Re-Examining the Contribution of Public Health Efforts to the Decline in Urban Mortality

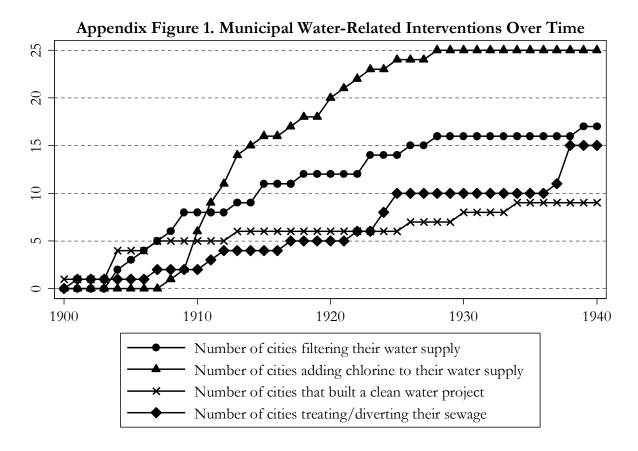
D. Mark Anderson

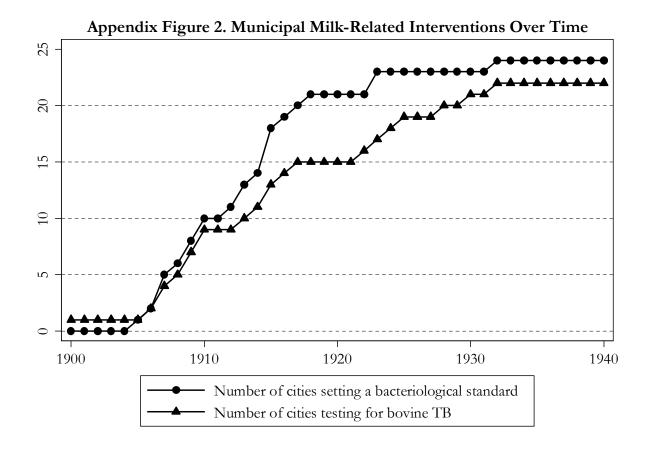
Kerwin Kofi Charles

Daniel I. Rees

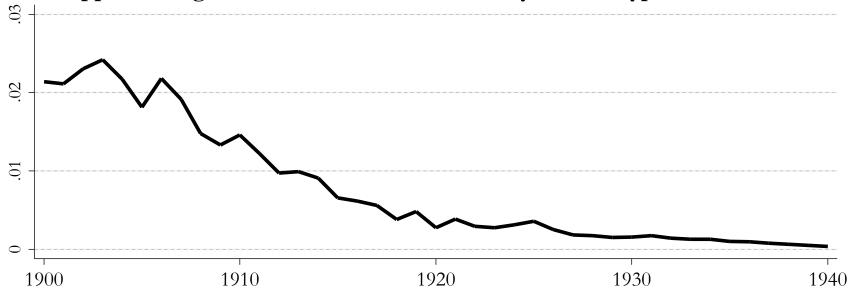
Online Appendix

Appendix A

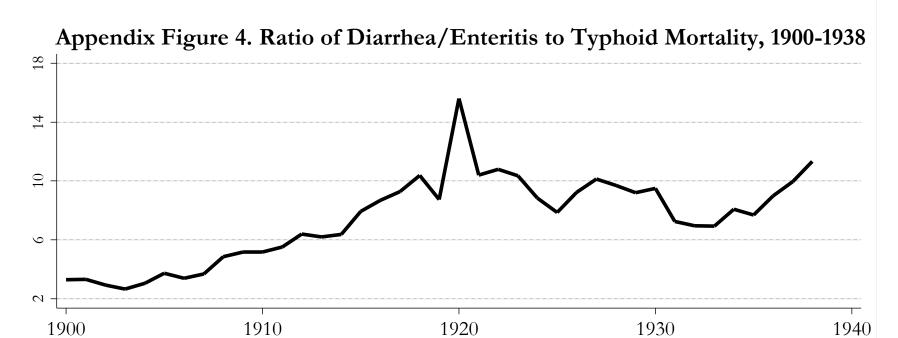




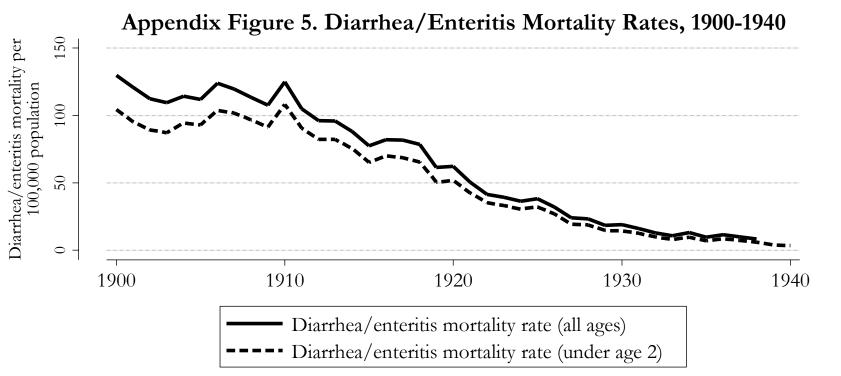




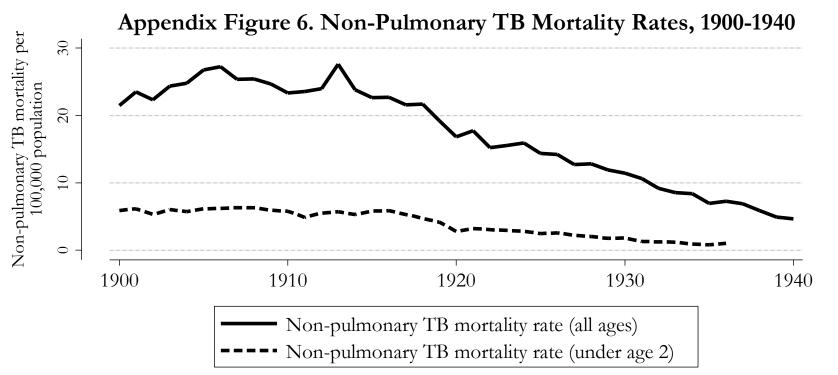
