Hist Arch (2023) 57:1254–1268
https://doi.org/10.1007/s41636-023-00437-9

ORIGINAL ARTICLE

# Death in the Time of Pandemic: A Tuscan Cholera Cemetery at Benabbio (1855)

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Accepted: 17 May 2023 / Published online: 22 November 2023


**Abstract** Cholera was one of the great killers of the 19th century. The pandemic waves that took place between 1823 and 1899 caused hundreds of thousands of deaths in the Mediterranean region and across Europe. However, the excavation of cholera cemeteries is very rare. This article presents the results of excavations at the cholera cemetery of Benabbio, a mountain village near Lucca (northwest Tuscany) in which cholera broke out in the late summer–early autumn of 1855, causing 46 deaths in a population of around 900 inhabitants. The excavation made it possible to detect for the first time the material characteristics of a cholera cemetery. The findings provide a new source for anthropologically reading the reaction of a community facing the mortality crisis, which fluctuated between acceptance of regulations imposed by the authorities and local strategies of resistance.

**Keywords** cholera · funerary archaeology · Grand Duchy of Tuscany · pandemic

**Supplementary Information** The online version contains supplementary material available at https://doi.org/10.1007/s41636-023-00437-9.

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## Introduction

In mid-1855, the Tuscan village of Benabbio fell victim to the third global cholera pandemic (1846–1860). Situated in the Lucca mountains, the village was hard hit, forcing the community to make new provisions for the dead. Between 2007 and 2011, the resultant cholera cemetery was completely explored by the paleopathology division of the University of Pisa (A. Fornaciari, Cariboni et al. 2010). In this article, after briefly illustrating the history of the spread of cholera in Tuscany and the sanitary measures implemented by the public authorities to counter the pandemic, the results of the archaeological excavation of the cholera cemetery of Benabbio are presented. The information deriving from historico-medical and archival sources is compared with what emerged from the excavation of the burials and from the study of skeletons of cholera victims. A picture emerges in which, under the pressure of the pandemic emergency, burial practices differ from the traditional norm, but in which residents only partially abide by newly imposed health regulations.

## Archaeology of Pandemics

In recent years, the topic of pandemic has aroused the interest of researchers from a range of disciplines, not least archaeology, and has gained momentum due to the current COVID-19 pandemic, as evidenced by

the numerous archaeological publications and studies dedicated to the sociocultural impact of pandemics (Ogundiran 2020; Gamble et al. 2021; Gutiérrez and Cameron 2021). The bioarchaeological and paleomolecular study of human remains from mass graves and from pandemic cemeteries has further deepened the knowledge of plague pandemics from prehistory to the modern age (A. Fornaciari 2017; Keller at al. 2019; Rascovan et al. 2019; Spyrou et al. 2019). The second plague pandemic struck the Western and Mediterranean worlds between 1347 and 1351 with the Black Death and repeated itself several times. The most important plague epidemics were the Plague of Milan (1630), the Great Plague of London (1665–1666), and the Plague of Marseille (1720–1722) (Alfani and Murphy 2017), but local outbreaks of the plague occurred until the early 19th century in places such as Malta (Calvert 1815; Eckert 2000). Excavations of burials of plague victims of the second pandemic of the modern age have been conducted in the Mediterranean area, especially in the French Midi, where scholars with combined archaeological and bioanthropological backgrounds have provided significant contributions to the understanding of the topic. The most important sites excavated and analyzed by French archaeologists are the cemetery Des Fédons, Lambesc (1590) (Bizot et al. 2005), the Cimetière de Lariey at Puy-St.-Pierre (1629–1630), Briançon (Signoli et al. 2007), the great mass grave pit of the Observance in Marseille (1720–1721), and the plague cemetery of Le Délos in Martigues (1720–1722) (Signoli 2006).

The most important archaeologically investigated plague cemetery in Italy is that of San Michele of Alghero (1582–1583) in Sardinia, where the remains of 180 individuals were buried together in 16 long and narrow trenches (Milanese 2010). In northern Italy, the Isle of Lazzaretto Vecchio in Venice revealed several burial sites containing plague victims from the mid-14th century to the early 17th century. Burials dating to the 16th century were found in large and long trenches. The burials from the early 17th-century epidemic were characterized by regular trenches on an east–west orientation or by rectangular graves containing varying numbers of corpses (Tran et al. 2011). Several pits from the plague epidemic of 1630 were discovered in the area of the Lazaretto of Modena in the Po Valley, which generally contained single burials in ordered rows, sometimes with double or triple burials in the same pit (Biagini 2018). An excavation in the Lazaretto of Imola (Bologna) brought to light two mass graves related to the plague of 1630–1632 (Rinaldo et al. 2014). In the Alpine area near Merano (Bolzano), the excavations at the Church of San Proclo a Naturno uncovered multiple graves of the 1636 plague from which six strains of *Yersinia pestis*, the plague bacterium transmitted by fleas, have recently been genetically sequenced. In addition, samples from some of these French and Italian contexts were successfully sequenced to establish the type strains of the phylogenetic tree of the second pandemic of *Yersinia pestis* (Bos et al. 2016; Guellil et al. 2020).

