

Assessing the Preparedness of the U.S. Health Care System Infrastructure for an Alzheimer's Treatment

Jodi L. Liu, Jakub P. Hlávka, Richard Hillestad, Soeren Mattke



For more information on this publication, visit www.rand.org/t/rr2272

Published by the RAND Corporation, Santa Monica, Calif.

© Copyright 2017 RAND Corporation

RAND® is a registered trademark.

Limited Print and Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law. This representation of RAND intellectual property is provided for noncommercial use only. Unauthorized posting of this publication online is prohibited. Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Permission is required from RAND to reproduce, or reuse in another form, any of its research documents for commercial use. For information on reprint and linking permissions, please visit www.rand.org/pubs/permissions.html.

The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest.

RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

Support RAND

Make a tax-deductible charitable contribution at
www.rand.org/giving/contribute

www.rand.org

Appendix

This appendix provides the sources for our model parameters and details on the projections.

Table A-1. Model Parameters, Values, and Sources

Parameter	Value	Description	Source
Timestep	1 year	Model parameter	—
Effective Alzheimer’s disease treatment (=1, else 0)	1	Model parameter	—
Year Alzheimer’s disease treatment available	2020	Model assumption	—
No. of dementia specialist visits to determine treatment eligibility	2	Model assumption	—
No. of infusions per Alzheimer’s disease treatment	14	Model assumption	—
Relative risk reduction with treatment	0.5	Model assumption	—
Population in 2017			
Age 55+, no MCI, no Alzheimer’s dementia	71.7 million	U.S. Census Bureau estimate of people 55 years and older minus those with Alzheimer’s disease and MCI	U.S. Census Bureau (2014)
MCI	13.8 million	Estimated based on a review of MCI prevalence studies. Prevalence data weighted by cohort size in U.S. Census. Data for 2017 interpolated from 2015 and 2020 estimates.	Lopez et al. (2003), Manly et al. (2005), Plassman et al. (2008), Ganguli et al. (2010); Petersen et al. (2010)
Alzheimer’s dementia in the home/community	5.0 million	Calculated as all Alzheimer’s disease patients in 2017 (5.5 million) minus those in nursing homes	Alzheimer’s Association (2017)
Alzheimer’s dementia in nursing homes	0.5 million	Calculated given number of occupied beds in nursing homes (1.4 million), the share of dementia patients in them (50.4%), and the share of Alzheimer’s disease among dementia patients (70%)	Centers for Medicare & Medicaid Services (CMS) (2015), Alzheimer’s Association (2017), Harris-Kojetin et al. (2016)
Died	2.0 million	U.S. Census Bureau data for population ages 55+	U.S. Census Bureau (2016)

Parameter	Value	Description	Source
Annual transition probabilities			
Probability of transitioning to MCI	3.0%	Interpolated from Yesavage et al. (2002) given the average age in the population ages 55+. Adjusted up to 3% based on an assumption that patients with early-stage MCI are underdiagnosed	Yesavage et al. (2002), Alzheimer's Association (2016)
Probability of transitioning from MCI to Alzheimer's dementia <i>without</i> treatment	6.5%	Derived from a meta-analysis conducted by Mitchell and Shiri-Feshki (2009)	Mitchell and Shiri-Feshki (2009)
Probability of transitioning from MCI to Alzheimer's disease <i>with</i> treatment	3.25%	Calculated as a product of a transitioning from MCI to Alzheimer's disease and an assumed relative risk reduction	—
Probability of transitioning from Alzheimer's disease in the home/community to a nursing home	9.25%	Derived the age-weighted average probability of transitioning to nursing home from Neumann et al. (2001)	Neumann et al. (2001)
Annual death rates			
Age 55+	2.19%	All-cause death rate based on U.S. Census Bureau mortality data	U.S. Census Bureau (2016)
MCI	3.13%	Derived from all-cause mortality of age cohort adjusted for increased mortality in MCI cohorts from Vassilaki et al. (2015)	Vassilaki et al. (2015)
Alzheimer's dementia in the home/community	3.46%	Derived from Neumann et al. (2001), weighted average of mortality of patients in mild and moderate stages of Alzheimer's disease	Neumann et al. (2001)
Alzheimer's dementia in nursing homes	44%	Estimate from Aneshensel et al. (2000)	Aneshensel et al. (2000)
Other epidemiological parameters			
Share of age 55+ population who receive cognitive screening each year	80%	Assumption based on expert input	—
Share of MCI population who receive further evaluation by a dementia specialist each year	50%	Assumption based on expert input	—
Share of MCI patients eligible for amyloid detection test	90%	Assumption based on expert input	—
Share of MCI patients who have clinically relevant amyloid burden	45%	Average of two estimates by Ong et al. (2014) and Doraiswamy et al. (2014)	Ong et al. (2015), Doraiswamy et al. (2014)
Share of MCI patients with amyloid who have no contradictions for treatment	80%	Assumption based on expert input	—

