claims) as the cognitive claim actual-to-total-expected rate, or CogATotalE (this is NonCogATotalE for non-cognitive claims).

We do not calculate a formal expectation of cognitive (or non-cognitive) claims as that effort is beyond the scope of this project. The actual-to-total expected ratio CogATotalE is appropriate for this use because we compare this ratio across other variables (in this case, state) rather than drawing conclusions from the magnitude of this ratio in isolation.

The CIRR for each state is calculated as:

$$CIRR_{state} = CogATotalE_{state} / CogATotalE_{nationwide}$$

The non-cognitive incidence rate relativity (NCIRR) is calculated in the same manner:

$$NCIRR_{state} = NonCogATotalE_{state} / NonCogATotalE_{nationwide}$$

The expected total incidence rates for each state are calculated as expected claims divided by the exposure. Expected claims are based on our analysis from assumptions developed from the 2017 Milliman *Guidelines*, including the following characteristics:

- Issue age
- Policy duration
- Sex
- Marital status
- Underwriting
- Policy type (comprehensive vs. facility-only or home health-only)
- Benefit richness (elimination period, benefit period)

These results show, for instance, that Louisiana has a 129% CIRR, indicating that cognitive LTCI claims in Louisiana have been 29% higher than expected compared to the incidence rates of all cognitive claims nationwide.

Table 3 shows the top 5 and bottom 5 states by their CIRR score.

Table 3
TOP AND BOTTOM 5 CIRR STATES

State	CIRR
Louisiana	129%
Alabama	123%
Mississippi	122%
Arkansas	121%
Utah	117%
…	…
South Dakota	90%
Pennsylvania	90%
Indiana	90%
Maryland	89%
Hawaii	87%

Similarly, Table 4 shows the top 5 and bottom 5 states by the NCIRR, i.e., the rate at which non-cognitive claim incidence rates exceed the nationwide expected non-cognitive incidence rates.

Table 4

TOP AND BOTTOM 5 NCIRR STATES

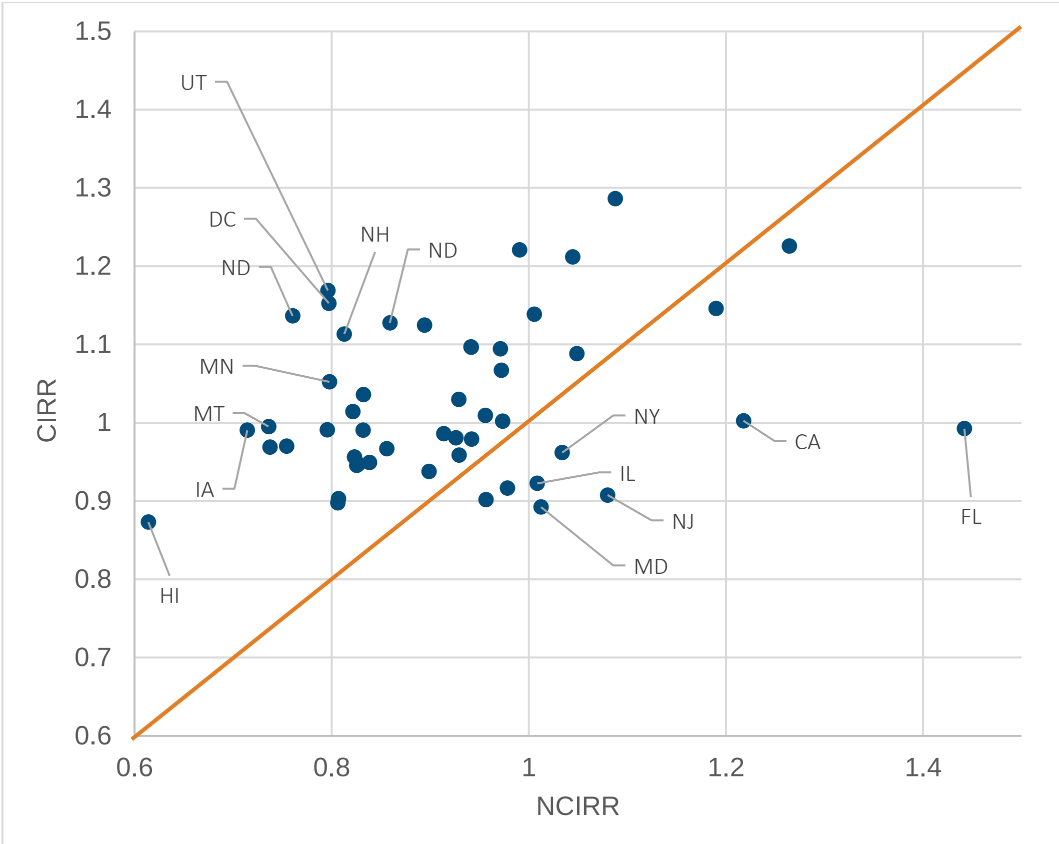
State	NCIRR
Florida	144%
Alabama	126%
California	122%
Georgia	119%
Louisiana	109%
…	…
Alaska	74%
Montana	74%
Iowa	71%
Hawaii	61%
Delaware	55%

