

Published in final edited form as:

J Am Geriatr Soc. 2014 November ; 62(11): 2095–2101. doi:10.1111/jgs.13105.

Statin Discontinuation Among Nursing Home Residents with Advanced Dementia

Jennifer Tjia, MD, MSCE¹, Sarah L. Cutrona, MD, MPH¹, Daniel Peterson, MS¹, George Reed, PhD¹, Susan E. Andrade, ScD¹, and Susan L. Mitchell, MD, MPH²

¹University of Massachusetts Medical School, Worcester, MA

²Hebrew SeniorLife, Boston, MA

Abstract

Background—Statin use in nursing home (NH) residents with advanced dementia neither prolongs life nor promotes comfort.

Objectives—To describe patterns of, and factors associated with, statin use and discontinuation in NH residents progressing to advanced dementia and followed for at least 90 days.

Design, Setting, Participants, Measurements—We constructed a retrospective inception cohort of NH residents with dementia from 5 states using a dataset linking 2007–2008 Minimum Data Set (MDS) to Medicare denominator and Part D files. Residents were observed from baseline (i.e. date of progression to very severe cognitive impairment with eating problems) and followed for at least 90 days to statin discontinuation or death. Logistic regression identified baseline factors associated with statin use. Cox proportional hazard regression identified factors associated with time to statin discontinuation.

Results—Of 10,212 cohort residents, 16.6% (n=1,699) used statins. Greater odds of statin use were associated with having diabetes (adjusted odds ratio [AOR] 1.24, 95% confidence interval [CI] 1.09–1.40), stroke (AOR 1.31, 95% CI 1.16–1.48), and hypertension (AOR 1.35, 95% CI 1.18–1.54); hospice enrollment was associated with lower odds (AOR = .75, 95% CI .64–.89). In follow-up, only 37.2% (n=632) discontinued statins. The median time to discontinuation was 36 days (interquartile range: 12 days–110 days). Shorter time to discontinuation was associated with hospitalization in prior 30 days (adjusted hazard ratio [AHR] 1.67, 95% CI 1.40–1.99) and greater total number of daily medications (AHR 1.02, 95% CI 1.01–1.04). When statins were discontinued, 15.0% (n=95) of residents stopped only statins while 47.5% (n=300) stopped at least one other medication.

Corresponding author: Jennifer Tjia, MD, MSCE, Associate Professor of Medicine, Division of Geriatric Medicine, University of Massachusetts Medical School, Biotech 4, Suite 315, 377 Plantation Street, Worcester, MA 01605; Phone: 508-856-3586; fax: 508-856-5024. jennifer.tjia@umassmed.edu.

Author Contributions: Jennifer Tjia was responsible for the study concept and design, acquisition of data, analysis and interpretation of data, and preparation and critical review of the manuscript. Sarah L. Cutrona was responsible for interpretation of data, and preparation and critical review of the manuscript. Daniel Peterson and George Reed was responsible for analysis and critical review of the manuscript. Susan E. Andrade and Susan L. Mitchell were responsible for study design, interpretation of data, and preparation and critical review of the manuscript.

Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Conclusion—Most NH residents who use statins at the time of progression to advanced dementia continue use in follow-up.

Keywords

pharmaceuticals; dementia; statins

INTRODUCTION

For patients with life-limiting illness, the Institute of Medicine (IOM) recommends clinical care that minimizes unnecessary or non-beneficial interventions.¹ Instead, end-of-life care should emphasize therapies that optimize quality of life. For patients with a life-limiting illness such as advanced dementia, an expert consensus panel suggests that certain medications such as statins may be inappropriate when the goal of care is comfort.² The rationale is that advanced dementia is characterized by very high mortality rates, high levels of functional disability, and eating dysfunction.^{3,4} While statins are commonly prescribed for the primary and secondary prevention of cardiovascular events in at-risk patients, their ability to promote benefits such as prolonged survival and comfort is unclear in the last weeks to months of life.⁵⁻⁷

Few studies examine patterns of chronic disease medication use⁸⁻¹⁰ or statin use as death approaches.^{5-7,11} Our prior study among nursing home (NH) residents with advanced dementia showed that 12% used a lipid-lowering drug, and that one-third discontinued that drug in the last weeks of life.¹⁰ Up to 50% of patients with other types of advanced illness used statins in the last six months of life,⁷ with no distinction in discontinuation rates by whether the statin was prescribed for primary or secondary prevention.⁶ Unfortunately, these prior studies were based on small samples drawn from specialized populations of managed care patients⁶, veterans⁷, or a limited geographic area.¹⁰

