Origins and effects of the rural public health programs in North Carolina

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Abstract

This project investigates the growth and effectiveness of the Country Health Organization (CHO) movement within the state of North Carolina. North Carolina was the primary pioneer in the rural public health movement. They opened one of the first CHOs in 1911, were home to about a third of all County Health Organizations in U.S. by 1917, and represented the first public health department to develop a state-wide plan of county health work. This study evaluates effectiveness of these CHOs based on changes in infant mortality, mortality from diarrhea and enteritis, and typhoid morbidity rates between 1910 and 1930 associated with the timing of county health work. Initial results suggest that these rural public health efforts led to reductions in mortality due to diarrhea and enteritis and typhoid morbidity. However, while infant mortality rates declined across the counties, whether the presence of a CHO was responsible for this is less clear. This stands in contrast to studies of comparable programs occurring during the same time period at the state and city level.

1. Introduction

This project investigates the growth and effectiveness of the Country Health Organization (CHO) movement within the state of North Carolina. CHOs represented an effort to bring public health work to the rural areas during the 1910s and 1920s, as prior to these programs, little or no public health work occurred outside of the municipalities and state health departments. However, a precedent for organized rural public health work was set with two independent efforts. In 1911, the Public Health Service was asked to send an officer to Yakima County in Washington to investigate the high rates of typhoid fever. This then developed into a permanent CHO in Yakima. During the same time, the Rockefeller Sanitary Commission was combatting the epidemic of hookworm across the Southeastern U.S. The success of these hookworm campaigns created a demand for additional public health work in the different counties, and many of the former hookworm stations were converted into CHOs. Across the United States, the number of counties with a CHO grew from just three in 1911 to over 500 by 1930.

The public health work in the decades prior to the New Deal has been recently of interest to economic historians. For example, Cutler and Miller (2005) document investments in water filtration and sewage for different urban areas between 1915 and 1925, and determine that these investments explain about 70% in the decline in urban mortality. Moehling and Thomasson (2014) look at the state-level public health education efforts financed through the Sheppard-Towner Act and find that they helped reduce infant mortality. And Bleakley (2007) estimates the effect of the hookworm eradication campaigns that helped lead to the development of the CHOs, and find that they led to increases in school enrollment, attendance, and literacy after the intervention.

Aside from the research on the hookworm eradication campaigns, there has been very little work studying the rural public health programs. These are also an important part of the history of American Public Health. The Sheppard-Towner Act was the first federal foray into public health efforts,

and many of the states which received funds directed them towards the different CHOs within their borders. Between 1925 and 1928, North Carolina sent on average about 70 to 80 percent of its federal Sheppard-Towner funds to its different County Health Organizations (U.S. Public Health Service 1936). And while the rural areas did not invest in water filtration and sewage systems like the large cities did during the 1910s, they nevertheless engaged in many different activities designed to improve the sanitary conditions of their environment.

2. Development of the County Health Organization in North Carolina

North Carolina was the primary pioneer in the County Health Organization movement. They opened one of the first CHOs in 1911, and were home to about a third of all County Health Organizations in U.S. by 1917. They were the first public health department to develop a state-wide plan of county health work. Their board of health encouraged counties to hire full-time county health officers and set up county health organizations. Counties were to do this through their own funds and funds provided by the state, with private organizations sometimes stepping in to help. Once the Act for the Protection of Maternity and Infancy (Sheppard-Towner Act) was passed in 1921, federal funds started showing up in the county budgets for CHO work as well. By 1930, almost 40 percent of the counties in North Carolina were engaging in rural public health work funded from a combination of county, state, federal, and private sources.

Figure 1 plots the growth of CHOs in North Carolina and separates counties into four somewhat arbitrary classifications. Counties with a CHO by 1916 are considered “early adopters,” those that set up a CHO between 1917 and 1921 are considered “middle adopters,” those that set up a CHO between 1922 and 1930 are considered “late adopters,” and those that did not set up a CHO at all are considered “non-adopters.” The early adopters include those counties which converted their hookworm treatment stations into CHOs, as well as those which took the funds and encouragement from the Rockefeller

Sanitary Commission to engage in rural public health work. These counties tended to precede the large expansion in rural public health work that occurred between 1917 and 1921, and counties that started participating during this period are classified as middle adopters. The jump in CHOs incorporated in 1921 was likely in anticipation of receiving federal Sheppard-Towner funds, but even in the years immediately preceding that, when there was no expectation of federal help, counties were engaging in public health work at a quickening pace. This pace slowed during the 1920s, but was still increased up to 1930. Counties which set up CHOs during this relatively slow period of increase were classified as part of the late adopter group.

