

Effects of Medicare Coverage for the Chronically Ill on Health Insurance, Utilization, and Mortality: Evidence from a Coverage Expansion for End-Stage Renal Disease

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Introduction

- Prior to the ACA, public insurance programs based eligibility on individual characteristics
- But some expansions base eligibility on medical conditions or disability
- These condition specific expansions may have distinct effects on health and health care utilization
- Strong consensus that health insurance increases utilization
- Effect of health insurance on health is varied
 - No effect on mortality from randomized RAND and Oregon studies
 - Some, but not all, non-experimental studies demonstrate improvements

Contribution of this paper

- Study the extension of Medicare coverage to people with End-Stage Renal Disease (ESRD) in 1973
 - Exogenous change in insurance coverage
 - Deaths due to ESRD are easy to observe in data
 - Mortality rate from ESRD was very high prior to 1973
- Identify potential mechanisms from geographic variation in mortality reduction and changes in treatment facilities
- Results:
 - ESRD program shifted insurance coverage to Medicare over private insurance and may have increased physician visits
 - Reduced deaths due to kidney disease
- Mechanisms
 - Mortality reduction larger in areas with more treatment facilities
 - Increased entry of dialysis clinics in areas with fewer clinics and higher burden of disease before program

Agenda

- 1 Background
- 2 Data and Empirical Approach
- 3 Effects of the Medicare Expansion
 - Health Insurance and Health Care Utilization
 - Mortality
- 4 Mechanisms
- 5 Conclusions

End-Stage Renal Disease

- Progressive decline of kidney function that limits ability of kidneys to filter blood leading to death
- Treatment emphasizes “renal replacement” using dialysis or kidney transplantation
- ESRD expansion provided Medicare coverage after three months of dialysis treatment and for up to one year following kidney transplant
- Enacted in November of 1972, implemented on July 1, 1973
- Expected to enroll around 35000 people and cost \$1 billion per year
- Simultaneous expansion of Medicare coverage to the long-term disabled

Data

- Health insurance data from the National Health Interview Survey (NHIS)
 - Only provides data on Medicare coverage for people under 65 from 1978 and on
 - Kidney disease defined based on interactions with health care system or disability
- Health care utilization from the NHIS beginning in 1969
- Mortality rates from 1968-1978 multiple cause of death files and SEER/Census population files
 - Assign deaths based on underlying or contributing cause of death
 - Restrict to whites because of evidence of age-heaping for non-white deaths
- Most analyses restrict to people between 45 and 84 years of age

Sources of Variation and Identification

- Introduction of ESRD program provides a natural experiment
- Prior to 1973, Medicare eligibility solely a function of age; ESRD (and SSDI) programs provide pathway for people under 65
- Suggests triple-difference model
 - Coefficient of interest would be the interaction of post, under 65, and kidney disease
 - Contemporaneous expansion to long-term disabled biases DDD estimate
 - Can sign bias and no bias in DD estimate restricted to people with kidney disease

Empirical Models

- Triple-difference model is

$$\begin{aligned}
 y_{iatgd} = & \beta_1 K_d + \beta_2 Post_t + \beta_3 Under65_a + \beta_4 K_d \times Post_t + \beta_5 K_d \times Under65_a \\
 & + \beta_6 Post_t \times Under65_a + \beta_7 K_d \times Post_t \times Under65_a \\
 & + X_{ig} \Gamma_1 + \tau_t + \alpha_a + \varepsilon
 \end{aligned}$$

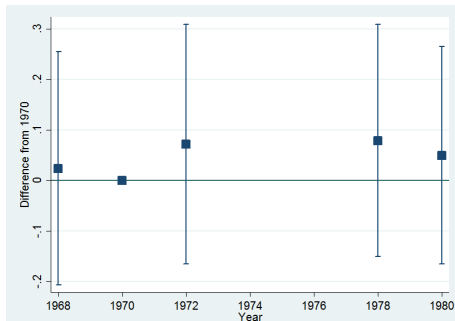
- β_7 is coefficient of interest
- Difference-in-differences model (restricting to people with kidney disease) is

$$\begin{aligned}
 y_{iatgd} = & \alpha_1 Post_t + \alpha_2 Under65_a + \alpha_3 Post_t \times Under65_a \\
 & + X_{ig} \Gamma_1 + \tau_t + \alpha_a + \varepsilon
 \end{aligned}$$