Therefore, we assembled an inception cohort of NH residents with dementia who recently advanced from moderate or severe to very severe cognitive impairment with eating problems from 5 large U.S. states in order to describe: 1) the prevalence and factors associated with statin use at time of decline to very severe cognitive impairment with eating problems; 2) incidence of statin discontinuation and time to discontinuation following decline; 3) the change in the number of other medications prescribed concurrent with the statin discontinuation; and 4) factors associated with statin discontinuation.

METHODS

Data Source

We used Minimum Data Set 2.0 data from January 1, 2007 to December 31, 2008 to assemble a cohort of NH residents with dementia from all licensed facilities (N=3,371) in five states (Minnesota, Massachusetts, Pennsylvania, California and Florida). The MDS is a standardized, clinically-based instrument used in US NHs to assess resident condition for clinical and reimbursement purposes. It collects information on the demographic, functional, medical, psychological, and cognitive status of residents.¹²⁻¹³ The Centers for Medicare and

Medicaid Services (CMS) require that each certified facility conduct an MDS assessment of all residents on admission, quarterly thereafter, and with significant changes in clinical status. We linked files to Medicare Part D data to measure medication use.

Study Population

To create the inception cohort, we initially identified all residents with dementia using Section I of the MDS 2.0, including those with dementia of the Alzheimer's type and dementia other than Alzheimer's type (n=367,410). We excluded residents who did not have an associated Medicare Part D file (n=80,768). We used the Cognitive Performance Scale (CPS) score to classify dementia severity. CPS scores correspond to levels of impairment: 1 (borderline intact); 2 (mild impairment); 3 (moderate impairment); 4 (moderately severe impairment); 5 (severe impairment); and 6 (very severe impairment with eating problems).¹⁴ We defined advanced dementia as CPS 6, which corresponds to a mean Mini-Mental Status Examination score of 0.4.¹⁴ We excluded residents with prevalent advanced dementia (CPS 6) on their first MDS assessment (n=27,327), and included residents with observed progression to CPS 6 on a subsequent MDS assessment (n=11,786). The baseline date for cohort entry was defined as the first MDS assessment with a CPS = 6. We excluded residents who did not have at least 90 days of observation following the baseline date (on or before October 1, 2008) or a recorded date of death (n=1,574), which resulted in n=10,212 comprising the inception cohort.

Study Variables

Statin Exposure

Statins were identified by the generic name in the Part D data and included: atorvastatin, fluvastatin, lovastatin, pravastatin, rosuvastatin, simvastatin. Part D data reports date of service including the date on which a prescription is filled and the days' supply; we defined statin exposure periods based on these two parameters.

In order to be classified as a statin user at baseline, patients were required to have a statin exposure period overlapping with the baseline date. Statin discontinuation was defined as the presence of a gap of at least 30 days after the last day for which pills were available to the patient (based on days' supply of the most recently filled prescription). For those who discontinued statins, the date of discontinuation was defined as the date on which the last prescription was filled plus the days' supply corresponding to the last prescription. For example, if January 1, 2007 were the date of the last prescription and this prescription provided 30 days' supply, then (in the absence of another prescription in the following 30 days) the date of discontinuation would be January 31, 2007. If, however, there were a prescription filled on February 14, 2007 (or on any other day within the 30 days following January 31st) then the patient was defined as continuing their statin.

Overall Medication Use

We identified overall medication use at two times: the baseline date and statin discontinuation date. We defined overall medication use on the baseline date to be equal to the count of unique drug names with an exposure period that overlapped with the baseline date. We also

calculated the change in overall medication use at the time of statin discontinuation based on the difference between the number of medications on day 15 after the statin stop date and the medication burden 15 days prior to the statin stop date. The overall medication use measure includes statins and other chronic disease medications administered on a daily basis. As needed medications were not included in this measure because they are typically dispensed once at the beginning of the nursing home stay, and infrequently thereafter unless used on a regular basis.