Archaeological and bioarchaeological data for other infectious diseases that caused mortality crises comparable to those caused by the plague are comparatively scarce. In Lucca (Tuscany, Italy), the 2006 excavation of a catastrophe cemetery dating to the first half of the 17th century, attributable to the plague of 1630–1631 or to the petechial typhus of 1648–1650, highlighted the problem of the recognizability of the pathogen causing the infection (Ciampoltrini and Spataro 2016; A. Fornaciari, Minozzi et al. 2020). In central France, the cemetery of Issoudum, formed by a series of mass burial pits from the late 17th to the early 18th century, was caused by an unknown epidemic event (Poulle 2007). The contribution of molecular investigations therefore becomes a decisive factor in the analysis of these cases.

Unlike the plague, cholera—one of the great killers of the 19th century—has not been the subject of many detailed archaeological investigations. Beside the case of Benabbio, presented here, scholars from the University of Palermo and the University of Florence excavated cholera burials and systematically explored a cemetery resulting from a pandemic of the disease, recovering disconnected human bones from an ossuary cave near the Sicilian village of Alia (Palermo). The osteological remains from Alia were studied by physical anthropologists between 1996 and 2000 and were attributed to the cholera victims of 1837, as recorded in the registers of the local parish archive (Chiarelli et al. 2002).

Farther afield, the archaeological investigation of the Richmond Penitentiary Cholera Cemetery of Grangegorman, in the suburbs of Dublin, provides an important study of the management of pandemic burials. During the works for a new light-rail line, a

professional archaeologist documented two charnel house trenches with human remains in secondary deposition and 30 articulated skeletons in single burials set out in two discrete parallel rows, all relating to the cholera pandemic of 1832 (Gooney 2020).

In recent years, paleomolecular studies of cholera have yielded important results. In 2014, researchers from the McMaster Ancient DNA Centre of Toronto sequenced the *Vibrio cholerae* genome from a special tissue specimen dating to 1849 and stored in the Mütter Museum Collection of Philadelphia (Devault et al. 2014). The study revealed that the strain of the Philadelphia specimen is 95%–97% similar to the 0395 genome, the classic strain of cholera, from which it differs by only 203 single nucleotide polymorphisms, as well as demonstrating the importance of archived medical remains as a resource for genomic research on the origins of past pandemics. A further and significant contribution to the bioarchaeology of cholera derives from the excavation and study of the Argentinian cholera cemetery of La Zanjia, close to the city of Cordoba, carried out by the Argentine Forensic Anthropology Team in 2011. The archaeologists discovered a large mass grave and recovered 13 skeletons buried in coffins and covered with lime. The individuals had been killed by the fifth cholera pandemic (1886–1887), as demonstrated by the paleogenetic analyses performed on sediment samples from the pelvic cavity of one skeleton (Ramirez et al. 2021).

The difficulty in cross-referencing historical data with osteoarchaeological remains becomes evident when cemeteries become defined as "cholera cemeteries" by historical and local oral tradition, even when the burials show a rather diachronic stratification during the 19th century and there are no clear elements that can help attribute the burials exclusively to cholera. This is the case, for instance, of the Harrison Township Cholera Cemetery in Pickaway County, Ohio (IRLAB—Institute for Research and Learning in Archaeology and Bioarchaeology 2020), and of the cemetery in Tver, a city about 200 km northwest of Moscow, Russia (Zinoviev 2007).

While epidemiological and historico-medical studies of cholera are abundant and have a long tradition, both in the Euro-Mediterranean (Hauser 1897; Evans 1987; Tognotti 2000) and global contexts (Rosenberg 1962; Gómez-Diaz 2008), archaeological investigations of cholera cemeteries are extremely scarce, which makes the Italian case of Benabbio particularly valuable. Benabbio is the first extensive and planned excavation of a cholera cemetery in the world. The challenge of this research is to make the material source speak about a topic dealt with, up to now, from the point of view of written sources. The materiality of the cemetery, its topography, the arrangement of the tombs, their formal characteristics, the objects accompanying the deceased, and the observations deducible from the taphonomy of the buried provide an original and new image of the ways in which a community reacted to the emergency, also manifesting phenomena of resistance to the rules imposed by the authorities. The archaeological source thus opens new scenarios for the history of medicine and diseases.