Notes: Based on annual data from Mortality Statistics and Vital Statistics of the United States for the period 1900-1940, published by the U.S. Census Bureau.



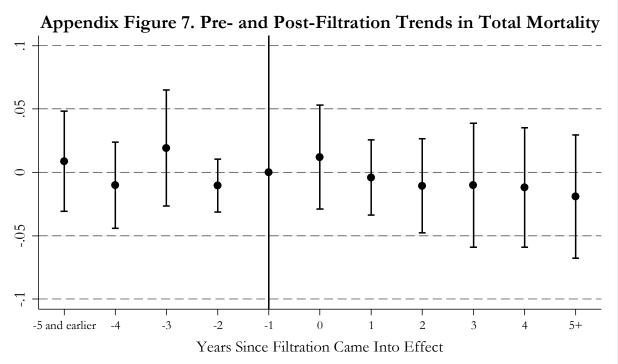
Notes: Based on annual data from *Mortality Statistics* and *Vital Statistics of the United States* for the period 1900-1938, published by the U.S. Census Bureau.



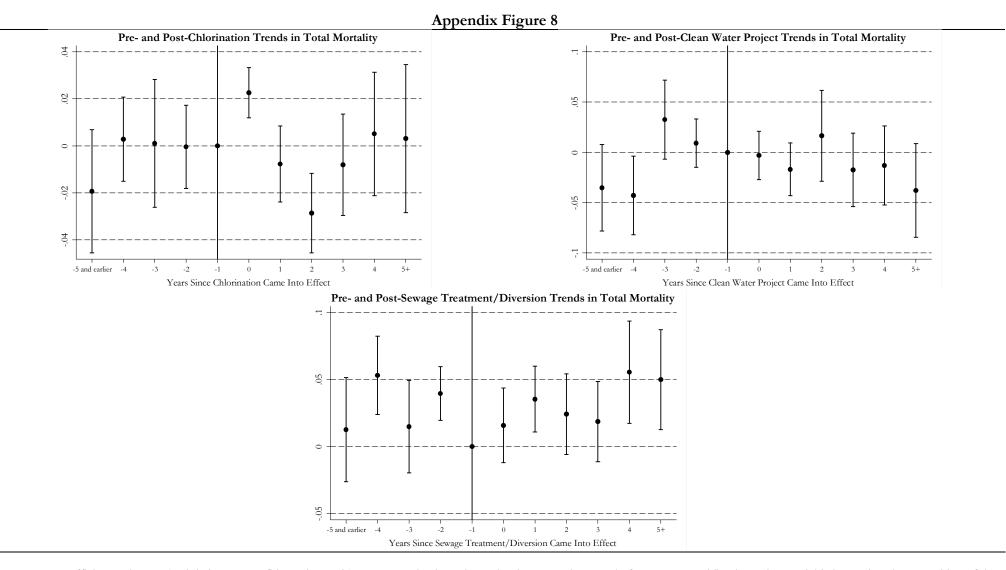
Notes: Based on annual data from *Mortality Statistics* and *Vital Statistics of the United States* for the period 1900-1940, published by the U.S. Census Bureau.



