Diabetes-Attributable Nursing Home Costs for Each U.S. State

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OBJECTIVE

To estimate the diabetes-attributable nursing home costs for each state.

RESEARCH DESIGN AND METHODS

We used a diabetes-attributable fraction (AF) approach to estimate nursing home costs attributable to diabetes (in 2013 dollars) in aggregate and per person with diabetes in each state. We calculated the AFs as the difference in diabetes prevalence between nursing homes and the community. We used the Centers for Medicare & Medicaid Services 2013–2015 Minimum Data Set to estimate the prevalence of diabetes in nursing homes and to adjust for the intensity of care among people with diabetes in nursing homes. Community prevalence was estimated using the Behavioral Risk Factor Surveillance System (BRFSS). State nursing home expenditures were from the 2013 State Health Expenditure Accounts.

RESULTS

The fraction of total nursing home expenditures attributable to diabetes ranged from 12.3% (Illinois) to 22.5% (Washington, DC; median AF of 15.6%, New Jersey). The median AF was highest in the 19–64 years age-group and lowest in the 85 years or older age-group. Nationally, diabetes-attributable nursing home costs were $18.6 billion. State-level diabetes-attributable costs ranged from $21 million in Alaska to $2.0 billion in California. Diabetes-attributable nursing home costs per person ranged from $374 in New Mexico to $1,610 in Washington, DC (median of $799 in Maine).

CONCLUSIONS

Our estimates provide state policymakers with an improved understanding of the economic burden of diabetes in each state's nursing homes. These estimates could serve as critical inputs for planning and evaluating diabetes prevention and management interventions that can keep people healthier and living longer in their communities.

The cost of nursing home care attributable to diabetes was estimated at $15 billion in 2012, making nursing home care the fourth largest contributor to the total direct medical costs of diabetes in the U.S. (1). Of all nursing home admissions for people with diabetes, an estimated 52% are attributable to diabetes (2). As the U.S. population continues to age, the demand for nursing home care is likely to increase. In 2016, ~15% of the U.S. population was aged 65 years and older (3). This fraction is expected to increase to 21% by 2030 (4).

Because of the high cost of nursing home care and the increasing prevalence of diabetes (5), state nursing home costs attributable to diabetes are likely to rise in the future. State health planners need information about the burden of diabetes in their state's nursing homes to encourage further investment in diabetes prevention and

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management interventions. By investing in prevention and management, states can improve the health of their community members and avoid future nursing home costs borne by Medicaid. In 2015, 62% of nursing home residents were covered by Medicaid (6) and state Medicaid programs spent $55 billion on nursing home care, which was ~10% of total Medicaid spending (7). Because policy decisions regarding Medicaid eligibility requirements for nursing home care are made by states, state policymakers need estimates of the nursing home diabetes-attributable costs at the state level. Furthermore, state-level estimates of diabetes-attributable nursing home costs are also needed to evaluate the benefits of state diabetes prevention interventions relative to their costs.

No previous study has quantified the state-level cost of nursing home care attributable to diabetes in the U.S. The Centers for Disease Control and Prevention (CDC) developed a Diabetes State Burden Toolkit to provide state-level estimates of the health and economic burden of diabetes, including diabetes-attributable nursing home costs (available at https://nccd.cdc.gov/Toolkit/DiabetesBurden). Here, we report the estimated diabetes-attributable nursing home costs for each state and describe the data and methods used to derive those estimates.

RESEARCH DESIGN AND METHODS

To estimate diabetes-attributable nursing home costs for each state, we used a diabetes-attributable fraction (AF) approach. First, we estimated total annual nursing home costs by state, age-group, and sex. Second, we estimated diabetes AFs for each state, also by age and sex. Third, we calculated diabetes-attributable nursing home costs as the product of age- and sex-specific state nursing home cost and the associated diabetes AF. Last, we summed age- and sex-specific costs to generate state-level estimates for each state.

