

Mortality on the Mormon Trail, 1847–1868

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and the BYU Pioneer Mortality Team*

How prevalent was death on the Mormon Trail? If you were a Mormon pioneer, what were your chances of dying while traveling to Zion? How many pioneers died? What were the causes of death? What was the difference in mortality experience of males versus females or old versus young? Were you more likely to die pulling a handcart or traveling in a wagon company? These and other questions relating to Mormon Trail mortality beg for answers. This paper considers these questions using data about those pioneers who crossed the plains from east to west¹ between the years 1847 and 1868.² There has been a variety of published work on mortality among pioneers, including historical reports, newspaper articles, public television documentaries, and special-interest publications³ in the past, but current resources and research techniques have resulted in more complete data. Although it is certain that additional data will come forth in the future, the detailed effort from the Church

1. The data considered here are restricted to those individuals who were assigned to a wagon or handcart company. Those individuals who died immigrating prior to being identified with a company, for example those dying prior to reaching a staging area such as Florence, Kaneshville, Mormon Grove, etc., or those dying at the staging area before being assigned to a company, are not included.

2. The transcontinental railroad was completed in 1869, materially altering the manner in which many immigrated.

3. “Special-interest publications” refer to church articles, advertisements, and reports by groups who may have a special interest in downplaying the health and mortality risks of crossing the plains.

Historical Department of The Church of Jesus Christ of Latter-day Saints over the last decade has provided enough information to sketch an outline of pioneer mortality.

About one hundred years ago, clerks in the Church Historian's Office of the LDS Church under the direction of Andrew Jenson initiated a study of the migration diaries, accounts, and records. They compiled indexes and brief histories of the Mormon companies that crossed the ocean and plains. Some of their research findings were published by Jenson in a series of articles.⁴ The bulk of their research was compiled in large reference volumes called "Church Emigration" that are on file in the Church History Library. In that compilation, Jenson estimated that nearly 6,000 died on the journey.⁵

Although records of the Mormon immigration seem to be better than those of most migrations in the U.S., the records are not complete. Historians have estimated that between 50,000 and 80,000 Mormons crossed the plains between 1847 and 1868.⁶ That is a wide range, and by its very breadth evidences the incompleteness of the existing records. Susan Black and others provide a general assessment of the mortality of immigrants, but state that the incompleteness of the data limit the

4. The articles appeared almost monthly between 1891 and 1893 in the *Contributor*, vols. 12, 13, and 14.

5. See Andrew Jenson, "Church Emigration Book," vol. 1, [p. 2], Church History Library, The Church of Jesus Christ of Latter-day Saints, Salt Lake City. Although his estimate was couched in the context of immigrants crossing the plains, Jenson gave no further details about how he determined this number or about his perception of the journey. A recent attempt to assess Mormon migration deaths clearly shows that Jenson took a broad view of determining the number of deaths. His death tally included those who traveled on ships, riverboats, railroads, in wagon and handcart companies, and while in transit at outfitting places or way stations; in other words, the entire breadth and spectrum of immigrant migration—not just those crossing the plains. He may have even included deaths of people who halted in Missouri or Iowa or in any place of Mormon gathering for an extended period of time. He also included deaths beyond 1868.

6. See Wallace Stegner, *The Gathering of Zion* (New York: McGraw-Hill, 1964), 9n, citing sources for 46,972 to 68,028. Leonard J. Arrington, *Great Basin Kingdom* (Cambridge, Mass.: Harvard University Press, 1958), 99: "more than 51,000 Mormon emigrants had been assisted to America, of whom 38,000 were British, and over 13,000 were from the Continent and Scandinavia," thus not including Americans. Jenson, "Church Emigration Book," vol. 1, [p. 2]: "We approximate that 80,000 L.D.S. emigrants crossed the Plains in Pioneer years." Arnold K. Garr, Donald Q. Cannon, and Richard O. Cowan, *Encyclopedia of Latter-day Saint History* (Salt Lake City: Deseret Book, 2000), 415: "more than 60,000."

conclusions that can be drawn.⁷ Subject to this caveat, they estimated that the number that died was between 4,200 and 5,000, with 4,600 as the median estimate. Although they don't give a percentage estimate, the illustration in their table uses 3.25% as a mortality rate. We note here that work is ongoing and additional data will gradually come forth.⁸

By comparison, Peter Olch estimated that “the overall mortality rate on the Oregon-California Trail was 6 percent of those starting west.”⁹ We note here that the Oregon Trail was about 700 miles (or 55%) longer. Recent data also indicate that the mortality rate along the Oregon Trail may actually be lower than estimated by Olch.¹⁰

In this paper we examine mortality along the Mormon Trail, from the staging areas where the wagon and handcart companies were formed to arrival in the Great Basin. These staging areas were moved farther west as the ability to travel up the Missouri River or by rail improved. Figure 1 gives a map of these posts and the dates they were used.