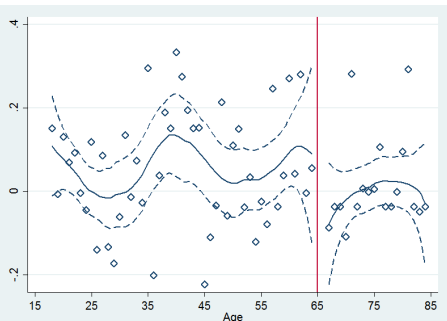
- α_3 is coefficient of interest
- Estimate linear probability models for insurance coverage; poisson models for counts and mortality rates

Event Study of Change in Insurance Coverage

Any Insurance—Effect by Year



Any Insurance—Effect by Age

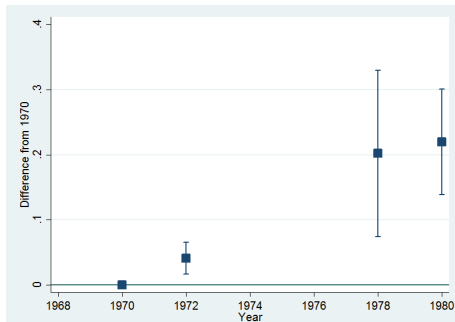


Source—National Health Interview Survey, 1968-1980

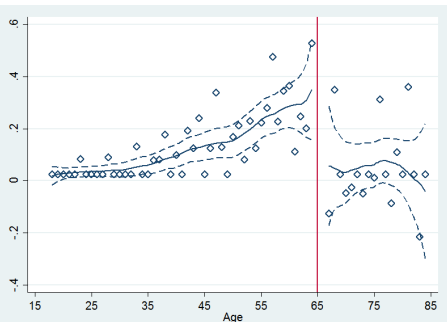
Notes—Sample in left panel restricted to people between 45 and 84 years of age. Points in left panel are year-specific triple-difference or difference-in-difference coefficients; points in right panel are local linear triple-difference or difference-in-difference coefficients. Confidence intervals are clustered on age in left panel; heteroskedasticity robust in right panel.

Event Study of Change in Medicare Coverage

Medicare—Effect by Year



Medicare—Effect by Age

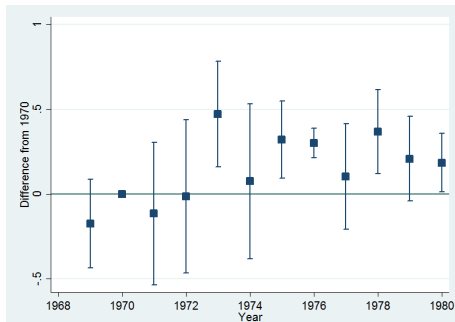


Source—National Health Interview Survey, 1970-1980

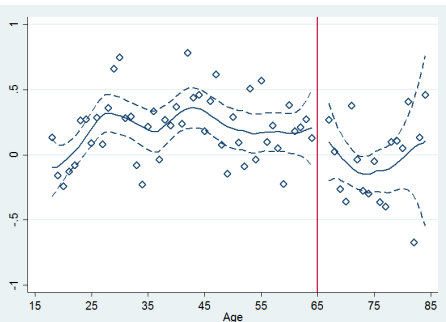
Notes—Sample in left panel restricted to people between 45 and 84 years of age. Points in left panel are year-specific triple-difference or difference-in-difference coefficients; points in right panel are local linear triple-difference or difference-in-difference coefficients. Confidence intervals are clustered on age in left panel; heteroskedasticity robust in right panel.

Event Study of Change in Doctors Visits

Doctor Visits—Effect by Year



Doctor Visits—Effect by Age



Source—National Health Interview Survey, 1969-1980

Notes—Sample in left panel restricted to people between 45 and 84 years of age. Points in left panel are year-specific triple-difference or difference-in-difference coefficients; points in right panel are local linear triple-difference or difference-in-difference coefficients. Confidence intervals are clustered on age in left panel; heteroskedasticity robust in right panel.