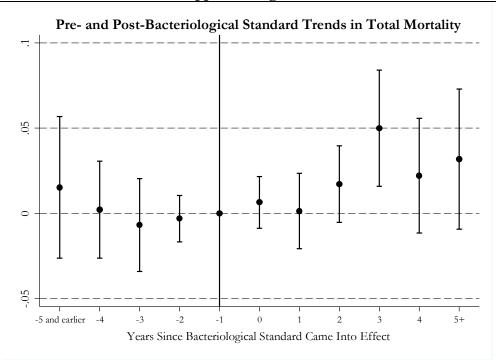
Notes: Based on annual data from *Mortality Statistics* and *Vital Statistics of the United States* for the period 1900-1940, published by the U.S. Census Bureau.

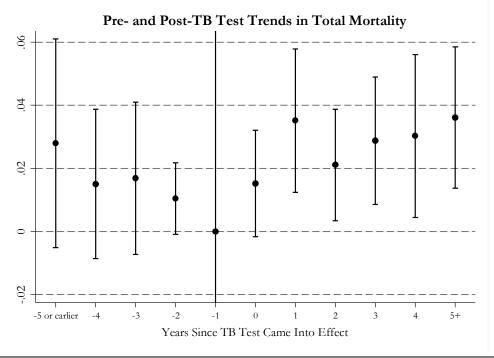


Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of deaths per 100,000 population in city ϵ and year ϵ . Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

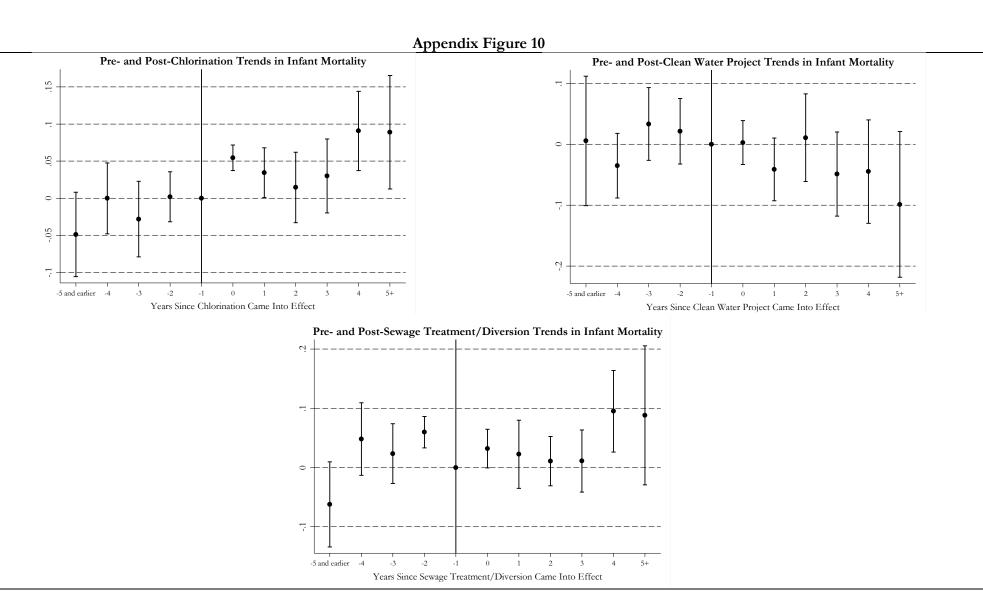


Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of deaths per 100,000 population in city c and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

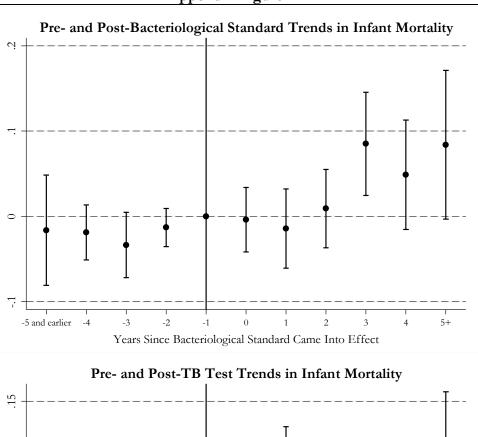


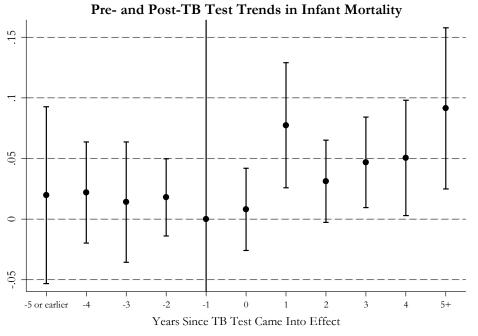


Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of deaths per 100,000 population in city ϵ and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