It is important to note that mortality from the staging area to the Great Basin is *not* the same as the mortality for the Mormon pioneer movement. The staging areas often experienced epidemics that resulted in numerous deaths. An indication of the extent of disease and death in some of these staging areas is given by Crandell, Bennett, and Ivie and Heiner.¹¹ Additionally, many of the pioneers traveled from the eastern U.S., Great Britain, or the European continent just to get to the staging

7. Susan E. Black and others, “Do We Know How Many Latter-day Saints Died between 1846 and 1869 in the Migration to the Salt Lake Valley?” *Ensign* 28 (July 1998): 40–44. See also Shane A. Baker, “Illness and Mortality in Nineteenth-Century Mormon Immigration,” *Mormon Historical Studies* 2, no. 2 (2001): 77–90, which discusses causes of death.

8. It has been suggested that since these data are based on individual enumeration, or “counting heads,” these counts are conservative (underestimate the actual numbers). Some believe that there are a considerable number of people who crossed the plains to Utah who left no documentary record. William Hartley, private communication to Melvin Bashore. Here we focus on the experience of the 56,042.

9. Peter D. Olch, “Treading the Elephant’s Tail: Medical Problems on the Overland Trails,” *Overland Journal* 6, no. 1 (1988): 25–31.

10. Personal communication from geographer Richard L. Reick. Reick revises those overland death rates downward, below the Mormon death rate. Dr. Reick’s data have yet to be published.

11. Jill N. Crandell, “Garden Grove, Iowa: From Mormon Way Station to Permanent Settlement 1846–1852” (master’s thesis, Brigham Young University, 2010); Richard E. Bennett, *Mormons at the Missouri, 1846–1852: “And Should We Die”* (Norman: University of Oklahoma Press, 1987); Evan L. Ivie and Douglas C.

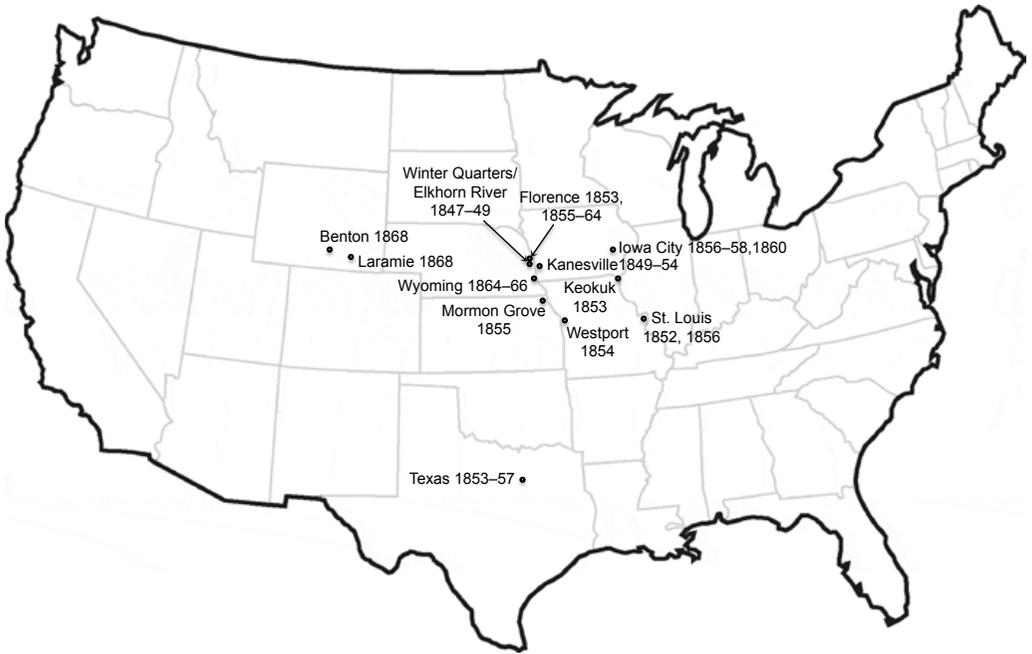


FIGURE 1. Staging areas between 1847 and 1868.