Activities at the CHOs in North Carolina fell into one of six categories. Education activities was the first of these, and included public meetings, letter mailings, and the publishing of bulletins and press articles. The second was the quarantining of individuals found to have measles, typhoid or influenza. School visits by either a doctor or nurse constituted the third, and during these visits they gave lectures, checked for conditions such as enlarged tonsils or adenoids, and vaccinated against smallpox. Vaccinations in non-school settings constituted the fourth group of activities for the CHOs, and these were given for smallpox, whooping cough, and typhoid fever. The fifth type of activity is listed as reviews of urban conditions, which essentially consisted of sanitary reviews. The final type of activity was the prevention and restoration of polluted soil, and was a distinctive characteristic of the rural public health programs. These types of activities had their origins in the hookworm eradication campaigns, and consisted of the inspection and building of sanitary bathrooms, the examination of soil specimens for bacteria or parasitic worms, and the treatment of infected soil areas.

Reports were collected for the different counties on a monthly basis throughout the 1920s, some of which from the later part of the decade still survive. From these it is possible to know that, for instance in August of 1927, across the different counties engaging in rural public health work, 3,848

individuals were vaccinated against smallpox, 23,198 individuals were vaccinated against typhoid, and 2,247 individuals were vaccinated against diphtheria. 2,958 new mothers were conferenced with in their home, while another 837 attended individual or group conferences. With respect to soil conservation, 452 privies were constructed in urban areas, while 399 were built in rural areas.

3. Analysis across mortality and morbidity outcomes

The effectiveness of these County Health Organizations at improving health within the different North Carolina counties are evaluated for their effects on infant mortality, mortality due to diarrhea and enteritis above and below the age of 2, and typhoid morbidity. Information on these different health outcomes between 1914 and 1930 was obtained from annual reports of the North Carolina Bureau of Vital Statistics. Information on infant mortality and mortality due to diarrhea and enteritis for children under the age of 2 are available over the full period. Mortality due to diarrhea and enteritis for persons over the age of 2 is not available between 1918 and 1921, and typhoid morbidity began being published in 1918.

Infant mortality rates are published as a single statistic in the Vital Statistics volumes, however for the other outcomes it was necessary to obtain age-specific data at the county level. This was constructed for the decennial census years from the individual census records compiled by Ancestry.com and obtainable through the NBER. The census years were then interpolated to obtain annual population by age information for each of the different counties in North Carolina. Information on the county health organizations themselves was obtained through the Public Health Service Bulletin "A history of county health organizations in the United States: 1908-1933," as well as loose-leaf records in the North Carolina State Archives. So far this information has only been used to identify the timing of the CHOs in North Carolina, but it also includes information on specific activities for some counties after 1926.

To look at the relationship between CHO adoption and infant mortality, mortality from diarrhea and enteritis, and typhoid morbidity, this project so far employs two relatively basic strategies. The first separates the counties into early, middle, late, or non-adopters as described in the section above, and plots the trends for the different health outcomes for each of the groups. The second estimates simple fixed effects models using each of the different outcomes as a different dependent variable and include variables for the presence of a CHO and its effect over time. As a first look at the data, Table 1 presents summary statistics by county-group and health outcome both for 1914 and 1930 (or, in the case of Typhoid morbidity, 1918 and 1930).

3a. Comparison of county groups

From Table 1, it is evident that all of the different health indicators improved between 1914 and 1930. The biggest improvements on a percentage change basis occurred for the cause specific health measures. Mortality due to diarrhea and enteritis declined for both age groups by about 40-50 percent between 1914 and 1930, depending on the county and age group. Typhoid morbidity decreased even more so. Between 1918 and 1930, typhoid incidence decreased by about 75 percent fairly evenly across the different county groups. Across all of the different outcomes, the middle adopters seem to have performed the best throughout the study period. With the exception of diarrhea and enteritis over the age of 2, counties adding a CHO between 1917 and 1921 had the biggest relative improvements in the different outcomes.

