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Seasoning, Disease Environment, and Conditions of Exposure
New York Union Army Regiments and Soldiers

Daniel Scott Smith

Death is the final event in the life of a person, but what structures its timing is not just the characteristics of the individual. Until the last few decades, studies of socioeconomic differentials in mortality depended on data collected for populations located in geographic units. Thus when nineteenth-century English investigators commented on the high mortality of the poor, they had to rely on correlations among registration districts in the incidence of the poor and the death rate. A skeptic might charge that this conclusion rested on an ecological fallacy because the evidence did not reveal who actually died within each district.

Although based on necessity and dependent on published data, this approach is conceptually not entirely fallacious. Family reconstitution studies of early modern village populations suggest that socioeconomic differences in mortality of people living in an area tended to be small or nonexistent, whereas differences between areas, particularly cities and rural areas, tended to be very large (Smith 1982). The risk of death faced by individuals in the past was one that they partially shared with their neighbors. In a mortality regime dominated by infectious diseases, dangers lurking in the food, water, and air threatened people living in proximity. On the other hand, such influences shared by neighbors are certainly not the entire story. Over and over again, for example, demographers have shown that death rates vary systematically with age.

Data sets constructed recently, such as the one detailing the experiences of Union Army enlisted men serving in the Civil War and after (Fogel 2000), represent a major advance beyond studies constrained by published tabulations. First, multiple and overlapping factors associated with the inci-

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dence of death can be assessed simultaneously. Second, variation in the risk of death can be examined over time.

Paradoxically, the pioneering analyst of disease mortality of individual soldiers that is recorded in this unique data set found that factors beyond the individual were important. Variations between urban and rural areas and between rural farmers and nonfarmers, indexes interpreted as tapping the incidence of prior exposure to disease, were major determinants of the risk of acquiring and dying from disease in the army. Childhood nutrition and health, inferred from height, did not matter. Economic resources, indexed by property wealth recorded in the federal census of 1860, may have had an influence only for diseases related to nutrition among residents of metropolitan counties (Lee 1997, and ch. 3 in this volume). It was not just the economists who might or should be surprised by these results. Historical demographers are confident that death rates for adults steadily increase with age, even among young men who served in the army. Yet this routinely observed pattern appears only for nonfarmers and for men enlisting in metropolitan counties (Lee's ch. 3 in this volume).

These results contain three paradoxes. First, the healthier, the wealthier, and large groups of the younger were not unambiguously more likely to live than the less healthy, poorer, and older. Second, the analysis of a unique individual-level data set uncovered the importance of a factor—prior exposure to disease—whose source was collective. Third, the orientation of the discipline of epidemiology (or sociology) seems to be more relevant for understanding these results than those of other disciplines.

4.1 Exposure to Risk at Place of Origin: Urbanization and Mortality

Given the importance of the definition, scope, and functioning of disease environments, more needs to be known about them. Building on Lee's work, this paper combines both individual- and aggregate-level data and attempts to specify several of the correlates of disease mortality at a finer level of detail. An investigation of the incidence and timing of disease mortality among Union Army enlisted men in companies from New York state is placed in the context of a parallel study of mortality of regiments and other units of army volunteers that were organized in the Empire State.

New York is the focus primarily because of a uniquely detailed published tabulation of outcomes of military service by regiments and other units. Its author was Frederick Phisterer (1912, vol. 1, 288–303), a pioneering statistician of the Northern military effort during the Civil War (1907).[1] For offic-

1. Born in Germany in 1836, Phisterer served in the regular army, entering as a private in the artillery in 1855 and leaving as a sergeant in 1861. Reenlisting in the U.S. Army in July 1861, he was discharged as captain in 1870. From 1877 onward he was active in the National Guard, rising to the rank of Brevet Major-General and the position of Adjutant-General of the New York National Guard. Living in Albany, between 1890 and 1908, he published three editions of a five-volume survey totaling 4,499 pages on the New York men and units who fought in the Civil War.

ers and enlisted men, he reported the numbers who were killed in action, who died of or recovered from wounds received in action, who died of disease, and who died of six other known causes (and one unknown cause) that were less frequent. He also tabulated these data separately for those who became prisoners of war and those who were never captured. Contemporaries and historians of the Civil War have highlighted the horrendous conditions and high death rates in prisoner-of-war camps. Since the fraction of a regiment that fell into enemy hands varied considerably depending on circumstances (the median percentage was 5.35 while the mean was 7.96 and the standard deviation 11.38), this adjustment is useful.

Among the 267 New York volunteer organizations, there were 183 regiments of infantry, 33 of cavalry, and 3 of engineers, and 48 regiments, battalions, or batteries of artillery. Unlike most of the compilers of other state reports, Phisterer provides an approximation of the population at risk. However, the column headed by the phrase "the number of men in organization among whom losses occurred" misleads. The heading in the recapitulation replaces "men" with "enlistments," indicating that those who reenlisted were counted more than once. In any case, the available proxy for the population at risk does not take account of other causes of attrition—transfer, desertion, discharge, etc.[2] Finally, Phisterer provides a detailed summary of the history of the unit, including the dates it was mustered in and out and places where it served. The former allows the calculation of death indexes by duration, and the latter information can be mapped onto regional disease environments.

In the nineteenth century, urbanization dramatically increased mortality (Haines 2001). Although less well documented, it also was related to health and morbidity. Contemporaries certainly believed as much. A medical examiner of draftees and recruits for a New York City district noted, among other comments, that "congestive diseases, as apoplexy, delirium tremens, &c, dependent on causes too palpably incident to a large, crowded, immoral, and ill-cleaned city to need specification, are numerously met with" (Roberts 1865, 264). Another city medical examiner, Dr. W. H. Thompson, reported on the unhealthy conditions in his district, especially for the Irish. He was also "struck with number of persons among the better classes, and native Americans, with weak constitution, deficient girth of chest, and slender physique, especially among the younger men. The contrast, in this respect, with what I had noted in American country-recruits in 1862 is so marked that I have been led to consider city-life in New York as exerting an unfavorable influence on physical development, especially in children" (Thompson 1865, 252).

