This is an overview of SAS programs used in the analysis for “COVID-19 hospitalization and mortality in community-dwelling racially and ethnically diverse persons living with dementia,” by Johanna Thunell, Patricia Ferido, and Julie Zissimopoulos published in the *Journal of the American Geriatrics Society* in 2023. 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\_demog2021.sas

* Source data: Medicare beneficiary summary files, clmid[year]
* Creates: bene\_demogall2021, bene\_demog2021
* 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\_year2021.sas, statyr.sas, bene\_status.fmt, p2egwp.fmt

* Source data: Medicare beneficiary summary files and harmonized files from bene\_demog2021
* Creates: bene\_status\_year[year]
* summarizes enrollment data.sas, HMO status.sas, dual eligibility.sas, Part D plan by year

sample\_selection\_3yrFFSptd0621.sas

* Source data: harmonized MBSF files (bene\_status\_year[year] and bene\_demog2021)
* Creates: samp\_3yrffsptd\_0621
* 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

ltc\_pos0620.sas

* Source data: RIF carrier files 2006 to 2020
* Creates: ltc\_poscarline\_2006- ltc\_poscarline\_2020
* Identify all POS claims with an LTC code

ltc\_partd0619.sas

* Source data: Part D pharmacy characteristics files 2006 to 2019
* Creates: pdeltc2006-pdeltc2019
* Identify all Part D claims from an LTC pharmacy

ltc\_prcdr0620.sas

* Source data: RIF carrier, inpatient, outpatient, SNF, HHA claims 2006 to 2020
* Creates: ltc\_prcdr\_2006-ltc\_prcdr\_2020
* Identify all LTC procedure codes from 2006 to 2020

ltc\_0620.sas

* Source data: ltc\_prcdr\_2006-ltc\_prcdr\_2020, ltc\_poscarline\_2006-ltc\_poscarline\_2020, pdeltc2006-pdeltc2020, RIF SNF claims
* Creates: ltc\_all2006-ltc\_all2020, ltc2006\_bene-ltc2020\_bene
* Combine LTC information from procedure, pharmacy claims, and POS codes and make beneficiary level

cci\_icd9\_10\_macro.sas

* Source data: code from Manitoba <http://mchp-appserv.cpe.umanitoba.ca/viewConcept.php?conceptID=1098>
* Macro for CCI calculation from Manitoba

cci\_ffsptd\_janapr\_21.sas

* Source data: RIF inpatient, outpatient, HHA, SNF, carrier 2020, samp\_1yrffsptd\_0621
* Creates: cci\_ffsptd\_bene20\_mardec
* Calculate CCI for 2020 using the March to December diagnoses in 2020

cci\_ffsptd\_mardec\_20.sas

* Source data: RIF inpatient, outpatient, HHA, SNF, carrier 202, samp\_3yrffsptd\_0621
* Creates: cci\_ffsptd\_bene21\_janapr
* Calculate CCI for 2021 using the January to April diagonses in 2021

**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\_2021q4.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\_2021.sas

* Source data: dementia\_dt\_1999\_2021, ADdrugs\_dts\_0619, bene\_demog2021
* Creates: dadrdincv\_1999\_2021
* Build dementia incidence dates using different methods of verification

**Prep**

Diagnosis/Outcome Pulls

covid\_dx.sas, covid\_dx2021.sas

* Source data: RIF carrier, HHA, inpatient, outpatient, SNF claims
* Creates: coviddx\_2017\_2020, coviddx\_snf\_2017\_2020, coviddx\_2021, coviddx\_snf\_2021
* Pull COVID DX from 2017 to 2021

get\_cc\_codes.sas, cc\_2021.sas

* Source data: RIF carrier, HHA, inpatient, outpatient, SNF claims
* Creates: bene\_diabetes\_ffsinc, bene\_hyperl\_ffsinc, bene\_hypert\_ffsinc, bene\_strketia\_ffsinc, bene\_atf\_ffsinc, bene\_ami\_ffsinc
* Get Icd codes for comorbid conditions and pull from claims

physician\_events, physician\_events2021.sas

* Source data: RIF carrier claims 2017-2021
* Creates: phys\_events\_2017\_2020, phys\_events\_2021
* Pull physician claims

inpatient\_stays.sas, inpatient\_stays2021.sas

* Source data: RIF inpatient claims 2017-2021
* Creates: acute\_ip\_2017\_2020, acute\_ip\_2021
* Pull inpatient visits

er\_visits.sas, er\_visits2021.sas

* Source data: RIF inpatient revenue center files 2017-2021
* Creates: er\_visits\_2017\_2020, er\_visits\_2021
* Pull ER visits