Estimating Total Nursing Home Costs

To estimate total nursing home costs, we first identified a source of health expenditure data that was categorized by health care services (e.g., nursing home care) and reported expenditures at the state level. The State Health Expenditure Accounts (SHEA) is an accounting of "personal health care" expenditures (excluding administrative and net costs of private health insurance, government public health activities, and investment in research and structures and equipment) (8) allocated to each state based on the National Health Expenditure Accounts (NHEA) data and state-level data from the economic census.

Because the SHEA was not available by age and sex, we needed to estimate state spending by age and sex using data from the NHEA. We used data from the 2012 NHEA, which is the latest year currently available. To estimate spending by age and sex at the state level, we first calculated expected spending by multiplying per capita nursing home spending estimates (by age and sex) from the NHEA (2012) by population estimates from the American Community Survey (ACS) (2013). We then summed these state, age, and sex spending estimates up to the state level and compared the state-level expected spending to the actual 2013 state-level spending reported in the 2013 SHEA. Last, we created a ratio of actual to expected state spending and multiplied our expected spending estimates by this ratio to ensure that the sum of all state, age, and sex stratified estimates were equal to the actual 2013 state-level estimates (9).

We used SHEA data from the "Nursing Care Facilities and Continuing Care Communities" category to represent the total state nursing home costs. Because continuing care retirement communities (CCRCs) are included in this cost category but are not considered to provide ongoing nursing care, we adjusted state-level nursing home costs by the national percentage of payments from CCRCs. According to revenues reported in the 2012 economic census, 20% of expenditures in this category were for CCRCs (10). State-level estimates of CCRC payments were not available from the economic census or other sources.

Estimating the AF

To estimate the AF, we needed three key estimates: the prevalence of diabetes in the community, the prevalence of diabetes in nursing homes, and the intensity of care for people with and without diabetes in nursing homes. We used the 2013 Behavioral Risk Factor Surveillance System (BRFSS) data to estimate diabetes prevalence in the community and the Centers for Medicare & Medicaid Services Minimum Data Set (MDS) (2013–2014) to estimate the diabetes prevalence in nursing homes. The MDS was also used to weight subgroups for the intensity of care provided to nursing home residents with and without diabetes using data on Resource Utilization Groups (RUGs) from the 2013–2015 MDS. We calculated the RUG-weighted AF as shown in Eq. 1 for each state by age-group and by sex:

$$AF = \left[\frac{N^D * RUG^D}{N^D * RUG^D + N^N * RUG^N} - C^D\right], \quad (1)$$

where N^D is the number of nursing home residents with diabetes, N^N is the number of nursing home residents without diabetes, RUG^D is the average RUG payment for nursing home residents with diabetes, RUG^N is the average RUG payment for residents without diabetes, and C^D is the prevalence of diabetes in the community as estimated in BRFSS 2013. Without the RUG weights, the AF is effectively the difference in diabetes prevalence between the nursing home and the community.

We weighted the number of nursing home residents by the mean RUG payments to account for the higher potential nursing home costs among people with diabetes compared with people without diabetes. RUGs represent levels of care intensity in nursing homes and are assigned to all residents based on their activities of daily living dependency score and other clinical care needs. We used the Medicare payments associated with each RUG as a measure of the intensity of care in adjusting our AF. (Although RUG information is collected for all nursing home patients, the Centers for Medicare & Medicaid Services only makes RUG payments to patients eligible for Medicare coverage in skilled nursing facilities. We used RUG payment rates as a measure of relative resource use, not as actual payments.)Payments were estimated from the SHEA as previously described. Because residents can have multiple levels of RUG payment throughout an episode of care, we assumed the maximum RUG payment reported in the MDS during the episode.

The number of nursing home residents with and without diabetes was estimated from the MDS data using a data reference period of April 2013 to May 2014. In calculating the RUG-weighted AF, we only

included residents with nursing home episodes of at least 100 days. Episodes were defined using the MDS User Manual's definition and can span multiple nursing home stays that may be separated by brief time intervals where the resident is discharged and then readmitted (11).