## The Cholera Pandemic and Its Spread in Tuscany (1854–1855)

Cholera spread globally at the dawn of the 19th century, thanks not least to the revolution of steam transport, which allowed the pathogen to spread rapidly by ship and by railway. Technological progress and the industrial revolution enabled the cholera bacterium to spread on a pandemic level from its region of origin, Bengal, in Southeast Asia, where it has been endemic for centuries. It is believed that cholera has a speed of propagation from 9 to 16 times greater than that of the plague, although the morbidity and mortality rates of cholera are significantly lower (Speziale 2003; Cliff and Haggett 2004). The disease first reached the shores of the eastern Mediterranean in 1823, eventually reaching Europe and Italy during the second pandemic of 1830–1837. In Tuscany, between August and October 1835, the disease mainly affected Livorno (Leghorn), where it caused 1,171 deaths (Betti 1856). Cholera reached pandemic levels in Italy during the period 1847–1849 and again, even worse, in 1854–1855 (Tognotti 2000; Gómez-Diaz 2008).

The cholera disease is caused by a comma-shaped bacterium, called "Vibrio" (*Vibrio cholerae*), transmitted by the fecal–oral route through the ingestion of water or food contaminated by the feces of infected humans or animals. The disease moves very rapidly. The first symptoms manifest themselves after 24–48 hours of incubation with increasingly violent bleeding that causes rapid dehydration of the body accompanied by cramps and vomiting. The

