Improving Mortality Data

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Objectives

General: To discuss improvements in data quality; analytic potentials of more timely data; and untapped synergies involving data linkages.

Specific: To discuss strengths and weaknesses of DVS' mortality data pertaining to –

- **Panelists' experience using these data; and**
- **Panelists' future research plans involving mortality data.**

Panelists were asked to provide input on –

- **How the data and the data system (quality, processing, dissemination, etc.) can be improved upon;**
- **Other potential uses of these data;**
- **Other data systems within the context of linkages (merges) with mortality data; and**
- **How these merged data might be used for research.**

My Experience 1973–2010

In 1973, my colleagues and I became the first non-NCHS researchers with access to computerized multiple-cause of death (MCD) microdata files: CY 1969 ACME, N = 1,921,990.

Our recommendations at the 1975 NCHS mortality conference led to entity-axis and record-axis MCD coding, still in use today.

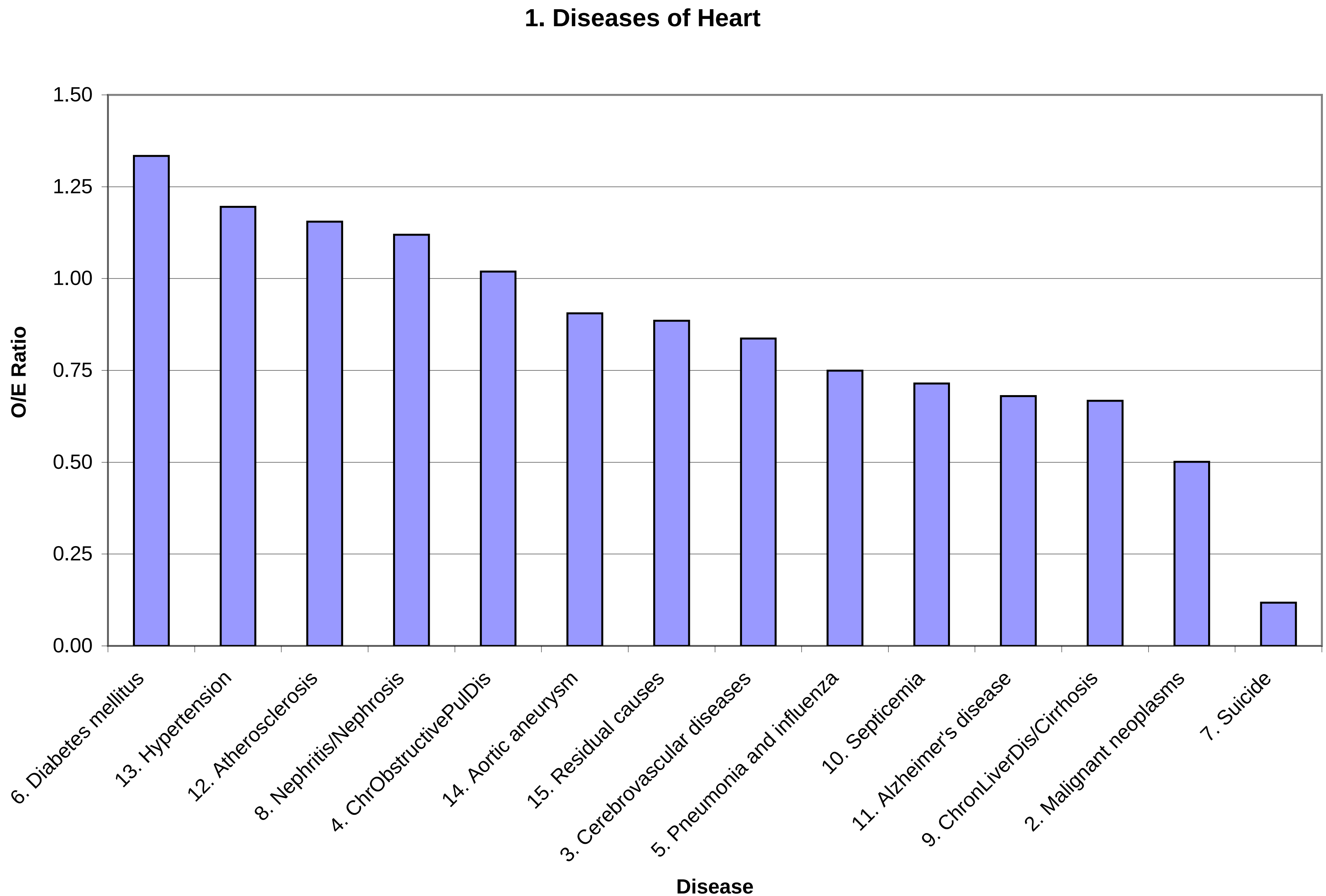
Relevant research areas –

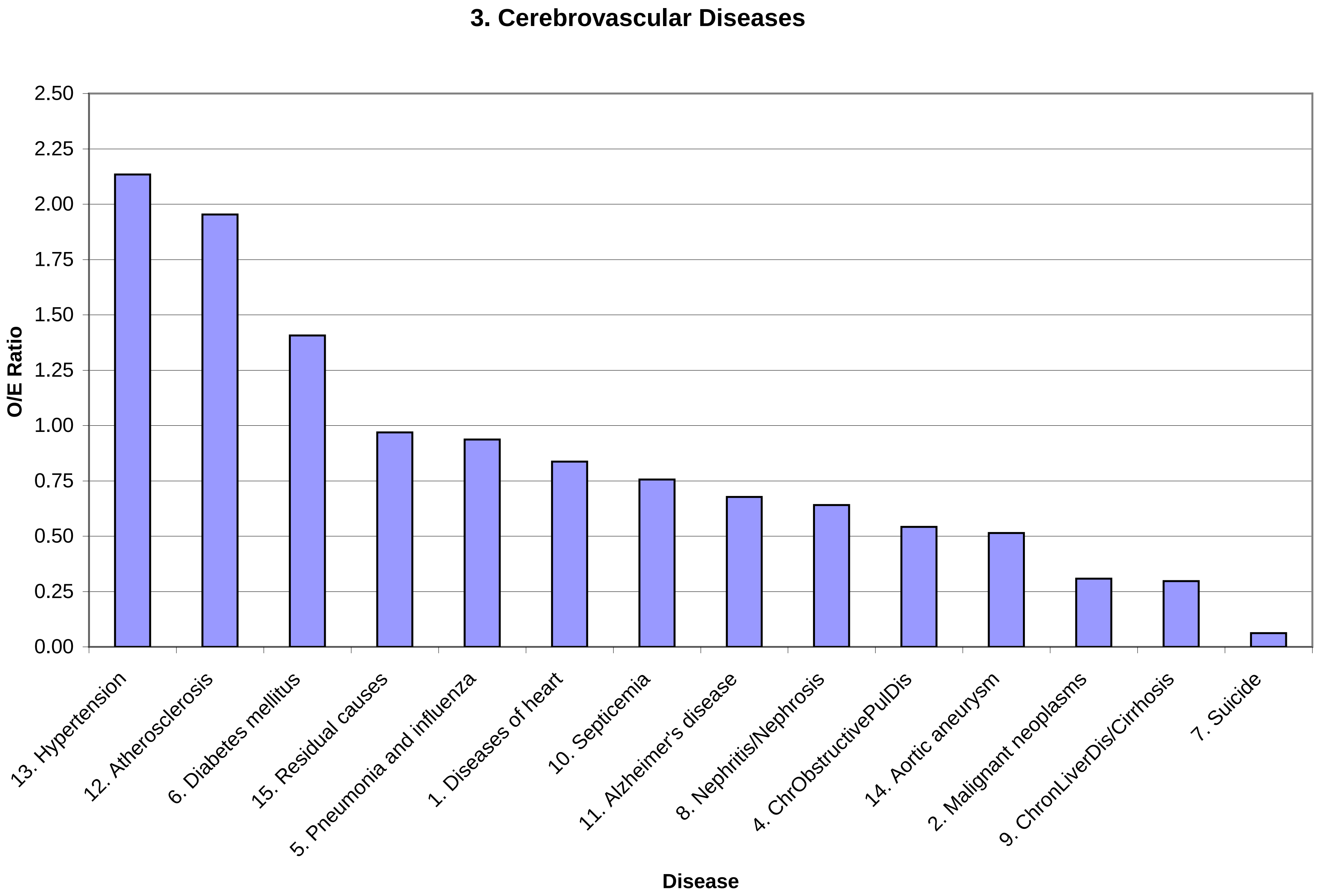
- **Underlying-cause and multiple-cause of death concepts and data**
  - **Total and cause-specific mortality**
  - **Mortality rates and trends**
- **Mapping cancer death rates by counties**
- **Linkages between morbidity and mortality, later extended to include disability**
- **Mortality endpoints for models of cancer initiation and promotion, with differential susceptibilities**