Diabetes prevalence in the community was calculated as the fraction of respondents self-reporting a diabetes diagnosis in the 2013 BRFSS data. As in previous studies (5), women who reported having diabetes only during pregnancy were not counted as having diabetes. The community prevalence estimates (C^D) for the 19–64 years age-group were age adjusted using the relative weights of the 19–44 and 45–64 years age-groups observed in nursing home data from the MDS (by state and sex). This was necessary because diabetes incidence and diabetes prevalence spike in the age range 45–64 years (12). Thus, we calculated an adjusted community prevalence to account for the age-related differences in prevalence. The age distribution for other age-groups (65–84 and ≥85 years) was similar between the community and the nursing home.

Overall cost estimates (for all age-groups and sexes combined) were calculated by summing each of the age-group– and sex-specific cost estimates within a state. National results are based on estimates made at the national level, not a sum of state-level results. All AFs, nursing home costs, and diabetes-attributable nursing home costs were initially calculated at the age-group and sex levels for each state. In RESULTS and Supplementary Data, we aggregated the age-group– and sex-level estimates up to the age-groups (sexes combined) and sexes (age-groups combined), separately. AFs reported at the state level were calculated as the sum of diabetes-attributable costs (across age-group and sex strata) divided by the sum of all nursing home costs.

Nursing Home Costs per Person With Diabetes

We estimated diabetes-attributable costs per person with diabetes in each state by dividing the diabetes-attributable nursing home costs estimated for each state by the total number of people with diabetes. The total number of people with diabetes in each state was estimated as the number of people with diabetes in the community (weighted estimates from BRFSS 2013) plus the number of active nursing home residents with diabetes from 2013 MDS quarterly assessments. Active nursing home residents were defined as residents with an assessment in the previous 120 days who were not discharged or deceased at the time of the assessment. All costs are reported in 2013 dollars.

RESULTS

Figure 1 displays the state-level RUG-weighted AFs for nursing home costs. The fraction of total nursing home expenditures attributable to diabetes ranged from 12.3% in Illinois to 22.5% in Washington, DC (Supplementary Table 1), with a median of 15.6% in New Jersey. Although the variation in RUG-weighted AFs across states was narrow (12.3–22.5%), we observed larger variation in the RUG-weighted AFs across age-groups. The youngest residents in nursing homes (19–64 years) consistently had the highest AFs (26.9% for the median state), whereas the oldest (≥85 years) consistently had the lowest AFs (6.7% for the median state) (Supplementary Table 1). Because diabetes is more common in older adults, there's a smaller difference between the community prevalence and the nursing home prevalence for these older age-groups, resulting in their relatively low AF.

Across all states, the average RUG payment was $393 for nursing home residents without diabetes and $411 for those with diabetes (P value <0.05). Applying the RUG weights as shown in Eq. 1 increased the AFs, on average. However, the contribution of these RUG weights to the overall RUG-weighted AF was small, increasing the AF by ~1% for the median state. Without the RUG weights, the AF ranged from 10.9% in Illinois to 22.0% in Washington, DC (median of 15.0% in Colorado).

Table 1 shows the diabetes-attributable nursing home costs. Large states such as California and New York had diabetes-attributable nursing home costs well over $1 billion in 2013. Meanwhile, small- and medium-sized states had more modest diabetes-attributable nursing home costs. For example, Delaware and North Carolina had diabetes-attributable costs of $64 million and $500 million, respectively. Nationally, diabetes-attributable costs were highest in the 65–84 years age-group at $10.6 billion. Adults in this age-group had a high burden of diabetes and accounted for more than half (52%) of all nursing home residents with diabetes. Adults aged 19–64 and 85 years or older had diabetes-attributable nursing costs totaling $5.0 billion and $2.9 billion, respectively. Nationally, the diabetes-attributable costs were $11.3 billion for women and $7.3 billion for men.