We see that certain states appear in both Table 3 and Table 4. For instance, Hawaiians have a low cognitive and non-cognitive incidence rate relativity compared to nationwide averages. This result is consistent with general industry observations that LTCI incidence rates in Hawaii are lower than nationwide averages (a result that Hawaii regulators often point to in discussions about LTCI premium rate increases). Similarly, Alabama has an overall higher LTCI claim incidence rate than nationwide, and this is evident in cognitive and non-cognitive claims.

We look at the relationship of the CIRR to the NCIRR to understand the relative propensity of policyholders to incur cognitive-based LTCI claims compared with non-cognitive LTCI claims. The scatter plot in Figure 3 shows the CIRR and NCIRR scores for 51 states (this includes Washington D.C.). States farthest away from the diagonal are those where we see disproportionately more cognitive claims than non-cognitive claims, or vice-versa. The diagonal represents where CIRR equals NCIRR. When both the CIRR and NCIRR are greater than 1, as with states in the top-right quadrant, cognitive and non-cognitive claim rates are higher than anticipated. States with CIRR and NCIRR values lower than 1, the bottom-left quadrant, have cognitive and non-cognitive claim rates lower than expected.

Figure 3

PLOT OF STATES BY CIRR AND NCIRR SCORE



As examples, Florida, New Jersey, California, Maryland, and Illinois all have cognitive-based incidence rates relatively lower than the expected non-cognitive incidence rates. We will use these data to evaluate the impact of neurology deserts.

Appendix B includes the CIRR, NCIRR, and the ratio (CIRR / NCIRR) for all 51 jurisdictions.

Results

We reviewed historical LTCI claims, including the propensity of policyholders to file cognitive (vs. non-cognitive) claims by state. We compared these cognitive and non-cognitive claim relativities across states. A full listing of these claim relativities is found in Appendix B.

Overall, we find a modest positive correlation coefficient (R = 10%) between the ANDI neurology deserts score and the propensity for LTCI policyholders to file cognitive (vs. non-cognitive) claims in that state. We note that when stroke claims are classified as non-cognitive, this correlation is reduced to 0%.

We also find a positive correlation (R = 38%) between states that had a high per-insured demand for neurologists, according to the AAN, and Milliman's CIRR. Appendix C shows the AAN's supply and demand estimates, per 10,000 life-years of LTC insureds from Milliman's data set. When stroke claims are classified as non-cognitive, this correlation remains similar (R = 37%).

We compared our state specific LTC insured CIRR and NCIRR (and CIRR / NCIRR) metrics to other similar datasets, including the supply of geriatricians, to observe any potential other correlations and patterns, but did not find any others as strong.

