Senior Thesis: Deaths in Pennsylvania Prisons

Zhenzhen Liu (zhenzhel@andrew.cmu.edu)
Advisor: Robin Mejia

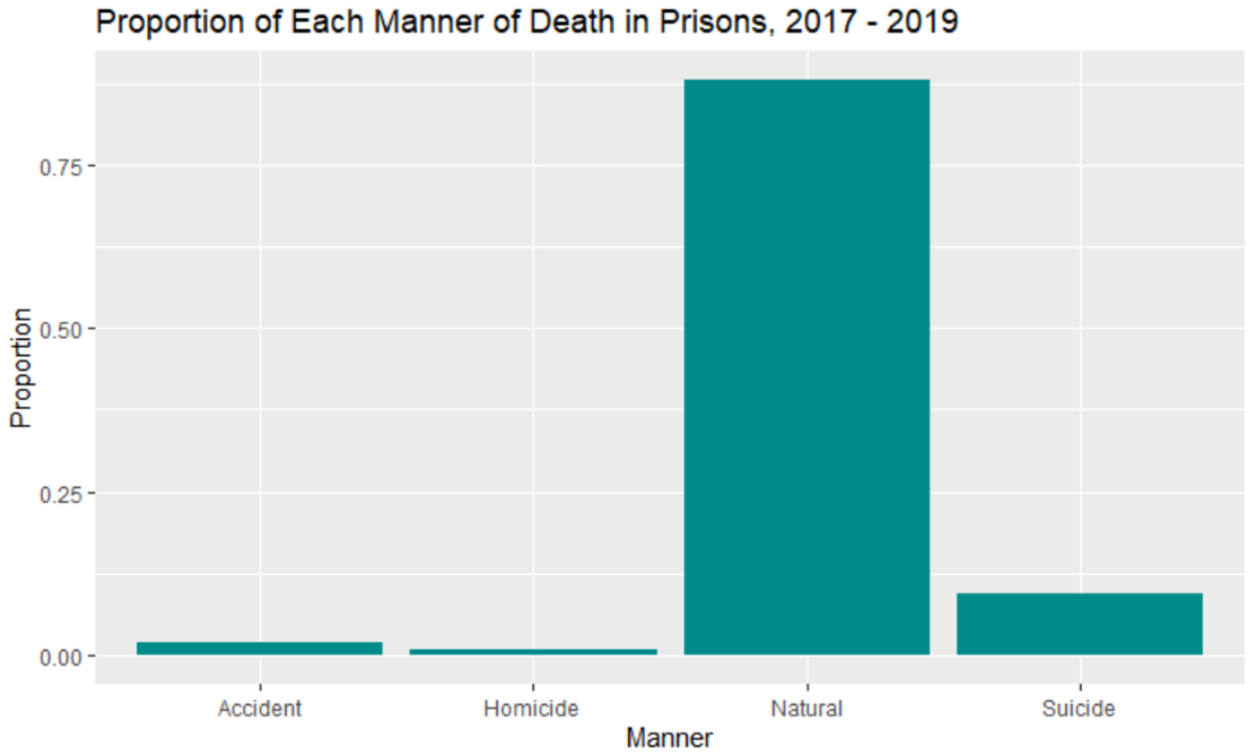
My thesis studies prison death rates, with a focus on natural death.

Exploratory Analysis	Population composition? Common causes? Facility-level variation?
Excess Deaths	How do the prison death rates compare with the general population ones?
Natural Deaths	What does the breakdown of causes look like among natural deaths?