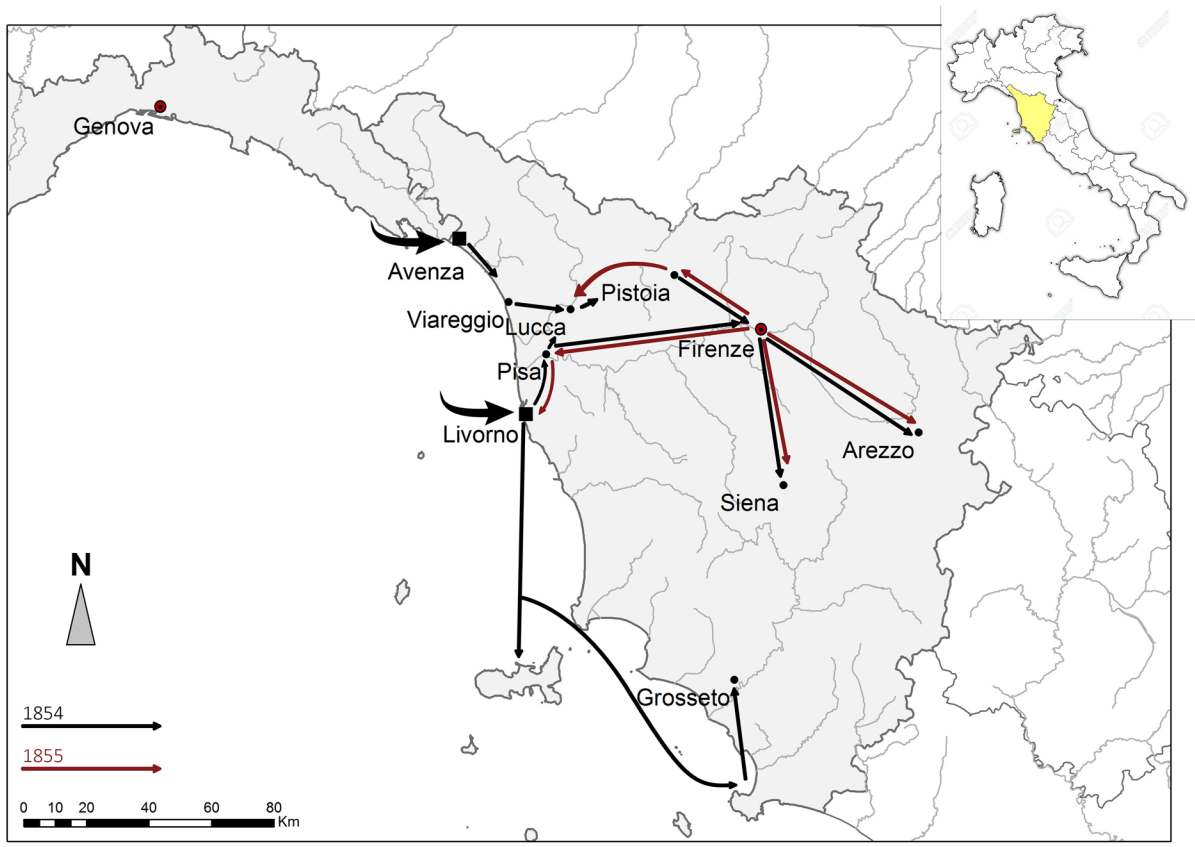


**Fig. 1** Cholera trajectory in Tuscany in 1854 and 1855. (Drawing by author, 2020.)

typical appearance of a person affected by cholera is that of sunken eyes, cold and bluish skin, wrinkles in the extremities, shaken by cramps, limbs contracted in a grotesque manner, and with rapid onset of death from dehydration. In the 1830s, the dramatic symptoms of cholera and the rapid course of the disease made a strong impression on Europeans, as they suffered the exotic disease firsthand in their countries for the first time. The causes and routes of the contagion were completely unknown before the bacteriological discoveries of Pasteur and Koch. The existence of organisms at the origin of the pathology was considered doubtful by most of the scientific world (Tognotti 2000).

A third cholera outbreak attacked Europe in 1853 and reached Italy in 1854–1855; it caused 248,514 deaths in the peninsula (Hauser 1897; Del Panta 1986) and was particularly devastating in Tuscany. As on other occasions, cholera arrived by sea on a small boat, this time traveling from Genoa to Avenza in northern Tuscany on 26 July 1854 (Fig. 1). Two severely ill crew members, violating the quarantine measures and sanitary cordons, reached Viareggio and spread the disease in the territories of the Grand Duchy of Tuscany. Concomitantly, the first cases of the disease appeared in Livorno, where a Neapolitan schooner arrived from Marseille with two passengers who had died of cholera during the crossing. From the coast, the disease reached the inner part of the region through the Valdarno, crossing by the railway "Leopolda," inaugurated by Grand Duke Leopoldo II of Lorrain only a few years before. At the end of 1854, after 3,403 fatalities out of 6,452 cases (53% lethality) (Betti 1857), cholera cases seemed to fall sharply until they disappeared almost completely in January. However, in February 1855 numbers exploded again with great violence in the area of Sesto Fiorentino, just north of Florence, where many commercial activities related to water, such as laundries, dyers, and several factories, contributed to the survival and new diffusion of *Vibrio cholerae*.

Following the route of the previous year but in the opposite direction, cholera spread again throughout Tuscany, reaching levels of exceptional morbidity and lethality. At the end of the pandemic in November 1855, the deaths in Tuscany numbered 29,730, of which 26,327 occurred in 1855 alone, with Lucca one of the most affected districts with 3,180 recorded deaths. The morbidity oscillated between 2% and 4%, with the highest levels in the urban areas of Florence and Arezzo, where lethality was 54% (Betti 1858).

## Medical Debate and Regulation of Cholera Burials of Tuscany

Until the identification of the cholera bacillus by Robert Koch in 1883, the true causes of the disease were not known by medical scholars and physicians. In Tuscany, during the first phase of the pandemic in 1854, the anatomo-pathologist Filippo Pacini discovered the Vibrio bacteria in the intestinal fluids of corpses of cholera victims by microscopy. Pacini advanced the thesis of a connection between the microorganism and the transmissibility of the disease, but his intuition was not credited by others (Pacini 1854). In the mid-19th century two theories dominated the scientific debate on the nature of cholera: the anticontagionist theory and the contagion model. Anticontagionists, influenced by the ancient miasmatic doctrines, held that cholera, like other diseases, spread through the air via miasmas from waste and stagnant water and from rotting corpses (Cipolla 1976; Gómez-Diaz 2008). The contagionists, conversely, thought that the spread of the disease took place through human-to-human contact by microscopic organisms. At that time, however, the idea of transmission by germs was less dominant: the contagionists were unable to demonstrate the existence of microscopic organisms and, therefore, failed to provide convincing evidence of the contagiousness of cholera (Richmond 1954; Tognotti 2011). Not only did the two theories cause scientific conflicts, but they also had important political and economic implications, affecting the state-policy decisions aimed at containing the devastating disease. France and Britain, for instance, as "liberal" states, supported the anticontagionist ideas and opposed the sanitary cordons, border controls, and practice of quarantine in order to avoid limitations on trade and damage to commercial enterprises. These states preferred to concentrate on the improvement of degraded urban areas, creating efficient sewage systems, new aqueducts, and demolishing dilapidated buildings. The Mediterranean states and the Hapsburg Empire, on the other hand, supported the contagionists' view, and therefore established quarantine measures and sanitary cordons (McNeill 1998; Huber 2006; Tognotti 2013).