DDD Estimates of Insurance and Utilization

	Any Insurance		Medicare		Any Private		Only Private		Doctor Visits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A: Difference-in-Difference-in-Difference										
DDD	-0.009 (0.052)	0.061 (0.096)	0.148** (0.042)	0.220+ (0.115)	-0.073 (0.110)	-0.028 (0.161)	-0.219* (0.085)	-0.206 (0.131)	0.216** (0.067)	0.090 (0.126)
Age Trends	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	147669	147669	118375	118375	188071	188071	118375	118375	371181	371181
B: Difference-in-Difference										
DD	0.037 (0.056)	0.125 (0.105)	0.191** (0.052)	0.313* (0.136)	-0.139 (0.099)	-0.049 (0.161)	-0.214* (0.083)	-0.246 (0.142)	0.281** (0.085)	0.169 (0.134)
Age Trends	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	1354	1354	800	800	1359	1359	800	800	2456	2456
Means										
45-64, Without Kidney Disease										
Pre	0.82		0.00		0.82		0.82		3.87	
Post	0.89		0.04		0.84		0.81		3.88	
45-64, With Kidney Disease										
Pre	0.79		0.00		0.79		0.79		9.38	
Post	0.86		0.21		0.68		0.55		10.77	

Source—Author's analysis of the National Health Interview Survey from 1968-1980.

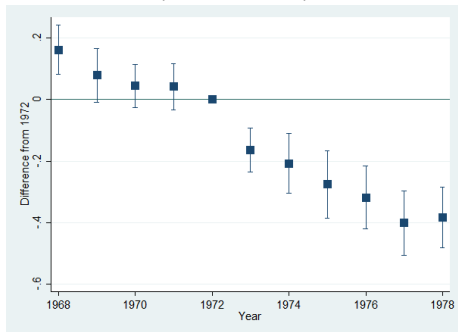
+ p<0.1, * p<0.05, ** p<0.01

Summary of Effects on Health Insurance and Doctors Visits

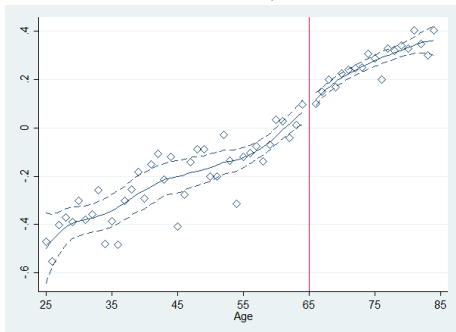
- No significant increase in overall insurance coverage, but shift towards Medicare coverage
 - Event study estimates imply increase in Medicare coverage only after policy change and only affected people under 65
- Some evidence of an increase in physician visits, but only in models without time trends
 - Estimates of effects on doctor visits are noisy with largest increases around 45 years of age

DDD Event Study of Kidney Disease Mortality

Cause-of-Death and Over/Under 65 Over Time (1972 reference)



Cause-of-Death and Before/After Over Age (65 reference)



Source—Author's analysis of Multiple Cause of Death Files, 1968-1990

Notes—Points are coefficients on time periods from a Poisson regressions of the number of deaths per 100,000 in an age-gender-time period cell on time or age fixed effects interacted with a dummy for kidney disease and either a dummy for being under 65 or after the second half of 1973. Break in time trends is when cause of death coding changed from ICDA-8 to ICD-9. Standard errors are two-way clustered on age and time.

DDD/DD Estimates of Mortality

Cause	Narrow Definition				Broad Definition		Chronic Only	
	(1) Underlying	(2) Underlying	(3) Any	(4) Any	(5) Underlying	(6) Any	(7) Underlying	(8) Any
DDD	-0.373** (0.049)	-0.073* (0.029)	-0.059** (0.007)	-0.021* (0.010)	-0.067** (0.011)	-0.010 (0.009)	-0.057* (0.027)	-0.020+ (0.012)
DD	-0.363** (0.053)	-0.079* (0.035)	-0.048** (0.014)	-0.025+ (0.014)	-0.073** (0.022)	-0.015 (0.011)	-0.064+ (0.034)	-0.024+ (0.014)
Age trends	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Underlying only?	Yes	Yes	No	No	Yes	No	Yes	No
Mean Kidney Disease Mortality Rates (45-64 year olds, per 100,000)								
1968-1973H1	6.3	6.3	38.2	38.2	13.1	49.6	5.3	34.8
1973H2-1978	5.1	5.1	35.6	35.6	8.6	43.4	4.4	31.2

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978.