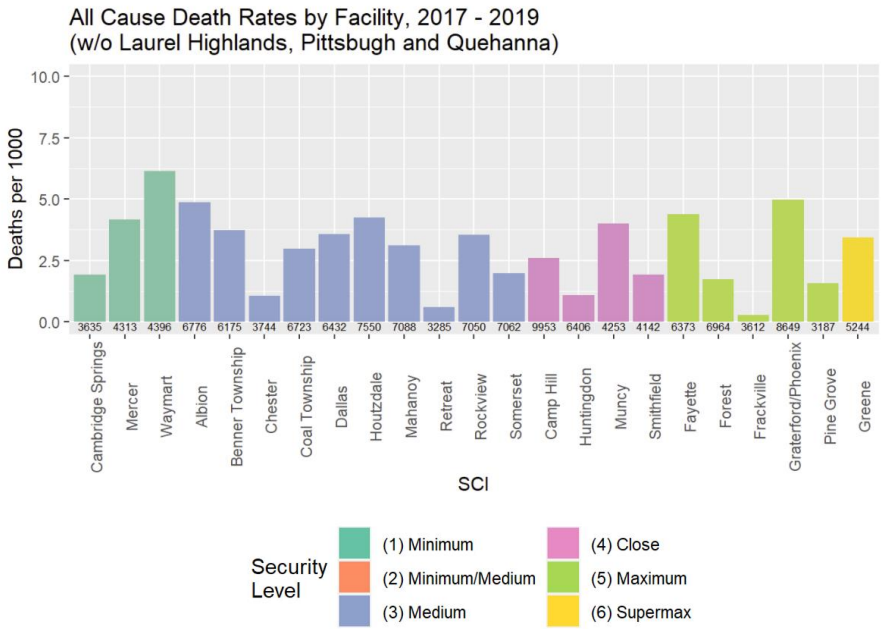
Data Sources

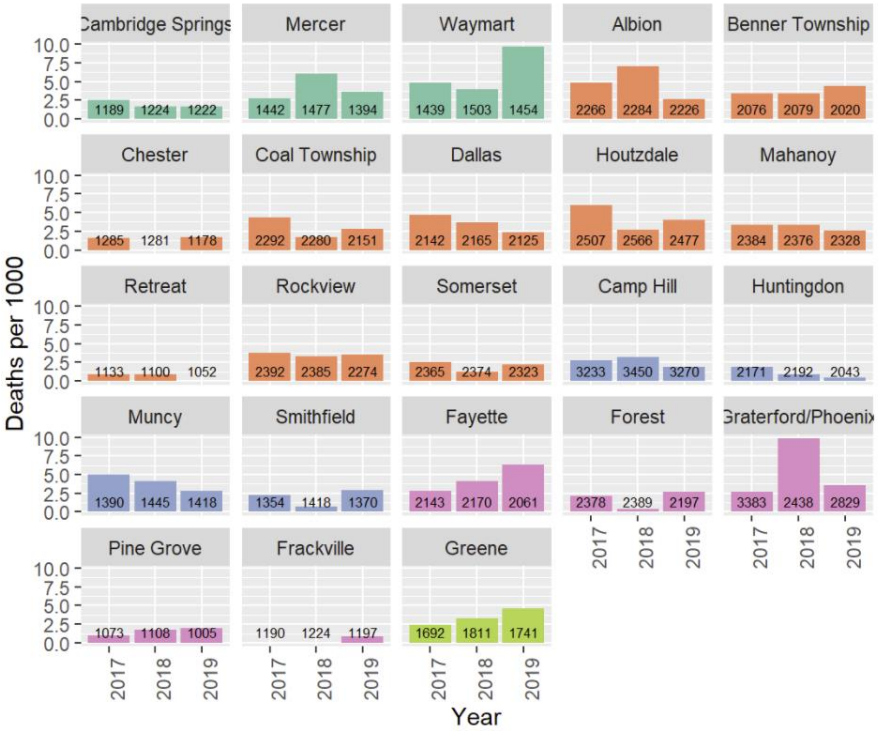
01	**Statistical Reports from PA DOC**	• State-level and facility-level population data, e.g. monthly population, age, race, and gender breakdown
02	**Pennsylvania Prisons Death Register Data**	• Individual-level death data from PA DOC • Acquired through RTK Act by Abolitionist Law Center • Includes manner and cause of death
03	**CDC Wonder Data**	• Death rates in general population • Categorizes deaths by ICD-10 Standard • Can query by demographics, cause, etc.

Natural death is the most common type of deaths in prisons.



Facility-level deaths are highly varied and do not show clear association with population size or security level.





Demographic composition is very different in the general population and prison population.

Race/Ethnicity	PA DOC Custody	General Population
White	42.86%	76.91%
Black	46.54%	11.48%
Hispanic	9.81%	7.62%
Other	0.79%	3.99%

Gender	PA DOC Custody	General Population
Male	93.95%	48.99%
Female	6.05%	51.01%

Age	PA DOC Custody	General Population
15-24	8.65%	15.92%
25-34	33.80%	16.48%
35-44	26.19%	14.50%
45-54	17.48%	16.30%
55-64	10.29%	17.61%
65-84	3.59%	19.19%

The general population are standardized to be comparable to the prison population.

Intuition: What would the death rates be if the prison population have not been incarcerated?