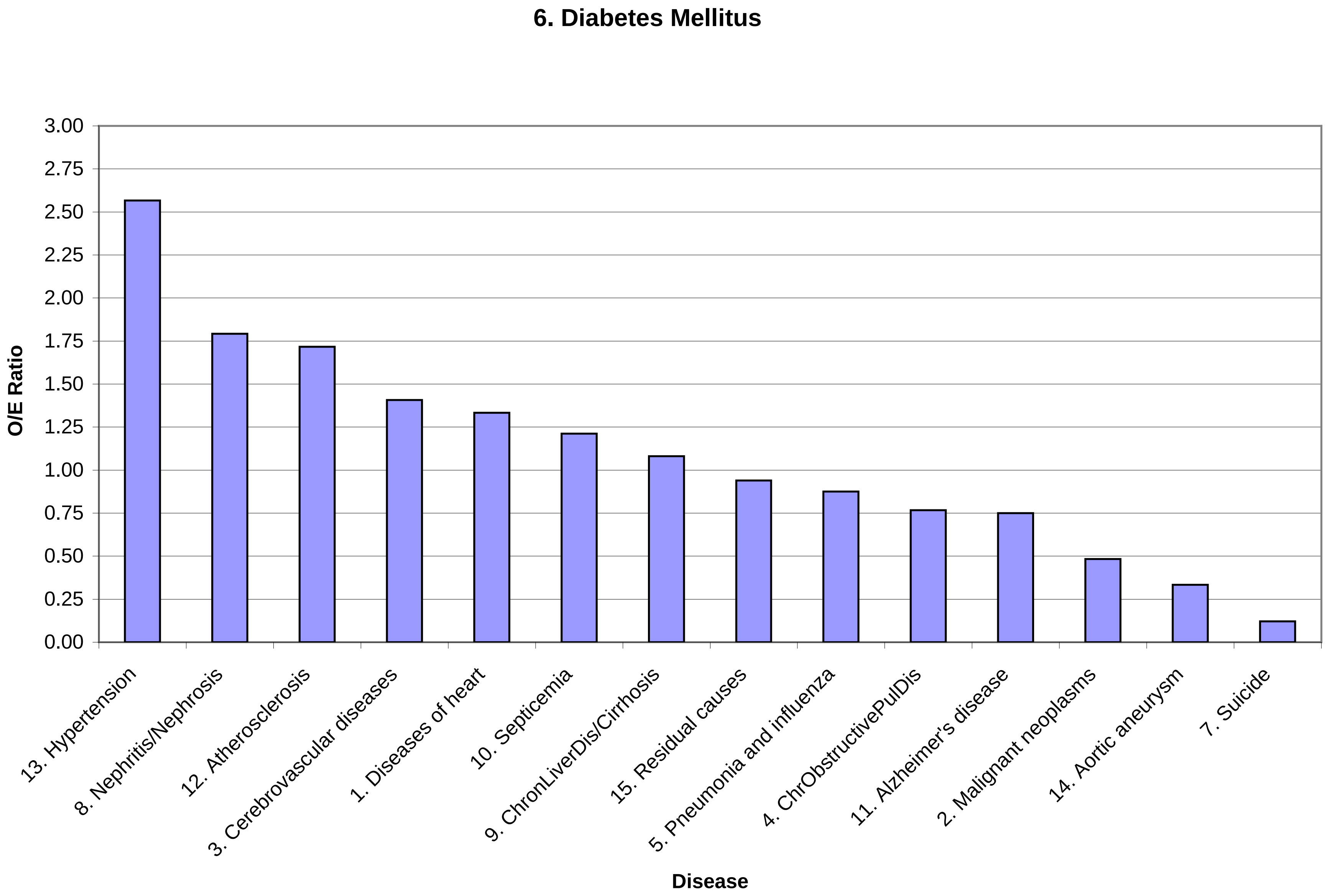
MCD Pairwise O/E Ratios

Ratios of Observed to Expected Age-Standardized Joint Frequencies of Multiple Causes: Unisex Mortality 1998, Age 65+