Figure 2 shows the diabetes-attributable costs per person with diabetes in each state. Diabetes-attributable nursing home costs per person with diabetes ranged from $374 in New Mexico to $1,610 in Washington, DC (Supplementary Table 3), with a median cost of $799 in Maine. The median per-person cost was $682 higher for people aged 65 years or older with diabetes (median of $1,067 in South Dakota) than for people aged 19–64 years with diabetes (median of $385 in Missouri). The median state diabetes-attributable cost per person was $353 higher for women with diabetes (median of $973 Missouri) than for men with diabetes (median of $620 in Kansas).

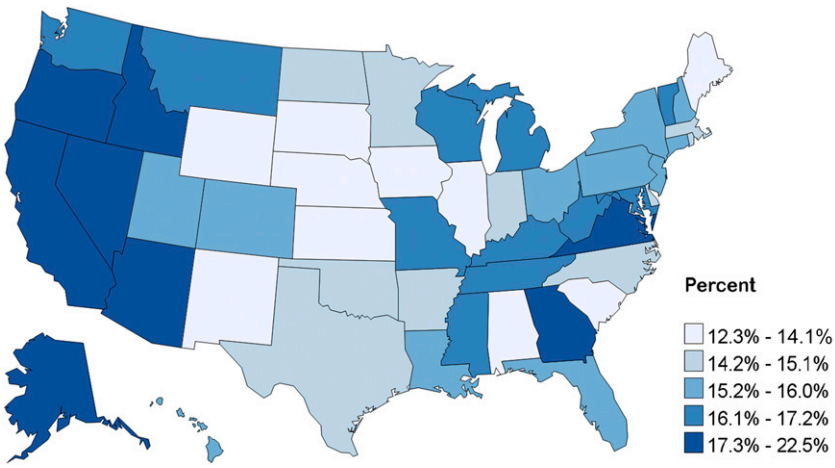

Figure 1—RUG-weighted diabetes AFs for nursing home expenditures by state.

Table 1—Diabetes-attributable nursing home costs by state, age-group, and sex (in millions of dollars), 2013

		Sex		Age-group (years)		
State	Overall	Male	Female	19–64	65–84	≥85
U.S.*	$18,580	$7,282	$11,298	$5,043	$10,609	$2,927
AK	$21	$8	$13	$7	$11	$3
AL	$198	$70	$128	$58	$115	$25
AR	$147	$54	$94	$37	$77	$33
AZ	$279	$123	$156	$59	$183	$37
CA	$1,971	$715	$1,256	$452	$1,088	$431
CO	$247	$103	$144	$79	$136	$32
CT	$379	$131	$248	$106	$212	$61
DC	$69	$26	$43	$19	$37	$13
DE	$64	$27	$36	$20	$41	$3
FL	$1,237	$409	$828	$272	$730	$235
GA	$421	$188	$233	$123	$237	$61
HI	$61	$27	$34	$13	$36	$12
IA	$203	$86	$117	$59	$97	$47
ID	$95	$39	$57	$24	$55	$16
IL	$638	$272	$366	$211	$404	$23
IN	$421	$157	$264	$125	$223	$73
KS	$179	$66	$113	$50	$104	$25
KY	$275	$104	$171	$81	$147	$47
LA	$223	$85	$138	$63	$107	$54
MA	$578	$248	$330	$148	$325	$104
MD	$488	$195	$293	$149	$291	$48
ME	$83	$32	$50	$24	$50	$8
MI	$628	$221	$407	$162	$335	$131
MN	$366	$160	$205	$108	$212	$46
MO	$434	$189	$245	$105	$249	$80
MS	$180	$71	$110	$49	$101	$30
MT	$57	$23	$35	$14	$35	$8
NC	$500	$191	$309	$157	$336	$7
ND	$61	$23	$38	$15	$29	$17
NE	$120	$46	$74	$32	$76	$12
NH	$94	$36	$58	$25	$55	$14
NJ	$624	$221	$403	$158	$349	$117
NM	$64	$26	$38	$16	$40	$8
NV	$97	$35	$62	$23	$61	$13
NY	$1,469	$614	$855	$346	$746	$377
OH	$887	$385	$502	$265	$505	$116
OK	$180	$67	$112	$52	$103	$25
OR	$265	$111	$154	$54	$186	$25
PA	$1,182	$461	$721	$288	$657	$237
RI	$91	$29	$62	$24	$48	$19
SC	$195	$84	$111	$66	$120	$10
SD	$48	$24	$24	$15	$29	$4
TN	$368	$139	$229	$93	$205	$71
TX	$908	$401	$507	$338	$537	$33
UT	$83	$29	$54	$24	$47	$12
VA	$544	$198	$346	$131	$298	$114
VT	$47	$17	$29	$12	$26	$9
WA	$423	$158	$265	$127	$253	$44
WI	$406	$178	$228	$113	$228	$64
WV	$133	$49	$84	$34	$76	$23

