This is an overview of SAS programs used in the analysis for “Benzodiazepine Use and the Risk of Dementia,” by Geoffrey Joyce, Patricia Ferido, Johanna Thunell, Bryan Tysinger and Julie Zissimopoulos published in the *Alzheimer’s & Dementia* in 2022. The programs are meant to run in order, with later programs relying on data created by earlier ones. A header program, not included, held most librefs so users will have to replace with their own.

**Sample**

clmids.sas

* Source data: Medicare Part A, B, and D claims - specifically carrier, dme, hha, hospice, inpatient, outpatient, SNF and Part D claims
* Creates: clmid[year]
* creates annual files flagging whether a beneficiary has a claim in that year from any of the files

bene\_demog2020.sas

* Source data: Medicare beneficiary summary files, clmid[year]
* Creates: bene\_demogall2020, bene\_demog2020
* creates a file of beneficiary non-time-varying demographics across all years of available data

p2egwp2018.sas

* Source data: Medicare Part D plan characteristics files
* Creates: p2egwp.fmt
* creates a format identifying different Part D plans made up of contract ID, plan ID and EGWP indicator

bene\_status\_year2020.sas, statyr.sas, bene\_status.fmt, p2egwp.fmt

* Source data: Medicare beneficiary summary files and harmonized files from bene\_demog2018
* Creates: bene\_status\_year[year]
* summarizes enrollment data.sas, HMO status.sas, dual eligibility.sas, Part D plan by year

sample\_selection\_3yrFFSptd0620.sas

* Source data: harmonized MBSF files (bene\_status\_year[year] and bene\_demog2020)
* Creates: samp\_3yrffsptd\_0620
* Summarize sample information and identify sample as those 67+ and enrolled in FFS and Part D in years *t-2, t-1,* and *t*

comorbidities.sas

* Source data: Medicare chronic conditions and other conditions files, bsfcc[year]
* Creates: cc9917
* Gets first date of all the chronic conditions to use as controls

other\_comorbidities.sas

* Source data: Medicare chronic conditions and other conditions files, otcc[year]
* Creates: otcc0017
* Gets first date of all the other chronic conditions to use as controls

enhancedplan.sas

* Source data: MBSF Summary files 2006-2013, Plan Characteristics 2006-2013
* Creates: bene\_specialplans\_0613
* Identify beneficiaries in EGWP/special plans that cover benzos prior to 2013

**Identify Dementia**

identify\_ad\_drug\_ndcs.sas

* Source data: Part D drug characteristics extract (pdch[year].drug\_char\_[year]\_extract)
* Creates: ad\_ndc2019
* Identifies all NDC’s for the following drugs used to treat dementia symptoms – donepezil, galantamine, memantine, rivastigmine

ADdrugs\_2019.sas

* Source data: Part D Events files (pde[year].pde\_demo\_[year]\_0[mo]), ad\_ndc
* Creates: ADdrugs\_0619, ADdrugs\_dts\_0619
* Pulls all drug claims for drugs used to treat dementia symptoms and creates a claim-level and date-level file

pull\_dementia\_dx\_2019q4.sas

* Source data: demdx.fmt, Part A and B claims – carrier, outpatient, inpatient, SNF, HHA
* Creates: dementia\_dx\_bcarrier\_[year], dementia\_dx\_hha\_[year], dementia\_dx\_inpatient\_[year], dementia\_dx\_outpatient\_[year], dementia\_dx\_snf\_[year]
* Pulls all dementia claims from the Part A & B files

dementia\_dxdt\_2021q4.sas

* Source data: demdx.fmt, dementia\_dx\_bcarrier\_[year], dementia\_dx\_hha\_[year], dementia\_dx\_inpatient\_[year], dementia\_dx\_outpatient\_[year], dementia\_dx\_snf\_[year]
* Creates: dementia\_dt\_1999\_2021
* Combines all dementia claims and makes it patient date-level

Build\_ADRD\_analytical\_2020.sas

* Source data: dementia\_dt\_1999\_2019, ADdrugs\_dts\_0619, bene\_demog2020
* Creates: ad.adrdincv\_1999\_2020
* Build dementia incidence dates using different methods of verification