These reductions in mortality and morbidity are tracked on an annual basis in the different figures. Figure 2 does so for infant mortality. Between 1914 and 1930, infant mortality declined across all of the different county-groups. However, there seems to have been persistent differences throughout the entirety of the period. Both the early and middle adopters had higher infant mortality rates at the beginning of the period, and closed only a portion of this gap by 1930. Additionally, although all four groups experienced a decline in infant mortality during the late 1910s and early 1920s, after this

there does not seem to have been much improvement throughout the rest of the decade. This is in contrast to infant mortality trends at the municipal level, which saw an acceleration of the decline in their infant mortality rate trends (Fox 2013). Additionally, the decline during the late 1910s and early 1920s does not appear to be significantly stronger or weaker for any of the different groups. A different story emerges when looking at cause-specific mortality however.

Figure 3 plots the mortality rate due to diarrhea and enteritis for children under the age of 2. At the beginning of the study period the average mortality rate coincided with the ordering of the county groups. In 1914, early adopters had the highest mortality rate due to diarrhea and enteritis, middle adopters the second highest, late adopters the third highest, and non-adopters the lowest. In general, as was the case for infant mortality, this ordering persisted to 1930. However, the gap between the different groups narrowed significantly. Looking at the older age group in Figure 4, the relationship between diarrhea and enteritis mortality and having a CHO is less clear. An important part of the time period is missing between 1918 and 1921, immediately preceding which seems to be a large upturn in the mortality rates. The upturn seems to be mitigated for the early adopters, but whether this continued is not known. There is some level of narrowing as well, although due to the variation in the trends, if that is something real or simply a product of stopping the analysis in 1930 cannot be said.

The final outcome of interest is typhoid incidence between 1918 and 1930, plotted in Figure 5. Most evident is the large decline in incidence over the 13 years studied. This was also present in Table 1, and as was the case there, all county groups experienced similarly large declines. Newly evident, is that there was not a large, obvious difference in the trends for the different county groups.

Figures 2 through 5 plotted infant mortality, diarrhea and enteritis mortality by two different age groups, and typhoid morbidity for the counties that began participating in rural public health early, middle, late, and not at all. In the case of infants, there is no obvious relationship between having a

County Health Organization and improvements in infant mortality. Looking at each of the counties individually that set up a CHO sometime between 1914 and 1930, it is difficult to see a relationship between the timing of the CHO and an eventual decline. For typhoid morbidity, it seems that all counties were able to drastically reduce the incidence of typhoid. With their emphasis on typhoid vaccinations, the CHO movement could potentially still claim credit for this. Counties were slowly able to immunize their populations against typhoid, which would have then reduced the incidence in the disease in nearby areas. Since there was no similar vaccination for diarrhea and enteritis, creating hygienic conditions was the primary method of reducing the incidence and would have remained more county-specific. This could be why the early and middle adopters of CHOs narrowed the gap in their diarrhea and enteritis mortality rates relative to the late and non-adopters.

3b. Fixed effect regressions

To investigate the relationship between the timing of CHO adoption and subsequent health outcome improvements, this section presents estimates from fixed effects regressions with the different health outcomes as dependent variables. The presence of a County Health Organization is indicated with a dummy variable, and an interaction term with time (CHO*t) is included to measure the effect of having a CHO over time. Estimates from these regressions are given in Table 2.

Across all of the different outcomes, the estimated coefficient on having a County Health Organization was negative when the interaction between the CHO and time was omitted, but tended to be positive with its inclusion. Estimated coefficients on the interaction term were negative across all of the different outcomes, and with the exception of infant mortality, economically and statistically significant. The combination of the positive coefficient for the indicator and negative coefficient for the interaction term likely indicates that if having a CHO caused mortality rates to decline, that it took some time for that to occur.

Turning to the individual health outcomes, Columns 1 and 2 in Table 2 present estimates from the regression using a county's infant mortality rate as the dependent variable. These regressions confirm what appeared in Figure 2, that the presence of a CHO is not significantly related to reductions in infant mortality. Although both variable coefficients are negative, they are not statistically significant. In terms of the magnitude of the coefficient on the interaction term, over 10 years the presence of a CHO was associated with a decrease in a county's IMR by about 3.7 units. Across the early adopter counties the actual decline was about 10.4 units, so the coefficient point estimate is able to explain only about a third of the reduction in infant mortality during the time period for the counties with a CHO before 1916. Additionally, given that these are only very basic regressions with no other covariates, this probably overstates the actual impact of the CHO on infant mortality. The economic and statistical significance was stronger for the interaction term in the regressions for the other health outcomes. Even acknowledging that these impacts are likely overstated, the associated reduction from the estimated coefficients closely reflected the actual reduction in diarrhea mortality and typhoid morbidity rates across the early adopter counties.