Continued on p. 1459

CONCLUSIONS

Our estimates quantify the impact of diabetes on nursing home costs in each state, which policymakers can use to describe the burden of diabetes in state nursing homes and develop interventions to reduce this burden. In 2013, estimated state-level nursing home expenditures attributable to diabetes totaled $18.6 billion across all states, ranging from $21 million in smaller states to more than $1 billion in larger states.

Efforts to minimize these nursing home costs begin with the primary prevention of diabetes in the community through practical lifestyle-change programs and population-level interventions. For example, in Ohio, the state action plan for chronic disease includes increasing the awareness of prediabetes (by distributing the American Diabetes Association's [ADA's] Prediabetes Risk Test), increasing the number of sites that offer the Diabetes Prevention Program (DPP), and increasing the number of community health workers trained in chronic disease management (13). The plan also includes several population-level interventions to support active living and healthy eating. Population-level interventions, such as active transportation policies and Supplemental Nutrition Assistance Program incentives for healthy food, help Ohio residents achieve the weight loss and physical activity goals to prevent diabetes.

Although these prevention interventions are proven to be effective, they do not address the current and short-term economic burden posed by the large number of prevalent cases among older adults. Recognizing the shortcomings of primary prevention, states may also consider supporting and investing in less expensive alternatives to nursing home care to reduce the cost borne by state Medicaid programs and families paying out of pocket. For example, the increased use of home health care can help people with diabetes live in the community longer and avoid costly nursing home expenses.

Our study has shown that an estimated $887 million in nursing home expenditures were attributable to diabetes in Ohio in 2013. With this evidence of the large economic burden of diabetes in Ohio nursing homes, the Ohio state legislature could consider funding additional programs to improve diabetes prevention and management, especially among older adults. State policymakers could also use our estimates

Table 1—Continued

State	Overall	Sex		Age-group (years)		
		Male	Female	19–64	65–84	≥85
WY	$24	$11	$12	$7	$14	$3
Summary						
Minimum	$21	$8	$12	$7	$11	$3
Maximum	$1,971	$715	$1,256	$452	$1,088	$431
Median	$223	$86	$138	$59	$120	$30

*The sum of all the state-level estimates may differ slightly from the national estimate. RUG-weighted AFs were estimated at the national and state levels separately. These estimates were applied to the national spending estimates to get the national diabetes-attributable cost estimates shown in this table.

to evaluate the cost-effectiveness of statewide diabetes prevention and treatment programs.

The state AFs and costs reported in this article underscore the need for continued efforts to reduce the burden of diabetes. However, such results are only useful if we have practical and effective ways of reducing the burden (14). Results from the DPP trial suggest that an intensive lifestyle intervention or treatment with metformin, a glucose-lowering drug (15), can halve the risk of diabetes. The National Diabetes Prevention Program (NDPP) is an effort to scale the results of the DPP trial using innovations and lessons learned from translational studies of the DPP. Along with community-level interventions to improve access to healthy food and encourage active lifestyles, the NDPP represents a plausible way for state policymakers to reduce the burden of diabetes and the associated nursing home costs.