As part of our analysis, we isolated the impact of gender, claim duration, and age across states to evaluate if these attributes drove differences in relative cognitive claim incidence rates. We found that cognitive claim incidence rate relativity across states was generally independent of those factors. Actuaries, underwriters, reinsurers, and regulators commonly look at these attributes as drivers of cost and utilization; they may also wish to look to other metrics such as geographic location and the supply of cognitive care, as well as other population health factors.

LIMITATIONS OF ANALYSIS

There are several important research limitations to consider in the analysis of this data. The dataset used to calculate the ANDI scores is prospective in nature for year 2025; however, the LTCI claims data from Milliman is retrospective in nature representing claims from years 2000-2017. The low correlation between the ANDI and CIRR scores may be explained by such limitations.

Many policyholders do not reside in the same state the policy was issued in; however, the data does not take into account migration patterns. Also, LTCI policyholders may hold other various types of health insurance products that provide access to preventative health or care management services, possibly influencing incidence of an LTCI claim.

Clinicians and LTCI companies characterize patients differently in the context of cognitive impairment and associated physical limitations. Physicians view patients holistically and may identify individuals as having both physical disabilities that impact activities of daily living and dementia or cognitive impairment, regardless of whether those physical disabilities result from cognitive impairment or from a separate condition. However, LTCI cognitive and non-cognitive claims are mutually exclusive. For example, some patients with cognitive LTCI claims may have unrelated physical disabilities that impact activities of daily living. On the other hand, the undiagnosed and non-disclosed cases of cognitive impairment may enter LTCI claim status as non-cognitive, yet cognitive impairment may be impacting activities of daily living. This is not accounted for in the data analysis.

Delirium and other reversible conditions are not usually investigated by LTCI claim teams. The impact of reversible conditions on LTCI claims was not included in the scope of this research.

IMPLICATIONS FOR THE INSURANCE INDUSTRY AND REAL WORLD

The present research highlights the association between state-by-state relativity of LTCI cognitive claims and the demand for neurologist care based on typical neurologist service utilization rates by ADRD patients. LTCI carriers benefit from education on neurological diseases and the value of access to comprehensive care for chronic medical conditions such as cognitive impairment because ADRD is closely linked to the incidence of cognitive LTCI claims.

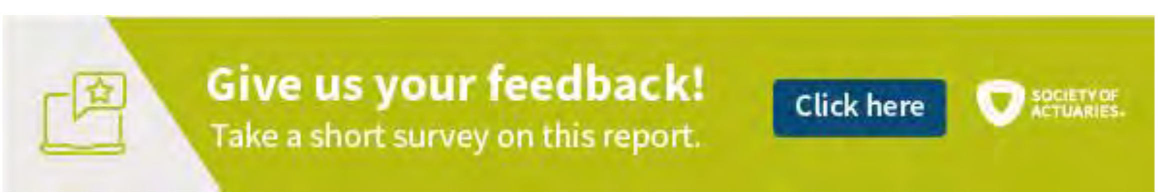
Furthermore, emphasizing the identification of treatable conditions that can cause or worsen cognitive impairment, such as delirium, may be beneficial to an LTCI carrier. Prior research has found up to one-third of all incoming LTCI claims presenting to a carrier were possibly impacted by delirium[28]. In states with a low supply of neurologists, LTCI cognitive claims may have a higher likelihood of being impacted by delirium because patients may have less opportunity for comprehensive guideline-based neurological evaluation to rule out delirium and other treatable conditions before being diagnosed with dementia.

A large portion of state Medicaid funding for LTC is spent on cognitive-related claims for members receiving care in a facility. By partnering and gathering more qualitative data on individuals at the initiation of their LTCI claims, private LTC insurance may provide valuable insights to Medicaid programs about the disease trajectory and treatment patterns of individuals in facility care for cognitive impairment. This data may offer insights for improving LTC outcomes both for private and public programs.

We isolated the difference in cognitive claims across states and showed that the state-by-state differences are independent of differences in age, gender, and policy duration. This information can be valuable for those insurance carriers pricing other health products such as critical illness, hybrid life and LTCI (or chronic illness) policies, and disability insurance. Carriers offering these policies would benefit from a greater understanding of trends in cognitive decline, as they evaluate experience and develop new assumptions for cash flow testing and pricing.