+ p<0.1, * p<0.05, ** p<0.01

Summary of Effects on Mortality

- Reduction in kidney disease mortality is small, but persistent across specifications
- Implied effect size is 110 to 400 fewer deaths among whites; 175 to 550 for all races
 - Assuming entire reduction due to program (10-35k enrollment), implies one percentage point reduction in mortality
 - Relative to increase in insurance coverage implies that insurance coverage reduced mortality by two to six percentage points
- Results are not due to “harvesting” [▶ Go](#)
- Results are robust to:
 - Varying the age ranges included [▶ Go](#)
 - Inclusion of additional controls for age trends [▶ Go](#)

Potential Mechanisms

- Demand: Increased access to medical care reduced mortality
 - Mortality should fall more for people under 65 (compared to over 65) in areas that had more treatment resources, all else equal
 - Incorporate measures of treatment resources in state
- Supply: Increased entry in the “renal replacement” market
 - More kidney disease treatment facilities in states with a greater burden of disease for people under 65
 - Regress number of treatment facilities in 1975 on 1971 count and age-group kidney disease mortality rate in 1971

Dialysis Clinics and Transplant Program Effects

	Narrow Definition			Chronic Only		
	(1)	(2)	(3)	(4)	(5)	(6)
A: Base Model						
DDD	-0.077** (0.028)	-0.076* (0.031)	-0.078* (0.033)	-0.060* (0.028)	-0.058+ (0.031)	-0.061+ (0.032)
×Log Dialysis Clinics Per Capita in 1971	-0.065** (0.023)		-0.093** (0.033)	-0.062* (0.025)		-0.086* (0.037)
×Log Transplant Programs Per Capita in 1971		-0.008 (0.060)	0.061 (0.063)		-0.009 (0.058)	0.057 (0.065)
B: Including Indicators for VA Treatment Facilities						
DDD	-0.080** (0.029)	-0.077* (0.031)	-0.081* (0.032)	-0.063* (0.029)	-0.059* (0.029)	-0.064* (0.031)
×Log Dialysis Clinics Per Capita in 1971	-0.067** (0.025)		-0.082* (0.037)	-0.065* (0.027)		-0.076* (0.037)
×Log Transplant Programs Per Capita in 1971		-0.016 (0.058)	0.044 (0.065)		-0.017 (0.057)	0.037 (0.064)

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978 and the publication "Kidney Disease Services, Facilities, and Programs in the United States".

+ p<0.1, * p<0.05, ** p<0.01

Entry of Dialysis Clinics and Transplant Programs

	Dialysis Clinics Per 100,000			Transplant Programs Per 100,000		
	(1)	(2)	(3)	(4)	(5)	(6)
Log Dialysis Clinics Per Capita in 1971	0.316*	0.362**	0.388**			
	(0.127)	(0.082)	(0.079)			
Log Transplant Programs Per Capita in 1971				0.710**	0.610**	0.751**
				(0.154)	(0.134)	(0.146)
Log Under 65 Kidney Disease Mortality Rate in 1971		0.648**	0.462+		0.627	-0.470
		(0.209)	(0.275)		(0.477)	(0.739)
Log 65 and Over Kidney Disease Mortality Rate in 1971			0.521			2.448*
			(0.523)			(1.127)

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978 and the publication "Kidney Disease Services, Facilities, and Programs in the United States" and the 1977 Social Security Bulletin. See text for details.

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

Summary of Mechanisms

- Mortality reduction is larger in states with more dialysis clinics
 - Increase in access to care; or
 - Increased entry in areas with more dialysis clinics in 1971
- Convergence in number of dialysis clinics per capita from 1971 to 1975 (lower entry in areas with more clinics)
- Increased entry in states with a greater burden of disease in 1971 for people under 65, no significant relationship for 65 and older

Conclusions

- Introduction of Medicare ESRD program:
 - Reduced mortality due to kidney disease
 - Increased insurance coverage and some measures of health care utilization
- Mortality reduction larger in areas with more treatment facilities
- May be welfare improving (not discussed, see paper), but highly dependent on assumptions
- Full results in paper
papers.ssrn.com/sol3/papers.cfm?abstract_id=2937364 (posted version is somewhat dated)

- 1 Kidney Disease Coding
- 2 Robustness of Mortality Result

Kidney Coding

ICDA-8 (1968-1978)

Narrow Definition:

Chronic Kidney Disease

582-584, 593.2, 792

Acute Kidney Disease

580-581, 593.1

Broad Definition (additions):