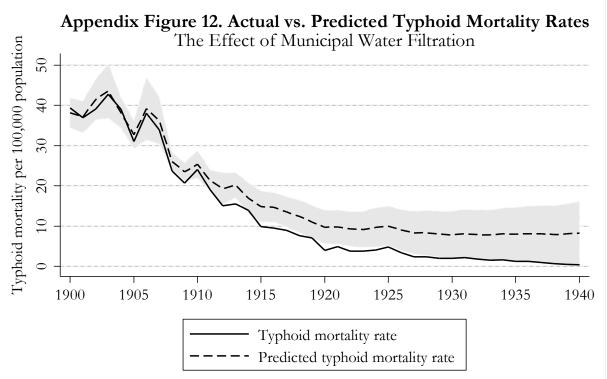


Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of infant deaths per 100,000 population in city c and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

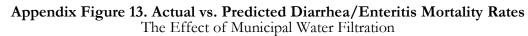


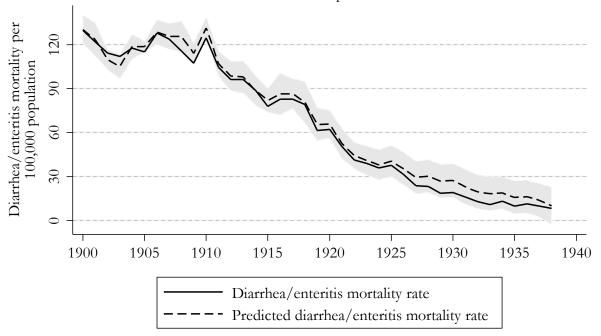


Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of infant deaths per 100,000 population in city ϵ and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

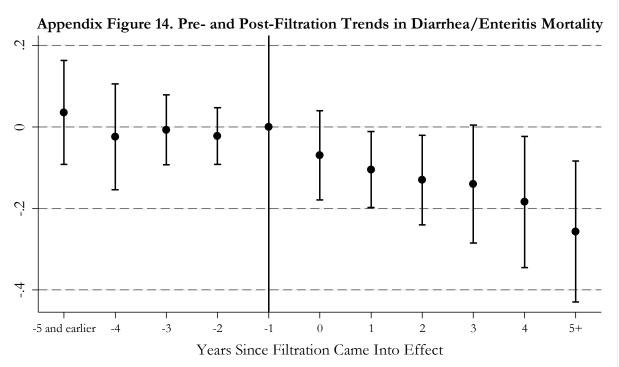


Notes: Based on annual data from *Mortality Statistics* and *Vital Statistics of the United States* for the period 1900-1940, published by the U.S. Census Bureau. Predicted typhoid mortality rates are calculated under the assumption that municipalities did not filter their water supply. Shaded area represents 90% confidence region around typhoid mortality rates.





Notes: Based on annual data from *Mortality Statistics* and *Vital Statistics of the United States* for the period 1900-1938, published by the U.S. Census Bureau. Predicted diarrhea/enteritis mortality rates are calculated under the assumption that municipalities did not filter their water supply. Shaded area represents 90% confidence region around diarrhea/enteritis mortality rates.



Notes: OLS coefficient estimates (and their 90% confidence intervals) are reported, where the omitted category is 1 year before treatment. The dependent variable is equal to the natural log of the number of diarrhea/enteritis deaths per 100,000 population in city ϵ and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects, and city-specific linear trends. Regressions are weighted by city population. Standard errors are corrected for clustering at the city level.

Appendix Table 1. Robustness Checks: The Effects of Water Quality, Sewage Treatment/Diversion, and Clean Milk on Typhoid Mortality

	(1)	(2)	(3)	(4)	(5)	(6)
	Control for wages	Control for region-by- year fixed effects	Unweighted	Drop New York City	Drop years 1917-1920	Dependent variable in levels
Water				•		
Filtration	172**	188**	205***	168**	183**	-9.70*
	(.072)	(.079)	(.070)	(.070)	(.076)	(4.88)
	{.037}	{.014}	{.002}	{.044}	$\{.020\}$	{.033}
	[-4.88]	[-5.05]	[-5.48]	[-4.58]	[-5.08]	
Chlorination	.010	.019	.006	012	002	802
	(.038)	(.049)	(.041)	(.042)	(.041)	(2.03)
	{.808}	{.732}	{.897}	{.808}	{.965}	<i>{</i> .707 <i>}</i>
	[.271]	[.514]	[.155]	[318]	[062]	
Clean Water Project	.043	.068	046	048	.049	5.11
J	(.074)	(.099)	(.069)	(.113)	(.074)	(5.08)
	{.627}	{.560}	{.565}	$\{.750\}$	{.587}	{.437}
	[1.22]	[1.83]	[-1.23]	[-1.32]	[1.35]	,
Sewage	. ,					
Sewage Treatment/Diversion	013	050	060	042	014	1.11
	(.062)	(.052)	(.054)	(.064)	(.055)	(1.83)
	{.850}	{.394}	{.332}	{.577}	{.826}	{.543}
	[374]	[-1.33]	[-1.62]	[-1.14]	[400]	
Milk						
Bacteriological Standard	052	069*	047	061	056	-3.68
	(.036)	(.039)	(.045)	(.048)	(.039)	(2.72)
	{.178}	$\{.099\}$	{.352}	{.311}	{.212}	{.232}
	[-1.47]	[-1.84]	[-1.25]	[-1.65]	[-1.54]	
TB Test	.029	.094*	.036	.045	.045	2.06
	(.060)	(.052)	(.066)	(.072)	(.069)	(2.53)
	$\{.702\}$	{.246}	{.629}	{.671}	{.631}	{.499}
	[.818]	[2.53]	[.970]	[1.23]	[1.26]	
Mean of typhoid mortality rate	13.6	12.6	12.6	12.9	13.3	12.6
N	949	1,024	1,024	983	924	1,024
\mathbb{R}^2	.938	.948	.911	.929	.943	.818