areas. Deaths prior to becoming a member of a wagon train or hand-cart company either in these staging areas or before reaching them *are not* included here. Sources for these data regarding the whole immigration are different from the wagon master diaries, personal histories, and church records we researched for this article. While some personal histories cover both the gathering to the trail and the trail experience itself, many historical records cover just one aspect of the experience. It is reasonable to assume that reaching the staging areas and sometimes residing there was a winnowing process in that the frail and ill were more likely to die prior to being assigned a company. In this case, the mortality rate reported here would be biased as regards determining the overall mortality rate of the immigrants.

METHODS

The data on immigration have been recorded for more than a century and a half in journals, diaries, and family histories. To get an accurate

Heiner, "Deaths in Early Nauvoo, 1839-46, and Winter Quarters, 1846-48," *Religious Educator* 10, no. 3 (2009): 163-73.

assessment of the mortality experience on the trail, data from these sources have been compiled by the LDS Church Historical Department.¹² The compilation is available at <http://statistics.byu.edu/news>. In a very real sense, the data file has been constructed by this team by “counting heads,” with the tally of deaths beginning when the company left the staging area and concluding on arrival into the Salt Lake Valley.¹³

The team cross-checked all available records to obtain as accurate a data set as possible. For example, table 1 lists the data found from three different sources on the John S. Higbee/James W. Bay company. As noted in this table, there are three diary entries regarding deaths. The first references a widow of John Walker dying. The second references the wife of Daniel Keeler dying of consumption. The third reference is the company record, recording that the total number of deaths in the company was three: two adults and an infant. One adult died of consumption and one adult died of cholera. From these three entries, three deaths were determined for the company, with the names of two individuals and an unnamed infant. Causes of death are known for two of these deaths. As in this illustration, there is considerable effort to locate all possible deaths and to cross-check to avoid double counting, miscounting, or missing deaths.

Each name identified with a death on the trail was then researched in the LDS Church’s Ancestral File for additional information. When available, this information was used to get a full name, sex, age, death date, place of death, sources of the information in the Ancestral File, and additional notes.¹⁴

Data on company size was also included. The primary source for the company size was provided by the company clerk. Secondary sources would be statements made in trail journals.

In summary, the work at the Church Historical Department created a data file containing the names and number of individuals dying and a database containing names and number of individuals immigrating in

12. Melvin Bashore initiated and followed through on this effort, doing intensive work from about 1998 to 2003 and then adding new information until his retirement in 2013. There were several service missionaries who helped with this labor-intensive effort.

13. Deaths that occur between the date of arrival and the end of that year are included in the current analysis as deaths on the trail. There are two reasons for this. First, for many deaths we only have the year and not the month of death. Second, deaths that occur soon after arriving may be attributable to the crossing.

14. Additional information included cause of death, name of parents, burial place, and so forth.

TABLE 1. Sample of data extracted from diaries, Ancestral File records, manuscripts in the Church History Library, published sources, and Jenson’s Church Emigration Book, showing variant records of the same three people. These various sources were cross-referenced to eliminate duplication in our count.

Name	Sources	Citation
Mary Gorriil Walker	Jane Jennings Eldredge, <i>Reminiscences</i> ; Ancestral File	Widow of John Walker, “while traveling up the Platt River Grand Mother died and was sewed up in a blanket and buried.” (Eldredge, <i>Reminiscences</i>)
Philinda Clark Eldredge Myrick Keeler	Ms 6578 (James Bay Journal); <i>Our Pioneer Heritage</i> , 5:455; Ancestral File; Ms 2775, p. 170	Consumption, wife of Daniel Hutchinson Keeler: “heared to day that sister Filinda keel died in Br James Townscens Co.” (James Bay, 9 July entry)
2 unidentified adults and 1 unidentified child	Journal History 13 Aug 1852 p. 1; Church Emigration Book	“Elder John S. Higbee reported that in his train of sixty-six wagons there had been three deaths (two adults and one child); one adult died of cholera, and one of consumption.” (Journal History)

each of the companies. For many of the deaths we have the name, age, and sex of the individual. For about 20% of these deaths, we also have the cause of death. From these data we sketch the following picture of mortality of the Mormon pioneers. Data are presented for those pioneers crossing by wagon and those crossing by handcart. The Willie and Martin handcart companies of 1856 suffered extreme difficulties, in part because of the late departure date. Because of this distinct circumstance, these two handcart companies are treated separately from the remaining handcart companies.