4. Closing discussion

As shown in Figure 2, North Carolina experienced a large growth in County Health Organizations during the 1910s and 1920s. Prior to this period, public health work occurring in the rural areas took the form of a single County Health Officer, usually a private physician who undertook his public duties part time. With the success of the hookworm campaigns across the Southeast, Watson Smith Rankin, Secretary of the North Carolina State Board of Health, helped create a state-wide plan of county health work and encouraged the adoption of county health organizations in the different areas. The first of these were former hookworm stations, converted with the financial help and guidance of the Rockefeller Sanitary Commission. With funding from the state of North Carolina, the counties themselves, private

organizations, and eventually the federal government through the Sheppard-Towner Act, nearly half of all North Carolina counties were engaging in rural public health work by 1930.

Comparing the timing of adoption to declines across different health outcomes, the impact of CHOs are most evident for the outcome of mortality due to diarrhea and enteritis. In addition, there seems to be a lag between when a county started investing in rural public health work and when mortality rates began to decline. Since it took time for areas to clean up the soil, build sanitary privies, vaccinate against typhoid and other diseases, and spread information about proper hygiene, this is to be expected. There appears to be an effect on reducing rates of typhoid incidence across the different areas, but relative to the relationship between having a CHO and mortality rates for diarrhea and enteritis, is less clear across the different analyses. This may be due to the typhoid vaccination push positively affecting all counties across North Carolina. More work needs to be done to try to clarify this.

Most interestingly, it appears as of the County Health Organizations did not have a significant impact on reducing infant mortality between 1914 and 1930. Early and Middle adopters of CHOs had infant mortality rates persistently higher than the late and non-adopters. And estimates from the fixed effects regressions were weak in economic and statistical significance. This finding is consistent with the origins and initial goals of the rural public health efforts in North Carolina. Their growth out of the hookworm and anti-typhoid programs, both of which were concerned about creating sanitary environmental conditions, appeared to lead to reductions in infectious diseases, but less of a reduction in infant mortality overall.

References

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Figure 1: Growth of CHOs in North Carolina