There were towns and cities in the state outside of New York City. Further, factors other than urbanization, such as residence along transporta-

2. Since the population at risk cannot be precisely captured, these measures are referred to as death indexes rather than rates.

tion routes such as the Erie Canal, could be associated with exposure to disease (Haines, Craig, and Weiss forthcoming, table 3). Data from New York state allow a subtler isolation of ecological variables that theoretically are associated with the extent of prior exposure to disease than is possible by merely characterizing counties as urban or rural. Two sources were used to index the disease environment among counties within the state of New York. Three censuses—the 1850 federal and the 1845 and 1855 state returns—yielded a relative index, however underestimated, of the crude death rate in each county. Township-level data from the 1845 census were also used to calculate the proportion in each county who resided in places with populations of 2,500 and larger and of 5,000 and larger.

Although men in regiments and especially companies were recruited locally, they did not all come from the same county. A rather elaborate procedure was used to index the disease environment of recruits in the various military units. Based on reports from families, the 1865 state census tabulated, for each regiment or other unit, the number of living New York–resident soldiers who were from each county (New York Secretary of State 1867, 637–48). The four counties with the largest share of troops in the 278 units included, on average, 74 percent of the men. In the 192 infantry regiments, the figure was 77 percent. The estimated death and urbanization index for each regiment was the average, weighted by the share of each county and the residual in the totals of living soldiers reported for each unit, of crude death rates and urbanization rates in these four counties and the residual.

The data from the New York state census of 1845 indicate (see table 4.1) that the urbanization effect on mortality is continuous rather than dichotomous. Crude death rates increased from a rate of 11.4 per 1,000 in townships under 1,000 in population to a rate of 15.7 per 1,000 for places between 7,500 and 60,000 in population. The rate for New York City was even

Table 4.1 Township Population Size and Census Crude Death Rate, New York 1845

		Town Population		
Population of Township	Crude Death Rate	Total	Percent	Number of Townships
Under 1,000	11.4	60,792	2.3	94
1,000–1,499	12.5	159,255	6.1	124
1,500–1,999	12.5	325,197	12.5	184
2,000–2,499	12.9	343,542	13.2	153
2,500–4,999	13.1	825,108	31.7	247
5,000–7,499	14.2	231,129	8.9	39
7,500–19,999	15.6	107,478	4.1	10
20,000–60,000	15.8	177,460	6.8	5
New York City	16.9	371,223	14.3	1
Total	13.86	2,601,184	—	857

Source: Calculated from New York Secretary of State (1846).

higher—16.9 per 1,000.[3] However, the extent of urbanization in a county, measured by the share of its population living in places over 5,000, bore no relationship to the crude death rate in the 812 towns under 5,000 in population. There was no spillover of higher urban mortality to the nonurban areas of a county. However, the crude death rate of a town was positively related to the death rate in the rest of the county. For the analysis in this article, practical considerations limited my refinement of the urbanization effect to the level of the county.

The published results of examinations for military service during the last half of the war provided estimates of the fraction of draftees, and of recruits and substitutes rejected for service of those presumably examined medically (Baxter 1875, vol. 1, pp. 637–767; Fry 1866, 165–213).[4] Since recruits and substitutes sought to join the army, their rejection rate is more likely than that for draftees to reflect actual health status (Smith 2000b).[5] These data are reported for thirty-one registration districts whose boundaries were those of congressional districts. The rate for each registration district was assigned to each county it included, with the nine districts in New York County merged into one. As before, the rate for the regiment is imputed by the weights derived from the distribution of soldiers among counties reported in the 1865 state census.

As table 4.2 shows, the imputed background urbanization and death rates for regiments and other units correlate with the deaths from disease during the Civil War. Regiments whose recruits came from counties that were more rural and that had lower crude death rates experienced higher mortality during the war. Regiments whose men were from counties that were part of congressional districts where fewer recruits and substitutes failed their medical examinations in the final two years of the war also had higher disease mortality during the war.

The relationship between imputed county-of-origin characteristics to mortality during the war is not as linear or continuous as the relationship between town size and the crude death rate in 1845 (table 4.1). Further, there was substantial variation not accounted for by the different classifications (see the eta-squared statistics in table 4.2). The plan to develop a background mortality index that would complement the urbanization effect

3. In his studies, Lee operationalized the effect of prior exposure to disease with a rural-urban dichotomy, based on having a city over 10,000 in Ohio, or in a metropolitan area in 1860 for troops from the entire North. Six counties—Albany, Erie, Kings, New York, Richmond, Rensselaer—of the sixty in New York in 1860 were classified as urban. It is quite plausible that men who enlisted in the fifty-four nonurban counties had not, on average, been exposed to disease to the extent of those joining in the six urban counties.

4. These estimates assume that draftees rejected for nonmedical reasons were never medically examined and that recruits and substitutes rejected because they were too old or too young were also not examined (Smith 2000).

5. In the calculation, those excluded because they were under- or overage were excluded from the denominator, as it was assumed that they never had a medical examination.

Table 4.2 Correlates of Disease Death Indexes for New York Regiments

Classification and Category	Disease Death Index	Number of Regiments
Inferred crude death rate in 1845	69.4	258
Under 11 per 1,000	94.8	7
12 per 1,000	82.3	52
13 per 1,000	80.9	86
14 per 1,000	55.1	69
15 per 1,000 and higher	51.6	64
η^2 and *F*-value	.023	1.50
Inferred crude death rate in 1855	69.4	258
Under 11 per 1,000	105.1	72
12 per 1,000	65.3	43
13 per 1,000	60.2	53
14 per 1,000	46.9	37
15 per 1,000 and higher	49.0	53
η^2 and *F*-value	.058	3.90**
Inferred share of population over 5,000 in 1845	69.4	258
Under 20%	98.8	48
20–30%	89.8	72
30–50%	50.3	64
50–70%	47.4	44
70% and higher	46.3	30
η^2 and *F*-value	.056	3.74**
Inferred share of population over 2,500 in 1845	69.4	258
Under 60%	105.8	73
60–70%	60.1	74
70–80%	53.5	54
80% and higher	50.1	57
η^2 and *F*-value	.058	5.19**
Inferred recruit medical rejection rate, 1863–65	69.4	258
Under 215 per 1,000 examined	106.2	61
215–300 per 1,000	67.9	97
300–350 per 1,000	45.6	35
350 and above per 1,000	49.9	65
η^2 and *F*-value	.054	4.81**
Actual region of organization of regiment	69.5	257
New York County	47.8	81
County contiguous to New York County	53.9	30
County on Erie Canal	71.7	60
Elsewhere in state	93.8	86
η^2 and *F*-value	.039	3.59*

Sources: New York Secretary of State (1846, 1857); Phisterer (1907, 80–91 and 288–303); Dyer (1959); Baxter (1875, vol. 2, pp. 637–767).

