UNIVERSITY *of* York

This is a repository copy of *Prescribing patterns of psychotropic medications among people living with dementia after disasters*.

White Rose
university consortium
Universities of Leeds, Sheffield & York

Prescribing patterns of psychotropic medications among people living with dementia after disasters

Sue Anne Bell, PhD, FNP-BC [1,2], John P. Donnelly, PhD[3,4], Muhammad Ghous, MBBS[2], Shrathinth

Venkatesh, PhD[1,2], Adriana Rojas, MPH,[1] Antoinette B. Coe, PhD, PharmD [2,5]

1. School of Nursing, University of Michigan, Ann Arbor, MI, USA

2. Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI, USA

3. HSR Center for Clinical Management of Research (CCMR), Veteran Affairs Ann Arbor

   Healthcare System, Ann Arbor, MI, USA

4. Department of Learning Health Sciences, University of Michigan School of Medicine, Ann

   Arbor, MI, USA

5. College of Pharmacy, University of Michigan, Ann Arbor, MI, USA

*Address correspondence to: Sue Anne Bell, PhD, FNP-BC. E-mail: sabell@umich.edu

Abstract

Background and Objectives: Disasters can worsen behavioral symptoms in people living with dementia, leading to disorientation, anxiety, and paranoia. In such situations, psychotropic medications may be inappropriately used to manage these symptoms. This study estimated the receipt of new, or changes to existing, psychotropic prescription medications post-disaster among fee-for-service Medicare beneficiaries with a dementia diagnosis.

Research Design and Methods: Medicare administrative claims data were used to examine the relationship between hurricane exposure and receipt of antipsychotic prescriptions among people living with dementia with no prior use. The primary outcome was a daily count of new psychotropic prescriptions per beneficiary, from Part D claims, residing in exposed and unexposed counties 12 months after the hurricane landfall. The secondary outcome was a daily count of increases in the dosage of psychotropic prescriptions. Federal Emergency Management Agency disaster declarations were used to determine disaster-exposed groups.

Results: A total of 70,307 traditional fee-for-service beneficiaries with a dementia diagnosis were included in the study. In analyses adjusted for age, sex, race/ethnicity, Part D low-income subsidy status, rurality and number of Elixhauser comorbidities conducted over a 12-month period following the three hurricanes, beneficiaries exposed to the hurricanes had a 10% higher rate of starting new antipsychotic prescriptions compared to those in unexposed counties (IRR: 1.10, 95% CI: 1.04-1.17). Analyses conducted by individual hurricanes revealed substantial differences, with higher rates of initiating antipsychotics following Hurricane Harvey (IRR: 1.21, 95% CI: 1.07-1.36), and no change after Hurricanes Irma (IRR: 0.97, 95% CI: 0.88-1.08) and Florence (IRR: 0.92, 95% CI: 0.80-1.05).

Discussion and Implications: Psychotropic prescribing increased after Hurricane Harvey but not after Irma or Florence, suggesting context-specific factors may influence clinical responses during disasters. Our findings highlight the importance of incorporating person-centered care and appropriate behavioral health responses into disaster preparedness planning for the dementia population.

Keywords: Disaster, Medication, Emergency Planning, Behavioral disturbance, Alzheimers

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Translational Significance

This study's findings are critical for translating disaster readiness into meaningful improvements in care for people living with dementia. The observed increase in psychotropic medication use after Hurricane Harvey highlights gaps in dementia care during times of crisis. These insights can guide the development of non-pharmacologic interventions, such as tailored training for caregivers and healthcare teams, to reduce reliance on medications as behavioral restraints. Additionally, the findings support policies integrating dementia care into disaster planning frameworks, addressing the complex factors impacting people living with dementia. A multidisciplinary approach is key to improving dementia outcomes during disasters.

3

Introduction

An estimated 6.9 million Americans are living with a diagnosis of Alzheimer's disease and other related dementias (ADRD).[1] Concurrently, large-scale disasters create social and environmental challenges or people living with dementia and contribute to negative impacts of pre-existing mental and cognitive conditions.[2] The increase in frequency and severity of weather and climate-related disasters calls for urgent knowledge, planning, and action related to supporting people living with dementia throughout these events.[3] However, there remains little understanding and acknowledgment of the negative health consequences resulting from disaster exposure in older adults with ADRD.

Due to a lack of situational awareness, people with dementia are almost entirely dependent on caregivers during the immediate period after a disaster. Throughout the disaster response and recovery period, people living with dementia and their caregivers may experience a disruption in normal routines that are critical to maintaining function within their communities and homes.[4] This can lead to increased behavioral agitation, known as behavioral and psychological symptoms of dementia (BPSD). BPSD can include such symptoms as depression or apathy, anxiety, agitation, aggression, psychosis, sleep disturbances, dysphoria, hallucinations, and delusions.[5-7] Post disaster, medication use may be an expedient way to manage symptoms related to dementia, and the challenging conditions of a disaster may contribute to misuse, manifested by either underuse, overuse, or inappropriate use. The prescribing of some psychotropic medications (e.g., antipsychotics) for BPSD may be used inappropriately as a form of restraint when symptoms worsen.[8]

There are known side effects from BPSD medications specific to people living with dementia. Specifically, some antipsychotics are known to affect adults with dementia; these include sedation, orthostatic hypotension, anticholinergic effects, extrapyramidal symptoms, cardiac arrhythmias, and seizures.[8] In fact, the Food and Drug Administration (FDA) issued a boxed warning concerning the increased risk of sudden cardiac death and cerebrovascular accidents in those with a dementia diagnosis

4

who were prescribed atypical antipsychotics for BPSD in 2005.[9, 10] Boxed warnings were added for first-generation antipsychotics (conventional antipsychotics) for this population after two large cohort studies showed similar risk.[11-13]

Few prior studies have empirically examined the effects of disasters on people living with dementia, and none to our knowledge have examined prescribing patterns during disasters. Therefore, the purpose of this study was to estimate rates of receipt for new, or changes in existing, psychotropic prescription medications post-disaster among fee-for-service Medicare beneficiaries with an ADRD diagnosis.