Other Diseases of Urinary System

590-599

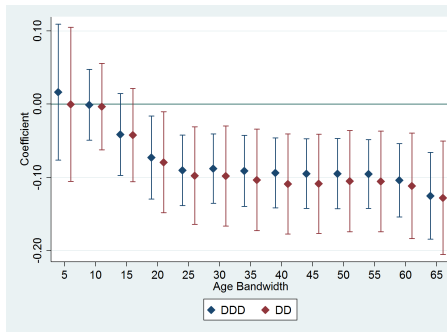
Hypertension

403-404

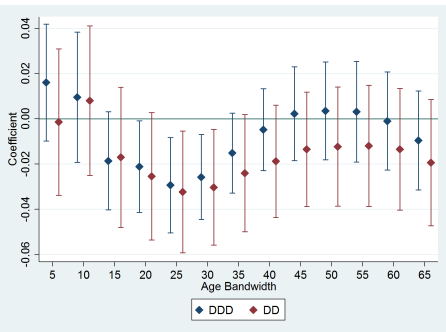
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Robustness to Alternative Bandwidths—Narrow

Narrow, Underlying Cause



Narrow, Underlying or Contributing Cause

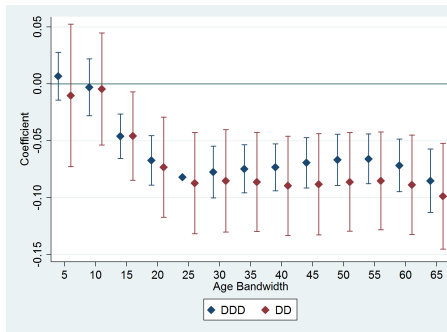


Source—Author's analysis of Multiple Cause of Death Files, 1968-1996.

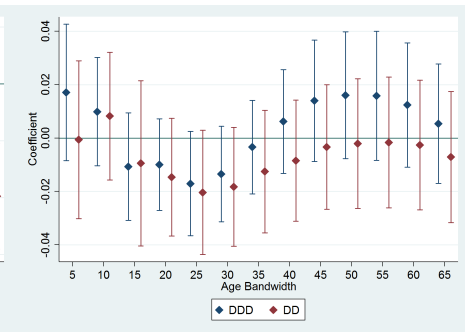
Notes—Difference-in-Difference models with time trends restricted to deaths to people under 65 years of age, models with age trends restricted to deaths due to kidney disease.

Robustness to Alternative Bandwidths—Broad

Broad, Underlying Cause



Broad, Underlying or Contributing Cause



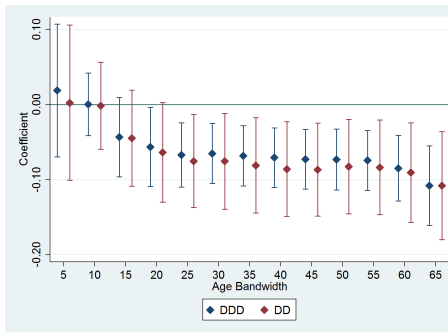
Source—Author's analysis of Multiple Cause of Death Files, 1968-1996.

Notes—Difference-in-Difference models with time trends restricted to deaths to people under 65 years of age, models with age trends restricted to deaths due to kidney disease.

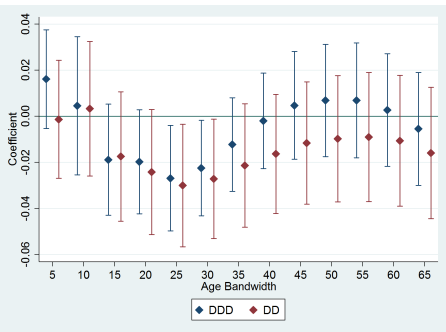
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Robustness to Alternative Bandwidths—Chronic

Chronic, Underlying Cause



Chronic, Underlying or Contributing Cause



Source—Author's analysis of Multiple Cause of Death Files, 1968-1996.

Notes—Difference-in-Difference models with time trends restricted to deaths to people under 65 years of age, models with age trends restricted to deaths due to kidney disease.