**Prep**

Drug Pulls

readin\_atc\_drugpull.sas -> bpsd\_ndcs.sas

* Source data: atc\_drug\_classes.csv
* Creates: antipsych\_ndclist\_multum
* Read in created list of NDC’s for BPSD drugs using the Multum drug database

pull\_bpsd\_pde20062018.sas

* Source data: Part D Events 2006-2018, antipsych\_ndclist\_multum
* Creates: bpsd\_pde0618
* Pulls BPSD drug claims 2006-2018

explore\_fdb\_antipsych.sas -> antipsych\_ndcs.sas

* Source data: Schaeffer Center created extract of the First DataBank Drug Database files
* Creates: fdb\_antipsych
* Identifies antipsychotic drugs and flag them from FDB

pull\_fdb\_antipsych.sas

* Source data: Part D Events 2006-2018, fdb\_antipsych
* Creates: antipsych\_pde0617
* Pulls antipsych drug claims 2006-2018

benzo\_ndcs.sas

* Source data: Schaeffer Center created extract of the First DataBank Drug Database files, Part D drug characteristics files 2006-2017
* Creates: benzo\_ndcs
* Identify NDC’s for benzodiazepines from Part D characteristics files and FDB

class1benzo\_pdepull.sas

* Source data: benzo\_ndcs, Part D events 2006-2017, RIF inpatient and SNF files
* Creates: benzos\_0617, class1benzo\_2006\_2017p
* Pull benzo drug claims and summarize use

zdrug\_pdepull.sas

* Source\_data: benzos\_0617, RIF inpatient and SNF files
* Creates: zdrug\_2006\_2017p
* Pull z-drug drug claims and summarize use

pull\_opioid\_rx.sas

* Source data: Schaeffer Center created list of NDCs related to Opioids, Part D Events 2006-2017, RIF inpatient and SNF files
* Creates: opioid\_pde0617
* Pulls opioid drug claims

opioid\_rx\_push.sas

* Source data: opioid\_pde0617
* Creates: opioid\_2006\_2017p
* Summarize opioid use

Diagnosis Pulls

pull\_depranxi\_dx.sas

* Source data: RIF carrier, SNF, inpatient, outpatient, HHA claims 1999-2018
* Creates: depranxi\_dxdt\_1999\_2018
* Pull depression and anxiety claims

pull\_downsyndrome\_dx.sas

* Source data: RIF carrier, SNF, inpatient, outpatient, HHA claims 1999-2018
* Creates: downsyn\_dxdt\_1999\_2018
* Pull down syndrome claims

pull\_insomnia\_dx.sas

* Source data: RIF carrier, SNF, inpatient, outpatient, HHA claims 1999-2018
* Creates: insomnia\_dxdt\_1999\_2018
* Pull insomnia claims

pull\_mnd\_dx.sas

* Source data: RIF carrier, SNF, inpatient, outpatient, HHA claims 1999-2018
* Creates: mnd\_dxdt\_1999\_2018
* Pull motor neuron disease claims

pull\_pain\_dx.sas

* Source data: RIF carrier, SNF, inpatient, outpatient, HHA claims 1999-2018
* Creates: pain\_dxdt\_1999\_2018
* Pull pain claims

**Analysis**

casecontrol\_3to1.sas

* Source data: mnd\_dxdt\_1999\_2018, downsyn\_dxdt\_1999-2019, addrugs\_dts\_0619, bene\_specialplans\_0613, samp\_3yrffsptd\_0620, class1benzo\_2006\_2017p, otcc0017, adrdincv\_1999\_2020
* Creates: casecontrols\_3to1\_[year]
* Create cohorts of a matched case-control sample matching those with ADRD to 3 non-ADRD beneficiaries on race, sex, and 5-year age-bands

adrdv\_logit\_3to1.sas

* Source data: insomnia\_dxdt\_1999\_2018, addrugs\_dts\_0617, antipsych\_pde0617, depranxi\_dxdt\_1999\_2018, casecontrols\_3to1\_[year], otcc0017, cc9917, class1benzo\_2006\_2017p
* Run sample characteristics and logistic regressions looking at benzo use in case-control matched cohorts

benzoforpain\_adrd2018\_inc.sas

* Source data: insomnia\_dxdt\_1999\_2018, depranxi\_dxdt\_1999\_2018, bpsd\_pde0618, pain\_dxdt\_1999\_2018, samp\_3yrffsptd\_0620, adrdincv\_1999\_2020, class1benzo\_2006\_2017p, otcc0017, cc9917, opioid\_2006\_2017p, zdrug\_2006\_2017p
* Creates: benzoforpain\_5to1\_adrdunv2020, benzoforpain\_5to1\_adrdv2018
* Impact of benzo use for those using it for pain, look at verified dementia in 2018 and unverified dementia in 2020

benzoforpain\_adrdcohorts\_inc.sas

* Source data: insomnia\_dxdt\_1999\_2018, depranxi\_dxdt\_1999\_2018, bpsd\_pde0618, pain\_dxdt\_1999\_2018, samp\_3yrffsptd\_0620, adrdincv\_1999\_2020, class1benzo\_2006\_2017p, otcc0017, cc9917, opioid\_2006\_2017p, zdrug\_2006\_2017p
* Impact of benzo use for those using it for pain with a pooled sample of pain dx in 2013, 2014 & 2015, looking at verified dementia in 2018 and unverified dementia in 2020

benzo\_v\_nonbenzo\_mortality.sas

* Source data: bene\_specialplans\_0613, class1benzo\_2006\_2017p
* Odds ratios of verified dementia by mortality, by those who survived and those who died