Methods

Using a combination of administrative claims and hurricane data, this retrospective cohort study examined receipt of psychotropic prescriptions during three recent large-scale hurricanes, Hurricanes Harvey (2017) in Texas, Irma (2017) in Florida, and Florence (2018) in the Carolinas. The study received Institutional Review Board (IRB) approval from the University of Michigan and reporting followed Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.

Data Source and study cohort

Administrative Medicare claims files from 2016-2019, including Medicare Part D, the Master Beneficiary Summary Files (MBSF), MBSF Chronic Conditions Supplement (MBSF-CC), and Medicare Provider Analysis and Review (MedPAR) files were used to create the study sample. Disasters were identified through the Federal Emergency Management Agency's (FEMA) open-source data and were limited to counties, which received individual assistance declarations.[14] The Micromedex Red Book was used to identify antipsychotics (see Supplementary Material).[15] The National Center for Health Statistics (NCHS) Urban Rural classification scheme file was used to identify rural counties.[16]

The study sample was determined using a 10% random sample from Part-D files (Figure 1). Beneficiaries were restricted to those aged 65 or older with fee-for-service Medicare and Medicare Part D residing in states affected by Hurricanes Harvey in 2017 (Texas), Irma in 2017 (Florida and Georgia), and Florence in 2018 (North Carolina and South Carolina). The sample was refined to individuals residing in counties categorized as "exposed" or "non-exposed" during the hurricane month. Exposed counties were those receiving FEMA Individual Assistance (IA) declarations, while non-exposed counties, although in the same states as the disasters, lacked FEMA IA declarations (Figure 2). To identify race, ethnicity, and ADRD diagnoses, we utilized criteria defined by validated algorithms from Research Triangle Institute (RTI) and Chronic Conditions Warehouse (CCW) by CMS.[17, 18]

Beneficiaries with ADRD were identified based on MBSF-CC claims by the end of the calendar year indicator. We excluded beneficiaries without Medicare Part A, B, and D coverage for a 25-month observation period (12 months before and 12 months after the hurricane(s) landfall, along with a 1-month buffer period after the hurricane), as well as decedents during this timeframe. Beneficiaries already on psychotropic medication during the 12-month period prior to hurricanes were also excluded. The sample was further narrowed to those with an ADRD diagnosis at the time of the hurricane.

Outcomes

The primary outcome was a daily count of new psychotropic prescriptions per beneficiary, from Part D claims, residing in exposed and unexposed counties, 12 months after the hurricane landfall. For each Part D claim, the first instance of a psychotropic medication per beneficiary was considered a new prescription claim. New medication prescriptions were identified by sorting all instances of prescription claims by start date per beneficiary, where the first instance was considered as a new medication. New medication was defined as no prior prescription of that psychotropic medication class in the 13-month period before the hurricane (12 months before landfall and a one-month buffer period). For the primary analysis, we focused on antipsychotics, while additional psychotropic medication classes, including antidepressants,

6

anti-dementia, and benzodiazepines, were considered for supplementary analyses (see Supplementary

Table 1 for a complete list).

The secondary outcome was a daily count of increases in the dosage of psychotropic prescriptions. An

increase in dosage was identified based on an increase in the daily strength (in mg) of a previously

prescribed medication. A dosage increase was recorded when a patient's new prescription of the same

medication had a higher daily dose than the preceding fill. To determine the total number of increases per

day, the data were grouped by patient and date, and all dosage increases occurring on the same day were

summed. For instance, if a patient was prescribed 6 mg/day of antipsychotic on the 1st day of the month

and the dosage was increased to 12 mg/day on the 10th day, this would be counted as a dosage increase

on that day. If the same patient was also taking another psychotropic medication, such as an antidementia

or benzodiazepine, and received a dosage increase for that psychotropic medication on the 10th day, each

increase would be counted separately within its respective medication class, resulting in one increase per

class for that day.

Statistical Analyses

We conducted a series of analyses to assess the relationship between hurricane exposure and receipt of

psychotropic prescriptions among people living with dementia. Our primary estimates compared 12-

month post-hurricane prescription drug claims of the exposed and non-exposed people living with

dementia populations for the three hurricanes. Since the dependent variables are daily counts of the

number of claims, we used a negative binomial regression model to account for the overdispersion in the

count data. Estimates were adjusted for age, sex, race/ethnicity, Part D low-income subsidy status,

rurality, and number of Elixhauser comorbidities. We also included month and year fixed effects in the

combined hurricane analysis to adjust for any seasonality or changes in prescribing behavior over time.