Resident Characteristics

Resident characteristics that were potentially associated with medication use were ascertained from the residents' full MDS assessments at their baseline date. These characteristics^{10,15,16} included: sociodemographics (age; sex; race/ethnicity; marital status); whether Medicaid was the primary payor; comorbidities (diabetes mellitus, heart failure, hypertension, peripheral vascular disease, stroke, cardiac dysrhythmia, renal failure, cancer, depression); nutritional problems (25% of meals uneaten), and presence of a feeding tube; behavioral problems by the Behavioral Index (0-2, higher scores indicate more severe behaviors)^{17,18}; functional status based on the sum of the activities of daily living (ADL) scores (0-28, higher scores indicate greater functional impairment); advance directives (living will, do not-resuscitate [DNR] order, do-not-hospitalize [DNH] order, medication restriction [i.e. resident or responsible party does not wish the resident to receive life-sustaining medications such as antibiotics or chemotherapy], and feeding restrictions [i.e. resident or responsible party does not wish the resident to be fed by artificial means if unable to be nourished orally]); enrollment in hospice; and hospitalization in the prior 90 days; and geographic location of the nursing home (California, Florida, Massachusetts, Minnesota, and Pennsylvania).

Data Analysis

We used descriptive statistics to describe resident characteristics, the proportion of residents using a statin at time of progression to advanced dementia and the number of non-statin medications stopped at the same time as the statin discontinuation. In an analysis including all residents in the cohort, we used logistic regression to compare residents using statins at baseline compared to those not using statins at baseline. In an analysis restricted to residents using statins at baseline, we used Cox proportional hazard models to identify the factors associated with time to statin discontinuation. We followed each resident from the baseline date to death, censoring at the end of the observation period (December 31, 2008), or the last date a prescription was filled. For both the logistic regression and Cox models, unadjusted analyses were followed by adjusted analyses including factors associated with outcomes at the $p < .05$ level in unadjusted analysis. All analyses were performed using STATA 10.1 (StataCorp, College Station, TX). The institutional review board of the University of Massachusetts Medical School approved this study.

RESULTS

The final cohort of 10,212 NH residents with advanced dementia were 73.9% female and 75.4% white. Overall, 68.4% had a DNR order, 16.9% were enrolled in hospice, and the

average number of medications used was 7 (standard deviation [SD]=4.8). (Table 1) Almost seventeen percent (16.6%; n=1,699) were prescribed statins at the time of decline to advanced dementia (i.e. time of entry into the cohort), and the average number of medications used by these residents was 10.3 (SD 4.8). In adjusted analysis, having a history of diabetes (adjusted odds ratio [AOR] 1.24, 95% confidence interval [CI], 1.09, 1.40), stroke (AOR 1.31, 95% CI, 1.16, 1.48), or hypertension (AOR 1.35, 95% CI, 1.18, 1.54) increased the odds of statin use at baseline, while being older (AOR .97, 95% CI .96, .98) and being enrolled in hospice (AOR .75 [95% CI, .64, .89]) decreased the odds of statin use at baseline. (Table 1)

Among the statin users with advanced dementia at baseline (N=1,699), 37.2% (n=632) discontinued statin use in the follow-up period. Mean follow-up time was 185 days, median follow-up time was 163 days. A total of n=924 (54.4%) statin users died in follow up. Of decedents, n=568 (61.5%) were using statins at death. When statins were discontinued, 15.0% (n=95) of residents stopped only statins while other daily medications were continued (i.e. had a net decrease of one in their overall medication burden). (Figure 1) Another 47.5% (n=300) of statin users had statins stopped along with at least one other medication, resulting in a net decrease of at least two in their overall medication burden. In contrast, the net medication burden increased in 34.6% (n=211) of residents at the time of statin discontinuation due to the addition of other medications. Among residents with advanced dementia on statins at baseline who discontinued these drugs, the median time to discontinuation was 36 days after baseline (interquartile range: 12 days, 110 days). Factors associated with increased hazard of (i.e. shorter time to) discontinuation after adjustment for factors significant at the p<.05 level in unadjusted analysis included residence in a nursing home in Florida (relative to California) (adjusted hazard ratio [AHR] 1.30, 95% CI 1.06, 1.60), being hospitalized in the 30 days prior to decline to advanced dementia (AHR 1.67, 95% CI 1.40, 1.99), having a greater medication burden at baseline (AHR 1.02, 95% CI 1.01, 1.04), and having a diagnosis of cancer (AHR 1.52, 95% CI 1.15, 1.98). (Table 2) At the end of the study period, 67% of those using statins at baseline remained on these drugs, representing 10% of the overall inception cohort with advanced dementia.