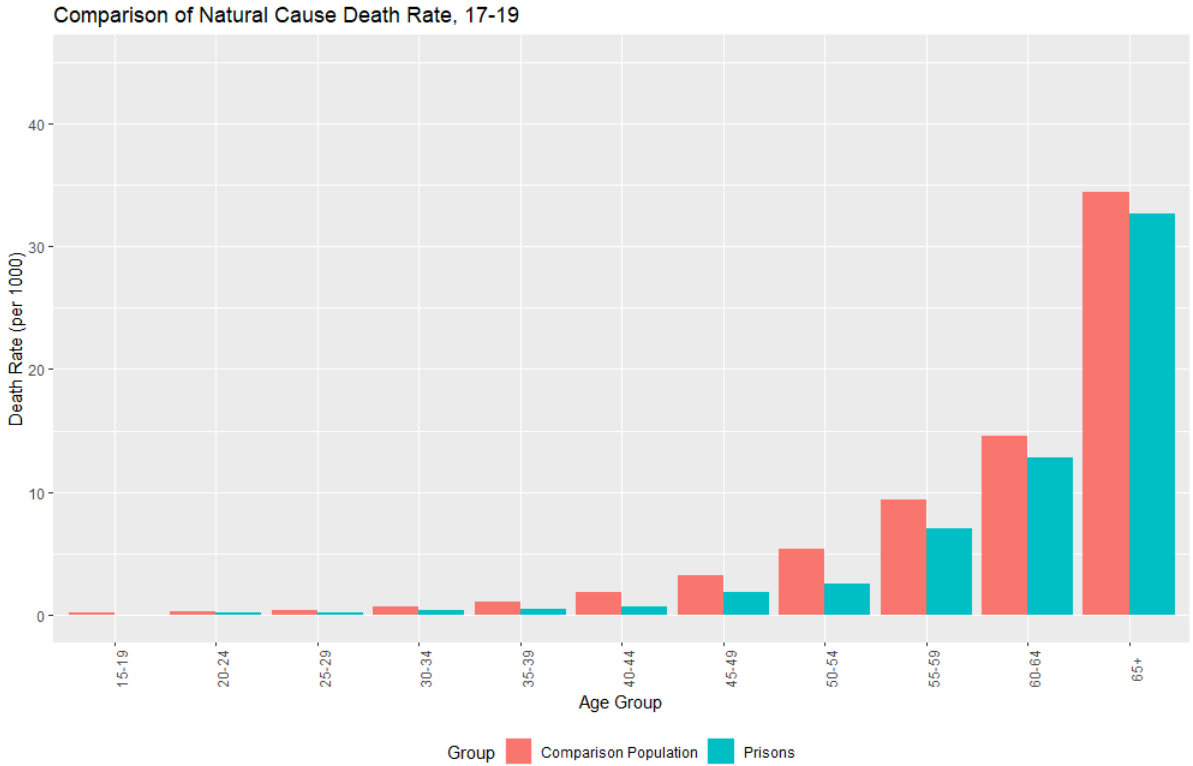
1. Find the death rate of each demographic group in general population
2. Find the proportion of each demographic group in prison population
3. Multiply them together

Demographics composition has a large impact on death rates.

Manners of Death	Prison Population	General Population	Age Standardized	Age & Gender Standardized	Age, Gender & Race Standardized
All Manners	3.54 [3.24, 3.87]	10.53 [10.49, 10.56]	3.88 [3.86, 3.90]	4.79 [4.76, 4.82]	5.64 [5.48, 5.60]
Natural	3.11 [2.83, 3.42]	9.58 [9.55, 9.61]	2.73 [2.72, 2.75]	3.17 [3.15, 3.19]	3.81 [3.76, 3.85]
Suicide	0.34 [0.25, 0.45]	0.15 [0.15, 0.16]	0.19 [0.18, 0.19]	0.29 [0.28, 0.30]	0.23 [0.22, 0.24]
Accident	0.06 [0.04, 0.12]	0.69 [0.68, 0.70]	0.81 [0.80, 0.82]	1.12 [1.10, 1.14]	1.14 [1.11, 1.17]
Homicide	0.03 [0.01, 0.07]	0.06 [0.06, 0.06]	0.09 [0.08, 0.09]	0.14 [0.13, 0.15]	0.38 [0.36, 0.40]

Deaths per 1000

The prison population appear to die older than the general population.



Natural deaths are studied in 20 fine-grained categories.