Parameter	Value	Description	Source
Capacity parameters			
Dementia specialist capacity scenario	Low, medium, high, or no limit	Estimated based on the number of neurologists, geriatricians, and geriatric psychiatrists; the average annual number of visits per full-time neurologist; and model assumptions of the excess capacity of the workforce. See Figures A-1 and A-2.	Dall et al. (2013), Geriatrics Workforce Policy Studies Center (2008, 2011)
PET capacity scenario	Low, medium, high, or no limit	Estimated from the historical number of PET scans conducted, the number of PET scanners in the United States; and expert input on the range of growth rates. See Figures A-3 and A-4.	NAMCS and NHAMCS 2008 data from Centers for Disease Control and Prevention (2017), Buck et al. (2010), Organisation for Economic Co-Operation and Development (2017)
Infusion capacity scenario	Low, medium, high, or no limit	Estimated based on the historical number of infusions of therapeutic or prophylactic substances, excluding chemotherapy and biologic response modifiers; expert input on range of growth rates. See Figures A-5 and A-6.	NAMCS and NHAMCS 2011 and 2013 data from Centers for Disease Control and Prevention (2017)
Average visits by a dementia specialist per year	2,860	Estimated annual number of ambulatory visits by a full-time clinical neurologist from Dall et al. (2013)	Dall et al. (2013)
Dementia specialists fraction of excess capacity	2.5%, 5%, or 7.5%	Model assumption that varies with the selected capacity scenario	—
Current PET scanners fraction of excess capacity	50%	Assumption based on expert input	—
New PET scanners fraction of excess capacity	80%	Assumption based on expert input	—
Current infusion centers fraction of excess capacity	10%	Assumption based on expert input	—
New infusion centers fraction of excess capacity	80%	Assumption based on expert input	—