RESULTS

How Many Came? How Many Died?

The big picture from the data file is that 56,042 immigrants left the staging areas from 1847 through 1868.¹⁵ Figures 2 and 3 give the age distribution of the immigrants leaving the staging areas. Also included in these

15. Melvin Bashore and the volunteer team have identified more individuals who are not in the data files searched here. These additional counts will add to the big picture but will probably not materially change the observed patterns reported here. These have not been included because there is some uncertainty or incompleteness about the record.

figures are the relative numbers of the U.S. white population for 1850.¹⁶ The number of children between one and ten years old seems remarkable. Fully 45% of the immigrants were under age twenty. Note, however, that the age distribution of the Mormon immigrants follows that of the U.S. white population with the exception of the number of infants and the number of individuals over 60.

The number of deaths reported in table 2 is based on deaths recorded in personal diaries and/or reported in the company records. There are 1,910 deaths, giving a mortality rate of approximately 3.41%. Of these there were 930 female deaths (3.48%) and 944 male deaths (3.27%).

Table 3 presents the breakdown of deaths by gender for this cohort of immigrants. The “Unknown” column represents those individuals whose gender is unknown. The “Unknown” row represents the counts of those individuals for whom we have a record that they traveled with a company but for whom we could not confirm a date of death, so it is unknown whether they survived the trail. Experts usually assume that those with unknown dates of death did not die on the trail but died after reaching the Salt Lake Valley. We make the same assumption here. From this table we note that there were 26,761 females and 28,901 males we can identify, with 380 individuals (last column) for whom sex could not be determined.

Age distribution of the pioneers is given in table 4, including the number of deaths in each age group. The mortality rates for those age 10 to 29 is less than 1.70%. This cohort of 21,607 individuals who arrived (comprising almost 40% of those emigrating during this time period) make up the “pioneer” stock that initially colonized the Great Basin and beyond, followed by the 12,942 surviving infants and children who would grow up in the Rocky Mountains.

Comparing Pioneer and General U.S. Mortality Rates

The U.S. annual mortality rate during this same time period was approximately 2.5% to 2.9%.¹⁷ Figure 2 and figure 3 show that the age distribution

16. By “relative numbers” we mean that if we had randomly drawn 55,662 individuals (the subset of the 56,042 individuals for whom we know their sex) from the U.S. white population in 1850, with the same number of males and females as in the Mormon immigration, we would expect to get the total age counts in these figures. U.S. population was obtained from the data file nhgis0001_ds10_1850_state, located at <https://www.nhgis.org>.

17. Herbert S. Klein, *A Population History of the United States* (Cambridge, U.K.: Cambridge University Press, 2004), 100–101, citing McClelland and Zeckhauser, *Demographic Dimensions of the New Republic*, 109.

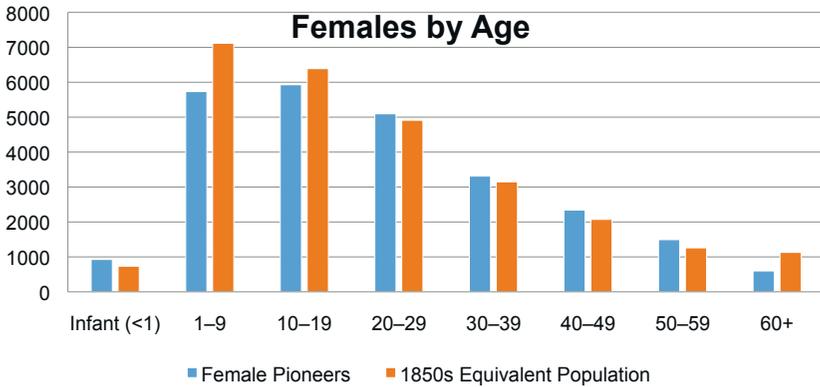


FIGURE 2. Age distribution of the 25,428 female immigrants with known age who left the staging areas between 1847 and 1868. Also plotted is the age distribution of the U.S. white female population in 1850, showing that the age distribution of immigrants was similar to the white population.