What's in the data: Causes		What we want: Categories
Metastatic Melanoma	→	Screenable Cancer
Intracerebral Hemorrhage		HASCVD
… …		… …

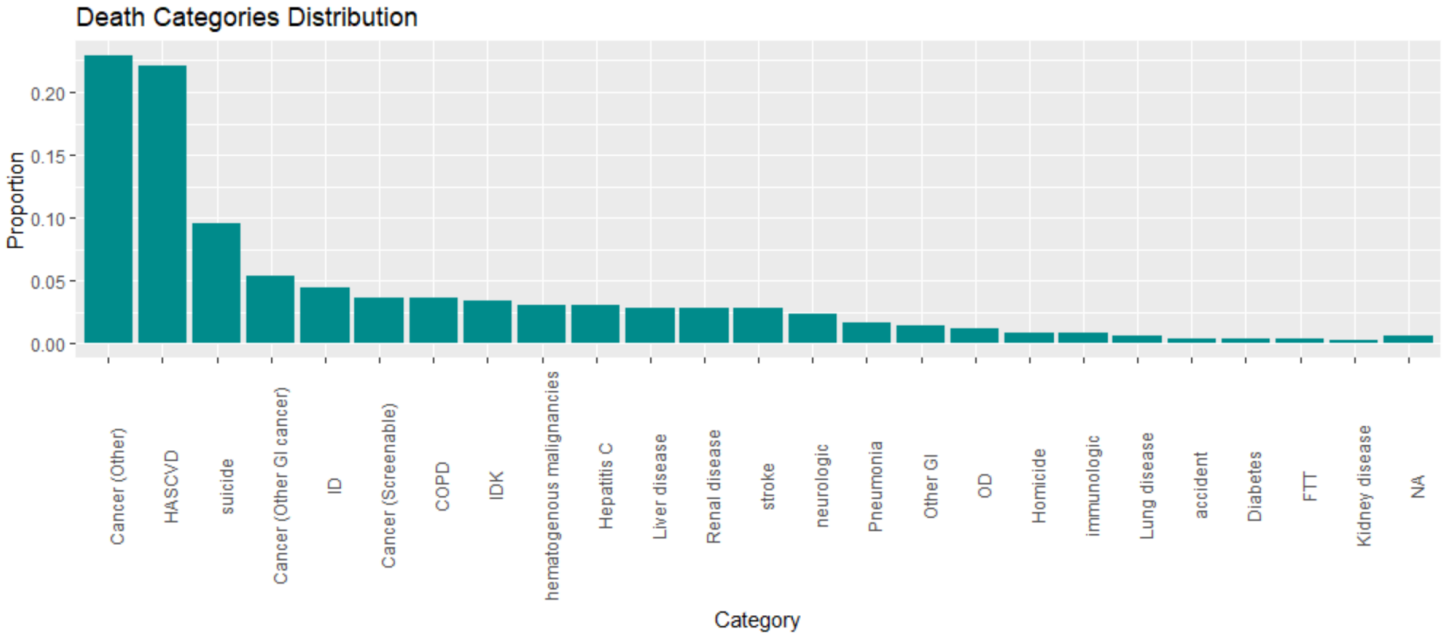
- ❏ How common are they in the prison deaths data?
- ❏ How can they reflect the quality of medical care?
  - ○ Screenable vs. non-screenable cancer
  - ○ Stroke vs. other HASCVD

    … …

Natural deaths are studied in 20 fine-grained categories.

- Cancer
  - Screenable Cancer
  - Unscreenable GI Cancer
  - Other Unscreenable Cancer
  - Hematogenous Malignancies
- Hypertensive Arteriosclerotic Cardiovascular Diseases (HASCVD)
  - Stroke
  - Other HASCVD
- Chronic Obstructive Pulmonary diseases (COPD)
- Immunologic diseases
- Neurological diseases
- Kidney diseases
- Liver diseases
- Lung diseases
- GI diseases
- Renal diseases
- Infectious Diseases
  - Pneumonia
  - Hepatitis C
  - Other Infectious Diseases
- Diabetes
- Failure to Thrive
- Hard to Classify

The two largest categories are other cancer and other HASCVD.



Cancer death rate is elevated in prisons, while HASCVD death rate is reduced in prisons.

Death Categories	Prison Population	General Population	Age Standardized	Age & Gender Standardized	Comparison Population
All Cancer	1.24 [1.06, 1.43]	2.19 [2.18, 2.21]	0.84 [0.83, 0.85]	0.9 [0.89, 0.91]	0.98 [0.96, 1.00]
All HASCVD	0.88 [0.73, 1.05]	3.25 [3.23, 3.27]	0.83 [0.82, 0.84]	1.07 [1.06, 1.08]	1.41 [1.38, 1.44]

Deaths per 1000

Death Categorization Limitations and Future Directions

- Uninformative and ambiguous cause of death data
- Imperfect mapping between death categories and ICD-10 codes
- **Future direction: Linking with National Death Index**