The scientific debate only partially influenced the practical choices of the doctors and health authorities fighting the disease. They generally treated all dead bodies as potentially infectious. In this respect, the behavior of Pietro Betti, the public health consultant and superintendent of the Grand Duchy of Tuscany since the first cholera emergency of 1835, was paradigmatic. On the basis of his observations of the spread of the disease, Betti had not only become a strong advocate of the contagion of cholera, but he also implemented a series of preventive measures in the direction of environmental remediation and control over the movement of the infected people. These measures included the isolation of the ill at home or in the hospital; the creation of hospitals only for those with cholera, with separate sectors for the ill and for convalescents; the disinfection of the houses, furniture, and objects belonging to the sick; the prohibition of butchery products and the purchase of pork meat; the disinfection of lavatories and sewers; and, particularly interesting from a funerary archaeology point of view, the regulation of burials (Betti 1856, 1857, 1858).

Numerous measures were imposed by Betti to regulate the burials of cholera victims, which he considered dangerous sources of infection, especially while the corpse was putrefying and there was the risk of the soil raising contagious "putrid emanations." Burial grounds had to be far from the town. This necessity, already developed by hygienists and illuminists in the 18th century, was included in the new legal code that Napoleon enacted for Italy in 1806. These laws were especially carefully applied in the urban areas of Tuscany, where there was often a perilous continuity between the cemeteries and churches (Tomasi 2001). The provisions in force in the grand duchy during cholera outbreaks after 1835, in addition to the need to transport bodies in coffins or in perfectly closed wagons, included laying bodies singly in every burial ditch; laying the body naked, with no coffin or shroud; and laying at least one *staio* (24.36 L) of strong lime on each body. Exceptions were made for foreign Anglicans, who could

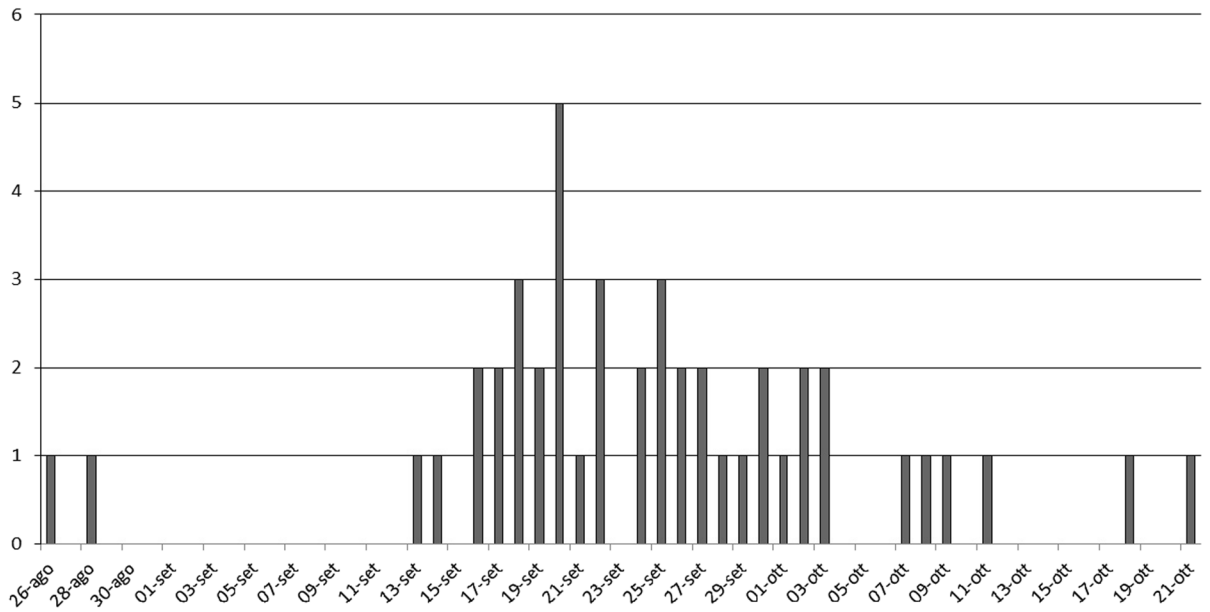


**Fig. 2** Deaths from cholera in Benabbio between 26 August and 21 October 1855. Note the trend of the mortality curve, with over 90% of the victims concentrated between 13 September and 11 October. (Drawing by author, 2020.)

use a coffin, but with no cover and a double layer of lime between the body and the coffin; furthermore, the ditch was half a *braccio* (0.583 m) deeper than normal. Although the clergy and the lay population objected to burying bodies naked as an affront to public decency, the authorities were inflexible in applying the rule (Betti 1856). However, as shall be seen, the excavation of Benabbio demonstrates tenacious forms of local resistance to the application of the rules issued by the state.