As cognitive claim counts grow with the aging population, this research highlights the need for LTCI carriers to improve the quality of data gathering during claims administration. Many carriers do not identify claims as cognitive or non-cognitive for reserving purposes, and therefore do not have the benefit of monitoring trends in these reasons for claims. This study also lays out a methodology for future research to evaluate other types of LTCI claims depending on factors such as supply of clinical specialists (cancer claims vs oncology specialist supply) across geographic areas.

Valuation and pricing actuaries will also benefit from collecting LTCI claims data with a greater degree of accuracy around the cause of claim, including cognitive claims. As LTCI companies move towards claims modernization, we anticipate that technologies such as predictive analytics and neuroinformatics will emerge to better characterize and stratify utilization risk, predict cause of claim, triage the type of claim, and estimate the duration of claims.



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Appendix A

Top 20 neurology desert states	2025 projected number of persons with ADRD	2025 projected number of adult neurologists	2025 projected number of adult neurologists per 10,000 persons with ADRD (ANDI)
Wyoming	26,000	14	5
North Dakota	32,000	18	6
South Carolina	240,000	154	6
South Dakota	40,000	28	7
Oklahoma	152,000	107	7
Iowa	146,000	104	7
Arkansas	134,000	98	7
Hawaii	70,000	52	8
New Mexico	106,000	79	8
Nevada	128,000	97	8
Mississippi	130,000	102	8
Maine	70,000	57	8
Idaho	66,000	54	8
Delaware	46,000	39	8
Alabama	220,000	186	9
Montana	54,000	46	9
Kansas	124,000	110	9
Vermont	34,000	31	9
West Virginia	88,000	79	9
Kentucky	172,000	159	9
Total top 20	2,078,000	1,614	7.8
Total US	14,414,000	16,572	11.5

Appendix B

CIRR, NCIRR, and CIRR / NCIRR results by state

Issue State	CIRR	NCIRR	CIRR / NCIRR
AK	97%	74%	131%
AL	123%	126%	97%
AR	121%	104%	116%
AZ	103%	93%	111%
CA	100%	122%	82%
CO	99%	83%	119%
CT	98%	94%	104%
DC	115%	80%	145%
DE	92%	55%	168%
FL	99%	144%	69%
GA	115%	119%	96%
HI	87%	61%	142%
IA	99%	71%	139%
ID	113%	86%	131%
IL	92%	101%	91%
IN	90%	81%	111%
KS	112%	89%	126%
KY	109%	97%	113%
LA	129%	109%	118%
MA	99%	91%	108%
MD	89%	101%	88%
ME	97%	75%	129%
MI	94%	90%	104%
MN	105%	80%	132%
MO	104%	83%	124%
MS	122%	99%	123%
MT	100%	74%	135%
NC	110%	94%	116%
ND	114%	76%	149%
NE	97%	86%	113%
NH	111%	81%	137%
NJ	91%	108%	84%
NM	96%	93%	103%
NV	92%	98%	94%
NY	96%	103%	93%
OH	96%	82%	116%
OK	110%	94%	117%
OR	101%	96%	106%
PA	90%	96%	94%
RI	95%	84%	113%
SC	114%	101%	113%
SD	90%	81%	112%
TN	109%	105%	104%
TX	107%	97%	110%
UT	117%	80%	147%
VA	98%	93%	106%
VT	101%	82%	123%
WA	95%	83%	115%
WI	95%	83%	115%
WV	100%	97%	103%
WY	99%	80%	125%