Figure A-1. Projected Dementia Specialist Workforce

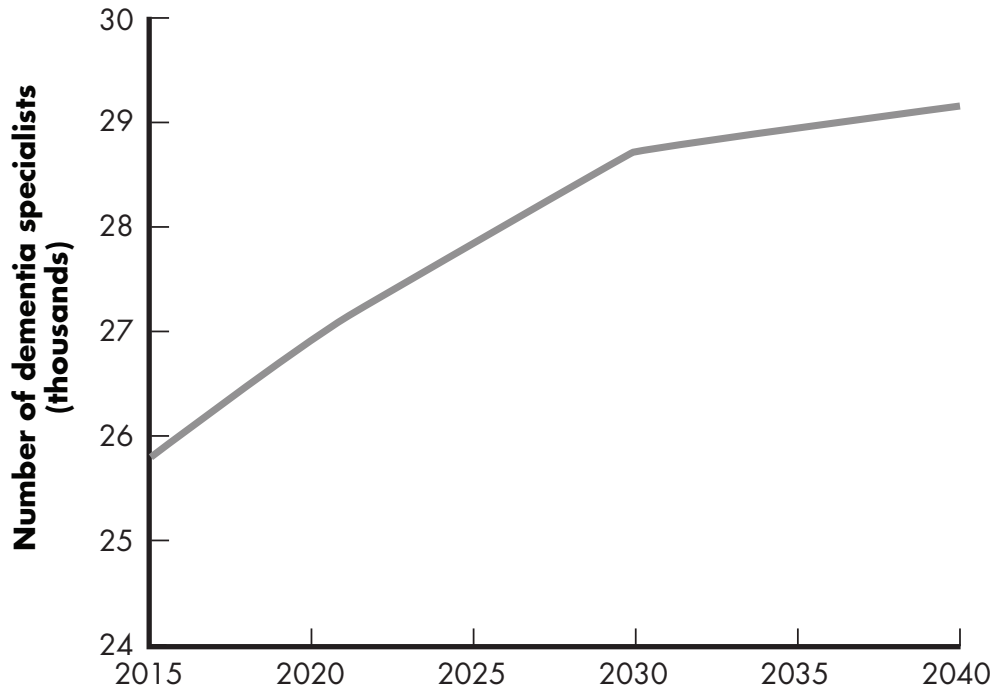
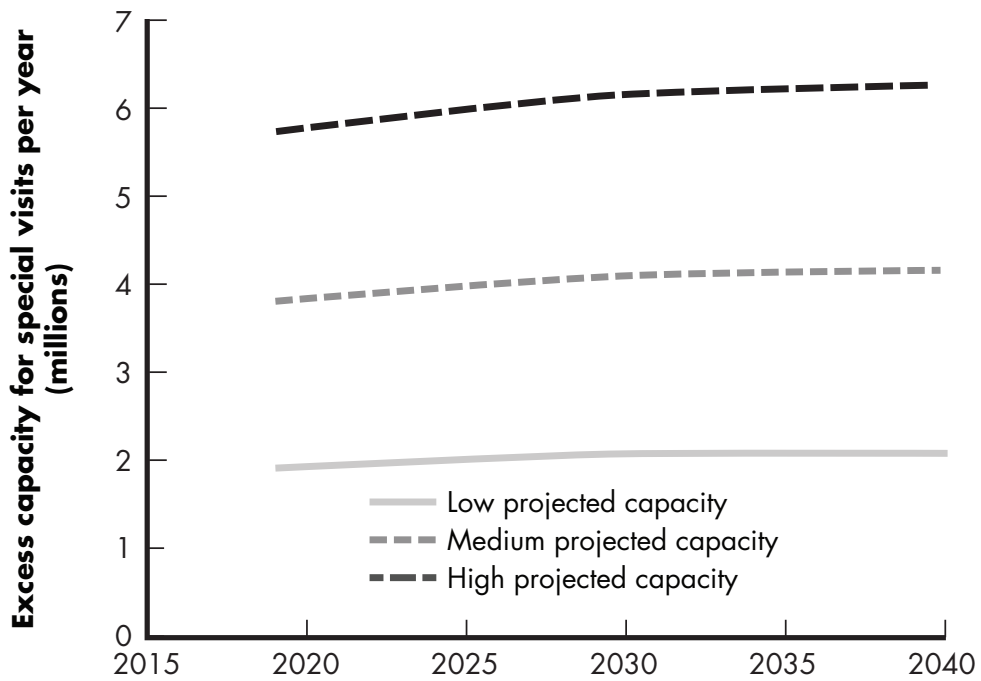


Figure A-2. Projected Capacity for Dementia Specialist Visits



NOTE: In the scenario for low projected capacity, we assume dementia specialists have 2.5 percent excess capacity that can be devoted to MCI patients. We assume 5 percent excess capacity in the medium scenario, and 7.5 percent in the high scenario.