^{*}Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Based on annual data from *Mortality Statistics* for the period 1900-1940, published by the U.S. Census Bureau. Each column represents the results from a separate OLS regression. In columns (1)-(5), the dependent variable is equal to the quartic root of the number of typhoid deaths per 100,000 population in city c and year t. In column (6), the dependent variable is equal to the number of typhoid deaths per 100,000 population in city c and year t. Controls include the demographic characteristics listed in Table 5, city fixed effects, year fixed effects and city-specific linear trends. In columns (1)-(2) and (4)-(6), regressions are weighted by city population. Standard errors, corrected for clustering at the city level, are in parentheses. P-values from wild cluster bootstrap procedure are in curly brackets and are based on 1,000 replications. Marginal effects are in square brackets.

Appendix Table 2. Typhoid Mortality and Lags of Filtration (1) (2)(3)Typhoid Mortality Year 0 .042 .036 .033 (.078)(.078)(.078){.744} {.783} $\{.806\}$ [1.13][.964][.891]1 Year After Filtration -.089 -.096 -.099 (.088)(.088)(.087){.370} {.330} {.309} [-2.39][-2.57][-2.65]2 Years After Filtration -.130 -.139* -.142* (.076)(.076)(.076){.127} {.120} {.153} [-3.48][-3.71][-3.81]-257*** 3+ Years After Filtration (.067) $\{.002\}$ [-6.88]3 Years After Filtration -.211*** -.214*** ... (.067)(.068){.004} {.004} [-5.64][-5.75]-.224*** 4 Years After Filtration -.219*** (.075)(.076) $\{.035\}$ $\{.035\}$ [-5.99][-5.87]5+ Years After Filtration -.286*** . . . (.072){.003} [-7.66]-.270*** 5 Years After Filtration (.066) $\{.007\}$ [-7.24]6 Years After Filtration -.267*** (.070){.006} [-7.16]7+ Years After Filtration -.300*** (.081){.011} [-8.04] Mean of typhoid mortality 12.6 12.6 12.6 rate N 1,024 1,024 1,024

 \mathbb{R}^2

.941

.942

.941

^{*}Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Based on annual data from *Mortality Statistics* for the period 1900-1940, published by the U.S. Census Bureau. Each column represents the results from a separate OLS regression. The dependent variable is equal to the quartic root of the number of typhoid deaths per 100,000 population in city *c* and year *t*. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects and city-specific linear trends. Regressions are weighted by city population. Standard errors, corrected for clustering at the city level, are in parentheses. P-values from wild cluster bootstrap procedure are in curly brackets and are based on 1,000 replications. Marginal effects are in square brackets.

Appendix Table 3. Robustness Checks: The Effects of Water Quality, Sewage Treatment/Diversion, and Clean Milk on Diarrhea/Enteritis Mortality

	(1)	(2)	(3)	(4)	(5)	(6)
	Control for wages	Control for region-by- year fixed effects	Unweighted	Drop New York City	Drop years 1917-1920	Dependent variable in levels
Water				-		
Filtration	139*	145	209***	171**	147	-6.93
	(.076)	(.087)	(.058)	(.065)	(.089)	(9.35)
	{.090}	{.152}	{.004}	{.022}	{.150}	{.521}
Chlorination	.072	010	.034	.149*	.095	6.56
	(.066)	(.066)	(.076)	(.072)	(.086)	(5.88)
	{.381}	{.911}	{.716}	{.175}	{.381}	{.391}
Clean Water Project	128	234**	.142	.135	122	-22.5*
·	(.118)	(.112)	(.140)	(.186)	(.135)	(11.0)
	{.404}	{.147}	{.420}	{.568}	{.503}	{.309}
Sewage						
Sewage Treatment/Diversion	.206*	.203**	.141	.259**	.172	13.7
	(.117)	(.090)	(.092)	(.098)	(.112)	(10.8)
	{.400}	{.195}	{.181}	{.118}	{.430}	{.579}
Milk						
Bacteriological Standard	.038	.094	.100	.040	.009	-1.75
	(.051)	(.069)	(.066)	(.071)	(.057)	(4.61)
	{.448}	{.241}	{.238}	{.564}	{.888}	{.714}
TB Test	.154**	.106**	.102	.217**	.177**	10.7*
	(.073)	(.046)	(.079)	(.079)	(.073)	(5.78)
	{.116}	{.033}	{.309}	{.062}	{.075}	{.159}
Mean of diarrhea/enteritis mortality rate	66.4	64.9	64.9	64.6	64.2	64.9
N	949	974	974	935	874	974
\mathbb{R}^2	.972	.979	.957	.968	.974	.939