DISCUSSION

We found that about 1 in 6 NH residents with advanced dementia, defined as very severe impairment with eating problems, are prescribed a statin at the time of decline to advanced dementia. Further, two-thirds of these residents continue on statins after reaching advanced stage disease.

Because swallowing and eating difficulties make medication administration burdensome and difficult for both the resident and the NH staff,²⁶ statin discontinuation is an intervention arguably consistent with the goal of maintaining patient comfort.² Further, there is little evidence to suggest that statins confer benefit that outweighs this burden among persons with weeks to months of remaining life expectancy. We know of no prior estimate of statin use and discontinuation in relation to the clinical challenge dysphagia or anorexia in this population, except our prior study showing that lipid-lowering medications were discontinued in about 30% of residents with advanced dementia.¹⁰

While one study previously reported that chronic medication use for comorbid medical conditions decreased over time among patients with life-limiting illness,⁸ another study suggests that the presence of a recognizable, life-limiting condition does not increase statin discontinuation.^{5, 27} Because the use of symptom management medications at the end-of-life increases the total number of drugs used near death,⁸ careful balancing of chronic disease versus acute symptom management medications should be considered to optimize quality of life.^{1,2,19}

We found that most discontinuations occurred within 30 days of decline to advanced dementia, and that many of these discontinuations were preceded by an acute hospitalization. Only one other study describes the timing of statin discontinuation in relation to the diagnosis of an advanced illness, and that study reported that patients diagnosed with lung cancer discontinued statins an average of 244 days after the time of cancer diagnosis.¹¹ Time to discontinuation relative to development of metastatic disease or death was not described.

Our study also found that recent hospitalization is the factor most strongly associated with statin discontinuation. Reasons for this are unclear. Prior studies indicate that hospitalizations in populations with advanced illness have limited clinical benefit,²⁰ involve aggressive interventions^{21,22} and result in distress for family members.^{23,24} The physical and medical setbacks associated with such hospitalizations may trigger end-of-life discussions, and such goals of care discussions have been shown to be associated with less aggressive medical care near death.²⁵ However, we are unable to distinguish whether the relationship between statin discontinuation and recent hospitalization was due to intentional discontinuation to meet comfort as the goal of care, was a marker for the development of a new clinical contraindication (e.g. hepatic congestion or liver function derangements), or was an inadvertent prescribing error.^{26,28}

Consistent with IOM guidance, prescribed interventions in patients approaching death should promote the main goal of care.¹ Prior studies report that over 90% of proxies of NH residents with advanced dementia state that their goal of care is comfort.^{3,4} Statins do not promote comfort and thus for the residents with advanced dementia, their role in the treatment plan is not substantiated. Even for the minority of residents with advanced dementia whose goal of care remains life prolongation, it is not clear that statins promote that goal given the very limited life expectancy in advanced dementia. While we were unable to specifically identify goals of care in this study, 64% of our statin users had a DNR order, 9.9% had a DNH order, and 14.1% were enrolled in hospice. While hospice enrollment was associated with lower statin use at cohort entry, none of these factors independently increased the likelihood of statin discontinuation after baseline. While our prior study did show that inappropriate medication use was lower with the presence of a DNH order, we did not observe this finding in the current analysis.¹⁰

We note several limitations of this study. First, we acknowledge that by creating an inception cohort based on decline to advanced dementia, we may have selected for patients who had recent hospitalizations because new 'change of status' MDS forms are typically completed following a return to the nursing home from the hospital. Therefore, it is unclear

whether hospitalizations are truly independent predictors of statin discontinuation, or whether they are just a marker for late stage disease. Second, we calculated overall change in number of medications at time of statin discontinuation, and not the actual number of changes (new starts and discontinuations), because overall medication use is the best measure of polypharmacy, a well-known independent risk factor for adverse drug events and poor outcomes. Third, we did not measure prn medications in change of overall medication burden with statin discontinuation. We acknowledge that the number of chronic disease drug discontinuations, and new starts for hospice related medications, would better allow us to understand whether statins were stopped as part of an overall shift in care to ‘comfort measures only’, but this was outside the scope of this study. Further, we did not include changes in advance directives or resident characteristics in this analysis as a time-varying covariate, and this may explain the lack of association for factors such as DNH orders and the outcome of statin discontinuation. Mitigating these limitations is the strength of the population-based sampling from 5 large states in the U.S. and inclusion of clinical data in attempting to understand statin use in advanced illness.