		Multiple Cause														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
#	**Multiple Cause**	Heart Dis.	Malign Neopl	CBV Dis.	COP Dis.	Pneu Influ	Diabt Mellit	Suicid	Nephri Nephro	ChrLiv Cirrho	Septic -emia	Alzhm Dis.	Athero -scler.	Hyper -tens	Aortic Aneur	Resid Dis.
1	Diseases of heart	--	0.50	0.84	1.02	0.75	1.33	0.12	1.12	0.67	0.71	0.68	1.15	1.20	0.91	0.89
2	Malignant neoplasms	0.50	--	0.31	0.69	0.59	0.48	0.17	0.53	0.44	0.58	0.30	0.29	0.58	0.25	0.72
3	Cerebrovascular diseases	0.84	0.31	--	0.54	0.94	1.41	0.06	0.64	0.30	0.76	0.68	1.95	2.13	0.51	0.97
4	ChrObstructivePulDis	1.02	0.69	0.54	--	1.50	0.77	0.19	0.71	0.61	0.66	0.50	0.79	1.00	0.96	1.19
5	Pneumonia and influenza	0.75	0.59	0.94	1.50	--	0.87	0.03	1.08	0.63	2.03	1.41	0.51	0.67	0.35	1.18
6	Diabetes mellitus	1.33	0.48	1.41	0.77	0.87	--	0.12	1.79	1.08	1.21	0.75	1.72	2.57	0.33	0.94
7	Suicide	0.12	0.17	0.06	0.19	0.03	0.12	--	0.05	0.11	0.03	0.12	0.11	0.16	0.05	2.18
8	Nephritis/Nephrosis	1.12	0.53	0.64	0.71	1.08	1.79	0.05	--	1.70	2.20	0.50	1.35	0.28	1.14	1.15
9	ChronLiverDis/Cirrhosis	0.67	0.44	0.30	0.61	0.63	1.08	0.11	1.70	--	1.29	0.18	0.47	0.60	0.39	1.58
10	Septicemia	0.71	0.58	0.76	0.66	2.03	1.21	0.03	2.20	1.29	--	0.83	0.60	0.64	0.64	1.52
11	Alzheimer's disease	0.68	0.30	0.68	0.50	1.41	0.75	0.12	0.50	0.18	0.83	--	0.80	0.82	0.27	0.94
12	Atherosclerosis	1.15	0.29	1.95	0.79	0.51	1.72	0.11	1.35	0.47	0.60	0.80	--	1.62	1.11	0.94
13	Hypertension	1.20	0.58	2.13	1.00	0.67	2.57	0.16	0.28	0.60	0.64	0.82	1.62	--	1.87	1.06
14	Aortic aneurysm	0.91	0.25	0.51	0.96	0.35	0.33	0.05	1.14	0.39	0.64	0.27	1.11	1.87	--	0.93
15	Residual causes	0.89	0.72	0.97	1.19	1.18	0.94	2.18	1.15	1.58	1.52	0.94	0.94	1.06	0.93	--


1. Diseases of Heart
O/E Ratio
1.50
1.25
1.00
0.75
0.50
0.25
0.00
6. Diabetes mellitus
13. Hypertension
12. Atherosclerosis
8. Nephritis/Nephrosis
4. ChrObstructivePulDis
14. Aortic aneurysm
15. Residual causes
3. Cerebrovascular diseases
5. Pneumonia and influenza
10. Septicemia
11. Alzheimer's disease
9. ChronLiverDis/Cirrhosis
2. Malignant neoplasms
7. Suicide
Disease


3. Cerebrovascular Diseases
O/E Ratio
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
13. Hypertension
12. Atherosclerosis
6. Diabetes mellitus
15. Residual causes
5. Pneumonia and influenza
1. Diseases of heart
10. Septicemia
11. Alzheimer's disease
8. Nephritis/Nephrosis
4. ChrObstructivePulDis
14. Aortic aneurysm
2. Malignant neoplasms
9. ChronLiverDis/Cirrhosis
7. Suicide
Disease


6. Diabetes Mellitus
O/E Ratio
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
13. Hypertension
8. Nephritis/Nephrosis
12. Atherosclerosis
3. Cerebrovascular diseases
1. Diseases of heart
10. Septicemia
9. ChronLiverDis/Cirrhosis
15. Residual causes
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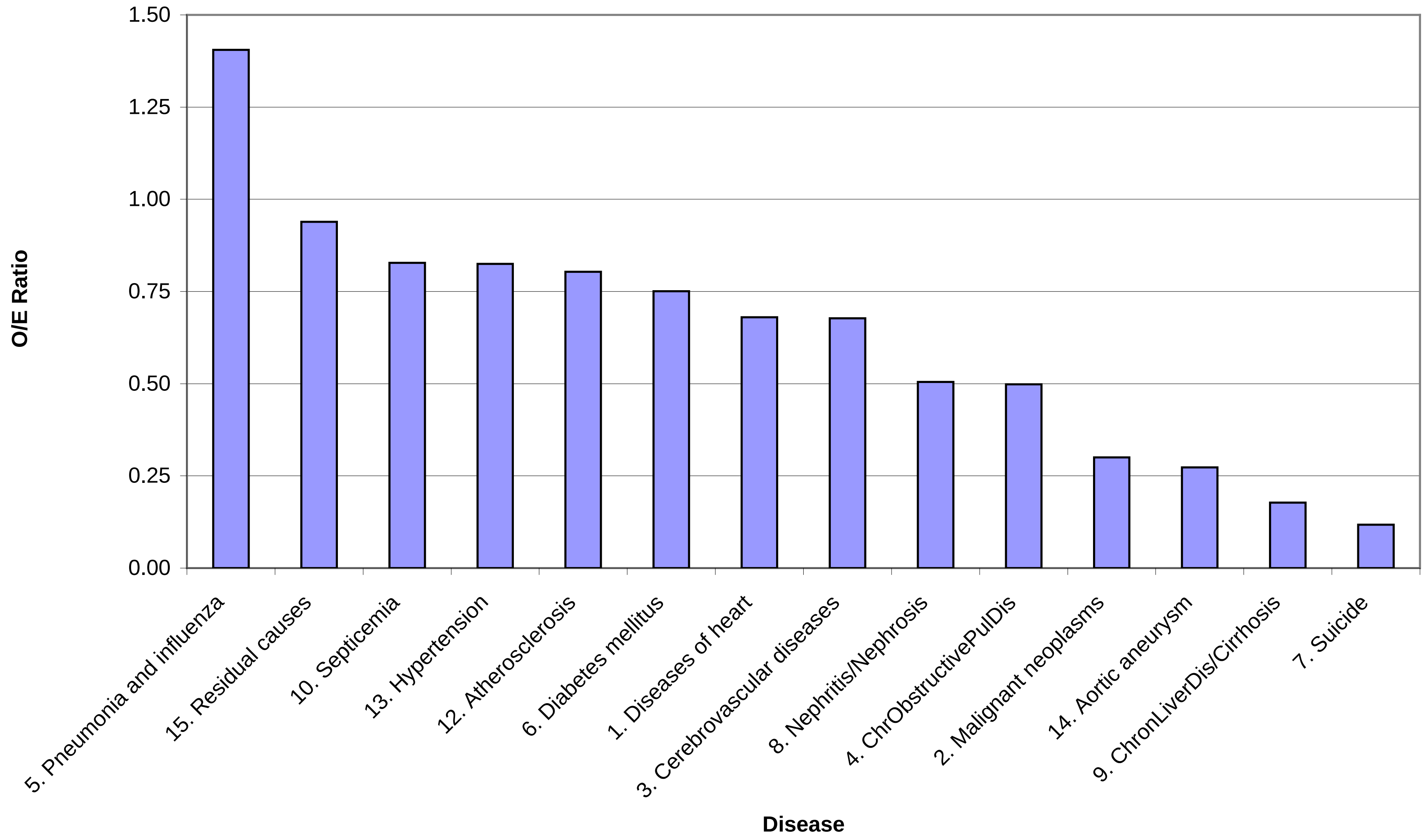
4. ChrObstructivePulDis
11. Alzheimer's disease
2. Malignant neoplasms
14. Aortic aneurysm
7. Suicide
Disease

11. Alzheimer's Disease



Cancer Death Rates by County

Empirical Bayes direct age-standardized death rates using special cancer mapping files prepared by the US EPA:

- **3,061 counties**
- **18 age groups**
- **2 sexes**
- **2 races**
- **3+ decades (1950-59, 1960-69, 1970-79, and later)**
- **31 cancer sites**

Using Ordinary Age-Standardization

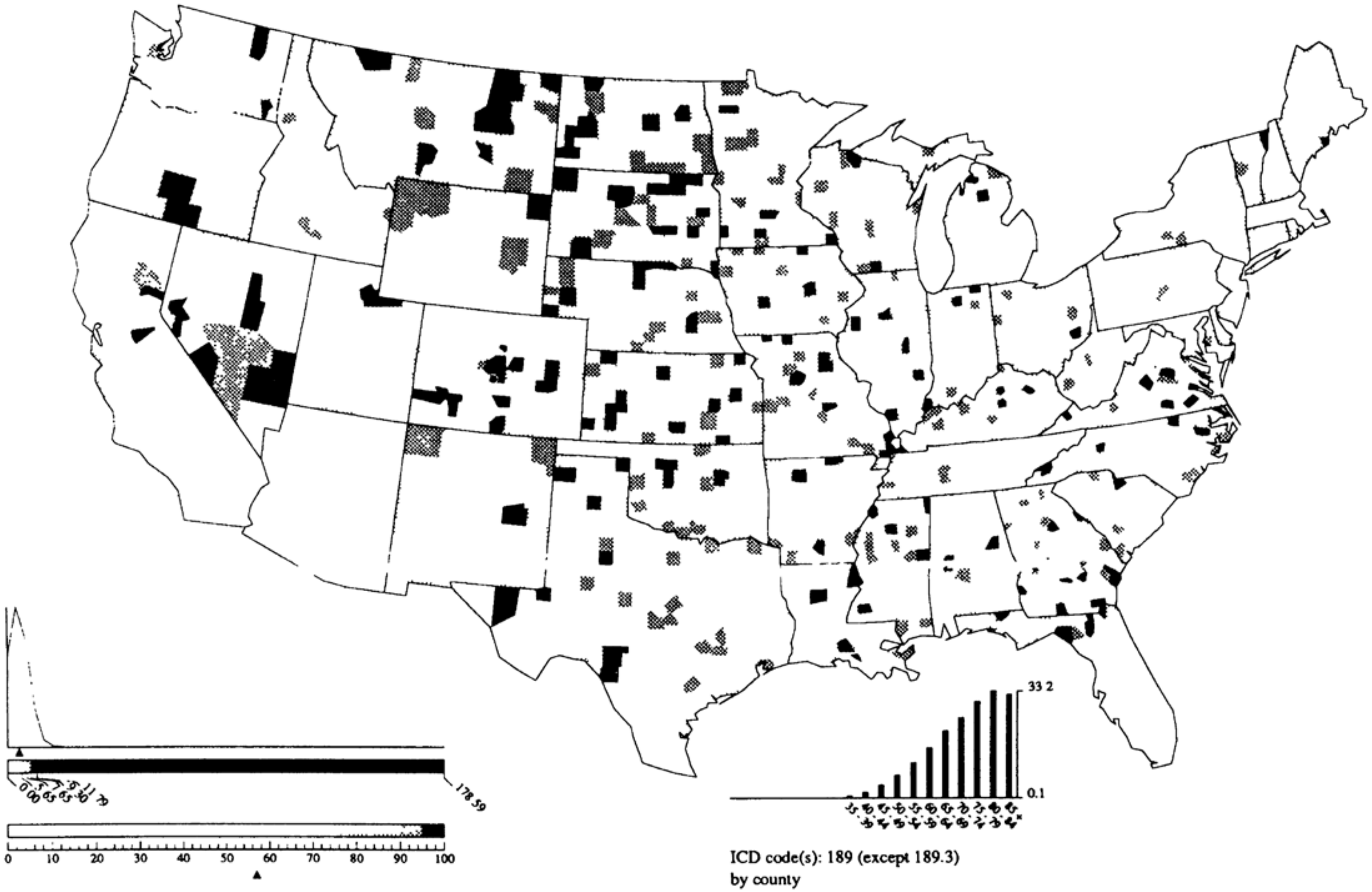


Figure 1. Direct Age-Standardized Death Rates (DASDR's) for Cancer of Kidney/Ureter per 100,000 Exposed Population According to County: U.S. White Males, 1970–1979. The frequency function in the lower left of the figure is a graph of the unweighted frequencies of the 3,061 county-specific DASDR's. The first tone bar below the graph indicates the range of the distribution (in units of 10^{-5}) and the locations of the 75th, 90th, 95th, and 98th percentiles, as defined on the second tone bar. The arrowheads below the graph and below the second tone bar indicate the location of the national death rate (MASDR). The bar graph in the lower right is a graph of the age-specific death rates (in units of 10^{-5}) for ages 35–39 to 85 years and older.