^{*}Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Based on annual data from *Mortality Statistics* for the period 1900-1938, published by the U.S. Census Bureau. Each column represents the results from a separate OLS regression. In columns (1)-(5), the dependent variable is equal to the natural log of the number of diarrhea/enteritis deaths per 100,000 population in city ϵ and year t. In column (6), the dependent variable is equal to the number of diarrhea/enteritis deaths per 100,000 population in city ϵ and year t. Controls include the demographic characteristics listed in Table 5, city fixed effects, year fixed effects and city-specific linear trends. In columns (1)-(2) and (4)-(6), regressions are weighted by city population. Standard errors, corrected for clustering at the city level, are in parentheses. P-values from wild cluster bootstrap procedure are in curly brackets and are based on 1,000 replications.

Appendix Table 4. Diarrhea/Enteritis Mortality and Lags of Filtration

	(1)	(2)	(3)
	Die	arrhea/Enteritis Mort	ality
Year 0	066	074	078
	(.076)	(.076)	(.078)
	{.450}	{.409}	{.391}
1 Year After Filtration	099	108*	113*
·	(.062)	(.062)	(.064)
	{.111}	{.089}	$\{.088\}$
2 Years After Filtration	122*	134**	138**
·	(.063)	(.063)	(.063)
	$\{.067\}$	{.053}	$\{.040\}$
3+ Years After Filtration	213**	•••	•••
·	(.099)		
	{.047}		
3 Years After Filtration		143	148
•		(.089)	(.088)
		{.107}	{.089}
4 Years After Filtration		185*	191*
		(.106)	(.106)
		{.126}	{.116}
5+ Years After Filtration		251**	•••
		(.108)	
		{.040}	
5 Years After Filtration		•••	209*
			(.104)
			{.073}
6 Years After Filtration		•••	253**
			(.100)
			{.027}
7+ Years After Filtration		•••	270**
			(.124)
			{.066}
Mean of dependent variable	64.9	64.9	64.9
N	974	974	974
\mathbb{R}^2	.971	.971	.971

^{*}Statistically significant at 10% level; ** at 5% level; *** at 1% level.

Notes: Based on annual data from *Mortality Statistics* for the period 1900-1938, published by the U.S. Census Bureau. Each column represents the results from a separate OLS regression. The dependent variable is equal to the natural log of the number of diarrhea/enteritis deaths per 100,000 population in city ϵ and year t. Controls include the demographic characteristics and remaining public health interventions listed in Table 5, city fixed effects, year fixed effects and city-specific linear trends. Regressions are weighted by city population. Standard errors, corrected for clustering at the city level, are in parentheses. P-values from wild cluster bootstrap procedure are in curly brackets and are based on 1,000 replications.

Appendix Table 5. Comparing our Preferred Specification to that of Cutler and Miller (2005)

	C&M Specification	Our Specification
Set of controls	See Appendix Table 7	See Table 5
Model choice	OLS	OLS
Weighting	Unweighted	Weighted by city population
Standard errors	Huber-White	Clustered at the city level
		· · · · · · · · · · · · · · · · · · ·
N	415	1,024
Years	1905-1936	1900-1940
Number of cities	13	25
	City in C&M sample	City in our sample
Baltimore, MD	yes	yes
Boston, MA		yes
Buffalo, NY		yes
Chicago, IL	yes	yes
Cincinnati, OH	yes	yes
Cleveland, OH	yes	yes
Detroit, MI	yes	yes
Indianapolis, IN		yes
Jersey City, NJ	yes	yes
Kansas City, MO		yes
Louisville, KY	yes	yes
Memphis, TN	yes	yes
Milwaukee, WI	yes	yes
Minneapolis, MN		yes
Newark, NJ		yes
New Orleans, LA	yes	yes
New York, NY		yes
Philadelphia, PA	yes	yes
Pittsburgh, PA	yes	yes
Providence, RI		yes
Rochester, NY	•••	yes
San Francisco, CA	•••	yes
St. Louis, MO	yes	yes
St. Paul, MN	•••	yes
Washington, D.C.		yes