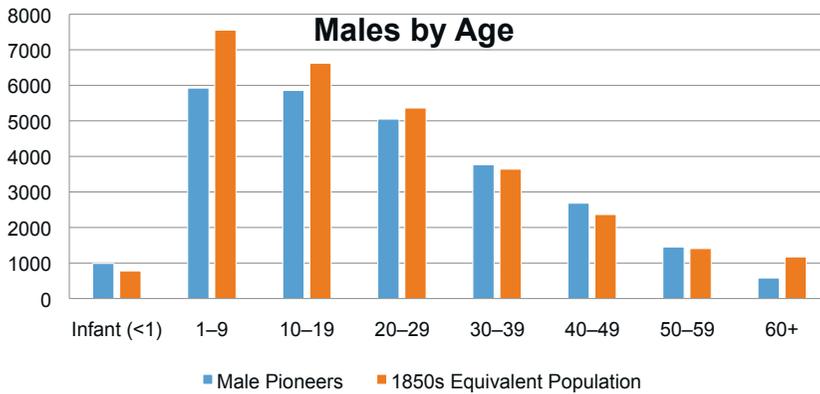


FIGURE 3. Age distribution of the 26,297 male immigrants with known age who left the staging areas between 1847 and 1868. Also plotted is the age distribution of the U.S. white male population in 1850, showing that the age distribution of immigrants was similar to the white population.

TABLE 2. Overall Mortality Rate of Mormon Pioneers Crossing the Plains. The count of immigrants is tallied from known records and includes many for whom we have no name. The total of deaths excludes people whose death date is unknown; they are assumed to have survived the trail.

Total immigrants	56,042
Total deaths	1,910
Mortality rate (%)	3.41
Total companies	307
Companies with no deaths	111
Companies with mortality between 0% and 5%	134
Companies with mortality between 5% and 10%	45
Companies with mortality over 10%	17

TABLE 3. Number of deaths and mortality rate by gender among the 56,042 Mormon pioneer immigrants for whom we have data.

Outcome	Female Count	Female %	Male Count	Male %	Sex Unkn Count	Unkn %
Died	930	3.48	944	3.27	36	9.47
Lived	19,075	71.28	20,121	69.62	27	7.11
Unknown	6,756	25.24	7,836	27.11	317	83.42
TOTAL	26,761	100	28,901	100	380	100

TABLE 4. Number of immigrants and number of deaths by age group. Percentage numbers represent the age-specific mortality rate for the immigration between 1847 and 1868.

Age Group (in years)	Number Died	Percent Died	Number Lived	TOTAL
Infant	247	12.69%	1700	1947
1-9	461	3.94%	11,242	11,703
10-19	171	1.45%	11,647	11,818
20-29	199	1.96%	9,960	10,159
30-39	176	2.48%	6,916	7,092
40-49	201	4.00%	4,830	5,031
50-59	185	6.27%	2,765	2,950
60-69	112	11.67%	848	960
70-79	32	16.08%	167	199
80+	8	36.36%	14	22
Unknown	118	2.84%	4,043	4,161
TOTAL	1,910	3.41%	54,132	56,042

of the immigrants was very similar to that of the U.S. white population in 1850. Figure 4 and figure 5 depict the age-specific death rate of females and males, respectively, among immigrants. Also tabulated are the rates for the U.S. population in 1860.¹⁸ We used the mortality rates for 1860 since there was a cholera outbreak in the U.S. in 1850, making the death rate unusually high that year and thus not a good year for comparison. With the exception of infants, the mortality rate was higher for those immigrating than for the U.S. white population.¹⁹

Infant Mortality

The mortality rates in figures 4 and 5 for pioneer infants²⁰ under one year of age are comparable to, and possibly even lower than, those of the infant U.S. white population of 1860.²¹ One hypothesis is that expectant mothers who were immigrating elected to wait a season until after delivery. In this case, infant deaths would not be recorded in our database.

Records show that there were 330 births on the trail. This yields a birth rate of 5.89 per thousand pioneers on the trail. We assumed that crossing the plains took an average of 75 days, so that must figure into our calculation comparing this birth rate to annual rates. For a 75-day period, the birth rate for the U.S. white population in 1855 calculates to 8.92 per thousand persons.²² Assuming this birth rate, we would have expected about 500 births on the trail. Similarly, the birth rate in England-Wales calculates to about 7.5 per thousand for a 75-day period, and in Sweden to about 6.67 per thousand, leading to 420 and 374 births expected, respectively. If most of the pioneers were from the U.S. or Europe, these numbers indicate that

18. Age-specific mortality rates were obtained from Michael R. Haines, *Estimated Life Tables for the United States, 1850–1900*, NBER Working Paper, historical paper no. 59 (Cambridge, Mass.: National Bureau of Economic Research, 1994), males 1860 and females 1860, available at <http://www.nber.org/papers/h0059.pdf>.