Harvesting/Donut Regressions

Cause	Narrow Definition				Broad Definition		Chronic Only	
	(1) Underlying	(2) Underlying	(3) Any	(4) Any	(5) Underlying	(6) Any	(7) Underlying	(8) Any
DDD	-0.446** (0.052)	-0.148** (0.049)	-0.080** (0.006)	-0.066** (0.017)	-0.144** (0.019)	-0.040** (0.011)	-0.134* (0.053)	-0.062** (0.021)
DD	-0.437** (0.056)	-0.150* (0.066)	-0.068** (0.015)	-0.065* (0.026)	-0.145** (0.043)	-0.040+ (0.022)	-0.136* (0.068)	-0.062* (0.026)
Age trends	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Underlying only?	Yes	Yes	No	No	Yes	No	Yes	No

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978.

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

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Robustness Checks

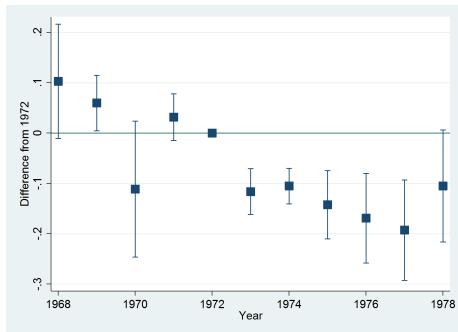
Power	Underlying Cause of Death					Underlying and Contributing Cause of Death				
	(1)	Age Trends		Time Trends		(6)	Age Trends		Time Trends	
		(2)	(3)	(4)	(5)		(7)	(8)	(9)	(10)
N/A	Linear	Quadratic	Linear	Quadratic	N/A	Linear	Quadratic	Linear	Quadratic	
A: Narrow Definition										
DDD	-0.373** (0.049)	-0.073* (0.029)	-0.059* (0.029)	-0.076 (0.056)	-0.075 (0.066)	-0.059** (0.007)	-0.021* (0.010)	-0.016 (0.010)	-0.017* (0.007)	-0.020** (0.007)
DD	-0.363** (0.053)	-0.079* (0.035)	-0.064* (0.031)	-0.067 (0.062)	-0.062 (0.071)	-0.048** (0.014)	-0.025+ (0.014)	-0.018 (0.013)	-0.009 (0.018)	-0.007 (0.018)
B: Broad Definition										
DDD	-0.197** (0.019)	-0.067** (0.011)	-0.048** (0.012)	-0.073** (0.010)	-0.070** (0.013)	-0.042** (0.006)	-0.010 (0.009)	-0.007 (0.008)	-0.030** (0.006)	-0.030** (0.007)
DD	-0.189** (0.025)	-0.073** (0.022)	-0.053** (0.017)	-0.066* (0.028)	-0.058+ (0.033)	-0.032** (0.010)	-0.015 (0.011)	-0.010 (0.010)	-0.021 (0.015)	-0.017 (0.014)
C: Chronic Definition										
DDD	-0.340** (0.046)	-0.057* (0.027)	-0.042 (0.026)	-0.062 (0.058)	-0.063 (0.067)	-0.056** (0.007)	-0.020+ (0.012)	-0.014 (0.011)	-0.018* (0.007)	-0.022** (0.007)
DD	-0.331** (0.051)	-0.064+ (0.034)	-0.047 (0.029)	-0.053 (0.064)	-0.050 (0.074)	-0.045** (0.013)	-0.024+ (0.014)	-0.017 (0.012)	-0.010 (0.019)	-0.009 (0.020)

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978.

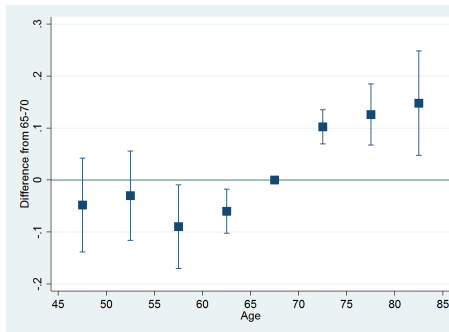
+ p<0.1, * p<0.05, ** p<0.01

Comparison of U.S. Mortality Changes to OECD Mortality Changes

Mortality Differences by Year



Mortality Differences by 5-Year Age Group



Source—Author's analysis of the World Health Organization Mortality Database for 1968 through 1978.