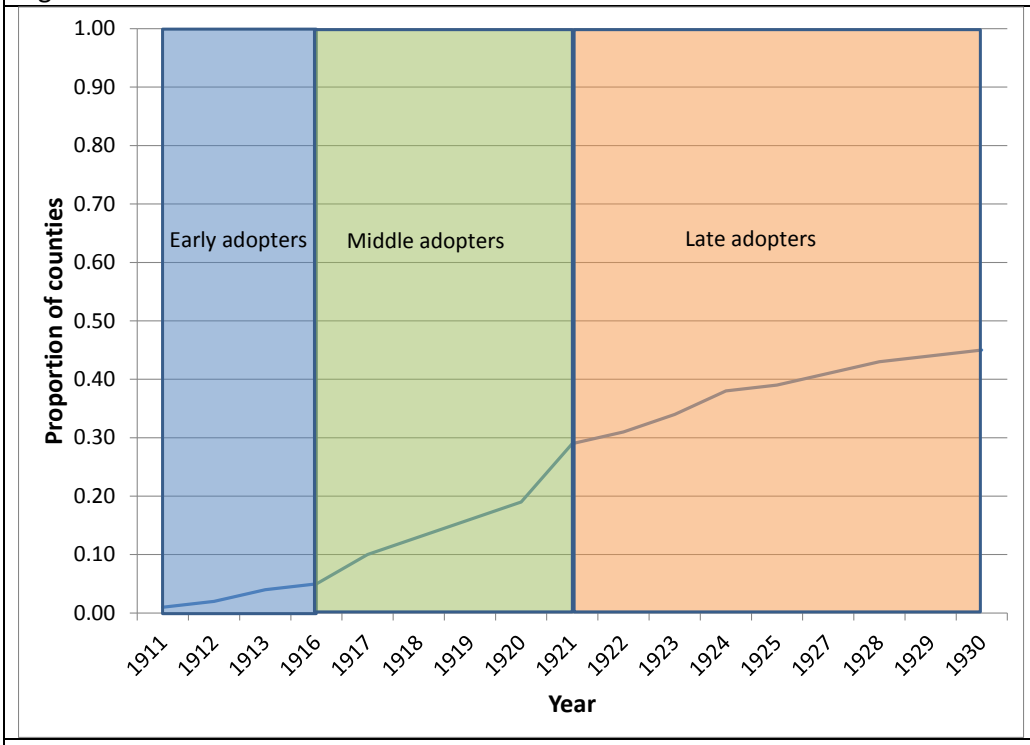

Figure2: Infant Mortality Rate trends by timing of CHO adoption

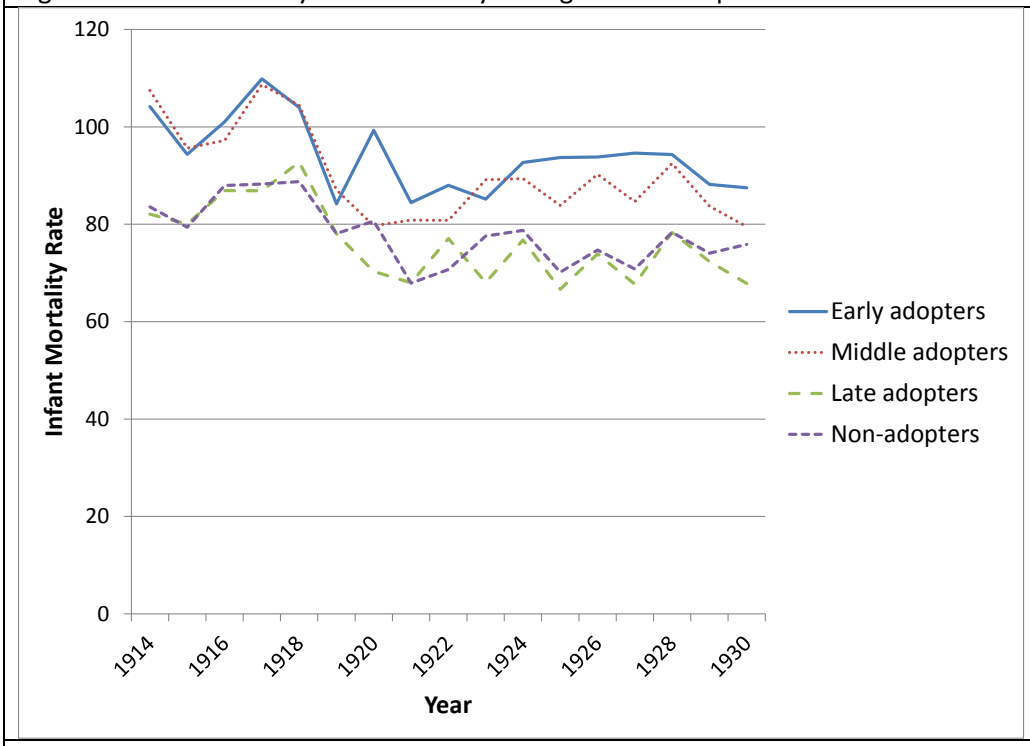

Figure 3: Diarrhea and Enteritis mortality rate trends age under 2 by timing of CHO adoption

Figure 4: Diarrhea and Enteritis mortality rate trends age 2+ by timing of CHO adoption