Figure A-3. Projected Supply of PET Scanners

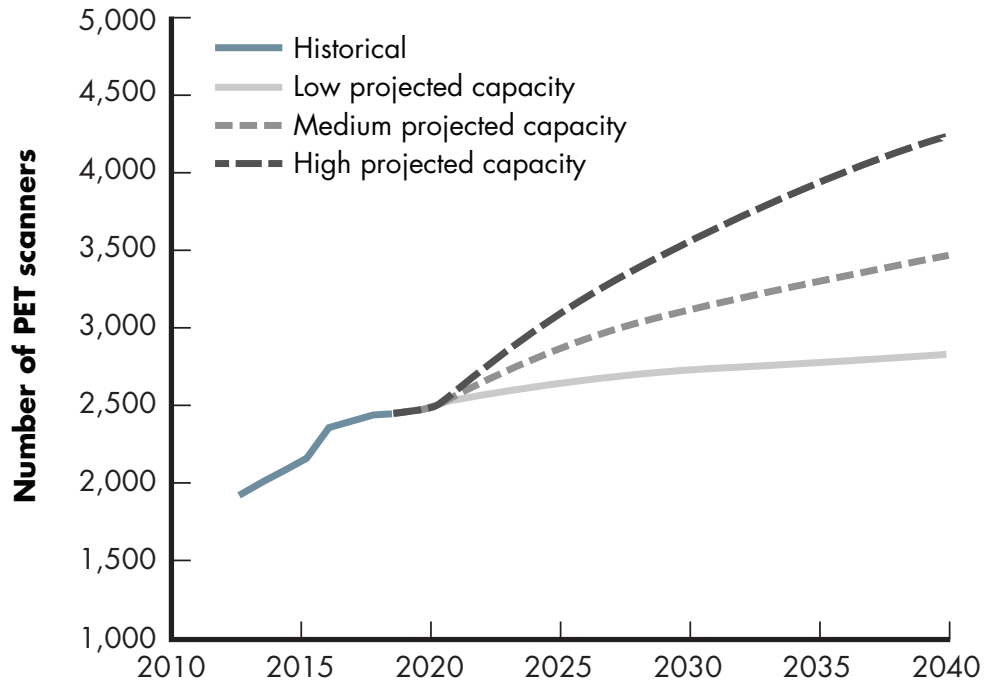


Figure A-4. Projected Capacity for PET Scans

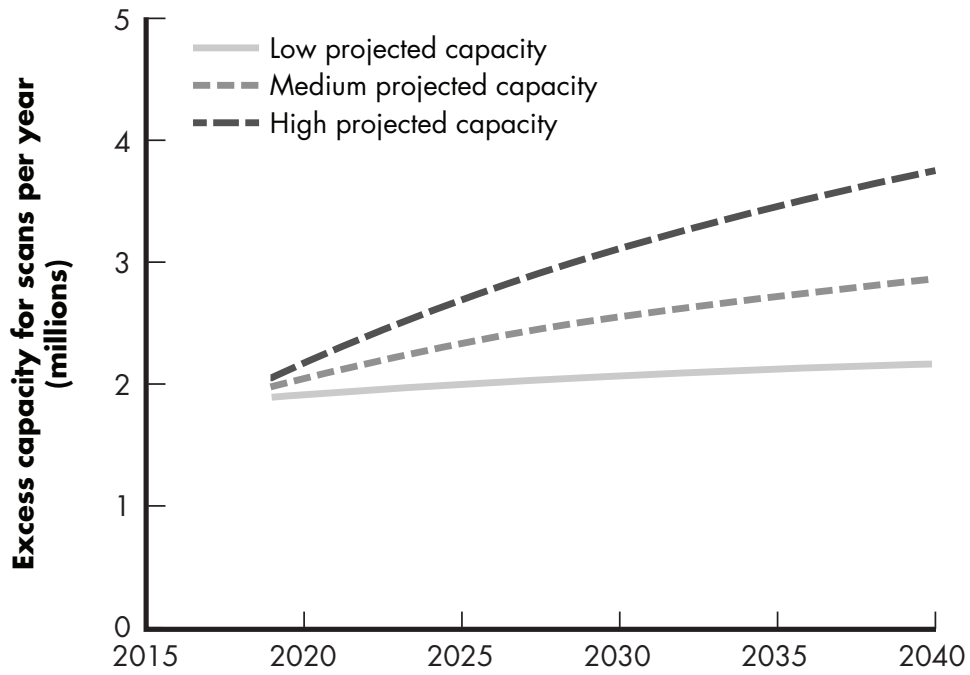


Figure A-5. Projected Supply of Infusions for Therapeutic or Prophylactic Substances Unrelated to Chemotherapy and Immunotherapy

