A Reassessment of the Role of Water Improvements in the Urban Mortality Decline in the United States, 1900-1930

During the nineteenth and early twentieth centuries the western world was the site of massive changes in technology. In addition to the improvements in economic well-bring that occurred during the process of industrialization, dramatic changes occurred in views of disease and disease causation, in the administrative apparatus surrounding the public's health, and in the methods of preventing and treating disease. However, the impact of these changes on the health and mortality transitions remains contested.

Late in the nineteenth century, cities in the United States confronted the problems of disposing of sewage and providing their inhabitants with pure water. Engineering feats—including large drainage projects, redirecting water flows, and building municipal water systems with filtration systems began in full force. That engineers were among the leading players in the area of public health was clear. At the same time germ theories of disease were replacing older ideas—filth and miasmatic—notions of disease etiology. Focusing on water purity and purification, in this paper I examine the role these technological changes played in mortality from typhoid fever and a number of other causes of death.

How important these efforts were to the overall mortality decline depends on the need for and extent of the changes in water supply that occurred. Estimates suggest that large efforts to purify water were occurring in the first few decades of the twentieth century. There is little question that in many cities the resultant decline in the rates of typhoid death were dramatic and followed closely the changes in water supply. Typhoid fever, however, in 1900 rarely exceeded 3% of the total mortality in large cities and consequently its reduction can explain only a small part of the overall decline in mortality that occurred between 1900 and 1930. Proponents of

purifying water, therefore, argued that it was caused much of decline in other causes of death (some of which were water-borne like diarrheal disease and some of which were air-borne).

Thus in assessing the role of water supplies on levels and trends of mortality, contemporary researchers moved quickly beyond the obvious relationship between typhoid fever and other water-borne disease categories to mortality rates more generally, largely by connecting typhoid fever death rates to the decline in other diseases. An interesting early argument about this interconnectedness of typhoid with other diseases is the "Mills-Reincke phenomenon" associated with a decline of typhoid following the filtration of water supplies. Both Hiram Mills and John Reincke observed a decline in the death rates from all causes minus typhoid with the purification of water supplies. (See Sedgwick and MacNutt 1910 and Mills (1913) for a description of their work). Allen Hazen quantified the reduction in the overall mortality rate that would follow improvements in water supply. Sedgwick and MacNutt (1910) quote an address by Hazen at the St. Louis Exposition in 1904 as saying "Where one death from typhoid fever has been avoided by the use of better water, a certain number of deaths, probably two or three, from other causes have been avoided."

Mills and Reincke apparently disagreed on the explanation for their empirical findings; Mills argued that it resulted from an increase of vital resistance due to purer drinking water and Reincke attributed it to the exclusion of disease germs by the filtration system. In both explanations the effect is directly from the drinking water and not the result of reduced exposure to typhoid. Hazen, however, maintains that the question of how the water supply is connected to diseases other than typhoid is problematic but it may be..."that a good water-supply, used freely and with confidence, results in a better general tone in the systems of the population," and so indirectly to a lower death-rate, and that a part of the reduction is represented by diseases having

no recognized connection with the quality of the water-supply. Consideration of these arguments led to greatly expanded estimates of both the effects of water quality on the general mortality rate and the importance of improvements in water quality to the decline in overall mortality levels (Sedgwick and MacNutt 1910).

Recently, Cutler and Miller (2005) attributed large proportions of the declines in mortality in twelve large cities to improvements in the water systems. They argue, that in their sample of cities from 1900 to 1936 "clean water technologies" accounted for 43% of the decline in the all-cause mortality rate, 74% of the reduction in infant mortality and 62% of the reduction in child mortality. Most of the 43% decline in the total death rate can be attributed to diarrheal disease, tuberculosis, pneumonia, meningitis and diphtheria/croup. Their analysis suggests no mechanism by which water technologies would produce these results, but they echo Hazen's theorem and the Mills-Reincke phenomenon.

How generalizable the results from these cities, many of which were experimental locations for testing the effectiveness of water filtration systems, remains a question that hinges both on the quality of water in many locations and the efforts made, when necessary, to improve its quality.

Using data from all registration cities over 50,000 in population in 1930, I examine the relationship between typhoid fever and other causes of death including those isolated by Cutler and Miller for the period from 1900 to 1930. My analysis is inclusive but is limited by the use of typhoid fever death rates as an indicator of the quality of the water supply. In a second analysis, I examine available data on a large number of cities (approximately 200 cities and urban places) where the data are the date of filtration and /or chlorination of water supplies (or information on the presence of chlorination or filtration by a particular date). These data allow both new

estimates of the extent of water purification and a closer look at the effects of changes in water quality on a number of causes of death.

Very preliminary results suggest that Cutler and Miller overestimate the importance of water purification in the mortality decline. In addition I find little relation between typhoid and other causes of death. For many urban places, changes in water quality are not associated with the magnitude of the decline in mortality (either from all causes, or from non-waterborne causes).

References

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