Appendix C

2012 Neurologist Supply and Demand per 10,000 life-years of LTC insureds

State	Supply	Demand	State	Supply	Demand
AK	5.2	8.1	MT	5.9	8.5
AL	5.6	8.9	NC	6.7	8.3
AR	6.2	11.3	ND	3.1	5.5
AZ	9.5	10.8	NE	2.9	4.5
CA	7.0	8.2	NH	7.3	7.1
CO	5.4	6.4	NJ	5.5	5.7
CT	5.1	5.2	NM	5.4	7.7
DC	14.2	3.8	NV	5.7	12.0
DE	6.5	9.4	NY	9.2	6.3
FL	8.4	9.7	OH	7.7	8.5
GA	6.9	9.6	OK	5.0	10.8
HI	3.3	4.1	OR	7.2	8.7
IA	2.9	5.1	PA	8.8	8.1
ID	4.6	9.7	RI	9.2	7.6
IL	6.0	6.9	SC	4.1	9.1
IN	6.5	10.4	SD	3.1	4.7
KS	4.4	6.6	TN	6.0	7.8
KY	5.6	9.7	TX	9.2	11.5
LA	8.2	9.9	UT	15.3	17.0
MA	12.7	6.9	VA	4.7	5.8
MD	9.8	6.1	VT	3.7	4.8
ME	5.6	7.9	WA	5.8	6.8
MI	8.7	9.8	WI	6.0	8.9
MN	6.5	5.4	WV	7.4	11.9
MO	7.5	7.8	WY	2.7	5.9
MS	7.6	14.1			

Nationwide	7.1	7.9

Appendix D

Who diagnoses and treats dementia?

The diagnosis, workup, and care management for patients with dementia involves a wide array of practitioners including physicians, nurses, neuropsychologists, allied health care professionals and home health aides[12,16]. Often these professionals' roles are interchangeably used by the public; however, they have differences in licensing, training, prescribing ability, and dementia expertise.

Primary care physicians (PCP) or general physicians (GPs) are medical professionals who act as the patient's primary point of contact for comprehensive care[5,12,20]. These are non-specialists who can refer complex cases to a higher level of care. In 2020, the Alzheimer's Association reported that 85% of PCPs say they are on the front lines of providing dementia diagnosis, and one year after diagnosis, less than a quarter of patients had seen a dementia expert[1]. After five years, the percentage of patients who had seen a dementia expert only increased to 36%. According to a survey conducted by the Alzheimer's Association, at least 50% of PCPs believe the medical profession is not prepared to meet the expected increase in patients needing dementia care[1]. Medical schools and residency programs offer little to no training for PCPs on how to evaluate and manage patients with cognitive concerns and dementia[6,23].

Access to dementia experts is limited and dependent on geographic location. Such specialists are important as they may more consistently evaluate the patient for reversible causes of dementia (such as delirium), provide access to critical research studies and state of the art clinical trials, and provide customized care planning for patients and families[7].

Among licensed medical professionals who diagnose, evaluate, and treat diseases, neurologists are consulted for all conditions related to the brain. In the United States, neurologists represent roughly 2% of the total physician workforce[17]. Neurologists evaluate and treat common conditions such as stroke, Parkinson's disease, epilepsy, delirium, dementia, and multiple sclerosis among others[20]. Within neurology, geriatric or behavioral neurologists are "subspecialists" and licensed medical professionals who complete additional fellowship training to understand all different types of dementia and methods to diagnose dementia. These neurologists also run dementia and aging focused clinical trials at major academic centers.

A type of PCP who specializes in aging is called a geriatrician. These are medical professionals who commonly work with neurologists and treat all conditions related to old age. Psychiatrists are licensed medical professionals who prescribe medications to treat difficult behaviors and agitation related to dementia, but approach dementia with a mental health perspective. Frequently neurologists, geriatricians, and psychiatrists all work together with the primary care physician[8].

Other professionals and allied health professionals who encounter dementia patients may include neuropsychologists who test and evaluate the dementia patient with cognitive tests (similar to IQ tests); however, they do not have a medical degree and cannot prescribe or treat patients with cognitive impairment[7]. Gerontologists have certificates and approach dementia with a social, cultural, and psychological lens to aging, however they do not practice medicine nor prescribe or treat patients.

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