For the individual hurricane analyses, we did not include these fixed effects because all beneficiaries

shared the same index date within each hurricane, eliminating the need for time adjustment. All standard

errors are clustered at the beneficiary level. Hurricane-specific estimates for hurricanes Harvey, Irma, and

7

Florence were conducted in order to more directly compare the exposed and non-exposed counties for each hurricane and examine the differences in effects between the hurricanes. Finally, absolute incidences and absolute incidence differences are reported to support understanding of the magnitude of the impact.

Several sub-analyses were conducted. First, to validate the primary estimates, we conducted a robustness check by excluding counties receiving public assistance from the control group. Counties with FEMA Public Assistance (PA) declarations were not removed from the control group for primary estimates. Since beneficiaries in these counties experienced the hurricane's impact to a lesser degree, the previous estimates might underestimate the actual hurricane impact. Second, beneficiaries who migrated before or after the hurricane landfall may experience different outcomes due to factors beyond our analytical control. To ensure that migration patterns did not influence our estimates, we restricted our sample to beneficiaries who remained in their county of residence throughout the 12-month post-hurricane period and conducted our analysis again. All analyses were carried out using Stata version 18 (College Station, Texas, USA).

Results

A total of 70,307 traditional fee-for-service beneficiaries with a dementia diagnosis were included in the study cohort (see Table 1). The development of the study cohort can be seen in Figure 1. The study sample consisted of two groups of older adults with a dementia diagnosis: those who were exposed to one of three large-scale hurricanes (n=32,982), and those who resided in an unaffected county in the same state as the hurricane (n=37,325). The mean age of exposed beneficiaries was 81.5 years (SD = 8.0), and 24,170 (73%) of beneficiaries were of white ethnicity. The mean number of Elixhauser comorbidities was 2.0 (SD = 3.3). Overall, almost 7% (n=2292) of the hurricane-exposed population started a new prescription for any antipsychotic, and almost 5% (n=1572) had a change in their existing prescription (Table 2).

In adjusted analyses conducted over a 12-month period following the three hurricanes, counties exposed to hurricanes had a 10% higher rate of starting new antipsychotic prescriptions daily per beneficiary compared to unexposed counties (IRR: 1.10, 95% CI: 1.04 – 1.17) (Figure 3a). Among beneficiaries who already initiated antipsychotics during the post-hurricane period, counties exposed to hurricanes had a 13% higher daily rate of dosage increases per beneficiary compared to unexposed counties. (IRR: 1.13, 95% CI: 1.04 – 1.22) (Figure 3b)

Analyses conducted by individual hurricanes revealed substantial differences, with the greatest impacts seen in Hurricane Harvey. Among counties exposed to Hurricane Harvey, there was a 21% higher daily rate of new prescriptions for antipsychotics per beneficiary (IRR: 1.21, 95% CI: 1.07 - 1.36) compared to unexposed counties during the 12 months after hurricane landfall. For beneficiaries already prescribed any antipsychotics, the daily rate of dosage increases per beneficiary (IRR: 1.14, 95% CI: 0.97 – 1.35) in exposed areas compared to unexposed areas during the 12-month period following the disaster was not significant.

However, for Hurricane Irma, there was no change in new prescriptions for antipsychotics (IRR: 0.97, 95% CI: 0.88 - 1.08) in exposed counties compared to unexposed counties. For beneficiaries already prescribed any antipsychotics, there was also no change in the daily rate of dosage increases (IRR: 0.97, 95% CI: 0.84 – 1.10) in exposed counties compared to unexposed counties during the 12-month period following the hurricane. For Hurricane Florence, we observed lower rates for both new antipsychotic prescribing (IRR: 0.92, 95% CI: 0.80 - 1.05) and changes in existing prescriptions (IRR: 0.92, 95% CI: 0.76 – 1.11) in exposed counties compared to unexposed counties during the 12-month period following the hurricane, but these associations were not statistically significant at the 0.05 alpha level.

We conducted sub-analyses focusing on beneficiaries who remained within their original county of residence to understand the effects of outmigration. In adjusted analyses conducted over a 12-month

9

period following hurricanes Harvey, Irma, and Florence, counties exposed to these hurricanes had a 9% higher daily rate of new prescriptions per beneficiary for any antipsychotics compared to unaffected counties (IRR: 1.09, 95% CI: 1.03 – 1.17). Additionally, for beneficiaries already on any antipsychotics, the analyses indicated an 11% higher daily rate of dosage increases per beneficiary in exposed counties compared to unexposed counties (IRR: 1.11, 95% CI: 1.02 – 1.21).

In adjusted analyses over a 12-month period following Hurricanes Harvey, Irma, and Florence, the exposed counties had a 16% higher daily rate of initiating new antipsychotic prescriptions per beneficiary compared to unexposed counties, excluding public assistance counties (IRR: 1.16, 95% CI: 1.09 – 1.24). Among beneficiaries who were already prescribed antipsychotics within the 12 months following all hurricanes, there was a 19% higher daily rate of dosage increase prescriptions per beneficiary in exposed areas compared to unexposed areas, excluding public assistance counties (IRR: 1.19, 95% CI: 1.09 – 1.30). These results closely align with our primary findings, indicating robustness and consistency among the outcomes.

In addition to relative incidences, absolute incidence rates and their differences were analyzed to understand the magnitude of the hurricane's impact on antipsychotic prescribing patterns. For every 1,000 beneficiaries living in hurricane-affected counties, the number of new antipsychotic prescriptions initiated each month over the 12 months following landfall ranged from 5.6 to 7.5, with an average of 6.6. In non-affected counties, the monthly rate of new antipsychotic prescriptions ranged from 5.1 to 6.6 per 1,000 beneficiaries, with an average of 5.9. This results in an absolute difference of 0.6, indicating that, on average, there were 0.6 more new prescriptions started each month for every 1,000 beneficiaries in affected areas compared to non-affected areas during the year following the hurricane.