**Significant at the 1 percent level.

*Significant at the 5 percent level.

failed. Instead, a methodological mountain has yielded something of a substantive mole hill. Since the background urbanization and mortality indexes were highly correlated (0.7 to 0.9), only one can be employed as a predictor of the wartime disease mortality index.

4.2 Disease Mortality and Shared versus Distinct Disease Environments of Men and Regiments

In addition to throwing men together from diverse disease environments, soldiering during the Civil War sent men into regions of the country with a range and variable intensity of disease patterns. The aggregated results tabulated by Phisterer permit some insight into the scope of disease environments in the Union Army. Usually ten companies, originally composed of approximately 100 men each, comprised an army infantry regiment. Although companies were sometimes detached from their regiments for special service, usually they were not. Companies in regiments in which the other companies had higher disease death indexes also suffered a higher incidence of fatalities from disease. A 1 percent increase in the disease death index of the men in all other companies in the regiment is associated with nearly a 1 percent increase in death index for companies in the New York regiments that experienced a high rate of combat-related deaths (Fox 1974, 183–241).[6] While common regional origin within New York is also relevant, the regression equation below also points to an effect from the region of service during the war.[7]

$$\text{Company Disease Index} = 7.87 + (0.881) \times (\text{Other Men in Regiment Disease Index})$$

Officers who led army companies obviously shared geographic locales with the men they led. Each company typically had three officers—a captain, a first lieutenant, and a second lieutenant—and thus each regiment typically included only thirty line officers and nine staff officers (Shannon 1928, vol. 2, 270). As the size of companies and regiments shrank through attrition, officers were more likely to be replaced than were men. The best estimate is that just over 5 percent of men in New York units in the Union Army were officers.[8] In just over a quarter of the regiments, no officers died

6. Included in this analysis are the thirty-nine "fighting regiments" that had more than 130 men killed or died from wounds or, if in a smaller unit, had a high percentage of such combat deaths.

7. The *F*-value for the equation is 233.3, with a standard error of the slope of 0.058 and an adjusted *R*-squared of 0.346; there were 433 companies in the analysis. This relationship could be spurious to the extent that the compiler William Fox had more complete coverage of either the deaths or the numbers enrolled in a unit.

8. In his detailed assessment, Phisterer (1907, 186), estimated that there were 16,000 officers and 294,000 enlisted men in New York volunteer units. Officers thus comprised 5.16 percent of the total strength, the figure used in dividing the figure for the total in the organization.

from disease outside of prison, and nearly 80 percent of the regiments had two or fewer disease deaths among officers. Given the small numbers in the base population of officers, it is not surprising that the correlation of the disease death index of officers and men within regiments is weak. On average, a 1 percent increment in the disease index for enlisted men increased the officer index by only a sixth of 1 percent.

$$\text{Officer Disease Index} = 10.35 + (0.172) \times (\text{Enlisted Men Disease Index})$$

The *F*-value is 21.46, the standard error of the slope is 0.037, and the adjusted *R*-squared is 0.083. There were 228 regiments in the analysis.

Any novelty in destination of service could be dangerous, as hinted by the disease death rates of two exceptional units that stayed home. The 925 men in the 20th and 28th artillery batteries, organized in late 1862 in New York City, served throughout the entire course of the war in Fort Schuyler and Fort Columbus, which guarded New York harbor. Only twelve of these men died of disease, giving them a death index of 5 per 1,000 man-years, a mere fifth of the overall average for soldiers from the state.

Most New York regiments served only in the eastern theater of operations and there mostly in the ninety miles between Richmond, Virginia, and Washington, D.C. Categorizing the units by a distinctive other region of service, table 4.3 suggests that being sent to Louisiana or along the Gulf of Mexico was the most hazardous. The lower Mississippi lived up to its reputation as a deadly region. From July 1861 to June 1865, disease death rates for Union soldiers in the Department of the Gulf were 26 percent higher than for the army as a whole (U.S. Surgeon General 1990, vol. 1).[9] However, experience in North or South Carolina, which was limited to the coastal area until the very end of the war, did not yield remarkably higher mortality indexes.

There was, however, marked variation in the incidence of disease within regions.[10] This variability is to be expected. At some point, as the incidence of sickness increases, a "tipping point" may be reached after which the number of cases and fatalities accelerates in a way not predictable by objective conditions. Such an epidemic occurred in the five regiments of the Vermont brigade in the fall of 1861, units whose living and sanitary conditions were, according to investigators, no more miserable than regiments in which the incidence of sickness was quite low (Benedict 1886, 237–40). Even without such an accelerant, clustering of deaths within particular companies and regiments is to be expected. These units encountered particular circumstances or their members had special characteristics that are not known or knowable to an investigator nearly a century and a half later.

9. Deaths occurring in general hospitals are excluded in this comparison.

10. Many of the regiments that had some experience outside of the eastern theater also spent time within that area. Employing analysis of variance for both four- and five-category regional classifications shows that the difference between regions was significant only at the 0.1 level.