19. We multiplied the U.S. rates by seven-twelfths to correlate with the fact that the mortality data is from the beginning of the company formation to the end of the calendar year, approximately from June through December, on the average.

20. By “infant” we mean a child born alive who is less than one year old at the time of departure from the staging area.

21. We multiplied the U.S. white population infant mortality by seven-twelfths of the annual mortality to account for the partial year that people were on the trail.

22. Ansley Coale and Melvin Zelnik, *New Estimates of Fertility and Population in the United States* (Princeton: Princeton University Press, 1963), 34, giving birth rates of 43 births per thousand persons per year for the U.S., 35 for England-Wales, and 31 for Sweden.

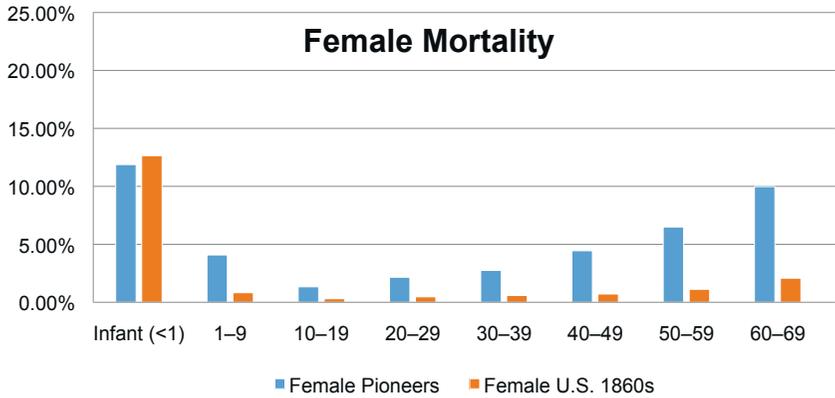


FIGURE 4. Age-specific mortality of the 26,761 female immigrants who left the staging areas between 1847 and 1868. Also plotted is the age-specific mortality rate for the 1860 white female U.S. population, showing that the mortality rate for female immigrants is higher for all ages except infants.

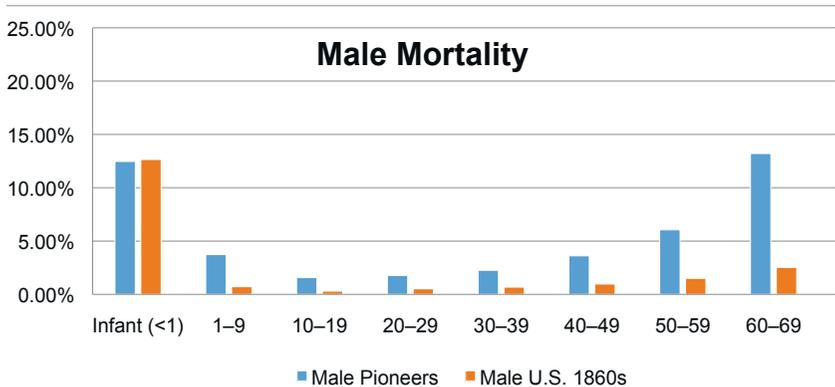


FIGURE 5. Age-specific mortality of the 28,901 male immigrants who left the staging areas between 1847 and 1868. Also plotted is the age-specific mortality rate for the 1860 white male U.S. population, showing that the mortality rate for male immigrants is higher for all ages except infants.

the number of births along the trail was lower than the general population, implying that there *were* some pregnant women who chose not to travel across the plains when delivery was expected. Other hypotheses are possible. However, examining any of these hypotheses is difficult with the current data. Any of these hypotheses suggest that the expectant mothers who elected to embark on the journey and deliver on the trail are *not* a representative sample of expectant pioneer women. This lack of representativeness will skew the data so that the death rate among infants would appear to be lower than would be expected had all expectant mothers started the journey without regard to their condition.