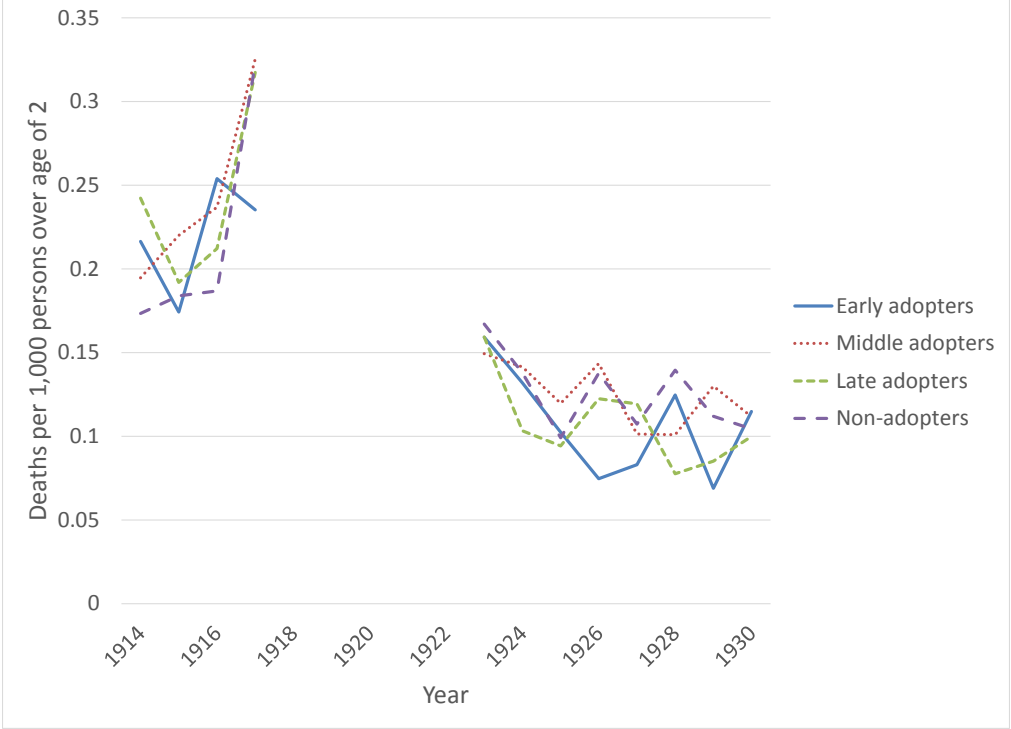

Figure 5: Typhoid morbidity rate trends by timing of CHO adoption

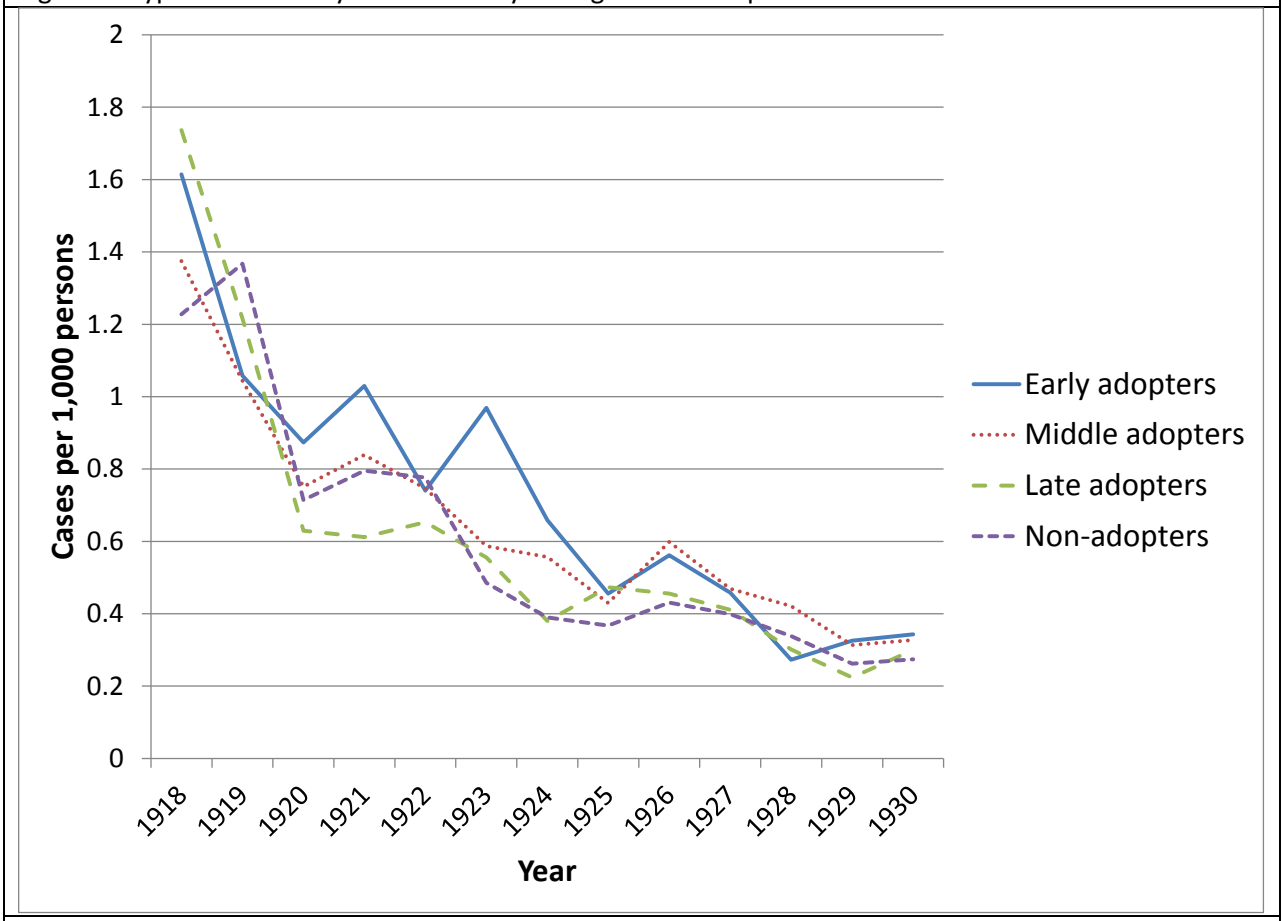

Table 1: Summary statistics by timing of CHO adoption

Mortality and Morbidity rates	All counties			Early adopters			Middle adopters		
	1914	1930	% Change	1914	1930	% Change	1914	1930	% Change
Infant mortality rate	90.00	76.49	15.0%	104.16	87.50	16.0%	107.47	79.52	26.0%
Diarrhea and enteritis, under 2	12.49	7.23	42.1%	17.74	9.74	45.1%	16.81	7.94	52.7%
Diarrhea and enteritis, over 2	0.19	0.10	47.3%	0.19	0.11	41.8%	0.19	0.12	38.4%
Typhoid morbidity rate	1.19	0.30	74.5%	1.33	0.44	67.3%	1.18	0.26	78.2%

Mortality and Morbidity rates	Late adopters			Non-adopters		
	1914	1930	% Change	1914	1930	% Change
Infant mortality rate	82.10	67.83	17.4%	83.56	75.86	9.2%
Diarrhea and enteritis, under 2	12.08	7.30	39.6%	10.08	6.48	35.8%
Diarrhea and enteritis, over 2	0.23	0.10	54.5%	0.17	0.09	49.0%
Typhoid morbidity rate	1.17	0.33	71.8%	1.17	0.28	75.6%

Note: Typhoid morbidity rates began being published in 1918, so the initial period for this variable is then

Table 2:

Dependent variable	IMR	IMR	DanE Under 2	DanE Under 2
	(1)	(2)	(3)	(4)
County Health Organization	-10.522**	-5.837	-4.059**	2.049