Table 4.3 **Disease Death Indexes for New York Regiments and Other Units by Rank, Cause, and Distinctive Region of Service, for Prisoners and Nonprisoners**

Region of Service of Regiment or Other Unit	Disease Death Indexes			
	Per 1,000 Man-Years	Per 1,000 Men	*N*	
			Men	Units
Totals for region of service	24.7	64.0	303,662	249
Only in eastern theater	22.1	54.0	204,239	164
Only in New York	5.0	13.0	925	2
Ever in Louisiana or Gulf region	41.8	110.5	30,229	28
Ever in the Carolinas	24.2	71.3	48,924	38
Ever in western theater	27.0	77.4	20,270	19
With Sherman to the sea	32.7	90.7	13,220	12
Not with Sherman	16.2	52.3	7,050	7
By military rank		63.2	317,340	264
Enlisted men		65.4	288,719	264
Officers		23.0	15,713	264
After being wounded		123.2	55,442	267
Enlisted men		122.2	52,245	267
Officers		136.1	3,197	267
Prisoners of war (disease)		153.0	31,066	267
Enlisted men		156.6	30,112	267
Officers		39.8	954	267
Prisoners of war (wounds and other)		32.3	31,066	267
Enlisted men		32.7	954	267
Officers		19.9	30,112	267

Notes: The denominator of the index based on man-years is the "number of men in organization among whom losses occurred" multiplied by the difference between date the regiment or other unit was mustered in and the date it was mustered out. Ideally, the denominator should be the average number of men in the unit over the duration of its service.

Sources: Phisterer (1907, 80–91 and 288–303); Dyer (1959).

Officers and men in the same regiment may have advanced (or failed to advance) through the South together, but they did not share entirely the smaller disease milieu of the camp. Phisterer's tabulations are especially valuable here in suggesting the boundaries of disease environments. Overall, enlisted men were three times as likely to die from disease as were officers (see table 4.3). While the Center for Population Economics (CPE) sample is restricted to enlisted men, limited evidence indicates that officers were taller, more likely to be native-born, and more frequently drawn from the ranks of the middle class than were enlisted men. As noted, these attributes are not associated with a lower death rate from disease. Whether officers were more likely to come from cities and larger towns than enlisted men is uncertain.

Officers and enlisted men did not live in immediate proximity. According

to regulations, privates in an army camp were grouped by company with a street in between. At one end, perpendicular to the street of enlisted men, were rows: first, noncommissioned officers, then the commissioned officers of the companies, and finally the staff and commander of the regiment, who were located in front of the baggage train. Behind the baggage train were the latrines for the officers, while the soldiers relieved themselves in latrines at the opposite end of the camp (Wiley 1952, pp. 55 and 373n. 45). Officers and men also ate at separate messes, and officers used their own funds to purchase food. The leaders and the led shared geographically defined disease environments (e.g., malarial regions) but not what might be called the micro-microbe-disease space.

The fourfold ratio of the mortality indexes between officers and enlisted men incarcerated in POW camps also illustrates the importance of the environment in which those in the Union Army served. With rare exceptions, Union officers were imprisoned in camps apart from captured enlisted men (Marvel 1994, 293). Imprisoned officers died more frequently than those who were never captured (and at much higher rate if duration of exposure could be calculated), but conditions for captured officers sometimes were not harsh (Mitchell 1988, 221n. 64). Nearly one in six captured New York enlisted men died in Confederate prisons compared to one in twenty-five officers.

A common circumstance—being wounded in action—yielded quite similar mortality outcomes for officers and enlisted men. Indeed, a slightly higher percentage of wounded officers died (13.6 percent) than wounded men (12.2 percent). Possible explanations of this similarity are that the distribution of severity of the wounds was not radically different for men and officers and that postwound infections were a great leveler. All else equal, officers should have had a lower wound case fatality rate. Because they were salaried and paid for their food, wounded officers were not hospitalized with enlisted men. If the wounds were minor, they were cared for in their own quarters by an orderly. Other options for wounded officers included care in a private hospital or sick-leave at home (Adams 1952, 171–72). The smaller disparity between the mortality indexes among officer and enlisted POWs due to wounds and other causes (19.5 and 32.7 per 1,000) compared to disease (39.8 and 156.6) leads to the speculation that officers were, on average, more severely wounded than men.

4.3 Measuring Length of Observation and Deaths of Individual Enlisted Men in New York Sampled Companies

Key to demographic analysis is the concept of population at risk. The rich detail in the sample of Union Army enlisted men can be exploited to capture when men first came under observation and when they no longer were. To do so required a variety of assumptions. In the version of the CPE

data set used in this paper, there were 7,617 enlisted men in companies organized by New York state. For 208 (2.73 percent), there were no dates except those for enlistment recorded on the descriptive roll of the company, the original source of the data. With the assumption that no military service record could be located, these men were dropped from the analysis; the implicit assumption here is that their mortality experience in the army was identical to those whose entry and exit dates could be determined.

Accepting the enlistment date provided in the descriptive rolls as the appropriate date of entry into observation was the most critical assumption. Other sources, presumably the military service records, provided up to three separate enlistment dates. Of these, some 7.5 percent came six or more months before the enlistment date on the descriptive roll and 5.4 percent came a year or more earlier. In all, 13.6 percent had earlier dates of enlistment, but very short intervals can be attributed to slight variants in recording the same date or as the result of men who served previously for three months under Lincoln's original call of 15 April 1861 for 75,000 men. New York provided 13,906 men in this instance. The longer intervals may be attributed to those enlisting in a sampled company after serving two years under the second call of 1861 in another company or regiment. New York provided the only troops (30,950) enlisting for two years under this call (Phisterer 1907, 3–4). Whatever the reason for the discrepancy between the enlistment date recorded on the descriptive roll and the enlistment dates appearing on other records, the former must be correct from a demographic perspective. The soldier is not at risk to die before joining one of the companies that were sampled at the beginning of the project. However, for 2.7 percent of the cases missing information on the date of enlistment in the descriptive roll, an enlistment date from other records was taken as the date of entry into observation.

Some ambiguity exists with respect to the date the soldier was last under observation during the war. On the assumption that the date of death was an important and definitive event, and given that there are no variant records of this date, it was accepted as correct. Of those who died of disease before 1866, 6.9 percent had some other occurrence in their lives recorded as taking place after they had died. For 3.5 percent of these deaths this unnatural event occurred more than three months after they had died. Since the timing of this postmortem event was found by computing the maximum date among all of the many events recorded by date in the data—discharge, military court action, release from hospital, etc.—the procedure is sensitive to errors in the original records or in the data entry.