Using Empirical Bayes Age-Standardization

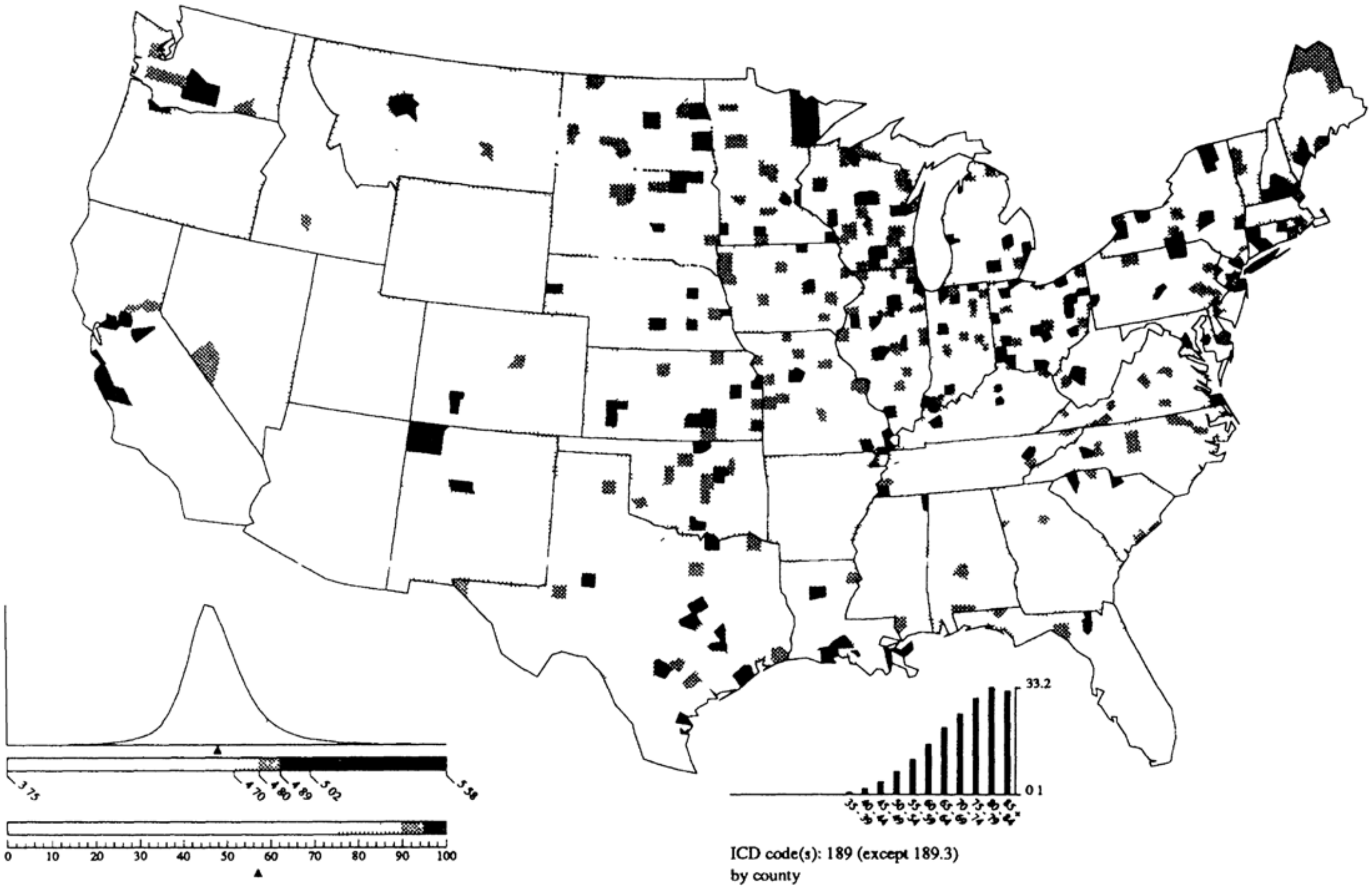


Figure 2. Empirical Bayes Age-Standardized Death Rates (EBASDR's) for Cancer of Kidney/Ureter per 100,000 Exposed Population According to County: U.S. White Males, 1970–1979. The frequency function in the lower left of the figure is a graph of the unweighted frequencies of the 3,061 county-specific EBASDR's. The first tone bar below the graph indicates the range of the distribution (in units of 10^{-5}) and the locations of the 75th, 90th, 95th, and 98th percentiles, as defined on the second tone bar. The arrowheads below the graph and below the second tone bar indicate the location of the national death rate (MASDR). The bar graph in the lower right is a graph of the age-specific death rates (in units of 10^{-5}) for ages 35–39 to 85 years and older.

Disabled Life Expectancy Beyond Age *x* in Year *y* (Sullivan, 1971)

$$e_{D\,x,y} = \int_0^\infty {}_t p_{x,y} \;\; \pi_{x+t,y} \;\; dt$$

where

$${}_t p_{x,y} = l_{x+t,y} \big/ l_{x,y}$$

and

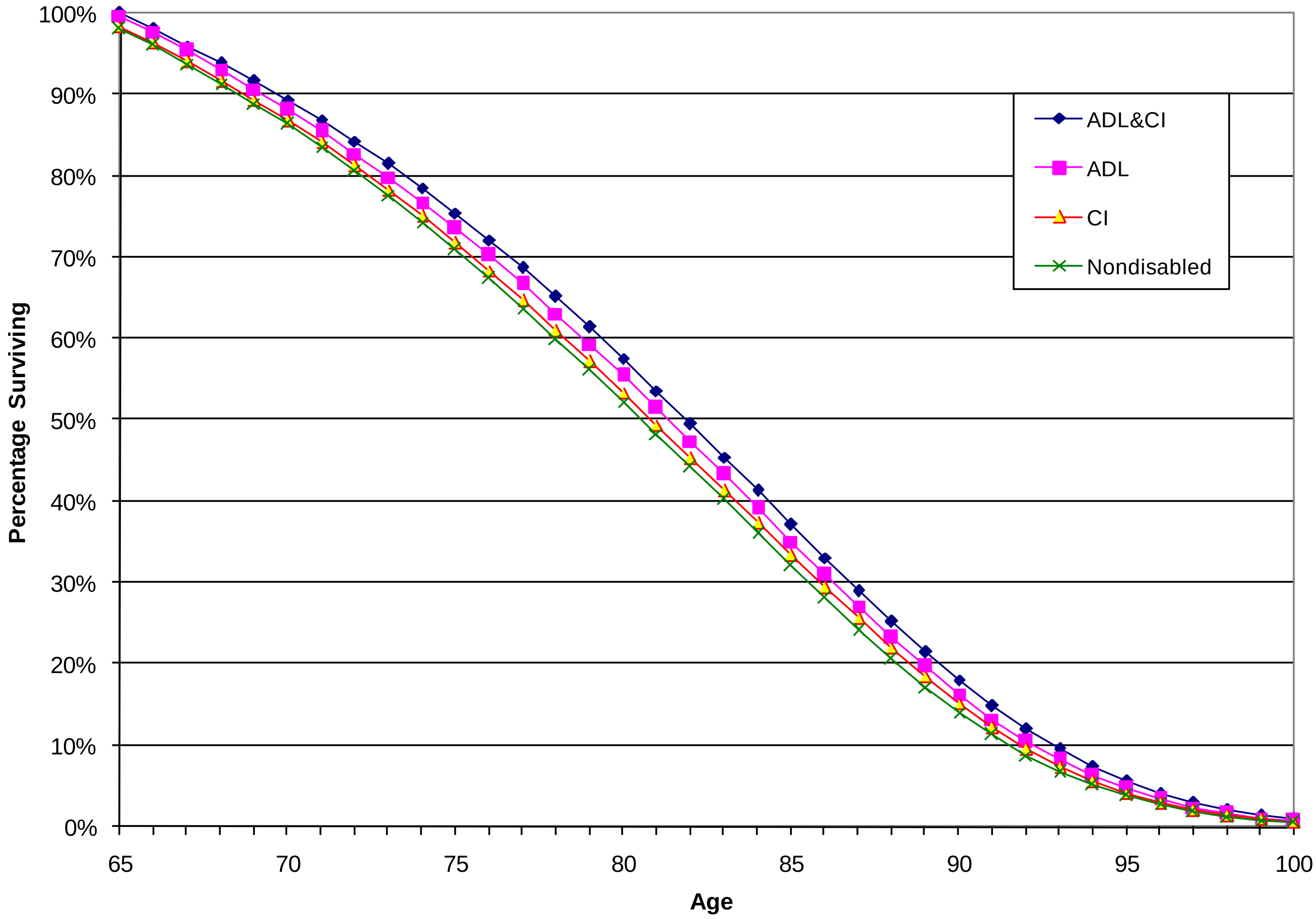
$\pi_{x+t,y} =$ disability prevalence at age $x+t$

Life Expectancy and HIPAA ADL Expectancy (in Years at Age 65), United States 1984 and 2004, by Sex