A similar pattern was observed for antipsychotic prescriptions involving dosage increases. Among beneficiaries in hurricane-affected counties, the number of antipsychotic dosage increase prescriptions per

10

month ranged from 4.5 to 6.3 for every 1,000 individuals, with an average of 5.7 over the 12-month period following landfall. In contrast, in non-affected counties, monthly rates ranged from 4.7 to 5.9, with an average of 5.2 per 1,000 beneficiaries. The absolute difference between the two groups was 0.5, indicating that, on average, there were 0.5 more dosage increase prescriptions for antipsychotics each month for every 1,000 beneficiaries in affected areas compared to those in non-affected areas throughout the year after the hurricane.

Discussion

This study evaluated the association between recent large-scale hurricanes and receipt of antipsychotic prescriptions among people living with dementia. We found increases in both new prescriptions and changes in dosage for antipsychotics when examining these three hurricanes together, with the substantial increases seen after Hurricane Harvey. Hurricane Harvey remains one of the most catastrophic disasters of this century, with wind gusts up to 145mph, unprecedented rain (up to five feet of rain was recorded in some places), and subsequent flooding occurring over several days.[19, 20] The resultant effects of the hurricane led to substantial infrastructure disruption, with over 20 temporary hospital closures and over 300,000 customers without power for up to two weeks in the Houston, Texas area.[20] During Hurricane Irma and Florence, damages were associated with high winds and storm surge, and concentrated in less urban areas, which did not result in the same prolonged impact as in Harvey.

Throughout the response and recovery period, people living with dementia and their caregivers may experience loss of functioning of both the community and their home, and with this, a disruption in normal routine. Limited prior evidence has described the impacts of disasters on people living with dementia, with several studies finding that disasters have a negative effect on the health of patients with dementia,[21] including increased hospitalizations and mortality,[22-24] and have described challenges during evacuations.[4, 25] This study highlights the immediate need for prioritization of emergency and disaster planning that targets the unique challenges faced by people living with dementia and their caregivers. The

potential implications of increased antipsychotic prescriptions, in terms of safety and quality of care, are especially important given the known risks associated with antipsychotic use in people living with dementia.

It is possible that beneficiaries who migrated prior to or after the hurricane might have different outcomes based on factors we were not able to adjust for in our analysis. To be certain migration patterns were not driving estimates, we conducted sub-analyses by limiting our sample to beneficiaries who did not migrate out of their county or residence for the entire 12-month period. Our findings in this population showed a higher rate of new prescriptions and dosage increases. These estimates might also have captured long-term effects from continued "exposure" to a county with a disaster declaration.

This study was not without limitations. The study population included beneficiaries with traditional Medicare and Medicare Part D prescription coverage, which may limit generalizability (e.g., Medicare Advantage enrollees or those without Part D coverage). Further, using the Research Triangle Institute Race Code has its own limitations, including not differentiating non-Hispanic Black and Hispanic Black patients. Given that our study found a higher rate of new antipsychotic prescriptions in the exposed counties, the observed higher counts of dosage increases may be at least partially driven by titration following the initiation of new psychotropics, rather than by dose increases in patients already on a stable regimen. Prescription medication claims may include overestimates of medication exposure, in cases where prescriptions were filled but not used, and may also underestimate exposure if insurance claims were not filed for prescription expenses. Finally, as with all observational studies, the possibility of residual confounding cannot be ruled out, although we have adjusted for as many relevant factors as possible. Nevertheless, there is an important need for continued research on the trends of prescribing of psychotropic medications among people living with dementia during both disaster and post-disaster settings. Knowledge of prescribing patterns for older adults with ADRD can better inform short and long-term disaster planning for this unique population.

12

Conclusion

Extreme weather events such as hurricanes continue to have devastating effects on affected communities.

Populations that are most in need of complex healthcare, such as those with dementia, are typically the

most affected by the disruption from these events, highlighting the importance of consistent access to

healthcare and appropriate use of psychotropic medications during the disaster response and recovery

periods. Components of readiness for populations living with dementia should be adequate, equitable,

efficient, and as individualized as possible to facilitate care and treatment in the event of a disaster.

Conflicts of Interest

Authors report no conflicts of interest.

Data Availability

The use of CMS data in this study was covered under a Data Use Agreement (DUA) and cannot be shared due to DUA restrictions. Information about analytic methods will be available upon reasonable request to the corresponding author, and detailed descriptions are provided in the Methods section of the paper. The studies reported in the paper were not preregistered.

Author Contributions

Authorship of this paper complies with ICJME criteria. S. A. Bell conceptualized and led all aspects of the study. J. P. Donnelly, M. Ghous, and S. Venkatesh developed the methodology, conducted statistical analyses, and contributed to manuscript writing. A. B. Coe contributed to methodology and manuscript writing. A. Rojas contributed to manuscript writing and project team organization.