If no death during the war era was recorded, the men were regarded as being under continuous observation in the first period until the date of the latest event recorded unless there was a definitive break of more than 0.25 years between a seeming date of departure and a subsequent date of reentry. The working assumption here was that a soldier was really under con-

tinuous observation until proven otherwise, a conjecture that by expanding the period at risk tends to minimize the measured mortality rate. For example, someone who deserted but later returned was treated as never having left. It would be possible to make better judgments, on a case-by-case basis, as to whether someone was really under observation at every point. Using assumptions that maximized the apparent length of the first period that the soldier was under continuous scrutiny, the goal was to minimize the complexity of the data set. Only if there was a gap of more than 0.25 years between a date of discharge and a date of reenlistment was the first period terminated by the discharge date. In this chapter, the relatively few second and ever-fewer subsequent observation spells that began with reenlistments were excluded from the analysis.

Limiting this study to soldiers from one state, even one as large as New York, sharply reduces the number of events to be analyzed. To maximize that number, 619 deaths from all specified noncombat causes are included. While death from disease was around four times higher than that experienced by young adult men in civilian life in the mid-nineteenth century, only 8.3 percent of sampled soldiers died from these causes. Almost half of the deaths were due to two causes: diarrhea (27.5 percent) and typhoid (22.3 percent). Other relatively numerous killers were fevers of various types (6.8 percent), dysentery (4.5 percent), tuberculosis (3.7 percent), pneumonia (3.2 percent), scurvy (2.6 percent), and starvation (2.6 percent). A handful of deaths probably incident to wounds (gangrene, erysipelas, and possibly some of the unspecified diseases) are included.

4.4 Seasoning and the Effect of Duration of Service

Seasoning—the elevation of disease and death from disease that occurred as a consequence of movement—is a pervasive phenomenon in the literature of historical demography. Whether moving to cities in the early modern era, to the Chesapeake region from Great Britain in the seventeenth century, or into the Union Army from rural Ohio, arrivals did poorly during their initial exposure to the new disease environment. As table 4.4 demonstrates for enlisted infantrymen in units organized in New York state, death from disease declined with the length of time served (Lee 1997, 42). The overall death rate from disease was 46.0 per 1,000 man-years. In the first year of observation the rate was 55.6 compared to 41.8 for the second year. For those under observation longer than two years, the rate was 34.8 per 1,000 from then until the end of military service.

As was the case for Ohio troops studied by Lee, the chances of death from disease peaked well into the first year of service. In New York, the death rate for the first six months was lower (45.2 per 1,000 man-years) than in the second six months (69.2). Given the predominance of infectious diseases, this delay in the seasoning peak is surprising. Only 11 percent of those whom

Table 4.4 **Death Rates by Duration of Exposure, New York Union Army Enlisted Men**

Period of Exposure	Death Rate per 1,000	Number of Deaths	Man-Years at Risk	Starting Cohort Size
Enlistment until exit	46.0	613	13,325	7,548
Enlistment to end year 1	55.6	330	5,928	7,548
Start year 2 to end year 2	41.8	147	3,514	4,338
Start year 3 until exit	34.8	136	3,883	2,721
First six months	45.2	151	3,343	
Second six months	69.2	179	2,585	
Third six months	47.7	94	1,968	
Fourth six months	34.2	53	1,545	
Fifth six months	50.3	62	1,232	
After 2.5 years to exit	27.9	74	2,652	2,283

Source: Fogel (2000).

the 1850 census (DeBow 1855, 23) reported dying from such diseases, classified then as zymotic, were sick longer than a month. The apparent delay in seasoning is consistent with the substantial increase in disease mortality in the Union Army during the first year and a half of the war (Elliott 1862; Olmstead 1866). Death rates from disease more than doubled between the third quarter of 1861 and the first quarter of 1862 and then rose by an additional 30 percent by the final quarter of 1862 (U.S. Surgeon General 1990, vol. 1).

Data collected in an innovative quantitative investigation of camp conditions are suggestive about the delay in peak seasoning mortality until the second half of the year of first service. Investigators from the U.S. Sanitary Commission, a nongovernmental organization, evaluated various aspects of the camps that they considered relevant to the incidence of sickness. The agency then coded the responses to questions about camp sites, tents, cleanliness, rations, discipline, water supply, medical services, etc., for 450 units that were surveyed between August and early December 1861. Conditions were ranked from 1 ("extremely bad") through 5 ("indifferent") to 10 ("perfect"); scores above 7 ("very good") were rarely awarded. In December 1861, Frederick Law Olmstead (1866, 34), the commission's executive director, reported on a tabulation of these scores for 200 regiments surveyed prior to 1 November 1861 and gave his impressions of the army's medical problems. Olmstead and his fellow commission directors, however, relied on prior beliefs and tabulations of each variable separately to support policy recommendations made in a letter to President Abraham Lincoln on 21 July 1861. They charged that "the careless and superficial medical inspection of recruits made at least 25 per cent of the volunteer army raised last year not only utterly useless, but a positive incumbrance and embarrass-

ment, filling our hospitals with invalids" (U.S. War Department 1899, 235). Using the microfilm edition of the original returns (Scholarly Resources 1999, microfilm roll 27, frames 268–1197, and roll 28, frames 8–28), conditions relevant to disease can be related to the rate of sickness a regiment experienced during a month.

Over a quarter of the 450 regiments whose conditions were quantified after being surveyed by the Sanitary Commission inspectors were from New York. On average, nearly four months (119 days) had passed between mustering in and inspection. The influences on sickness early in the war were not those that can be related to mortality from disease during the first year of service. Neither the overall sickness rate (57 per 1,000) nor its components—sick in quarters, in the regimental hospital, or in the general hospital—bore any relationship to the extent of urbanization or the crude death rates of the counties where the units had been recruited. Perhaps surprisingly, none of the conditions in the camps had an impact on the rate of sickness.[11] The only indicator that predicted significantly more sickness was the report that the initial medical examination had been inadequate. On average, the sickness rate in the twenty-seven regiments that had a thorough examination upon entering the army was only 33.0 per 1,000 strong compared to the overall rate of 56.6, a finding that supported one of the main prescriptions of the Sanitary Commission for reform.

There is suggestive evidence that the theory of the Sanitary Commission as to what mattered shaped how their investigators assessed the evidence. That is, the retrospective conclusion about the thoroughness of the initial medical inspection, presumably learned in conversation with the regimental surgeons (whose training was almost always favorably evaluated by the man from the Sanitary Commission), was not independent of knowledge of the monthly sickness rate.