	(1.857)	(4.137)	(0.622)	(1.462)
CHO*t		-0.367		-0.478**
		(0.285)		(0.109)
Constant	84.559**	84.449**	10.89**	10.746**
	(0.505)	(0.519)	(0.169)	(0.174)
Observations	1,666	1,666	1,666	1,666
Number of counties	98	98	98	98
Adjusted R-squared	0.028	0.029	0.069	0.109

Dependent variable	DanE Over 2	DanE Over 2	Typoid Morbidity	Typoid Morbidity
	(5)	(6)	(7)	(8)
County Health Organization	-0.099**	0.016	-0.357**	0.428**
	(0.013)	(0.028)	(0.091)	(0.114)
CHO*t		-0.008**		-0.058**
		(0.002)		(0.007)
Constant	0.179**	0.178**	0.710**	0.682**
	(0.004)	(0.004)	(0.030)	(0.031)
Observations	1,176	1,176	1,248	1,248
Number of counties	98	98	96	96
Adjusted R-squared	0.061	0.076	0.023	0.061

Notes:
Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1
IMR is the standard infant mortality rate, or number of infant deaths per 1,000 live births, DandE under 2 is the number of deaths due to diarrhea and enteritis to children under the age of 2 to the population of children under the age of 2, DandE Over 2 is the number of deaths due to diarrhea and enteritis to persons over the age of 2 to the population of persons over the age of 2, and Typhoid Morbidity is the number of cases of Typhoid per 1,000 persons.