Of the 330 infants born on the trail, 42 are reported to have died in the first 28 days (neonatal deaths). Of these 42, 19 died on the day they were born. Three of these 19 are reported to be stillborn births and not actual infants born alive who then died. Some of the remaining 16 deaths on the day of birth may have been stillborn infants who were not reported as such. Removing the confirmed stillborn deliveries, we have 39 deaths in 327 live births. This gives a live birth neonatal death rate of 11.93%. We have not found any reference to a neonatal death rate among the U.S. white population for the mid-nineteenth century to compare. Annual death rate for 1860 for the infant U.S. white population is estimated to be about 21.6%.²³ We multiply that rate by five-twelfths so that we can compare it to trail births (we estimate an average of five months between birth on the trail and the end of the year), giving a rate of 9.0% for the U.S. population. This 9% is clearly lower than the 11.93% observed on the pioneer trail.²⁴

There were 1,617 infants who were born prior to joining a company. Of these, 205 died, giving a 7-month death rate of 12.68%. The U.S. rate for a 7-month period and age is estimated to be 12.6%, ostensibly the same.

Mortality by Mode and by Departure Month

Two questions come to mind regarding the pioneers' journey across the plains. First, is there a difference in mortality rate of those in wagons as compared with handcarts? Second, does the time the company left in

23. Haines, *Estimated Life Tables for the United States*, table 2, White Population, 1860.

24. These data correct earlier calculations of infant mortality rates reported to the media in, for example, "New Study: Mormon Pioneers Were Safer on Trek Than Previously Thought, Especially Infants," *Deseret News*, July 20, 2014, at <http://www.deseretnews.com/article/865607257/New-study-Mormon-pioneers-were-safer-on-trek-than-previously-thought-especially-infants.html?pg=all>.

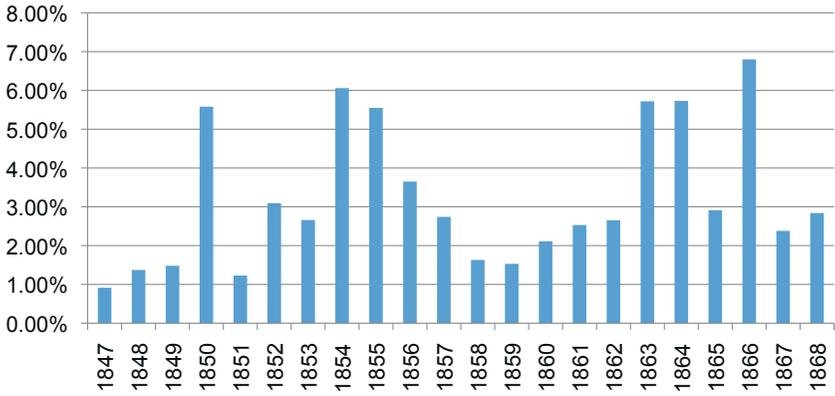


FIGURE 6. Mortality by year of departure for wagons.

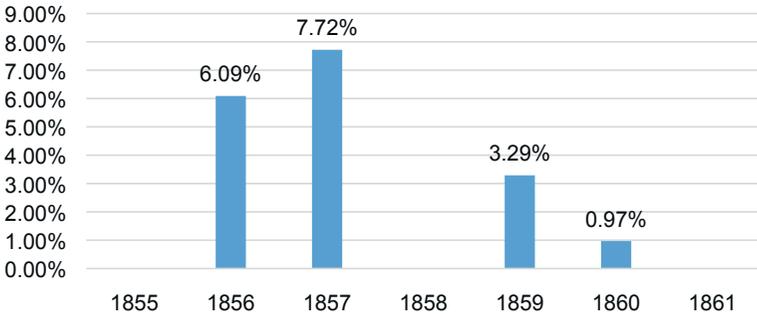


FIGURE 7. Mortality by year of departure for handcars, excluding Willie and Martin companies. The Willie and Martin companies (1856) suffered a mortality rate of about 16.5%.