Notes—Points in panel A are quadruple-difference estimates by year comparing mortality from kidney disease to all other deaths in the United States versus all other OECD member states that joined prior to 1969, relative to 1971 for the indicated age groups. Panel B reports quadruple-difference estimates by age group comparing before, versus after, the Medicare expansion, with versus without kidney disease, in the United States versus all other OECD member states. Standard errors are clustered on country.

Cross-Country Estimates of Mortality Reduction

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
United States								
× Post	-0.047**	-0.054***	-0.042***	-0.045***				
	(0.016)	(0.013)	(0.009)	(0.009)				
× Kidney × Post	0.037	-0.082	0.037	-0.083	0.040	0.026	0.041	0.031
	(0.108)	(0.068)	(0.107)	(0.067)	(0.054)	(0.063)	(0.056)	(0.069)
× Under 65 × Post	0.038	0.022**	0.038	0.022**	0.038	0.022**	0.038	0.022**
	(0.025)	(0.008)	(0.025)	(0.008)	(0.025)	(0.008)	(0.025)	(0.008)
× Kidney × Under 65 × Post	-0.108+	-0.083	-0.108+	-0.081	-0.102+	-0.073	-0.111+	-0.082
	(0.056)	(0.057)	(0.055)	(0.057)	(0.057)	(0.056)	(0.057)	(0.057)
Only Members Before 1969	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Country Interactions	No	No	No	No	Yes	Yes	Yes	Yes
Year-by-Kidney	No	No	No	No	No	No	Yes	Yes

Source—Authors' analysis of the World Health Organization Mortality Database for 1968 through 1978, covering the United States and OECD Member States at any point in time.

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Impact of the SSDI and ESRD Expansions on Kidney Disease Mortality

	Narrow Definition		Broad Definition		Chronic Only	
	(2)	(4)	(5)	(6)	(7)	(8)
A: White, 45-64 years old						
# Deaths in 1978	2132	14453	3276	17201	1817	12557
# Deaths Averted	167.7	311.2	236.4	172.9	108.9	252.2
95% CI	(27 - 309)	(5 - 617)	(155 - 318)	(-128 - 474)	(1 - 216)	(-43 - 548)
B: White, 0-64 years old						
# Deaths in 1978	2890	18529	4235	21808	2448	16037
# Deaths Averted	227.4	399.0	305.6	219.2	146.8	322.0
95% CI	(36 - 418)	(7 - 791)	(200 - 411)	(-162 - 601)	(2 - 292)	(-55 - 699)
C: All, 45-64 years old						
# Deaths in 1978	3283	19349	4959	22902	2862	16924
# Deaths Averted	258.3	416.7	357.8	230.2	171.6	339.9
95% CI	(41 - 475)	(7 - 826)	(234 - 482)	(-170 - 631)	(2 - 341)	(-58 - 738)
D: All, 0-64 years old						
# Deaths in 1978	4498	25149	6474	29444	3890	21887
# Deaths Averted	353.9	541.6	467.1	295.9	233.2	439.5
95% CI	(57 - 651)	(9 - 1074)	(306 - 629)	(-219 - 811)	(3 - 463)	(-75 - 954)
Underlying only?	Yes	No	Yes	No	Yes	No

Source—Author's analysis of Multiple Cause Mortality Files for 1978.

Life Years Saved and Cost per Life Year

	W/o Kidney Disease		W/Kidney Disease		(5) DD	(6) # Life Years	(7) \$000s/LY
	(1) Post	(2) Post-Pre	(3) Post	(4) Post-Pre			
Narrow Definition, Underlying and Contributing Cause							
0-84	71.88	1.51	71.48	1.51	-0.005	-16689	-168.1
0-65	61.89	0.69	61.78	0.70	0.010	33657	67.1
45-65	19.46	0.21	19.40	0.21	0.005	11673	63.5
Chronic Definition, Underlying and Contributing Cause							
0-84	71.83	1.50	71.48	1.51	0.010	33380	84.1
0-65	61.87	0.69	61.78	0.70	0.013	42009	53.7
45-65	19.45	0.20	19.40	0.21	0.007	14992	49.5
Broad Definition, Underlying and Contributing Cause							
0-84	71.98	1.47	71.48	1.51	0.032	106648	26.3
0-65	61.91	0.68	61.78	0.70	0.021	71434	31.6
45-65	19.47	0.20	19.40	0.21	0.012	25431	29.2

Source—Author's analysis of Multiple Cause Mortality Files for 1968-1978.