The results of this study are subject to methodological and data limitations. First, we must consider that nursing home costs deemed attributable to diabetes in this study are simultaneously related to other major diseases such as obesity and cardiovascular disease. Intensive lifestyle interventions like the NDPP and community-level interventions impact the risk of multiple diseases, including obesity, cardiovascular disease, and diabetes. Because of the interrelated nature of these diseases, we do not interpret the AF simply as the percentage reduction in costs if diabetes prevalence was reduced to zero. Instead, we acknowledge that for state health planners and policymakers, the available interventions are generally focused on lifestyle change and weight loss, which are essential for diabetes prevention as well as the prevention of other diseases. Regardless of the sources of the burden, state-level AFs highlight potential cost savings and improved quality of life that could be achieved with proven diabetes prevention interventions.

Second, there are limitations related to the data sources used for this study. Estimates from the BRFSS represent self-reported lifetime prevalence and are mostly defined using have-you-ever-been-told questions. This leaves the possibility of underestimating, because not all cases of diabetes have been diagnosed. Meanwhile, the item from the MDS that defines diabetes is coded by the nursing facility for people that are being actively treated for diabetes. Because of the proximity and access to health care while staying in a nursing home, there may be fewer undiagnosed cases of diabetes in nursing homes than in the community. This difference in how diabetes prevalence is measured in the nursing home versus the community could lead to overestimation of the AF.

We also faced data limitations related to the SHEA and the RUG payments from the MDS. First, because SHEA data were not available by age and sex, we had to use NHEA data to estimate state costs at the age and sex level. These estimates may not truly reflect the state-level variations. Second, our initial analysis of RUG payments revealed that payments were missing for ~20% of residents who were discharged to a hospital on their most recent assessment. We considered dropping this group but ultimately decided to use the maximum RUG payment across all assessments within their episode of care. We chose this approach because it avoids a selection problem in which we could be excluding many of the sicker residents with diabetes, because they were discharged to the hospital more often than people without diabetes.

Despite these limitations, our results are similar to published literature that used different data. Compared with our national estimate of $18.6 billion in 2013, the ADA's most recent report on the cost of diabetes estimated diabetes-attributable costs of $14.7 billion for nursing homes in 2012. The ADA used a similar AF approach that relied on measuring the excess prevalence of diabetes. Thus, differences in the diabetes-attributable costs are likely attributed to using different sources of cost data. The ADA used data from the National Nursing Home Survey (NNHS) (conducted in 2004) and data on the cost per day in nursing homes from a 2012 report by Genworth Financial (a long-term care and life insurance company) (1). Their report estimated an AF of 17%, approximately one percentage point higher than the median state and approximately two percentage points higher than our national estimate using the MDS data. Although the

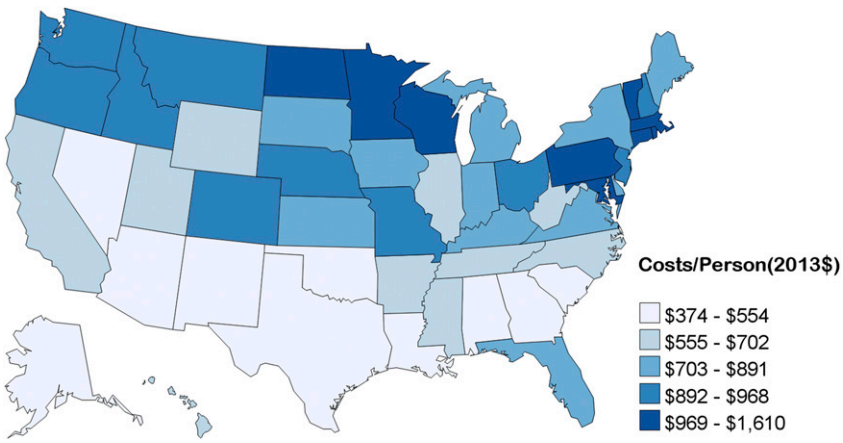

Figure 2—Cost of diabetes in nursing homes per person with diabetes (in the community and in nursing homes).

national AF that we estimated was lower than the ADA's, we estimated higher diabetes-attributable costs because of the higher total cost of nursing home care reported in the SHEA (for all nursing home residents). The ADA report and this study both excluded costs from CCRCs.