## The Cholera Cemetery of Benabbio (1855)

When cholera reached Benabbio in August 1855, the village population numbered 900 inhabitants. Parish registers record that, within two months, deaths amounted to 46 out of a total of 71 infections (7.9% morbidity, 65% lethality, and 5.1% mortality). As the graph of mortality in Figure 2 demonstrates, over 90% of the deaths occurred between 13 September and 11 October. Within one month the pandemic flame was consumed; cholera has a fast propagation speed, but the disease usually infects with intensity for a relatively short period (Speziale 2003). In 1855 the cemetery in Benabbio was still in the churchyard of Santa Maria Assunta, located in the middle of the village, as were the walled tombs used for collective burials managed by different confraternities in the oratories. In these walled tombs the bodies were buried without being covered by earth. Burying people infected with cholera required a place far from the village, and the choice fell on the site of the ancient medieval castle of Benabbio, within its ruins on the top of the hill that dominates the village (A. Fornaciari and Coschino 2012). It was established that cholera victims would be buried around the castle's ancient church dedicated to San Michele (St. Michael), which by the 19th century had been reduced to a simple rural oratory (Bini et al. 2010). The choice was not accidental. It not only met the health need imposed by the authorities, removing the infected dead from the village, it also safeguarded the Roman Catholic need to bury the dead in sacred ground adjacent to a religious building. Archaeological excavation has brought to light the remains of 43 individuals and, for the first time, has permitted the study of a cemetery planned under the pressure of a cholera emergency.

The topography of the cemetery shows its planning (Supplementary Fig. 1). The graves were arranged in rows, and they occupied all the space available in the churchyard and along the southern side of the church.

The average depth of burials was between 80 and 90 cm, while the width did not often exceed 50 cm. Only the burials located in the churchyard showed the use of lime: six had layers of lime below and above the body of the deceased. The dead, as demonstrated by the taphonomic observations and the imprint left by the fabric in the lime, had been buried in shrouds, sometimes with clothes—as shown by buttons and remains of yarn—and sometimes with the wooden support used by the undertakers to transport the dead body. One burial showed, under the skeletal remains, traces of a series of wooden elements containing numerous nails, which was probably part of a support for transporting the corpse—perhaps an improvised stretcher reusing wooden planks. The position of the bodies was frequently unusual (Supplementary Fig. 2): eight burials with lime; six burials in prone position; five burials in lateral position; seven with the limbs flexed unnaturally; and seven double burials. In typical 19th-century burials, bodies are arranged in supine position with the hands symmetrically crossed on the thorax or on the abdomen, generally with a rosary in the hands. In Benabbio the dead affected by cholera appear crouched, with flexed and asymmetrical limbs, lying on their sides, sometimes prone. These anomalies were probably caused by two factors: the rush to inter, whereby the gravediggers did not bother to lay out the shrouded bodies correctly, and the maintenance, due to rigor mortis, of the position taken by the bodies at the time of the death, with the limbs contracted by cramps and dehydration. In some cases, two individuals were buried in the same grave, probably having died on the same day. Finally, the excavation revealed the burial of some grave goods, such as devotional objects (rosaries, bronze crosses, medallions) and jewelry (earrings, pendants, rings). Some objects carry an evident apotropaic meaning, such as a silver dolphin-shaped pendant and a bronze digital ring with a Lorraine cross, usually used as an amulet against infectious diseases (Supplementary Fig. 3) (Signoli 2006). The memory of the catastrophe is preserved on the site in some epigraphs that recall the burial of victims of cholera, placed in the years immediately following 1855 on the facade and south side of the church.

Anthropological study of the human remains determined the sex and the age of each skeleton at the point of death, and the results were compared to information from archival sources. A list of cholera victims survives in the parish archive of Benabbio, which provides the name (and consequently the sex), age, and date of death of each victim (Archivio di Stato di Lucca 1855; Archivio Parrocchiale di Benabbio 1855). By cross-referencing anthropological with archival and stratigraphic data, it is possible to identify almost every individual and reconstruct the chronology and spatial succession of inhumations (Baldino 2011). One of the results of this forensic approach is a mapped sequence of the burials, extending from the churchyard to the space along the south side of the church (Fig. 3).

The space available around the church was used logically. The first ditches were dug in the churchyard, in front of the church, and they were occupied by the people deceased before 21 September 1855. Other ditches were dug afterward in two rows along the south side of the church for those who died during the remainder of the pandemic. The empty graves found at the end of the southern rows show that they were dug according to a precise plan, but more numerous than necessary, and that the pandemic ended before they were all used. There are no mass graves at Benabbio, but seven double burials. This is typical of small communities, where the number of individuals inside the same burial reflects daily mortality (A. Fornaciari 2017). Mortality reached a peak of five deaths in a single day on 20 September, with three days between 18 and 25 September marked by three daily deaths, and nine other days characterized by double deaths (Fig. 2). The planning of the ditches probably limited their overuse to no more than two individuals per ditch even in the most dramatic moments of the pandemic. In reality, managing single ditches was far more straightforward than a mass grave would have been, which would also have been in contravention of the rules established by the Tuscan health authorities.