In summary, while statin use in late life remains controversial, we find evidence of a practice of discontinuation with clinical status decline. Whether these discontinuations are associated with improved quality of life or poorer prognosis has yet to be determined, but are the subject of a randomized clinical trial by the Palliative Care Research Cooperative Group examining whether statin discontinuation affects survival and quality of life in patients with advanced life-limiting illness.²⁹[ClinicalTrials.gov identifier NCT01415934] While our paper highlights some reasons for discontinuations, further investigation to tie changes in goals of care with changes in medication prescribing deserve attention.

Acknowledgments

Funding/Support: This study was supported by the Agency for Healthcare Research and Quality grant (R21 HS19579; PI: Tjia). Dr. Cutrona is supported by Award Number KL2TR000160 from the National Center for Research Resources (NCRR). Dr. Mitchell is supported by NIH-NIA K24AG033640. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NCRR or the National Institutes of Health.

Sponsor's Role: The funding organizations did not participate in the design or conduct of the study, in the collection, analysis or interpretation of the data, or in the preparation, review, or approval of the manuscript.

REFERENCES

1. Field, M.; Cassell, C. *Approaching death: Improving care at the end of life*. National Academy Press; Washington DC: 1997. Institute of Medicine Report..
2. Holmes HM, Sachs GA, Shega JW, et al. Integrating palliative medicine into the care of persons with advanced dementia: Identifying appropriate medication use. *J Am Geriatr Soc*. 2008; 56:1306–1311. [PubMed: 18482301]
3. Mitchell SL, Teno JM, Kiely DK, et al. The clinical course of advanced dementia. *N Engl J Med*. 2009; 361:1529–1538. [PubMed: 19828530]
4. Luchins DJ, Hanrahan P. *J Am Geriatr Soc*. 1993; What Is Appropriate health care for end-stage dementia? 41:25–30. [PubMed: 7678104]
5. Vollrath AM, Sinclair C, Hallenbeck J. Discontinuing cardiovascular medications at the end of life: Lipid-lowering agents. *J Pall Med*. 2005; 8:876–881.
6. Bayliss E, Bronsert MR, Reifler LM, et al. Statin prescribing patterns in a cohort of cancer patients with poor prognosis. *J Pall Med*. 2013; 16:1–7.