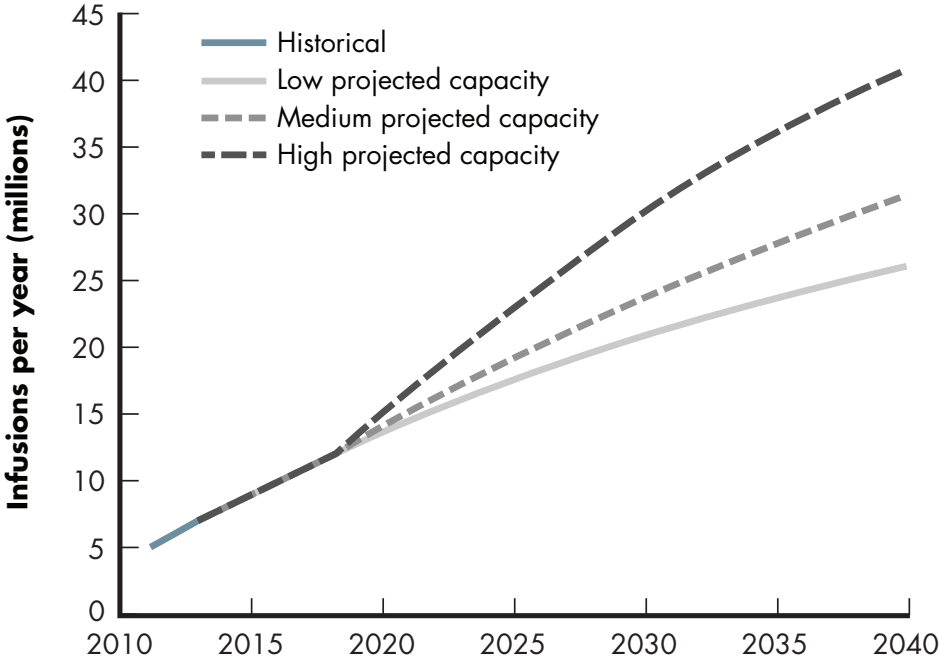
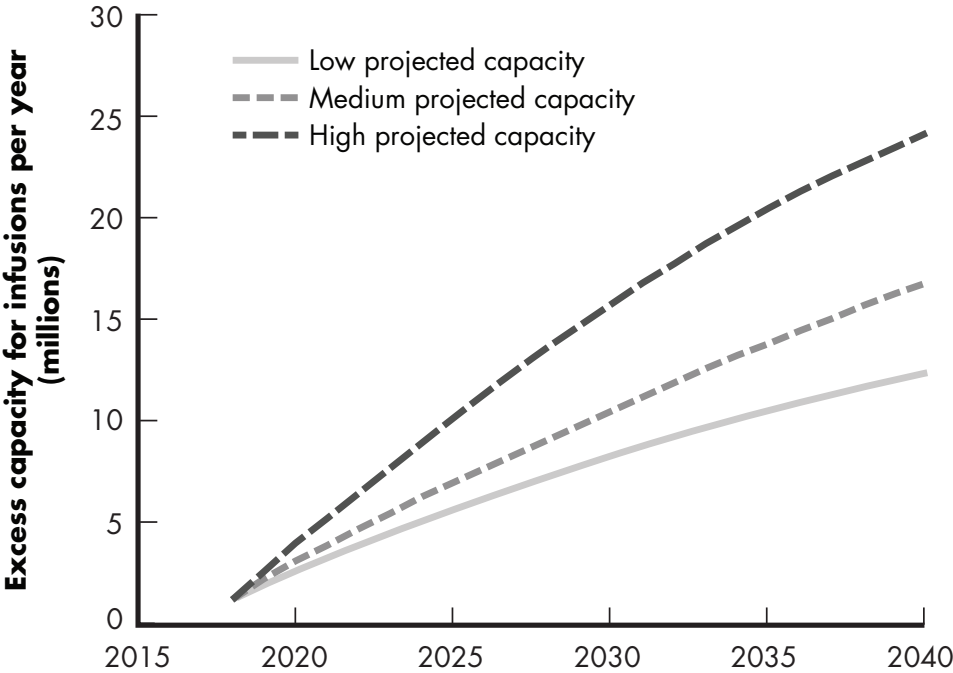