The material evidence supplied from archaeological excavation shows that orders of the health authorities were only partially applied: the ditches were not particularly deep; bodies were buried with wooden elements and not naked, but in shrouds, sometimes with clothes and grave goods; lime was present in only six burials and usually in quantities lower than prescribed; and, finally, there were seven cases of double burials, perhaps the most serious derogation from the health rules. If noncompliance with the regulations is, in some cases, justified by the haste in which burials proceeded, which was itself recommended by the health authorities, more often it can

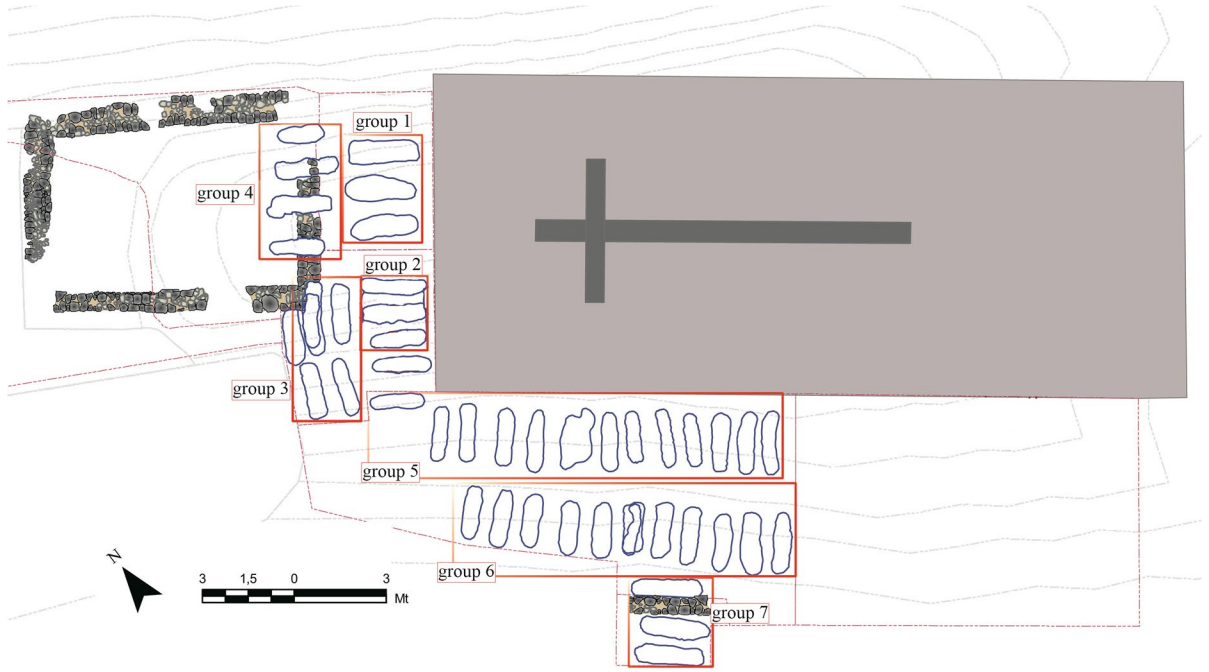


**Fig. 3** Map of the cholera cemetery with the sequence of the occupation of the space by groups of burials, from the churchyard to the space along the south side of the church. (Drawing by Francesco Coschino, 2015.)

be observed that typical elements of modern Catholic ritual (dressing the deceased and burying devotional objects, hence the presence of family members/mourners) show a tenacious resistance to the imposition of emergency hygiene rules. The material reality coincides only partially with the orders of the authorities, revealing a form of autarkic and popular resistance to the application of the rules that, although influenced by Catholic beliefs, was not free from apotropaic and superstitious influences.

## Bioarchaeology at Benabbio Cholera Cemetery

The study of the skeletons (39 adults and 4 subadults) from the cholera cemetery allows the observance of a sample of the population killed by the disease.[1] The age groups affected differ from those generally represented in nonpandemic cemeteries. The mortality profile of a population outside times of pandemic normally peaks during infancy–early childhood and for women of childbearing age, due to the risks of pregnancy, growing gradually for both sexes with increasing age in adulthood. In Benabbio cemetery, the mortality-age distribution is the result of cholera action on the village population, with a high percentage over 50 years old—about 56% of the total (older people were probably more vulnerable to cholera)—a scarcity of subadults, but a fair number of adults under 50 years of age (Fig. 4). This paleodemographic pattern is associated with epidemic catastrophe cemeteries and has been noted in European plague cemeteries (Castex 2007, 2008; DeWitte 2010, 2014; Castex et al. 2011).