14

References

1. 2024 Alzheimer's disease facts and figures. Alzheimers Dement. 2024;20(5):3708-821. Epub 20240430. doi: 10.1002/alz.13809.
2. National Alzheimers and Dementia Resource Center. Emergency Preparedness Toolkit for People Living with Dementia. Washington, D.C.: U.S. Department of Health and Human Services, Administration for Community Living, 2022.
3. Zuelsdorff M, Limaye VS. A Framework for Assessing the Effects of Climate Change on Dementia Risk and Burden. The Gerontologist. 2024;64(3). doi: 10.1093/geront/gnad082.
4. Peterson LJ, Hackett SE, Dobbs D, Haley WE. Dementia Caregivers' Perspectives on Disaster Preparedness: Barriers, Resources, and Recommendations. The Gerontologist. 2024;64(3). doi: 10.1093/geront/gnad076.
5. Kales HC, Gitlin LN, Lyketsos CG. Assessment and management of behavioral and psychological symptoms of dementia. Bmj. 2015;350:h369. Epub 20150302. doi: 10.1136/bmj.h369.
6. Steinberg M, Shao H, Zandi P, Lyketsos CG, Welsh-Bohmer KA, Norton MC, Breitner JC, Steffens DC, Tschanz JT. Point and 5-year period prevalence of neuropsychiatric symptoms in dementia: the Cache County Study. Int J Geriatr Psychiatry. 2008;23(2):170-7. doi: 10.1002/gps.1858.
7. Lyketsos CG, Carrillo MC, Ryan JM, Khachaturian AS, Trzepacz P, Amatniek J, Cedarbaum J, Brashear R, Miller DS. Neuropsychiatric symptoms in Alzheimer's disease. Alzheimers Dement. 2011;7(5):532-9. doi: 10.1016/j.jalz.2011.05.2410.
8. Parsons C. Polypharmacy and inappropriate medication use in patients with dementia: an underresearched problem. Ther Adv Drug Saf. 2017;8(1):31-46. Epub 20161001. doi: 10.1177/2042098616670798.
9. Lenzer J. FDA warns about using antipsychotic drugs for dementia. BMJ. 2005;330(7497):922. doi: 10.1136/bmj.330.7497.922-c.
10. U.S. Food & Drug Administration. Public health advisory: Deaths with antipsychotics in elderly patients with behavioral disturbances. Washington, D.C.2005 [February 28, 2023]. Available from: https://wayback.archive-it.org/7993/20170113112252/http://www.fda.gov/Drugs/DrugSafety/PostmarketDrugSafetyInformationforPatientsandProviders/ucm053171.htm.
11. Gill SS, Rochon PA, Herrmann N, Lee PE, Sykora K, Gunraj N, Normand SL, Gurwitz JH, Marras C, Wodchis WP, Mamdani M. Atypical antipsychotic drugs and risk of ischaemic stroke: population based retrospective cohort study. BMJ. 2005;330(7489):445. Epub 20050124. doi: 10.1136/bmj.38330.470486.8F.
12. Schneeweiss S, Setoguchi S, Brookhart A, Dormuth C, Wang PS. Risk of death associated with the use of conventional versus atypical antipsychotic drugs among elderly patients. CMAJ. 2007;176(5):627-32. doi: 10.1503/cmaj.061250.
13. Schneider LS, Dagerman KS, Insel P. Risk of death with atypical antipsychotic drug treatment for dementia: meta-analysis of randomized placebo-controlled trials. Jama. 2005;294(15):1934-43. doi: 10.1001/jama.294.15.1934.
14. Federal Emergency Management Agency. Disaster Declarations 2022 [February 28, 2022]. Available from: https://www.fema.gov/disasters.
15. Merative. Micromedex RED BOOK 2024 [August 27, 2024]. Available from: https://www.merative.com/documents/brief/micromedex-redbook-brochure.
16. National Center for Health Statistics. NCHS Urban-Rural Classification Scheme for Counties 2023 [August 27, 2024]. Available from: https://www.cdc.gov/nchs/data_access/urban_rural.htm.
17. Centers for Medicare & Medicaid Services. Chronic Conditions Data Warehouse Chronic condition data warehouse: Medicare administrative data user guide 2021 [May 22, 2021]. Available from: https://www.ccwdata.org/documents/10280/19002246/ccw-medicare-data-user-guide.pdf.
18. ResDAC. Research Triangle Institute (RTI) race code. 2024 [August 27, 2024]. Available from: https://resdac.org/cms-data/variables/research-triangle-institute-rti-race-code

15

19. Blake ES, Zelinsky DA. National Hurricane Center Tropical Cycle Report: Hurricane Harvey. Miami, Florida: National Hurricane Center, 2018.

20. Texas Hospital Association. Texas Hospital Association Hurricane Harvey Analysis. Houston, Texas: 2018.

21. Miyagawa A, Kunii Y, Gotoh D, Hoshino H, Kakamu T, Hidaka T, Kumakura T, Fukushima T, Yabe H, Kawakatsu S. Effects of the Great East Japan Earthquake and the Fukushima Daiichi Nuclear Power Plant accident on behavioural and psychological symptoms of dementia among patients. Psychogeriatrics. 2021;21(5):709-15. Epub 20210605. doi: 10.1111/psyg.12728.

22. Parks RM, Benavides J, Anderson GB, Nethery RC, Navas-Acien A, Dominici F, Ezzati M, Kioumourtzoglou MA. Association of Tropical Cyclones with County-Level Mortality in the US. Jama. 2022;327(10):946-55. doi: 10.1001/jama.2022.1682.