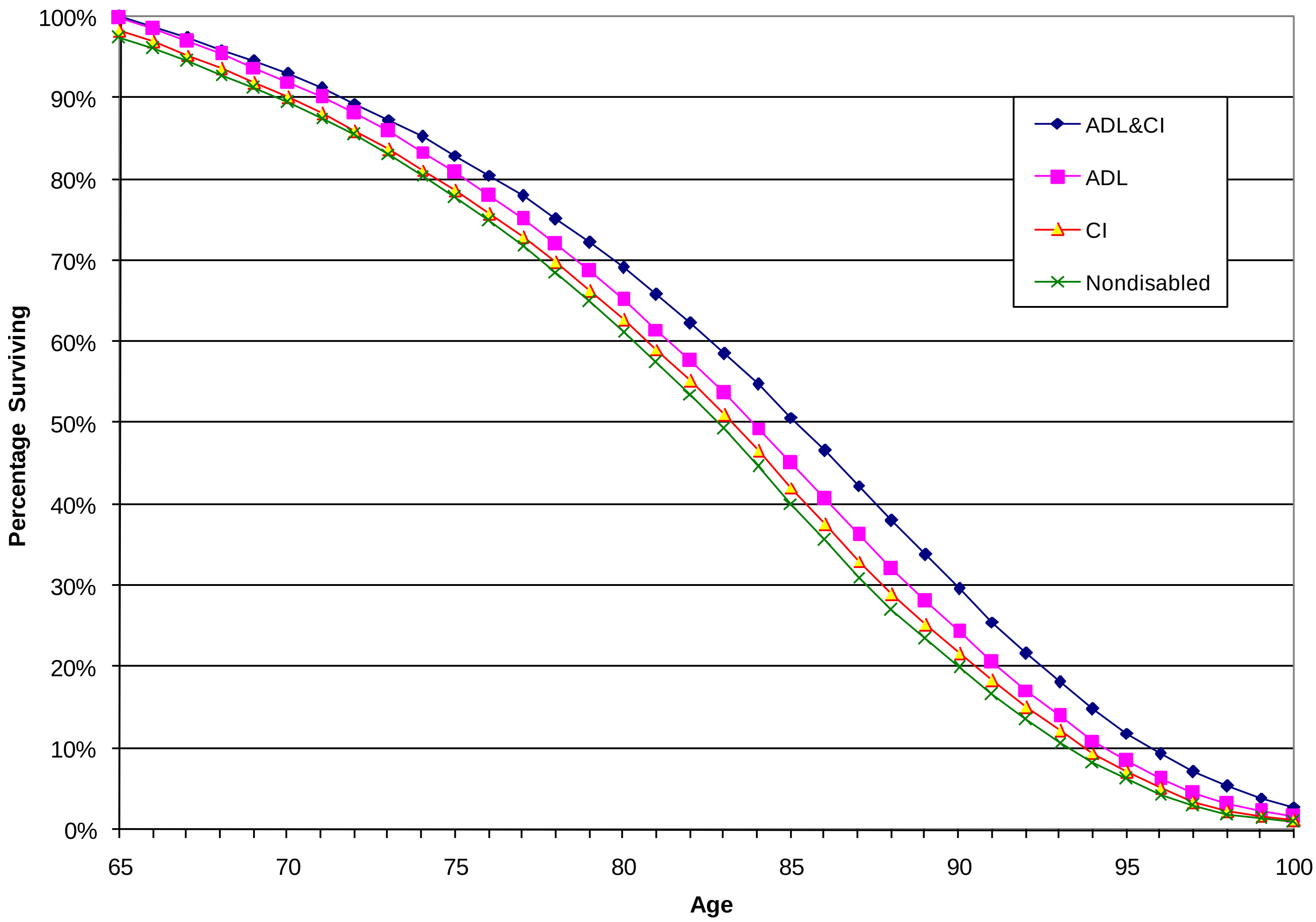
	Males				Females			
	1984	2004	Change	Relative Change	1984	2004	Change	Relative Change
Life Expectancy	14.46	16.67	2.21	15.3%	18.64	19.50	0.85	4.6%
ADL Expectancy	1.23	0.98	-0.25	-20.1%	2.41	1.88	-0.53	-22.0%

Source: Authors' calculations based on 1984 and 2004 NLTCS, 1984 life tables interpolated from 1980 and 1990 life tables in Bell and Miller (2005), and 2004 life tables from Social Security Online.

Joint Relative Survival at Ages 65+, Meets Any HIPAA Trigger, United States 2004, Males



Joint Relative Survival at Ages 65+, Meets Any HIPAA Trigger, United States 2004, Females



Survival Status One Year After Being Assessed for the HIPAA Disability Trigger, and Ratio of Actual to Expected Number of Deaths Assuming that the Nondisabled Death Rates Would Apply in the Absence of Disability, United States 2004, Age 65 and Above, by Age, Sex

Meets HIPAA Disability Trigger[1]	Age	Status 1 Year After Assessment: Alive	Dead	Total	Percent Dead	s.e.(Percent Dead)	Expected	A/E Ratio	s.e.(A/E)
No	65-69	8,122,821	126,522	8,249,343	1.53%	0.20%			
	70-74	8,182,373	171,201	8,353,574	2.05%	0.28%			
	75-79	6,820,477	202,821	7,023,298	2.89%	0.35%			
	80-84	5,046,042	184,157	5,230,199	3.52%	0.40%			
	85-89	2,425,234	177,691	2,602,925	6.83%	0.68%			
	90-94	883,445	68,289	951,734	7.18%	1.35%			
	95+	152,379	26,268	178,647	14.70%	2.25%			
	Total	31,632,770	956,949	32,589,719	2.94%	0.15%			
Yes	65-69	203,427	35,869	239,296	14.99%	3.39%	3,670	9.77	2.54
	70-74	314,968	68,605	383,573	17.89%	3.59%	7,861	8.73	2.13
	75-79	496,634	104,002	600,636	17.32%	2.73%	17,345	6.00	1.20
	80-84	604,920	193,728	798,648	24.26%	2.41%	28,121	6.89	1.05
	85-89	644,989	204,089	849,078	24.04%	2.01%	57,963	3.52	0.46
	90-94	379,489	151,011	530,500	28.47%	3.17%	38,064	3.97	0.87
	95+	155,616	98,259	253,875	38.70%	2.59%	37,330	2.63	0.44
	Total	2,800,044	855,563	3,655,606	23.40%	1.06%	190,354	**4.49**	0.32
Total		34,432,814	1,812,511	36,245,325	5.00%	0.17%			

Meets HIPAA Disability Trigger[1]	Sex	Alive	Dead	Total	Percent Dead	s.e.(Percent Dead)	Expected	A/E Ratio	s.e.(A/E)
Yes	Males	818,257	316,762	1,135,019	**27.91%**	2.12%	64,323	**4.92**	0.54
	Females	1,981,787	538,801	2,520,587	**21.38%**	1.20%	118,009	**4.57**	0.44
	Both Sexes	2,800,044	855,563	3,655,606	**23.40%**	1.06%	182,333	**4.69**	0.34

	Dead, Controlling for … Age	Age & Sex
Actual − Expected	665,208	673,230
Percent of Deaths	**36.70%**	**37.14%**
Std Error (Pct of Deaths)	2.02%	2.00%

Note 1: The HIPAA disability trigger requires 2+ ADL disabilities or severe cognitive impairment requiring substantial supervision.