In a regiment with a lot of sickness, what or who was to be blamed? Thirty-five of the 117 New York regiments were inspected on more than one occasion during the five-month period. The investigators reported the same evaluation of the initial medical examination for only twenty-two of the regiments. In thirteen cases, the inspectors differed on whether the examination upon entering the army had been adequate. For eight regiments, the scoring of the initial medical examination as inadequate was associated with a much higher rate of sickness (36 per 1,000 on average) than that experienced during the month that the inspector reported a thorough initial exam. For the five remaining anomalous regiments, a more favorable assessment of the initial examination with a smaller increase in the sickness rate (5 per 1,000).

11. This was not true in the data that included all of the inspections. Regiments from regions (the Midwest and northern New England) that had greater disease mortality during the war also experienced a higher incidence of early sickness.

Table 4.5 Death Rates by Geographic Location of Service

Region of Service	Death Rate per 1,000	Number of Deaths	Man-Years at Risk
First service region total	50.0	458	9,152
Eastern theater	49.8	365	7,325
Louisiana and Gulf	71.2	61	856
Carolinas	26.6	24	903
Western theater	119.4	8	67
For second geographic region of service			
First service region total	36.8	154	4,186
Eastern theater	32.2	95	2,947
Louisiana and Gulf	43.6	21	481
Carolinas	45.2	28	620
Western theater	71.9	10	139
For both first and second geographic regions			
First service region total	45.9	612	13,338
Eastern theater	44.8	460	10,272
Louisiana and Gulf	65.9	82	1,337
Carolinas	34.1	52	1,523
Western theater	87.4	18	206

Sources: Fogel (2000); Dyer (1959).

The risk of death from disease continued to decrease after the first year of service. Possibly due to the small sample of deaths in later six-month intervals, the decrease was not monotonic. Lee also found a second peak toward the end of the second year of service in his analysis of Ohio troops.

The seasoning effect is intertwined with the destination of service. If most of the service in a region were concentrated into the first segment of a company's tour of duty, then the apparent effect of serving in that region would be exaggerated. Table 4.5 divides the sample into the first and all other subsequent geographic locations of service. The results concur with the finding in the regimental-level data (table 4.3) that service in Louisiana and the Gulf region was most hazardous to life. However, these data, tabulated throughout by the region of first service, suggest that the apparent higher mortality in Louisiana and the Gulf is elevated because of the high rate of New York men sent there at the beginning of their time in the army. Initial service in the Carolinas was not less deadly than soldiering elsewhere.[12]

Many factors contributed to the incidence of death from disease among New York enlisted infantrymen. For each of these variables, column (2) of table 4.6 reports the index per 1,000 men of dying from disease while they

12. Figures tabulated at the conclusion of the war indicate that Union soldiers in coastal South Carolina—the Department of the South—experienced higher disease mortality than the rest of the army in the first and last years of the war but lower mortality in the middle half (U.S. Surgeon General 1990, vol. 1).

Table 4.6 **Logistic Regression of Longitudinal Disease Mortality Index by Timing of Death**

Variable and Category	Bivariate Results: Percent (1)	Bivariate Results: Index (2)	Entire-Sample Odds Ratio (3)	Death-in-First-Year Odds Ratio (4)	Death-after-First-Year Odds Ratio (5)
Height****			Group (n.s.)	Group (n.s.)	Group (n.s.)
Under 65″	16.3	71	1.02	0.97	1.07
65–66″	27.6	66	0.76*	0.69*	0.87
67–68″	28.7	88	Ref.	Ref.	Ref.
69″ or taller	27.4	104	1.05	1.01	1.14
Inferred previous enlistment (before date in descriptive roll)**			Group**	Group*	Group (n.s.)
No discrepancy	87.6	85	Ref.	Ref.	Ref.
Gap under one year	8.3	96	1.02	1.10	0.92
Gap greater than one year	4.1	25	0.26***	0.31**	0.12*
Region of county of enlistment****			Group (n.s.)	Group*	Group (n.s.)
New York County	26.5	60	0.79	0.57**	1.04
Contiguous to New York	13.7	57	0.75	0.54*	1.07
On Erie Canal	20.0	85	0.84	0.72	0.98
Elsewhere in state	39.8	108	Ref.	Ref.	Ref.
Occupational group****			Group**	Group**	Group (n.s.)
Professionals and proprietors	7.9	50	0.79	0.55	1.13
Unclassified and missing	3.6	65	0.96	0.73	1.24
Farmers	31.2	120	1.43**	1.42*	1.26
Workers	57.3	70	Ref.	Ref.	Ref.
Country of birth****			Group**	Group (n.s.)	Group (n.s.)
United States	53.5	103	Ref.	Ref.	Ref.
Canada	7.0	61	0.62*	0.70	0.58
England	4.4	71	0.84	0.82	0.90
Ireland	19.4	66	0.74*	0.65*	0.80
Germany	10.7	48	0.55**	0.62	0.57
Other foreign country	5.0	59	0.63	0.58	0.68

Year of enlistment****	100.0	83.6	Group*	Group****	Group (n.s.)
1861	26.4	83	1.02	0.52**	1.50
1862	32.5	107	1.08	0.63*	1.58
1863	9.7	99	Ref.	Ref.	Ref.
1864	20.6	72	1.04	1.32	0.75
1865	10.8	23	0.42**	0.60	0.04
Birth cohort****			Group****	Group****	Group****
Before 1830	20.6	124	1.98****	1.80***	2.42****
1830–39	35.3	71	0.96	0.88	1.11
1840 and after	44.1	75	Ref.	Ref.	Ref.
Location of first distant service in field****			Group**	Group*	Group**
Eastern theater	78.0	80	Ref.	Ref.	Ref.
Louisiana or Gulf	8.9	133	1.72***	1.25	1.98***
Carolinas	11.1	61	1.07	0.51	1.42
Western theater	2.0	133	1.52	1.30	0.93
Ever a prisoner of war?****			Group****	Group****	Group****
Yes	3.0	332	6.23****	2.54***	8.14****
No	97.0	76	Ref.	Ref.	Ref.
Length of term***			Group (n.s.)	Group (n.s.)	Group (n.s.)
Under three years	14.5	54	0.81	0.92	0.31
Three years or more	85.8	89	Ref.	Ref.	Ref.
Intercept			–2.45	–2.49	–3.49
Standard error			(.21)****	(.27)****	(.32)****
Initial –2 log-likelihood			3,900.0	2,469.9	1,934.8
Improvement with model			306.0****	168.1****	161.3****
Base-sample size			6,784	6,785	3,886
Number of disease deaths			567	302	265

Source: Fogel (2000).