23. Parks RM, Anderson GB, Nethery RC, Navas-Acien A, Dominici F, Kioumourtzoglou MA. Tropical cyclone exposure is associated with increased hospitalization rates in older adults. Nat Commun. 2021;12(1):1545. Epub 20210309. doi: 10.1038/s41467-021-21777-1.

24. Bell SA, Miranda ML, Bynum JPW, Davis MA. Mortality After Exposure to a Hurricane Among Older Adults Living with Dementia. JAMA Netw Open. 2023;6(3):e232043. Epub 20230301. doi: 10.1001/jamanetworkopen.2023.2043.

25. Holle CL, Turnquist MA, Rudolph JL. Safeguarding older adults with dementia, depression, and delirium in a temporary disaster shelter. Nurs Forum. 2019;54(2):157-64. Epub 20181209. doi: 10.1111/nuf.12309.

Tables and Figures

Table 1. Characteristics of ADRD populations exposed to a hurricane vs unexposed

	Exposed	Unexposed	p-value[a]
Unique Beneficiaries, _n_	32,982	37,325	
Beneficiaries taking Antipsychotics, _n_			
Begin New Prescription	2,292	2,354	
Dosage Increases	1,572	1,638	
Sociodemographic characteristics			
Age in years, Mean (SD)	81.5 (8.0)	81.0 (7.9)	<0.001
Sex, _n_ (%)			0.007
Male	11,107 (33.7)	12,211 (32.7)	
Female	21,875 (66.3)	25,114 (67.3)	
Race and Ethnicity, _n_ (%)			
White	24,170 (73.3)	27,851 (74.6)	<0.001
Black	3,435 (10.4)	4,689 (12.6)	<0.001
Hispanic	4,463 (13.5)	4,039 (10.8)	<0.001
Other/multiple	914 (2.8)	746 (2.0)	<0.001
Low Income Subsidy, _n_ (%)			0.033
Eligible for low-income subsidy at least once	12,850 (39.0)	14,836 (39.8)	
Never Eligible for low-income subsidy	20,132 (61.0)	22,489 (60.3)	
Number of Elixhauser comorbidities, Mean (SD)	2.0 (3.3)	1.9 (3.1)	<0.001

Abbreviations: ADRD, Alzheimer's disease and related dementias; SD, standard deviation.

[a]: chi-squared test used to compare proportions; t-test used to compare means

Table 2. Number of ADRD Beneficiaries (12-month post-hurricane) taking antipsychotics with at least one of the prescription outcomes

	Exposed	Unexposed
All Hurricanes, n (%)		
Begin New Prescription	2292 (6.9)	2354 (6.3)
Increase in Dosage	1572 (4.8)	1638 (4.4)
Total Beneficiaries [a]	**32,982**	**37,325**
Harvey, n (%)		
Begin New Prescription	393 (6.7)	990 (5.6)
Increase in Dosage	243 (4.1)	663 (3.8)
Total Beneficiaries [a]	**5,902**	**17,585**
Irma, n (%)		
Begin New Prescription	1587 (7.2)	639 (7.2)
Increase in Dosage	1111 (5.0)	452 (5.1)
Total Beneficiaries [a]	**22,183**	**8,899**
Florence, n (%)		
Begin New Prescription	312 (6.4)	725 (6.7)
Increase in Dosage	218 (4.5)	523 (4.8)
Total Beneficiaries [a]	**4,897**	**10,841**

Abbreviations. ADRD, Alzheimer's disease and related dementia.
[a] Entire study population of beneficiaries who initiated any class of psychotropic medication during the 12-month post-hurricane period.

18

Figure 1. Study Cohort Diagram
Alt Text: Flowchart diagram showing participant selection. Boxes represent inclusion/exclusion criteria and cohort subgroups, connected by arrows indicating progression from initial sample to final sample.

Figure 2. Map of Exposed Counties for Hurricane Harvey, Irma, and Florence
Alt Text: Choropleth map of Southern U.S. counties shaded in varying blues to represent data values. States include Texas, Georgia, Florida, and others. No labels or patterns shown.

Figure 3. Forest Plot for (a) New Prescriptions and (b) Dosage Increase Prescriptions.
Alt Text: Forest plot showing incident rate ratio (IRR) in exposed vs. unexposed counties (12-month post-hurricane) for (a) new antipsychotic prescriptions, and (b) dosage increase prescriptions.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

```
┌──────────────────────────┐
│ 10,889,773 Medicare fee-  │
│ for-service beneficiaries │      ┌──────────────────────────┐
│ with Part D coverage      │      │ 9,194,753 beneficiaries   │
└──────────────────────────┘      │ dropped for not being in  │
                                   │ an "exposed" or "non-     │
                                   │ exposed" county at the    │
                                   │ time of the hurricane     │
                                   └──────────────────────────┘
┌──────────────────────────┐
│ 1,695,020 beneficiaries   │      ┌──────────────────────────┐
└──────────────────────────┘      │ 1,040,834 beneficiaries   │
                                   │ dropped for not having    │
                                   │ continuous part A, B and  │
                                   │ D coverage for 25-month   │
                                   │ observation period        │
                                   └──────────────────────────┘
┌──────────────────────────┐
│ 654,186 beneficiaries     │      ┌──────────────────────────┐
└──────────────────────────┘      │ 37,831 beneficiaries      │
                                   │ dropped from post-        │
                                   │ hurricane period for      │
                                   │ already being on          │
                                   │ psychotropic medication   │
                                   │ within the 12 months      │
                                   │ before the hurricane      │
                                   └──────────────────────────┘
┌──────────────────────────┐
│ 616,355 beneficiaries     │      ┌──────────────────────────┐
└──────────────────────────┘      │ 546,048 beneficiaries     │
                                   │ with no ADRD diagnosis in │
                                   │ year of hurricane dropped │
                                   └──────────────────────────┘
┌──────────────────────────┐
│ 70,307 beneficiaries      │
└──────────────────────────┘
```