Figure A-6: Projected Capacity for Infusions



References

- Alzheimer's Association, "2016 Alzheimer's Disease Facts and Figures," *Alzheimer's & Dementia*, Vol. 12, No. 4, 2016, pp. 459–506.
- , "2017 Alzheimer's Disease Facts and Figures," *Alzheimer's & Dementia*, Vol. 13, No. 4, 2017, pp. 325-373.
- Aneshensel, Carol S., Leonard I. Pearlin, Lené Levy-Storms, and Roberleigh H. Schuler, "The Transition from Home to Nursing Home Mortality Among People with Dementia," *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, Vol. 55, No. 3, 2000, pp. S152–S162.
- Buck, Andreas K., Ken Herrmann, Tom Stargardt, Tobias Dechow, Bernd Joachim Krause, and Jonas Schreyogg, "Economic Evaluation of PET and PET/CT in Oncology: Evidence and Methodologic Approaches," *Journal of Nuclear Medicine*, Vol. 51, No. 3, 2010, pp. 401–412.
- Centers for Disease Control and Prevention, "Ambulatory Health Care Data: Questionnaires, Datasets, and Related Documentation," web page, August 31, 2017. As of October 4, 2017: https://www.cdc.gov/nchs/ahcd/ahcd_questionnaires.htm
- Centers for Medicare & Medicaid Services, *Nursing Home Data Compendium 2015 Edition*, Washington, D.C.: U.S. Department of Health and Human Services, 2015. As of October 5, 2017: https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/Downloads/nursinghomedatacompendium_508-2015.pdf
- CMS—See Centers for Medicare & Medicaid Services.
- Dall, Tim M., Michael V. Storm, Ritashree Chakrabarti, Oksana Drohan, Chris Keran, Peter Donofrio, Victor W. Henderson, Henry J. Kaminski, James C. Stevens, and Thomas R. Vidic, "Supply and Demand Analysis of the Current and Future US Neurology Workforce," *Neurology*, Vol. 81, No. 5, 2013, pp. 470–478.

- Doraiswamy, P. Murali, R. A. Sperling, K. Johnson, Eric M. Reiman, T. Z. Wong, M. N. Sabbagh, Carl H. Sadowsky, A. S. Fleisher, A. Carpenter, A. D. Joshi, M. Lu, M. Grundman, M. A. Mintun, D. M. Skovronsky, M. J. Pontecorvo, Ranjan Duara, Marwan Sabbagh, Geoffrey Lawrence Ahern, Richard F. Holub, Mildred V. Farmer, Beth Emmie Safirstein, Gustavo Alva, Crystal F. Longmire, George Jewell, Keith A. Johnson, Ron Korn, Jeanette K. Wendt, Dean Wong, R. Edward Coleman, Michael Devous, Danna Jennings, Michael W. Weiner, Cynthia A. Murphy, Karel D. Kovnat, and Jeff D. Williamson, “Florbetapir F 18 Amyloid PET and 36-Month Cognitive Decline: A Prospective Multicenter Study,” *Molecular Psychiatry*, Vol. 19, No. 9, 2014, pp. 1044–1051.
- Ganguli, Mary, Chung-Chou H. Chang, Beth E. Snitz, Judith A. Saxton, Joni Vanderbilt, and Ching-Wen Lee, “Prevalence of Mild Cognitive Impairment by Multiple Classifications: The Monongahela-Youghiogheny Healthy Aging Team (MYHAT) Project,” *American Journal of Geriatric Psychiatry*, Vol. 18, No. 8, 2010, pp. 674–683.
- Geriatrics Workforce Policy Studies Center, *Projection on Future Number of Geriatric Psychiatrists in the United States*, New York: American Geriatrics Society, 2008.
- , “Table 1.4, Projection on Future Number of Geriatricians in the United States,” American Geriatrics Society, May 2011. As of October 4, 2017:
http://www.americangeriatrics.org/files/documents/gwps/Table%201_4.pdf
- Harris-Kojetin, Lauren D., Manisha Sengupta, Eunice Park-Lee, Roberto Valverde, Christine Caffrey, Vincent Rome, and Jessica Lendon, *Long-Term Care Providers and Services Users in the United States: Data from the National Study of Long-Term Care Providers, 2013–2014*, Washington, D.C.: National Center for Health Statistics, Vital Health Statistics, Vol. 3, No. 38, 2016. As of October 5, 2017:
https://www.cdc.gov/nchs/data/series/sr_03/sr03_038.pdf
- Lopez, Oscar L., William J. Jagust, Steven T. DeKosky, James T. Becker, Annette Fitzpatrick, Corinne Dulberg, John Breitner, Constantine Lyketsos, Beverly Jones, Claudia Kawas, Michelle Carlson, and Lewis H. Kuller, “Prevalence and Classification of Mild Cognitive Impairment in the Cardiovascular Health Study Cognition Study: Part 1,” *Archives of Neurology*, Vol. 60, No 10, 2003, pp. 1385–1389.
- Manly, Jennifer J., Sandra Bell-McGinty, Ming-X. Tang, Nicole Schupf, Yaakov Stern, and Richard Mayeux, “Implementing Diagnostic Criteria and Estimating Frequency of Mild Cognitive Impairment in an Urban Community,” *Archives of Neurology*, Vol. 62, No. 11, 2005, pp. 1739–1746.
- Mitchell, Alex J., and Mojtaba Shiri-Feshki, “Rate of Progression of Mild Cognitive Impairment to Dementia: Meta-Analysis of 41 Robust Inception Cohort Studies,” *Acta Psychiatrica Scandinavica*, Vol. 119, No. 4, 2009, pp. 252–265.