telehealth\_modifiers.sas, telehealth\_modifiers2021.sas

* Source data: RIF inpatient, outpatient, carrier, SNF, HHA base and revenue claims 2017-2021
* Creates: telemod\_benemonth, telemod\_benemonth2021
* Pull all claims with telehealth modifier on procedure codes

telehealth.sas, telehealth2021.sas

* Source\_data: RIF inpatient, outpatient, carrier, HHA, SNF claims
* Creates: temp.telehealthprcdr\_2017\_2020, temp.telehealthprcdr\_2021
* Pull all claims with procedure code for telehealth visit

outcomes\_monthly\_setup.sas

* Source data: coviddx\_2017\_2020, telehealthprcdr\_2017\_2020, acute\_ip\_2017\_2020, phys\_events\_2017\_2020, er\_visits\_2017\_2020
* Creates: covid\_benemonth, telehealth\_benemonth, acuteip\_benemonth, phys\_benemonth, er\_benemonth
* Make claim-level outcome files monthly

outcomes\_monthly\_setup2021.sas

* Source data: coviddx\_2021, telehealthprcdr\_2021, acute\_ip\_2021, phys\_events\_2021, er\_visits\_2021
* Creates: covid\_benemonth2021, telehealth\_benemonth2021, acuteip\_benemonth2021, phys\_benemonth2021, er\_benemonth2021
* Make claim-level outcome files monthly

**Analysis**

analytical\_build\_ptd19.sas

* Source data: samp\_3yrffsptd\_0621, adrdincv\_1999\_2021, ltc2015\_bene-, ltc2020\_bene, covid\_benemonth, telehealth\_benemonth, acuteip\_benemonth, er\_benemonth, phys\_benemonth, telemod\_benemonth, bene\_status\_year2017-, bene\_status\_year2020, cci\_ffsptd\_bene0720\_marsep, MBSF chronic condition files 2017-2020
* Creates: samp\_monthly\_wcovid
* Create monthly dataset that feeds into yearly one

analytical\_build\_2021.sas

* Source data: samp\_3yrffsptd\_0621, adrdincv\_1999\_2021, ltc2019\_bene, ltc2020\_bene, ltc2021\_bene, covid\_benemonth2021, telehealth\_benemonth2021, acuteip\_benemonth2021, er\_benemonth2021, phys\_benemonth2021, telemod\_benemonth2021, bene\_status\_year2021, bene\_diabetes\_ffsinc, bene\_hyperl\_ffsinc, bene\_hypert\_ffsinc, bene\_strketia\_ffsinc, bene\_atf\_ffsinc, bene\_ami\_ffsinc, cci\_ffsptd\_bene21\_janapr
* Creates: samp\_monthly\_wcovid2021
* Create monthly dataset that feeds into yearly one for 2021 sample

covidplwd\_models\_final.sas

* Source data: samp\_monthly\_wcovid, MBSF chronic conditions files 2017-2020, MBSF ABCD summary files 2017-2020, ziptozcta0719, medinc\_1119, educ\_1119, coviddx\_2017\_2020
* Creates: covidmodelprep
* Create original analytical dataset that only looked at first COVID dx instead of any COVID dx

covidanyplwd\_models.sas

* Source data: coviddx2017\_2020, coviddx\_snf\_2017-, coviddx\_snf\_2020, samp\_monthly\_wcovid, covidmodelprep, MBSF ABCD 2014-2019 Summary Files
* Creates: covidmodelprepany, covidmodel\_urbanrural3
* Create analytical dataset and run models for any COVID, COVID hospitalization, death and death after hospitalization

covidanyplwd\_models\_sample.sas

* Source data: RIF 2020 Inpatient claims, covidmodel\_urbanrural3
* Run sample characteristics on analytical sample

covidmodels\_byrace.sas

* Source data: covidmodelprepany
* Creates: benzoforpain\_5to1\_adrdunv2020, benzoforpain\_5to1\_adrdv2018
* Run models by race

rr\_covidanyplwd\_models2021.sas

* Source data: coviddx\_2021, coviddx\_snf\_2021, samp\_monthly\_wcovid2021, MBSF ABCD 2014-2021 Summary Files, ziptozcta0719, medinc\_1119, educ\_1119, cci\_ffsptd\_bene21\_janapr, urbanruralcont, RIF 2021 inpatient claims
* Creates: rr\_covidmodelprepany\_2021
* Run models for a period in 2021 from January to March

rr\_covariate\_tables.sas

* Source data: covidmodelprepany, rr\_covidmodelprepany\_2021
* Run covariate descriptions for each model subsample