Death and Sewers

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In his 1989 book *Constructing Urban Culture*, Stanley Schultz concludes that "filtration of water and sewage brought a dramatic drop in typhoid mortality rates, a drop that averaged 65 percent in selected major cities." Like other urban historians before him, Schultz asserts that the sanitation improvements implemented at the beginning of this century were the cause of the mortality decline. While few would question that modern sanitation facilities have led to improved health, matters of interest to economists include the number of lives saved and the dollar price paid per life spared.

Our research has attempted to address these issues by examining whether cities' expenditures on water systems, sewers, and refuse management programs during the "Progressive Era" provided attractive investment returns in the form of reduced deaths from such "waterborne" diseases as typhoid, diarrhea, and dysentery. We have examined relationships between US municipal sanitation expenditures and death rates from 1899 to 1929. Urban historians consider this period to have been an era of reform, whose heralding of the environmental movement's first awakening led to an expansion in municipalities' expenditures on such works. By 1907, virtually every American city had installed sewers, and most large cities were using filtration and chlorination to assure safe water supplies.

From the very late 1890s until the very early 1930s, the federal government published compilations of financial and mortality statistics for cities. Data on both dollar outlays and deaths are contained in various editions of the *Bureau of Labor Statistics Bulletin* for the years 1899-1902, and in the *Census Bulletin* for 1902-1903. The Bureau of the Census published *Mortality Statistics of Cities* annually between 1900 and 1936, and it distributed *Financial Statistics of Cities* in most years between 1905 and 1931. Our analysis of these statistics ends with those compiled for 1929, before Depression-era programs provided funds from Washington for municipal improvements. The main focus of our work has been to link statistically the death rates from typhoid, diarrhea, and dysentery (all of which are spread by impure water and by poor methods of waste disposal) to expenditures on sanitation (water supply works, and facilities to treat wastewater and refuse).

Water: Sources and Disposal

The sanitary history of an urban area is likely to follow one of four general patterns. The pattern that prevails is determined by the type of water resource on which the specified city is located:

Cities situated along the oceans or their inlets could not draw water from the abundant supplies close at hand, and often have had to rely on sources located hundreds of miles away. On the other hand, these cities have found it convenient to dispose of household and industrial wastes in the adjacent salt water.

Cities located on fresh water lakes have historically used the lakes both for water supplies and for waste disposal. Such cities have been forced to separate water intakes geographically as far as possible from sewer outfalls, in order to avoid befouling the drinking water with the wastes. This interdependency has created what are, arguably, the most difficult sanitation problems faced by urban areas.

Cities located along major rivers simply have drawn water upstream from the major areas of urban activity and have disposed of wastes downstream. The flow of the water eliminated most of the types of problems faced by lakefront cities, although care was essential to assure that sewage backwash would not have the potential to reach water intake areas.

Cities served by smaller rivers have had to look elsewhere for water supplies, utilizing distant lakes and rivers or relying on wells. Yet such cities have used their small rivers for waste disposal, although they may have had to build sewers leading to downstream points where these rivers could accommodate large volumes of wastewater.

Each city in the sample that we analyzed has been classified into one of the four categories. We have examined whether the effects of the water, sewer, and refuse variables differ by city type. It appears that different types of cities faced different constraints in attempting to reduce mortality through investment in water, sewer, and refuse works; therefore, the payoffs to these investments varied between cities. As a consequence, the incentives were for different cities to employ different mixes of these variables in their sanitation investment strategies.

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Money Well-Spent

Available evidence suggests that there was a substantial payoff, in reduced deaths from waterborne diseases, to outlays for water works, sewer systems, and waste collection/disposal. It is interesting, however, to note observable differences among the city categories. While expenditures on sanitation system improvements (capital equipment plus operating costs) averaged $42.93 per resident annually across the four city types, the range was from a low of $40.27 in cities along minor rivers to a much higher $48.92 in cities along oceans or inlets. The greater outlays in salt water areas are attributable to the more costly capital equipment for public water systems in those cities.