- Neumann, Peter J., S. S. Araki, A. Arcelus, A. Longo, George Papadopoulos, Kenneth S. Kosik, Karen Kuntz, and A. Bhattacharjya, “Measuring Alzheimer’s Disease Progression with Transition Probabilities: Estimates from CERAD,” *Neurology*, Vol. 57, No. 6, 2001, pp. 957–964.
- Ong, Kevin T., Victor L. Villemagne, Alex Bahar-Fuchs, Fiona Lamb, Narelle Langdon, Ana M. Catafau, Andrew W. Stephens, John Seiby, Ludger M. Dinkelborg, Cornelia B. Reininger, Barbara Putz, Beate Rohde, Colin L Masters, and Christopher C. Rowe, “A Beta Imaging with 18F-Florbetaben in Prodromal Alzheimer’s Disease: A Prospective Outcome Study,” *Journal of Neurology, Neurosurgery, and Psychiatry*, Vol. 86, No. 4, 2015, pp. 431–436.
- Organisation for Economic Co-Operation and Development, “Computed Tomography (CT) Scanners (indicator),” web page, 2017. As of April 2017:
<https://data.oecd.org/healthqt/computed-tomography-ct-scanners.htm>
- Petersen, Ronald C., Rosebud O. Roberts, David S. Knopman, Yonas E. Geda, Ruth H. Cha, V. S. Pankratz, B. F. Boeve, E. G. Tangalos, R. J. Ivnik, and W. A. Rocca, “Prevalence of Mild Cognitive Impairment Is Higher in Men. The Mayo Clinic Study of Aging,” *Neurology*, Vol. 75, No. 10, 2010, pp. 889–897.
- Plassman, Brenda L., Kenneth M. Langa, Gwenith G. Fisher, Steven G. Heeringa, David R. Weir, Mary Beth Ofstedal, James R. Burke, Michael D. Hurd, Guy G. Potter, Willard L. Rodgers, David C. Steffens, John J. McArdle, Robert J. Willis, and Robert B. Wallace, “Prevalence of Cognitive Impairment Without Dementia in the United States,” *Annals of Internal Medicine*, Vol. 148, No. 6, 2008, pp. 427-434.
- U.S. Census Bureau, “2014 National Population Projections Tables,” 2014. As of October 5, 2017:
<https://www.census.gov/data/tables/2014/demo/popproj/2014-summary-tables.html>
- , “National Intercensal Datasets: 2000-2010,” December 2, 2016. As of October 5, 2017:
<https://www.census.gov/data/datasets/time-series/demo/popest/intercensal-2000-2010-national.html>
- Vassilaki, Maria, Ruth H. Cha, Yonas E. Geda, Michelle M. Mielke, David S. Knopman, Ronald C. Petersen, and Rosebud O. Roberts, “Mortality in Mild Cognitive Impairment Varies by Subtype, Sex, and Lifestyle Factors: The Mayo Clinic Study of Aging” *Journal of Alzheimer’s Disease*, Vol. 45, No. 4, 2015, pp. 1237–1245.
- Yesavage, Jerome A., Ruth O’Hara, Helena Kraemer, Art Noda, Joy L. Taylor, Steve Ferris, Marie-Christine Gély-Nargeot, Allyson Rosen, Leah Friedman, Javid Sheikh, and Christian Derouesné, “Modeling the Prevalence and Incidence of Alzheimer’s Disease and Mild Cognitive Impairment,” *Journal of Psychiatric Research*, Vol. 36, No. 5, 2002, pp. 281–286.