7. Silveira MJ, Kazanis AS, Shevrin MP. Statins in the last six months of life: A recognizable, life-limiting condition does not decrease their use. *J Pall Med.* 2008; 11:685–693.
8. Currow DC, Stevenson JP, Abernethy AP, et al. prescribing in palliative care as death approaches. *J Am Geriatr Soc.* 2007; 55:590–595. [PubMed: 17397439]
9. Blass DM, Black BS, Phillips H, et al. Medication use in nursing home residents with advanced dementia. *Int J Geriatr Psychiatry.* 2008; 23:490–496. [PubMed: 17944007]
10. Tjia J, Rothman MR, Kiely DK, et al. Daily medication use in nursing home residents with advanced dementia. *J Am Geriatr Soc.* 2010; 58:880–888. [PubMed: 20406320]
11. Tanvetyanon T, Choudhury AM. Physician practice in the discontinuation of statins among patients with advanced lung cancer. *J Palliat Care.* 2006; 22:281–285. [PubMed: 17263055]
12. Morris, JR.; Hawes, C.; Murphy, K., et al. Resident Assessment Instrument Training Manual and Resource Guide. Eliot Press; Natick, MA: 1991.
13. Rahman AN, Applebaum RA. The nursing home minimum data set assessment instrument: manifest functions and unintended consequences - Past, present, and future. *Gerontologist.* 2009; 49:727–735. [PubMed: 19531805]
14. Morris JN, Fries BE, Mehr DR, et al. MDS Cognitive Performance Scale. *J Gerontol.* 1994; 49:M174–182. [PubMed: 8014392]
15. Avorn J, Gurwitz JH. Drug use in the nursing home. *Ann Intern Med.* 1995; 123:195–204. [PubMed: 7598302]
16. Doshi JA, Shaffer T, Briesacher BA. National estimates of medication use in nursing homes: Findings from the 1997 Medicare current beneficiary survey and the 1996 medical expenditure survey. *J Am Geriatr Soc.* 2005; 53:438–443. [PubMed: 15743286]
17. Liperoti R, Mor V, Lapane KL, et al. The use of atypical antipsychotics in nursing homes. *J Clin Psychiatry.* 2003; 64:1106–1112. [PubMed: 14628988]
18. Snowden M, Sato K, Roy-Byrne P. Assessment and treatment of nursing home residents with depression or behavioral symptoms associated with dementia: A review of the literature. *J Am Geriatr Soc.* 2003; 51:1305–1317. [PubMed: 12919245]
19. Brauner DJ, Muir JC, Sachs GA. Treating nondementia illnesses in patients with dementia. *JAMA.* 2000; 283:3230–3235. [PubMed: 10866871]
20. Sampson EL, Blanchard MR, Jones L, et al. Dementia in the acute hospital: prospective cohort study of prevalence and mortality. *Br J Psychiatry.* 2009; 195:61–66. [PubMed: 19567898]
21. Teno JM, Mitchell SL, Gozalo PL, et al. Hospital characteristics associated with feeding tube placement in nursing home residents with advanced cognitive impairment. *JAMA.* 2010; 303:544–550. [PubMed: 20145231]
22. Morrison RS, Siu AL. Mortality from pneumonia and hip fractures in patients with advanced dementia. *JAMA.* 2000; 284:2447–2448. [PubMed: 11074771]
23. Gaugler JE, Mittelman MS, Hepburn K, et al. Predictors of change in caregiver burden and depressive symptoms following nursing home admission. *Psychol Aging.* 2009; 24:385–396. [PubMed: 19485656]
24. Epstein-Lubow G, Gaudiano B, Darling E, et al. Differences in depression severity in family caregivers of hospitalized individuals with dementia and family caregivers of outpatients with dementia. *Am J Geriatr Psychiatry.* 2011; 20:815–819. [PubMed: 21997604]
25. Wright AA, Zhang B, Ray A, et al. Associations between end of life discussion, patient mental health, medical care near death, and caregiver bereavement adjustment. *JAMA.* 2008; 300:1665–1673. [PubMed: 18840840]
26. Bell CM, Brener SS, Gunraj N, et al. Association of ICU or hospital admission with unintentional discontinuation of medications for chronic diseases. *JAMA.* 2011; 306:840–847. [PubMed: 21862745]
27. Shaffer T, Simoni-Wastila L, Toler W, et al. Changing patterns in medication use with increasing probability of death for older Medicare beneficiaries. *J Am Geriatr Soc.* 2010; 58:1549–1555. [PubMed: 20670381]
28. Boockvar K, Fishman E, Kyriacou CK, et al. Adverse events due to discontinuations in drug use and dose changes in patients transferred between acute and long-term care facilities. *Arch Int Med.* 2004; 164:545–550. [PubMed: 15006832]

29. Abernethy AP, Aziz NM, Basch E, et al. A strategy to advance the evidence base in palliative medicine: Formation of a palliative care research cooperative group. *J Palliat Med.* 2010; 13:1407–1413. [PubMed: 21105763]

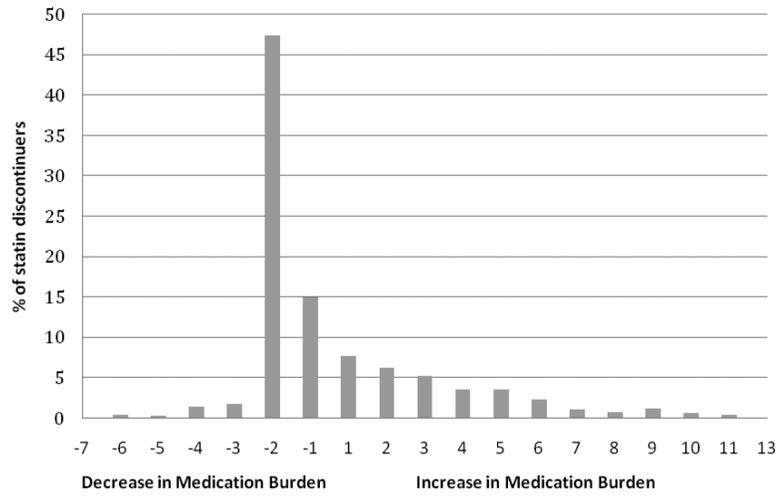


Figure 1. Change in net medication burden at time of statin discontinuation, among residents discontinuing statins after diagnosis of advanced dementia (n=632)*