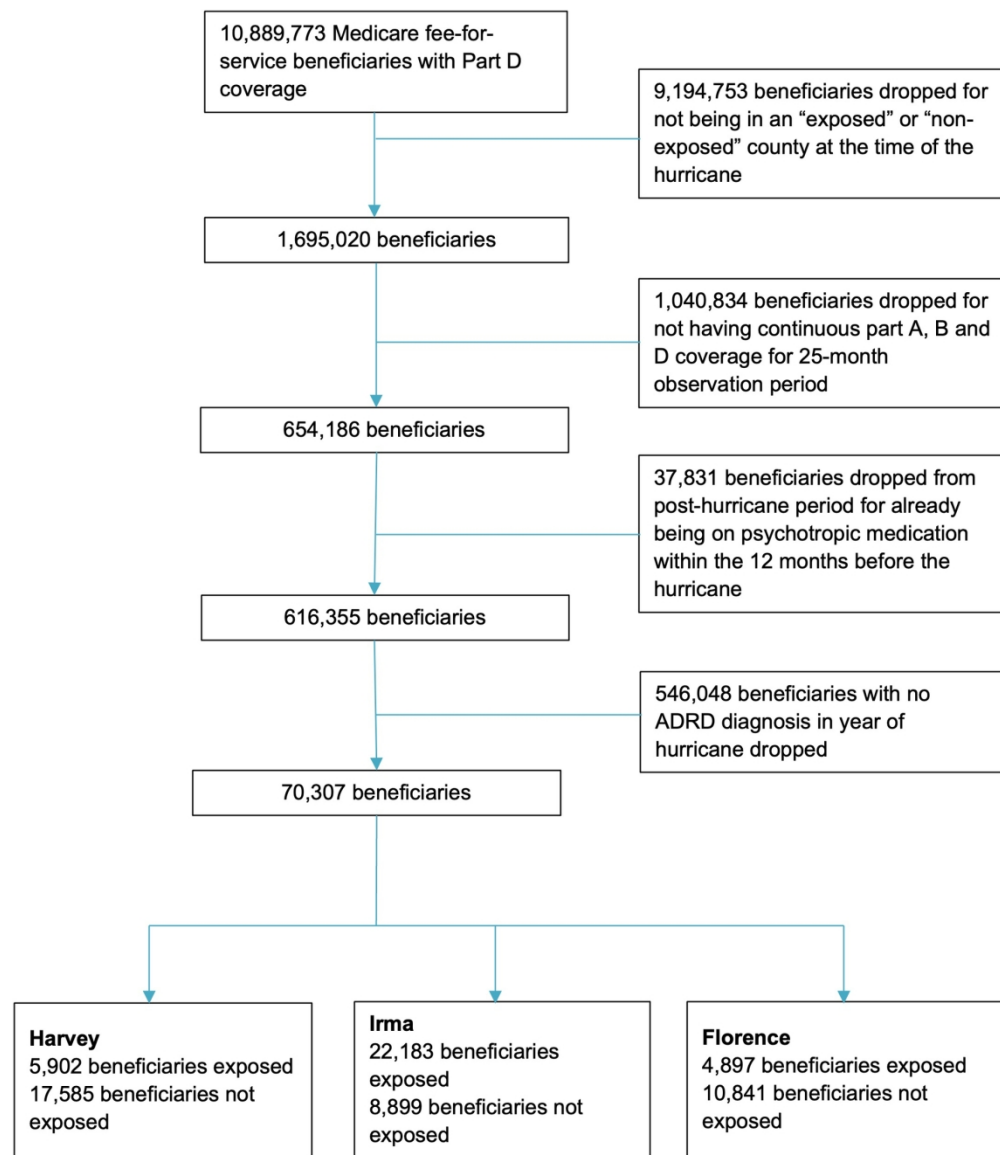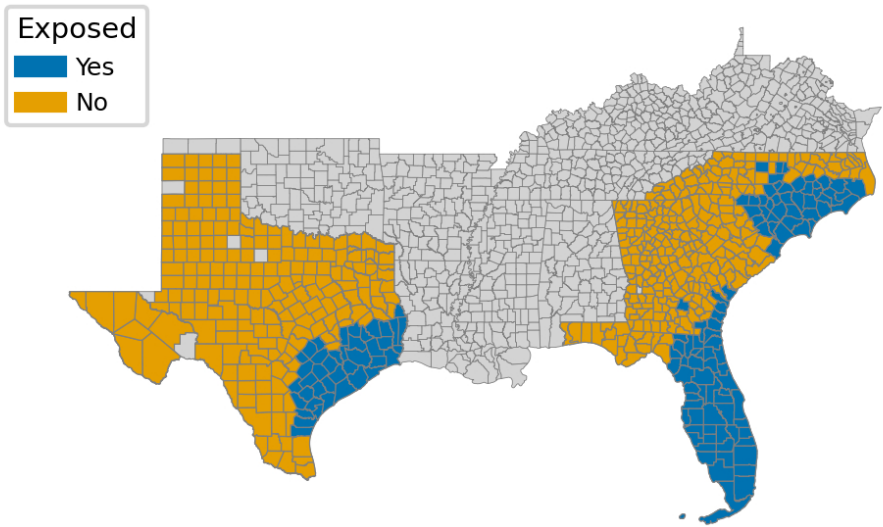| Harvey	Irma	Florence
5,902 beneficiaries exposed	22,183 beneficiaries exposed	4,897 beneficiaries exposed
17,585 beneficiaries not exposed	8,899 beneficiaries not exposed	10,841 beneficiaries not exposed

Figure 1. Study Cohort Diagram
Alt Text: Flowchart diagram showing participant selection. Boxes represent inclusion/exclusion criteria and cohort subgroups, connected by arrows indicating progression from initial sample to final sample.