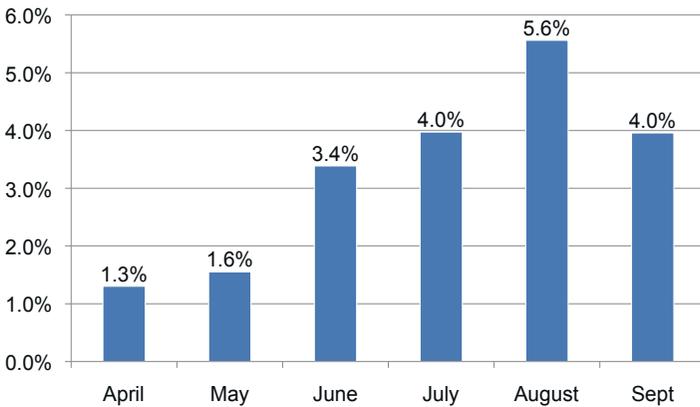


FIGURE 8. Mortality rates by month of departure for the 56,042 immigrants that left the staging areas between 1847 and 1868.

the year have any effect on mortality rates? The Willie and Martin handcart companies accounted for almost 39% of the immigrants crossing by handcart. These two companies had a mortality rate of about 16.5%. The extremely high mortality rates in these two companies are well known. Figures 6 and 7 show that mortality rates for the other handcart companies were considerably smaller (about 4.5%) but still (statistically significantly) higher than the mortality rates of the wagon train immigrants (about 3.4%). These are overall rates and do not adjust for any difference in ages of the handcart pioneers versus the wagon train pioneers. Figure 8 gives the mortality rates by departure month.²⁵

CAUSES OF DEATH

Less than 20% of the deaths report a cause, and some of these reported causes may be in error. Given the limitations in sample size, sample representativeness, and nineteenth-century medical diagnostics and disease classification, we cannot do a statistical study of cause-specific mortality rates for immigrating pioneers. However, a brief survey of cause data is interesting because of what is and what is not tabulated. Of those reported causes, over 50% list cholera or diarrhea as cause of death (see Rushton²⁶). Of the remaining handful of deaths where cause is listed, the most prevalent are “run over by a wagon,” “stampeded,” “consumption,” “drowned,” “fever,” and “accidentally shot.” It seems clear that there were considerable risks of death by some form of accident.

There are only 4 deaths reported from “Indians,” 2 people were reportedly “eaten by wolves,” 2 deaths from a poisonous bite or scorpion sting, and one murder. Weather factors, freezing, and exposure such as were prevalent in the Willie and Martin handcart companies were usually not reported in these data. Although it is difficult to give a detailed analysis of such scant data, the picture seems to show that deaths from accidents were common, while deaths from “Indians” and “wolves” were not.

CONCLUSIONS

Many have heard of inspiring but heart-wrenching pioneer stories of specific individuals and families. Statistical tabulations of data gathered from

25. Brigham Young's vanguard company left in April 1847 and had no deaths.

26. Patricia Rushton, “Cholera and Its Impact on Nineteenth-Century Mormon Migration,” *BYU Studies* 44, no. 2 (2005): 123–44.

records and diaries do not illustrate the difficulties, perils, and miracles experienced by the pioneers. Some of the volunteers working on obtaining these data were brought to tears while they read through the journal entries. Though we cannot pretend to understand such trials and blessings from the tables and figures presented here, surveying many journals in gathering these data has revealed sketches of the trials and the tender mercies of the Lord. The reader can access such accounts in the Mormon Pioneer Overland Travel database available online. Here we have simply summarized the statistics that can be obtained to date.

Melvin L. Bashore recently retired as a curator of historic sites with the LDS Church Historical Department. He received his BFA in modern painting from the University of Utah, his MEd from University of Missouri–St. Louis, and his MLS in library science from BYU. He worked for the Church Historical Department for thirty-eight years and conceived and developed the Mormon Pioneer Overland Travel database (<http://history.lds.org/overlandtravels/>). In 2010, he received a Distinguished Service Award from the Oregon-California Trails Association for his work on this project. He has been researching trail mortality for more than a decade. He has also published numerous articles in wide-ranging historical journals. His recent publications include “The Bloodiest Drama Ever Perpetrated on American Soil: Staging the Mountain Meadows Massacre for Entertainment,” *Utah Historical Quarterly* 80 (summer 2012): 258–71, and “Quitting Coffee and Tea: Marketing Alternative Hot Drinks to Mormons,” *Journal of Mormon History* (forthcoming).

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The BYU Pioneer Mortality Team consists of volunteer undergraduate actuarial students at BYU. Members of this team include Bryce Cook, Kyle Francis, Arthur Lui, Merrick Johnson, Kerissa Poulson, Aaron Smith, Corinne Saltzman, and Justin Thunell. The team is directed by H. Dennis Tolley, and correspondence for this article should be directed to him (tolley@stat.byu.edu).