Table 1

Characteristics of Residents with Advanced Dementia Using Statins at Baseline

Characteristic	Overall N=10,212	Residents using statins N=1,699		Adjusted Odds Ratio (95% CI)
	n (%) ^a	n ^a	%	
Mean Age, years (SD)	85.0 (SD 7.3)	83.1 (7.0)	n/a	.97 (.96, .98)
Sex				
Male	2,663 (26.1)	529	19.9	Referent
Female	7,549 (73.9)	1,170	15.5	.93 (.81, 1.06)
Race/ethnicity				
White, not Hispanic	7,701 (75.4)	1,221	15.9	Referent
Asian/Pacific Islander	424 (4.2)	95	22.4	1.04 (.79, 1.37)
Black, not Hispanic	1,088 (10.7)	205	18.4	1.03 (.84, 1.21)
Hispanic	970 (9.5)	169	17.4	.91 (.74, 1.11)
Other	29 (.3)	<10	31.0	2.04 (.89, 4.68)
Marital Status				
Not currently married	7,567 (74.1)	1,189	15.7	Referent
Currently Married	2,645 (25.9)	510	19.3	1.11 (.98, 1.27)
Medicaid				
No	3,462 (33.9)	563	16.3	--
Yes	6,750 (66.1)	1,136	16.8	--
State Residence				
California	3,278 (32.1)	578	17.6	Referent
Florida	2,686 (26.3)	449	16.7	.91 (.77, 1.07)
Massachusetts	1,334 (13.1)	67	17.1	1.17 (.97, 1.42)
Minnesota	572 (5.6)	377	11.7	.77 (.57, 1.03)
Pennsylvania	2,342 (22.9)	2,342	16.1	.93 (.79, 1.10)
Comorbid Conditions				
Diabetes Mellitus	3,022 (29.6)	714	23.6	1.24 (1.09, 1.40)
Heart Failure	2,127 (20.8)	397	18.7	.89 (.78, 1.02)
Stroke/TIA	2,489 (24.4)	542	21.8	1.31 (1.16, 1.48)
Hypertension	6,980 (68.4)	1,318	18.9	1.35 (1.18, 1.54)
Peripheral Vascular Disease	1,475 (14.4)	254	17.2	--
Cardiac Dysrhythmia	1,668 (16.3)	298	17.9	--
Renal Failure	1,126 (11.0)	215	19.1	.92 (.77, 1.09)
Cancer	768 (7.5)	139	18.1	
Mental Health Diagnoses				
Depression	4,928 (48.3)	892	18.1	1.05 (.94, 1.18)
Anxiety	2,153 (21.1)	348	16.2	--
Bipolar	249 (2.4)	48	19.3	--

Characteristic	Overall N=10,212	Residents using statins N=1,699		Adjusted Odds Ratio (95% CI)
	n (%) ^a	n ^a	%	
Schizophrenia	291 (2.9)	57	19.6	--
Behavioral Index Score				
0	7,856 (76.9)	1,304	16.6	--
1-2	2,356 (23.1)	395	16.8	--
Activities of Daily Living (ADL) score				
< 28	4,437 (43.4)	760	17.1	--
28	5,775 (56.6)	939	16.3	--
Feeding tube	2379 (23.3)	389	16.4	--
Advance Directive				
Living Will	2,013 (19.7)	343	17.0	--
DNR	6,983 (68.4)	1,089	15.6	1.02 (.90, 1.17)
DNH	1,266 (12.4)	168	13.3	.87 (.72, 1.07)
Feeding restriction ^b	2,126 (20.8)	310	14.6	1.05 (.87, 1.24)
Medication restriction ^c	733 (7.2)	90	12.3	.81 (.63, 1.07)
Hospice (vs not)	1,721 (16.9)	239	13.9	.75 (.64, .89)
Mean medication use, # (SD)	7.07 (SD 4.8)	10.3 (SD 4.8)	n/a	1.16 (1.15, 1.18)
Hospitalized <30 days prior to baseline (vs none)	3,994 (39.1)	748	44.0	1.03 (.92, 1.17)

--" not significant at p<.05 level in unadjusted analysis. **Bold** indicates significant at p<.05 level. Adjusted for age, sex, race/ethnicity, marital status, state of residence, diabetes mellitus, heart failure, stroke/TIA, hypertension, renal failure, depression, DNR, DNH, feeding restriction, medication restriction, hospice enrollment, medication use (#), hospitalization < 30 days of baseline

^aUnless otherwise noted

^bFeeding Restrictions – The resident or responsible party (family or legal guardian) does not wish the resident to be fed by artificial means (e.g. tube, intervention nutrition) if unable to be nourished by oral means.