Table 1 lists the number of lives saved annually through the reduction in waterborne diseases that accompanied a 1% increase in expenditures on each of six categories. These categories relate to annual capital outlays and operating costs for water, sewer, and refuse disposal systems. Across all cities in the pooled sample, a 1% increase in each of the six categories would have been accompanied by the saving of almost 27 lives annually in an average sized community. In light of the average population of slightly less than 200,000 for cities in our sample, the expenditure per life saved works out to be just in excess of $3,000 ([1% x $42.93 average annual outlay x 194,223 people]/ 26.99 lives = $3,089 per life). Even in light of the lower price levels present in this earlier era, the expenditures would appear to have been justifiable.

Implications and Conclusions

There are serious differences among the types of cities listed in the table. A 1% increase in spending on water works (Water–Capital) in salt water cities was accompanied by almost 24 lives saved per year, a much greater number than was realized elsewhere. A similar increase in annual expenditures on water disinfection (Water–Operating), however, would have had its greatest effect on cities bordering fresh water lakes, where such spending would have been consistent with 11 lives saved annually. Increased spending on sewer capital accompanied the greatest preservation of life through eliminating waterborne diseases along rivers, particularly in minor river cities, where a 1% spending increase was accompanied by more than 20 lives saved per year. An added 1% annual operating outlay for sewers in minor river cities was consistent with almost 10 lives saved. The 16 lives saved in fresh water lake cities that accompanied a 1% rise in expenditure on refuse capital could have been countered by 13 more *deaths* that accompanied increased annual expenditures on refuse collection and disposal, a curious result in that such spending was consistent with reduced mortality in the other city types.

Statistical analysis of the type employed in our study provides proof only of simultaneous occurrence, not of causation. Of course, the direct impact that improved sanitation would be expected to exert allows us to infer with some confidence that the expenditures discussed above were largely responsible for the reduced death toll from waterborne diseases early in the 20th century. Some of the specific results are of special interest. For example, while most cities began disinfecting their water supplies during this period, the impact was substantial only in the fresh water lake cities. The intelligent location of sewage works appears to have been quite important to cities located along both major and minor rivers, but the annual operating expenditures on sewer systems were of additional importance only to cities served by minor rivers. Finally, while most of the expenditures were consistent with the saving of lives, it is puzzling that outlays for refuse operations, as well as those for water capital, are shown to have accompanied a considerable reduction in the preservation of life in cities on fresh water lakes. ■

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Table 1: Lives Saved Annually per City with 1% Increase in Sanitation Expenditures

Type of Expenditure	Type of City Water Resources				Average for All Cities
	Salt Water	Lake	Major River	Minor River	
Water – Capital	23.73	–14.28	1.81	0.66	8.79
Water – Operating	2.49	11.08	2.07	–3.57	–1.29
Sewer – Capital	9.03	1.17	10.97	20.15	12.58
Sewer – Operating	–0.05	2.10	–1.86	9.69	1.26
Refuse – Capital	2.68	15.81	2.22	–0.33	2.01
Refuse – Operating	4.61	–12.93	4.71	7.27	3.65
Total	42.49	2.94	19.92	33.88	26.99

ORER News

Students Recognized

A number of U of I real estate students received scholarships during the past year. Scott Stortzum, a senior from Tolono, was awarded a $2,000 Morgan L. Fitch award through the Illinois Real Estate Educational Foundation. Three graduate students received fellowships through RREEF, a firm that manages pension fund investments in real estate. Chicagoans Winston Langston and Paul Macklin both received $5,000 awards, and Elayne Taylor-Tyler of Hazel Crest was awarded a $2,500 fellowship. Craig Hewerdine, a senior from Paxton, was awarded the $1,500 SIOR Scholarship. Chicago's chapter of the Society of Industrial and Office Realtors® funds this annual award to the most outstanding undergraduate real estate student, as selected by real estate faculty members.

Those who served as Fall 1992 officers of Rho Epsilon are E. Michael Hoadley, a senior from Elgin, president; Scott England, a senior from Wheaton, vice president; Calvin Cooke, a junior from Crystal Lake, treasurer; and Marvin Sledge, a senior from Chicago, secretary. Hoadley repeated as president in Spring 1993, and Hewerdine was vice president. Joining them as officers were M. Greg Bante, a sophomore from Naperville, treasurer; and JoDee Reidelberger, a senior from Du Quoin, secretary. Incoming junior Bante has been elected president for the Fall 1993 semester. Those joining him as officers will be Anthony Blanchard, a graduate student from Texas, vice president; Scott Nicholson, a junior from Lombard, treasurer; and Kelly Cooper, a senior from Decatur, secretary.

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