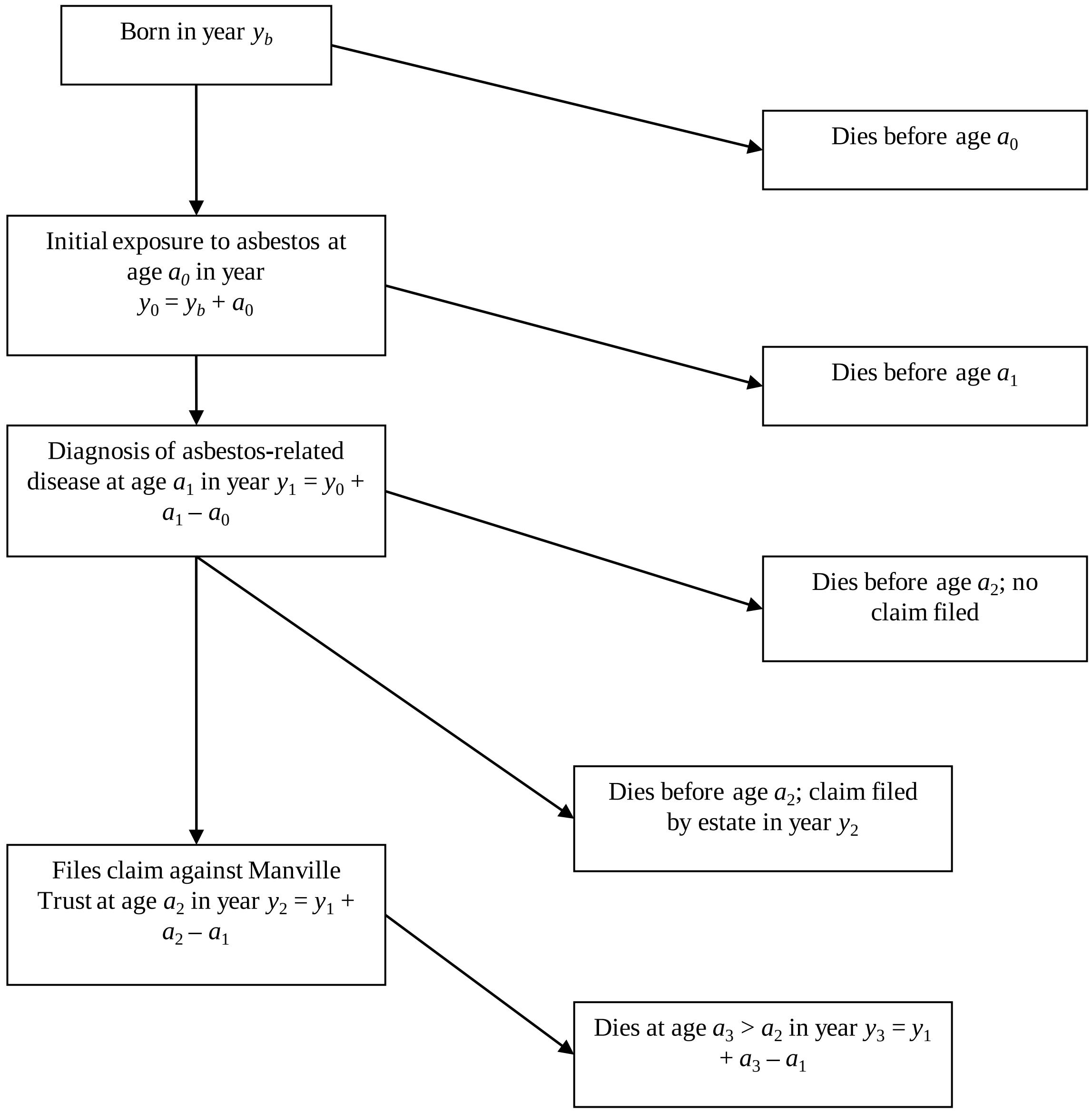
Source: Author's calculations based on the 2004 NLTCS.

Cancer Compartment Models

Representative applications:

- **Stochastic compartment models for lung, stomach, and breast cancers (Tolley et al. 1981; Manton and Stallard 1984).**
- **Manville Trust asbestos claims data for mesothelioma and lung cancer (Stallard 2001; Stallard et al. 2005).**

States and Transitions: Compartment Model of Asbestos-Related Disease Claims



Mesothelioma Claims Model

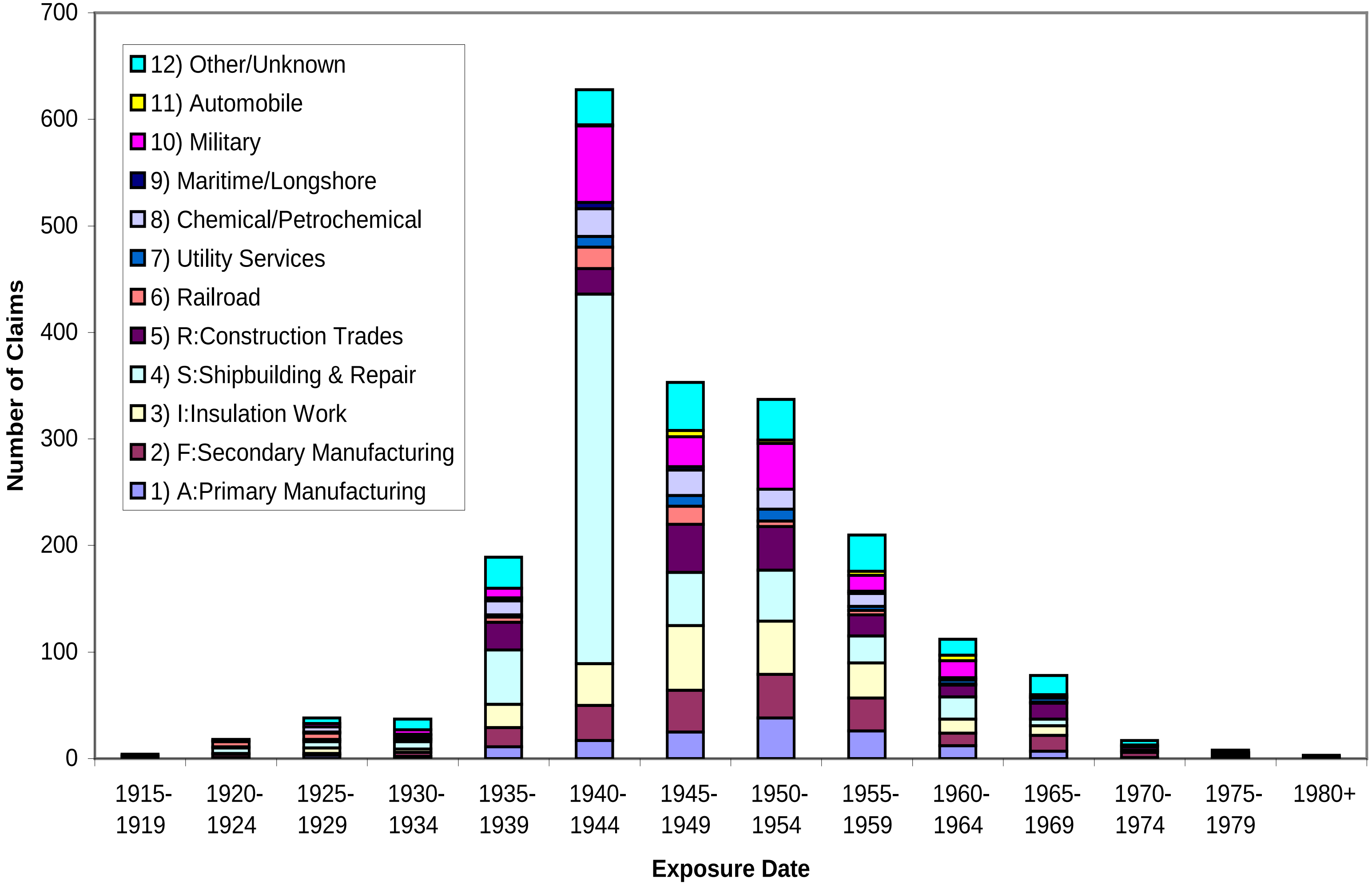
For fixed a, y, and t_0; with $t > t_0$:

$$C_{a,y}^{y+t_0} = N_{a,y} \times Q_{a,y}^{t_0} \quad \text{and} \quad C_{a,y}^{y+t} = N_{a,y} \times Q_{a,y}^{t}$$

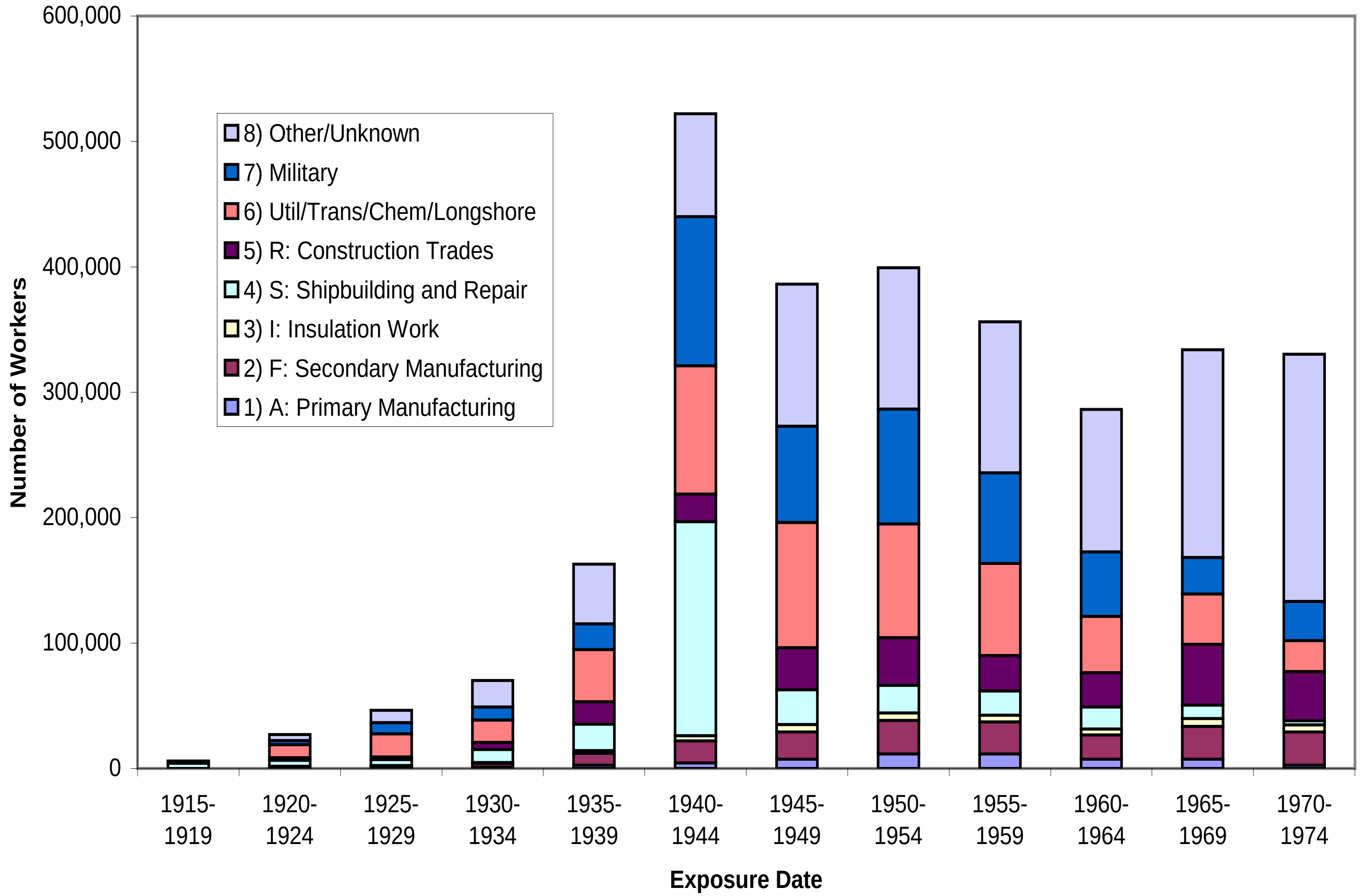
which implies that

$$C_{a,y}^{y+t} = C_{a,y}^{y+t_0} \times Q_{a,y}^{t} / Q_{a,y}^{t_0}$$

Qualified Male Mesothelioma Claims, 1990-1992, by R2 Occupation Group and Date of First Exposure
(Source: Authors' Calculations)



Estimated Number of Exposed Male Workers by Occupation and Date of Start of Exposure (Source: Authors' Calculations)



Future Research Plans Involving Mortality Data

Mortality is a major endpoint in my future research plans. For example –

1. NLTCS:

- **Currently linked to Medicare files, including vital statistics;**
- **Also linked to VHA files, with healthcare information for services outside of the Medicare program;**
- **NDI Plus linkage would provide MCD data to complement Medicare and VHA diagnoses of significant medical conditions.**

2. Framingham Heart Study and Framingham Offspring Study data:

- **Longitudinal modeling of the development of major morbidity and mortality outcomes;**
- **Currently compartmentalizing pre- and post-morbidity processes with endpoints/startpoints based on CHD, stroke, cancer, diabetes, hypertension disease and mortality;**
- **Accurate tracking of mortality is essential.**

Future Research Plans Involving Mortality Data

3. Alzheimer’s Disease Predictors Study:

- **Supplemented with population-based cohorts of Alzheimer’s patients**
  - **Incidence of Alzheimer’s among disease-free persons;**
- **Longitudinal modeling of the progression of Alzheimer’s among newly diagnosed cases;**
- **Need genetic markers and newly measured biomarkers;**
- **Accurate tracking of mortality is essential.**

4. Supplemented with data from: HRS, MCBS, SEER, HHS

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