^cMedication Restrictions- The resident or responsible party (family or legal guardian) does not wish the resident to receive life-sustaining medications (e.g., antibiotics, chemotherapy).

Table 2

Unadjusted and Adjusted Cox Models for Time to Statin Discontinuation after Decline to Advanced Dementia (n=1671, including 28 statin discontinuations on entry)

Characteristic	Unadjusted Hazard Ratio (95% CI)	Adjusted Hazard Ratio (95% CI)
Mean Age, years	1.00 (.99, 1.01)	--
Female sex (vs male)	.88 (.74, 1.04)	--
Race/Ethnicity (vs White)		
Asian/Pacific Islander	1.03 (.47, 3.35)	.97 (.67, 1.41)
Black, not Hispanic	.98 (.77, 1.26)	.90 (.70, 1.16)
Hispanic	1.28 (1.00, 1.65)	1.13 (.87, 1.46)
American Indian/Alaskan	1.25 (.47, 3.35)	1.47 (.54, 3.98)
Currently Married (vs not currently married)	1.12 (.94, 1.32)	--
Medicaid (vs not)	.71 (.60, .83)	.80 (.68, .95)
State Residence (vs California)		
Florida	1.29 (1.05, 1.57)	1.30 (1.06, 1.60)
Massachusetts	1.01 (.78, 1.30)	1.21 (.93, 1.59)
Minnesota	1.07 (.68, 1.67)	1.20 (.76, 1.90)
Pennsylvania	.84 (.67, 1.05)	.95 (.75, 1.21)
Comorbid Conditions		
Diabetes Mellitus	.98 (.83, 1.15)	--
Heart Failure	1.18 (.98, 1.43)	--
Stroke/TIA	1.16 (.98, 1.37)	--
Hypertension	1.11 (.91, 1.35)	--
Peripheral Vascular Disease	1.04 (.84, 1.30)	--
Cardiac Dysrhythmia	1.08 (.87, 1.33)	--
Renal Failure	1.29 (1.02, 1.64)	1.14 (.89, 1.45)
Cancer	1.53 (1.17, 1.99)	1.52 (1.16, 1.98)
Mental Health Diagnoses		
Depression	1.02 (.87, 1.19)	--
Anxiety	1.12 (.93, 1.36)	--
Bipolar	1.00 (.62, 1.62)	--
Schizophrenia	.72 (.45, 1.17)	--
Behavioral Index Score (vs 0)		
1-2	.92 (.86, 1.11)	--
Activities of Daily Living score (vs < 28)	1.14 (.97, 1.34)	--
Feeding tube	.81 (.67, .97)	.96 (.78, 1.18)
Advance Directive		
Living Will	.99 (.81, 1.21)	--
DNR	.85 (.72, 1.00)	.91 (.77, 1.08)
DNH	1.08 (.81, 1.44)	--

Characteristic	Unadjusted Hazard Ratio (95% CI)	Adjusted Hazard Ratio (95% CI)
Feeding restriction ^a	.87 (.70, 1.09)	--
Medication restriction ^b	.99 (.69, 1.44)	--
Hospice (vs not enrolled in hospice)	1.12 (.86, 1.46)	
Mean medication use at baseline, #	1.03 (1.01, 1.05)	1.02 (1.01, 1.04)
Hospitalization <30 days prior to baseline (vs none)	1.83 (1.56, 2.14)	1.67 (1.40, 1.99)

"--" not significant at p<.05 level in unadjusted analysis. **Bold** indicates significant at p<.05 level.

^a Feeding Restrictions – The resident or responsible party (family or legal guardian) does not wish the resident to be fed by artificial means (e.g. tube, intervention nutrition) if unable to be nourished by oral means.

^b Medication Restrictions- The resident or responsible party (family or legal guardian) does not wish the resident to receive life-sustaining medications (e.g., antibiotics, chemotherapy).