Appendix Table 6. Comparing City Characteristics of our Sample to that of Cutler and Miller (2005)

	Mean
	(SD)

	C&M Sample	Our Sample
Population	800,805 (724,467)	806,454 (1,174,634)
% Female	.502 (.015)	.503 (.016)
% Nonwhite	.116 (.107)	.090 (.100)
% Foreign	.175 (.100)	.193 (.109)
% Under 15	.261 (.025)	.255 (.032)
% 15 to 44	.531 (.022)	.529 (.025)
% 45 and Older	.208 (.032)	.216 (.038)
N	415	1,024

Notes: Unweighted means with standard deviations in parentheses.

Appendix Table 7. List of Controls in Cutler and Miller (2005)

	Description
Filtration	= 1 if city had a water filtration plant, = 0 otherwise
Chlorination	= 1 if city chemically treated water supply, = 0 otherwise
Filtration w/in 5 Years	= 1 if city began filtering water supply within 5 years, = 0 otherwise
Chlorination w/in 5 Years	= 1 if city began chemically treating water supply within 5 years, = 0 otherwise
Sewage Treatment ^a	= 1 if city had a sewage treatment plant, = 0 otherwise
Sewage Chlorination ^b	= 1 if city chemically treated its sewage, = 0 otherwise
Lake Michigan Outfalls	= 1 for Chicago after Lake Michigan sewer outfalls were shut off, = 0 otherwise
Cleveland Intake Tunnel	= 1 for Cleveland after intake tunnel was built to draw water from Lake Erie, = 0 otherwise
$ln(Mortality)_{t-1}$	One-year lag of natural log of city mortality rate
$ln(Mortality)_{t-2}$	Two-year lag of natural log of city mortality rate
$ln(Mortality)_{t-3}$	Three-year lag of natural log of city mortality rate
$ln(Mortality)_{t=4}$	Four-year lag of natural log of city mortality rate
$ln(Mortality)_{t-5}$	Five-year lag of natural log of city mortality rate
ln(Population)	Natural log of city population
% Female	Percent of city population that was female
% Black	Percent of city population that was black
% Other Nonwhite	Percent of city population that was a nonwhite race other than black
% Foreign	Percent of city population that was foreign born
% Under 1	Percent of city population that was under 1 years of age
% 1 to 4	Percent of city population that was 1 to 4 years of age
% 5 to 9	Percent of city population that was 5 to 9 years of age
% 10 to 14	Percent of city population that was 10 to 14 years of age
% 15 to 19	Percent of city population that was 15 to 19 years of age
% 20 to 24	Percent of city population that was 20 to 24 years of age
% 25 to 34	Percent of city population that was 25 to 34 years of age
% 35 to 44	Percent of city population that was 35 to 44 years of age
% 45 to 64	Percent of city population that was 45 to 64 years of age
% 65 and Older	Percent of city population that was 65 years of age or older

^a Three cities in C&M's sample period constructed sewage treatment plants (Baltimore in 1911, Cleveland in 1922 and Milwaukee in 1925).

^b One city in C&M's sample period chlorinated its sewage (Cleveland in 1922).

Appendix Table 8. Differences in Recorded Infant Mortality Counts between Cutler and Miller (2005) and the U.S. Census Bureau's *Mortality Statistics*

				u's Mortality Statistics
		C0 M2 1 1	Correct infant	
		C&M's recorded	mortality count	
C'.	37	infant mortality	from Mortality	D (1'0' / 1 1)
City	Year 1910	count ^a	Statistics ^b	Reason for difference (when known)
Baltimore, MD		1417.07	2146	
	1911	1295.99	1960	
	1912	1384.03	2022	
	1913	1343	2011	
	1914	1312.43	1949	
	1915	1093.48	1626	
	1916	1158.78	1770	
	1917	1183.75	1780	
Chicago, IL	1910	6595.52	6844	
	1911	6017.86	6252	
	1912	6394.31	6678	
	1913	6649.87	6939	
	1914	6571.52	6878	
	1915	5942.99	6219	
	1916	6566.35	6910	
	1917	6246.72	6664	
	1931	766	2992	To calculate, one needs to add white infant mortality (=2,617) and nonwhite infant mortality (=375). It appears as if C&M incorrectly added mortality for one-year-olds, rather than infants, for whites (=391) and nonwhite infant mortality, which gives their
C OII	1010	702.425	017	recorded total of 766.
Cincinnati, OH	1910	793.435	917	
	1911	630.712	721	
	1912	693.419	805	
	1913	706.664	<u>801</u>	
	1914	637.264	750	
	1915	524.823	619	
	1916	623.426	736 	
	1917	563.757	688	
Cleveland, OH	1924	2366	1386	To calculate, one needs to add white infant mortality (=1,219) and nonwhite infant mortality (=167). It appears as if C&M incorrectly added overall nonwhite mortality (=1,147) and white infant mortality (=1,219), which gives their recorded total of 2,366.
Detroit, MI	1920	2734	2885	C&M incorrectly recorded infant mortality for whites only, which was 2,734. Nonwhite infant mortality was 151.