Notes: Ref. = Reference category; n.s. = not significant.

****Significant at the .01 percent level.

***Significant at the .1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

were in the Union Army. (The percentage of men in each category appears in column [1]). Overall, 8.36 percent of those who enlisted died from disease while they were in the army.

Three variables—year of enlistment, term of service, and birth cohort—should be regarded as controls. These indicators have statistical but not substantive relevance. The first two affect the proportion every dying of disease by altering the potential period at risk. It is not surprising, for example, that only 2.3 percent enlisting in 1865 died of disease while in the army. Age, of course, bears a substantive relationship to the risk of death, but this relationship is so well known that it lacks interest here. That only the oldest age group—those born before 1830—had a higher fraction die of disease may be attributed mostly to the fact that men born before 1830 were much older than the birth cohort of the 1830s. They were 38.6 years old at the time of enlistment compared to 26.6 for those born in the 1830s and 19.8 for those born in 1840 or after. Depending on location or status, infantrymen differed in average age. For example, natives were three years younger than the foreign-born, those enlisting in New York City were 1.1 years older and farmers were 1.3 years younger than the overall average. Such differences in age distribution potentially can obscure or distort the relationships that are of more genuine interpretive interest. Hence age is included as a separate variable in the analysis.

Three of the indicators reflect different wartime circumstances. Not surprisingly, ever being a prisoner of war of the Confederates was particularly deadly. No less than one-third of captured New York infantrymen in the CPE sample died of disease. In addition, first serving beyond the Atlantic coast—either in the western theater or in the Louisiana–Gulf of Mexico region—elevated the disease death index.

Of particular interest are those attributes characterizing the soldiers at or before the time of enlistment in one of the sampled companies. Those who had not previously served in the army (8.6 percent), farmers (12.0 percent), the native-born (10.3 percent), those who enlisted in upstate New York outside of the areas of New York City and the Erie Canal (10.8 percent), and those who were of more than 69 inches in height (10.4 percent) were more likely to die from disease in the army.

Additionally, men who enlisted in counties that had lower rates of medical rejections for service of recruits and substitutes in the last two years of the war ($r = –0.07$), that were less urban in 1845 ($r = –0.07$), and that had lower crude death rates in 1855 ($r = –0.08$) were also modestly (but statistically significantly) more likely to die from disease in the Union Army. As was shown by Lee (1997, and ch. 3 in the present volume), seemingly healthier men from apparently healthier environments were particularly likely to succumb to disease during the war.

To deal with the influence of a range of interrelated variables requires, of course, a multivariate approach. Taking a relatively simple approach to

complexity, table 4.6 uses logistic regression analysis to estimate the odds of death from disease over the entire period the soldier was in observation (column [3]).[13] Since the categorical and interval-level aggregate variables statistically overlap, the latter are omitted from table 4.6. Not unexpectedly, the statistical significance of some of the remaining variables wanes in this assessment, including height and the variable detailing the geographic region of enlistment within the state. Everything considered, farmers were more likely—and those born in Canada and Germany among the foreign-born were less likely—to die from disease. Interpretation should follow the Seussian objection to identifying specific importance of any variable with how many "stars upon thars," i.e., *** attached to standard errors to indicate the extent of statistical significance.[14] The level of statistical significance depends on how validly each variable was defined and how reliably each was measured, and on the number of covarying indicators included in the analysis. Recall that table 4.1 suggested that a continuous relationship existed between the size of a town and the crude death rate. The county of enlistment is, of course, larger than the town of enlistment. Further, soldiers tended to enlist in central places—towns and cities that were larger than the places where they actually lived. Given the rates of geographic mobility in nineteenth-century America, an enlistee's town of residence could often differ from the place he spent his childhood and youth. A safe conclusion is that, all else considered, prior exposure to disease did increase one's risk of death from disease while serving in the Union Army, rather than that it was a farm background that *really* mattered (also see Lee's ch. 3 in this volume).

To isolate the impact of seasoning, separate logistic regression analyses were undertaken of disease mortality during the first year (column [4] of table 4.6) and the interval following the conclusion of the initial year of service (column [5]). The logic here is that the background factors associated with prior exposure to disease should be much stronger in the first year than thereafter. That logic of the source of seasoning mortality is confirmed, most suggestively by the importance of region of enlistment during the first year of service and the nearly complete absence of its impact thereafter. Similarly, variation in the risk of death wanes after the first year of service among soldiers whose prewar occupations differed.[15] Two of the factors re-

13. Again, this index differs from a true cohort death probability since it does not account for varying lengths of time that the soldier was in the army before exiting via death from combat, desertion, discharge, etc.

14. As told by Dr. Seuss (Geisel 1961, 3–4), the Plain Belly Sneeches had "none upon thars": "But, because they had stars, all the Star-Belly Sneetches / Would brag, We're the best kind of Sneetch on the beaches."

15. It should be noted that the shrinkage of the sample contributes the decline in the indicators of statistical significance. In the first year, some 302 disease deaths occurred to an original 6,786 enlistments. After the first year, there were only 265 deaths caused by disease among the 3,887 soldiers who were still in the army at the beginning of the second year of service. Thus, some of the odds ratios diverge after the first year, even though they are less likely to pass a test of statistical significance.

lated to wartime experience—being a prisoner of war, and the region of first service—increase in importance after the first year. During the first two years of the Civil War, prisoners were generally exchanged or paroled after relatively brief incarceration. Later in the conflict, prisoner exchanges between the Union and Confederate forces broke down.