166x191mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

US Counties: Hurricane Exposure (Harvey, Irma, Florence)

States: Texas, Florida, Georgia, North & South Carolina

Map of Exposed Counties for Hurricane Harvey, Irma and Florence

86x63mm (300 x 300 DPI)

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

(a) New prescriptions

All Hurricanes
IRR: 1.10 (CI: 1.04, 1.17)

Hurricane Harvey
IRR: 1.21, (CI: 1.07, 1.36)

Hurricane Irma
IRR: 0.97 (CI: 0.88, 1.08)

Hurricane Florence
IRR: 0.92 (CI: 0.80, 1.05)

Incidence Rate Ratio (log-scale)

(b) Dosage increase prescriptions

All Hurricanes
IRR: 1.13 (CI: 1.04, 1.22)

Hurricane Harvey
IRR: 1.14, (CI: 0.97, 1.35)

Hurricane Irma
IRR: 0.97 (CI: 0.84, 1.10)

Hurricane Florence
IRR: 0.92 (CI: 0.76, 1.11)
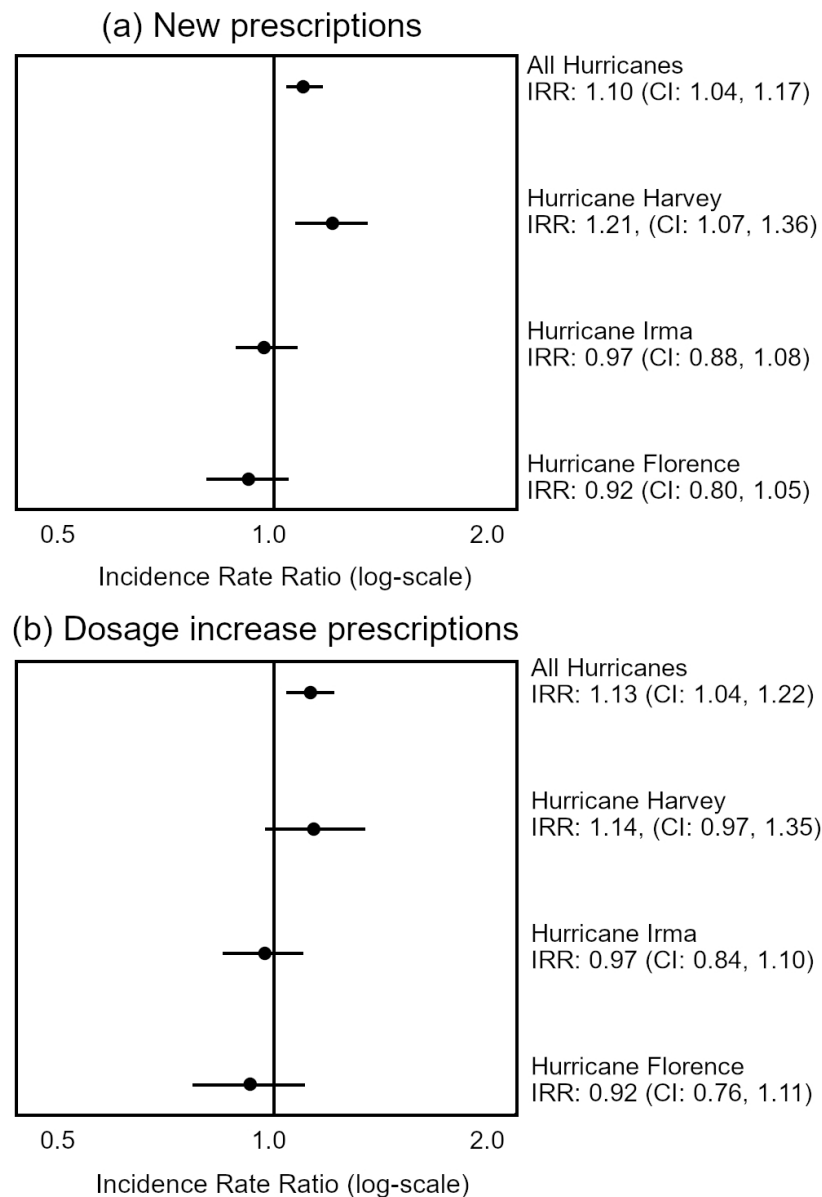
Incidence Rate Ratio (log-scale)

Figure 3. Forest Plot for (a) New Prescriptions and (b) Dosage Increase Prescriptions.
Alt Text: Forest plot showing incident rate ratio (IRR) in exposed vs. unexposed counties (12-month post-hurricane) for (a) new antipsychotic prescriptions, and (b) dosage increase prescriptions.

88x124mm (300 x 300 DPI)