Another study examined the role of diabetes in nursing home admissions using longitudinal data from the National Health and Nutrition Examination Survey (NHANES) and a simulation model based on those data. Russell et al. (2) found that among people with diabetes, 52.1% of all nursing home admissions were attributable to diabetes. Because this estimate is reported among a sample of people with diabetes, we must multiply it by the fraction of people with diabetes in nursing homes to make a fair comparison with our estimates. For example, nationally, for people aged 65–84 years in nursing homes, we found that 41.6% had diabetes. This calculation (52.1% × 41.6%) results in an AF of 21.7%, which could be applied similarly to overall nursing home costs of $53.3 billion for people aged 65–84 years nationally (data not shown for this stratum). This would result in diabetes-attributable nursing home costs of ~$11.6 billion. Meanwhile, our AF approach results in an AF of 19.9% and diabetes-attributable nursing home costs of $10.6 billion for the same age-group. This comparison suggests that our approach results in a similar, but somewhat more conservative, estimate of diabetes-attributable nursing home costs than what is implied by the Russell et al. (2) estimate.

To our knowledge, this is the first study to report diabetes-attributable nursing home costs per person. Because we calculated per-person costs using the total number of people with diabetes in a state, variations in per-person costs are largely the result of differences in the relative demand for nursing home care across age-groups, sexes, and states. The demand for nursing home care is higher among women and people aged 65 years or older, likely due to longer life expectancy for women and higher rates of disability among older adults. We observed diabetes-attributable per-person costs of $881 for women and $585 for men, nationally. In people aged 65 years or older, we observed per-person costs of $1,019 compared with $339 for people aged 19–64 years.

Because of the large differences in demand for nursing home care by age, we expected that states with older populations would have higher per-person costs. For instance, states with older populations, such as Pennsylvania, had high per-person costs ($1,135) (Supplementary Table 3). Meanwhile, some states with younger populations, such as Utah, had lower per-person costs ($581). Although demographic differences appear to impact per-person costs nationally and for many states, some states did not follow this trend. Despite having some of the oldest populations, Florida and Maine have per-person costs at or below the state-level median ($703 and $799, respectively). Variation in these per-person costs could be driven by other demographic and nondemographic factors not observed in this study. These might include differences in state Medicaid eligibility or coverage levels, programs to increase the use of home- and community-based services, or differences in the health status of nursing home patients with diabetes. Additional research is needed to better understand the range of factors driving the variation in per-person costs.

By using the MDS data and our AF approach to estimate the diabetes-attributable costs, we provide state policymakers with data to enhance their understanding of the economic burden of diabetes in their state's nursing homes. In a recent position statement, ADA highlighted the disease-specific needs of nursing home residents living with diabetes and the lack of disease-specific protocols to address those needs (16). The erratic intake of food for nursing home residents, the risk of severe hyper- and hypoglycemia, and a greater dependence on others for care all contribute to the cost of care for nursing home residents with diabetes. An investment in disease-specific protocols to address these needs is underscored by the results of this analysis and the higher intensity of care we observed in the RUG payment data for nursing home residents with diabetes.

Overall, the nursing home costs attributable to diabetes were substantial across the U.S. in 2013. Although we did find a slightly higher intensity of care for people with diabetes than for those without it in nursing homes, the diabetes-attributable nursing home costs were almost entirely driven by the much higher prevalence of diabetes in nursing homes than in the community. Our results also suggest that people with diabetes are being admitted to nursing homes earlier in life than people without diabetes. To reduce nursing home costs, state and national policymakers can prioritize investments in diabetes prevention and patient-centered care models that keep people with diabetes healthier and living in the community longer.

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Author Contributions. S.J.N. participated in the design of the study and the data analysis and wrote, edited, reviewed, and approved the manuscript. A.A.H., S.S.S., P.Z., and T.J.H. participated in the design of the study, provided critical review of the manuscript, and reviewed, edited, and approved the manuscript. D.C.P. analyzed the data and reviewed, edited, and approved the manuscript. S.J.N. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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