Even after taking into account both background and wartime factors, an indicator that relates to the sharing of more particular mortality environments or the process of contagion also must be incorporated into the analysis. This indicator—the percentage of other men who died from disease in a sampled company—represents an attempt to operationalize the concentration of mortality experience associated with soldiering together than cannot be attributed to the areas of origin within New York state or to broad geographic regions of service while in the army.[16] In order to isolate this factor, which taps otherwise unmeasured aggregate influences on mortality, on seasoning, the analysis in table 4.7 divides company-mortality incidence into periods during (column [2]), and after (column [3]) the first year of service as well as overall (column [2]).

Overall, its inclusion resulted in a 9.3 percent improvement of the model. An absolute increment of 10 percent in the disease death index of the other men in a company increased the death index for the individual soldier by 5.4 percent. Its effect on the other variables shows up markedly in the attenuation of the impact of location of first service. This outcome is not surprising, since both service location and the intracompany concentration of death are indicators measured at the aggregate level. However, it had almost no impact on the other company-level indicator—where the unit was organized within New York state. Effects on individual-level characteristics such as nativity and occupation are barely noticeable. This bunching of death within companies in a regiment is an independent dimension of the structuring of disease mortality.[17]

This paper has demonstrated that a multiplicity of factors must be considered to understand variation in death from disease of soldiers from New York during the Civil War. Background factors such as occupation and type of residence, sensibly viewed as related to the extent of prior exposure to disease, mattered. Once in the army, the risk of death varied depending on how long the soldier had served and whether he had prior military service. The background factors mattered to any great extent only during the initial year of experience in the military. After a year of service, seasoning having

16. For example, consider a company with 100 infantrymen that experienced eight deaths from disease. In this case, the clustering index for a soldier who died of wartime disease was 7/99 and 8/99 for a man who did not. If two or more companies from the same regiment were included in the CPE sample, the base of the index is the entire number sampled from the regiment.

17. Without the addition of other variables, the ordinary least squares estimate is that an increase of 10.0 per 1,000 in the death index of other men in a company would increase the individual index by 5.6 per 1,000.

Table 4.7 **Logistic Regression of Longitudinal Disease Mortality Index by Timing of Death with Company-Disease Mortality Included**

Variable and Category	Entire-Sample Odds Ratio (1)	Death-in-First-Year Odds Ratio (2)	Death-after-First-Year Odds Ratio (3)
Height	Group (n.s.)	Group (n.s.)	Group (n.s.)
Under 65″	1.02	0.99	1.03
65–66″	0.76*	0.70*	0.85
67–68″	Ref.	Ref.	Ref.
69″ or taller	1.04	1.00	1.12
Inferred previous enlistment (before date in descriptive roll)	Group**	Group*	Group (n.s.)
No discrepancy	Ref.	Ref.	Ref.
Gap under one year	1.01	1.04	0.96
Gap greater than one year	0.28**	0.33**	0.13*
Region of county of enlistment	Group (n.s.)	Group*	Group (n.s.)
New York County	0.86	0.58**	1.00
Contiguous to New York	0.83	0.60*	0.98
On Erie Canal	0.88	0.76	0.90
Elsewhere in state	Ref.	Ref.	Ref.
Occupational group	Group*	Group*	Group (n.s.)
Professionals and proprietors	0.79	0.55	1.11
Unclassified and missing	0.94	0.71	1.24
Farmers	1.37**	1.34*	1.26
Workers	Ref.	Ref.	Ref.
Country of birth	Group**	Group (n.s.)	Group (n.s.)
United States	Ref.	Ref.	Ref.
Canada	0.62*	0.72	0.54
England	0.87	0.83	0.93
Ireland	0.74*	0.64*	0.74
Germany	0.62*	0.71	0.63
Other foreign country	0.68	0.64	0.69
Year of enlistment	Group*	Group***	Group (n.s.)
1861	1.03	0.59*	1.36
1862	0.94	0.62*	1.22
1863	Ref.	Ref.	Ref.
1864	1.04	1.38	0.75
1865	0.47*	0.74	0.04
Birth cohort	Group****	Group****	Group****
Before 1830	1.95****	1.82***	2.36****
1830–39	0.96	0.89	1.10
1840 and after	Ref.	Ref.	Ref.
Location of first distant service	Group (n.s.)	Group (n.s.)	Group (n.s.)
Eastern theater	Ref.	Ref.	Ref.
Louisiana or Gulf	1.35*	1.23	1.55*
Carolinas	1.06	0.58	1.33
Western theater	1.10	0.76	0.93
Ever a prisoner of war?	Group****	Group**	Group****
Yes	5.52****	2.11**	7.98****
No	Ref.	Ref.	Ref.

(*continued*)

Table 4.7 (continued)

Variable and Category	Entire-Sample Odds Ratio (1)	Death-in-First-Year Odds Ratio (2)	Death-after-First-Year Odds Ratio (3)
Length of term	Group (n.s.)	Group (n.s.)	Group (n.s.)
Under three years	0.80	0.86	0.35
Three years or more	Ref.	Ref.	Ref.
CPE Company Disease Mortality Index (%)[a]	1.0539****	1.0867****	1.0661****
Intercept	–2.89	–2.99	–3.70
Standard error	(.23)****	(.23)*****	(.32)****
Initial –2 log-likelihood	3,900.0	2,469.9	1,934.8
Improvement with model	334.4****	189.3****	179.5****
Base-sample size	6,784	6,785	3,886
Number of disease deaths	567	302	265

Source: Fogel (2000).

Notes: Ref. = Reference category; n.s. = not significant.

[a]Company disease mortality based on each duration specified.

****Significant at the .01 percent level.

***Significant at the .1 percent level.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

been accomplished, soldiers recruited from upstate New York died from disease at a rate identical to that of soldiers enlisted in New York County, in contiguous counties, or counties the Erie Canal traversed. Experience in the army also helped to determine disease mortality. If the soldier found himself in a more dangerous disease environment—along the lower Mississippi or the Gulf of Mexico, or, most drastically, in a POW camp—he was more likely to die from disease. Finally, the soldier shared mortality risks with those men with whom he was in close contact—the other enlisted men in his company and regiment. With the troops, but not intermingled with them and the microorganisms they embodied, officers were much less likely to succumb to disease.

Why did so many Union Army soldiers die of disease during the Civil War? Perhaps because the sources of mortality were so diverse.

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