Jersey City, NJ				No mistakes for Jersey City
Louisville, KY	1910	328.389	503	• • •
- -	1911	298.928	441	
- -	1912	46.4965	448	
-	1913	322.27	486	
- -	1914	338.518	496	
-	1915	250.146	379	
- -	1916	283.827	418	
- -	1917	271.929	397	
Memphis, TN	1910	173.2	345	
<u>-</u>	1911	175.645	348	
 	1912	185.973	373	
	1913	157.88	319	
	1914	158.831	317	
	1915	118.738	228	
- -	1916	0		Data for Memphis, TN are not reported in 1916.
-	1917	158.43	311	
Milwaukee, WI	1926	865	856	C&M incorrectly transposed the "5" and "6"
New Orleans, LA	1910	571.931	1061	· •
	1911	595.471	1071	
- -	1912	416.903	774	
- -	1913	500.74	934	
- -	1914	477.419	883	
	1915	492.79	927	
	1916	404.008	757	
	1917	446.364	866	
Philadelphia, PA	1910	4557.6	5334	
	1911	4093.3	4769	
- -	1912	3659.92	4201	
- -	1913	3925.69	4618	
-	1914	4170.24	4870	
- -	1915	3634.78	4233	
	1916	3669.4	4252	
- -	1917	3921.49	4637	
Pittsburgh, PA	1901	6578	1580	C&M incorrectly recorded the overall mortality count instead of the infant mortality count.
- -	1904	771	1771	C&M incorrectly entered "1771" as "771"
-	1910	2024.02	2259	
-	1911	1648.01	1812	
	1912	1648.71	1811	

	1913	1754.65	1957	
	1914	1672.1	1868	
	1915	1670.73	1765	
	1916	1688.55	1893	
	1917	1744.14	1983	
	1924	1530	1440	
St. Louis, MO	1910	1452.74	1689	
	1911	1345.61	1573	
	1912	1263.1	1467	
	1913	1246.83	1478	
	1914	1278.93	1508	
	1915	1014.65	1181	
	1916	1061.51	1264	
	1917	1012.88	1252	

^a In the Cutler and Miller data set, the variable "mort0_1" represents the infant mortality count. Their dependent variable of interest, the natural log of the infant mortality rate, can be recreated with the following STATA command:

gen lninfmrt = $ln((mort0_1*100000)/age0_1)$, where "age0_1" is the city infant population.

^b The infant mortality counts for each year listed above can be found in the following *Mortality Statistics* tables:

Year	Location
1901	Mortality Statistics 1900 to 1904, Table 2, pp. 180-197; or Table 8, pp. 270-311
1904	Mortality Statistics 1900 to 1904, Table 2, pp. 654-671; or Table 8, pp. 744-785
1910	Mortality Statistics 1910, Table 3, pp. 204-251; or Table 9, pp. 455-501; or Table 11, pp. 533-574
1911	Mortality Statistics 1911, Table 1, pp. 150-173; or Table 2, pp. 174-257; or Table 7, pp. 466-512; or Table 9, pp. 537-567
1912	Mortality Statistics 1912, Table 1, pp. 28-49; or Table 6, pp. 255-301; or Table 8, pp. 335-377
1913	Mortality Statistics 1913, Table 1, pp. 222-243; or Table 6, pp. 486-539; or Table 8, pp. 577-625
1914	Mortality Statistics 1914, Table 3, pp. 192-219; or Table 4, pp. 220-303; or Table 9, pp. 567-621; or Table 11, pp. 660-709
1915	Mortality Statistics 1915, Table 3, pp. 184-211; or Table 4, pp. 212-297; or Table 9, pp. 553-607; or Table 11, pp. 645-694
1916	Mortality Statistics 1916, Table 3, pp. 150-175; or Table 9, pp. 406-449; or Table 11, pp. 483-525
1917	Mortality Statistics 1917, Table 3, pp. 172-197; or Table 9, pp. 441-487; or Table 11, pp. 523-568
1920	Mortality Statistics 1920, Table 3, pp. 140-174; or Table 9, pp. 479-539; or Table 11, pp. 586-646
1924	Mortality Statistics 1924, Table 9, pp. 358-390
1926	Mortality Statistics 1926, Table 9, pp. 285-317
1931	Mortality Statistics 1931, Table 9, pp. 396-440

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