Males appear to be more affected than females, even if the difference is not statistically significant (Fig. 5). The stature of individuals reveals surprising results, with a median stature of males recorded at 171±4.3 cm (from 159 to 179 cm) and 161±4.5 cm (from 156 to 170 cm) for females.[2] The 10 cm difference between men and women is comparable to current populations (10–12 cm) (Martin and Saller 1956–1959) and, overall, Benabbio inhabitants appear to have been tall compared to other medieval and early modern Italians (Arcaleni 2006;

[1] The osteoarcheological study was based on a range of methods. As a general reference, see Nikita (2017).

[2] Stature was calculated on 32 adults (18 males and 14 females) following the method of Trotter and Gleser (1952, 1958, 1977).

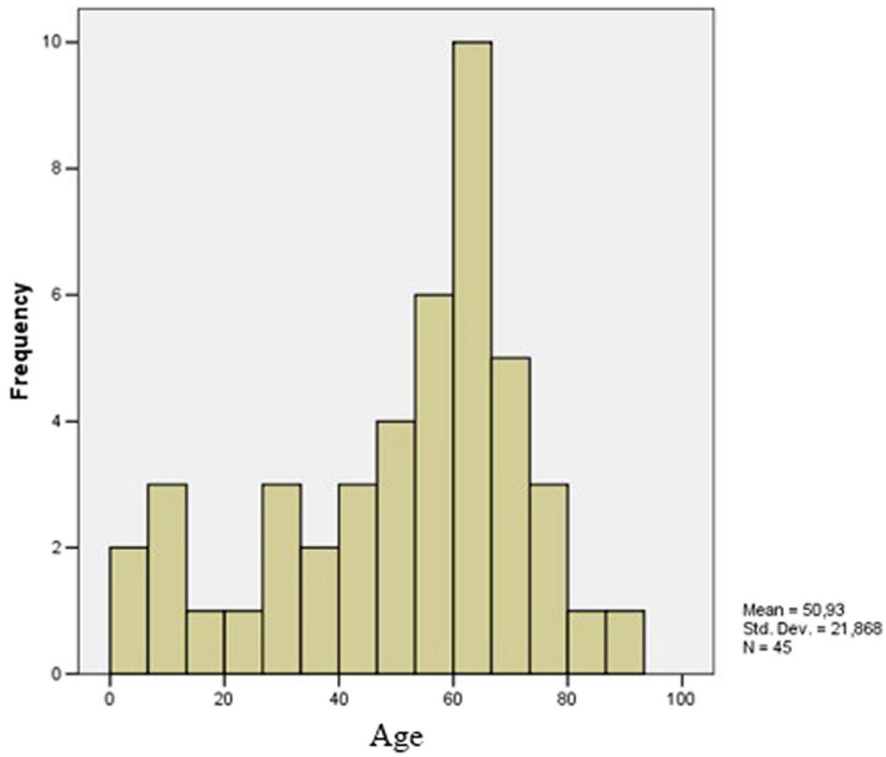


**Fig. 4** The demographic profile of the cholera cemetery of Benabbio from the archival data. (Drawing by author, 2015.)

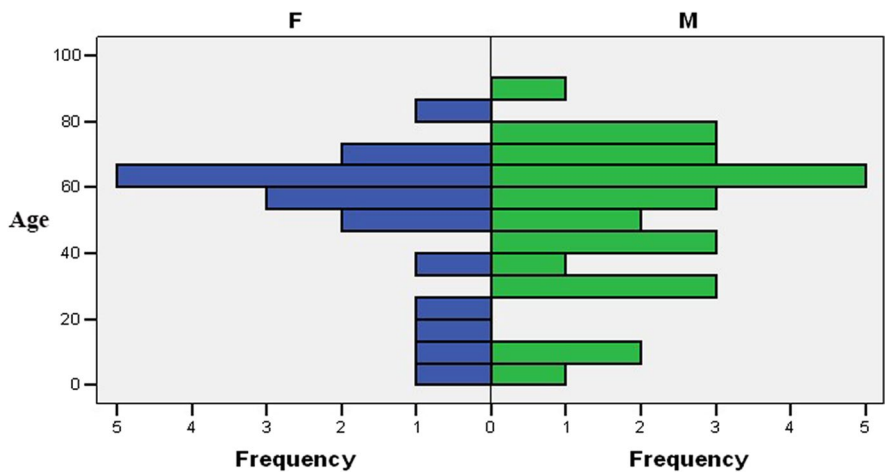


**Fig. 5** The demography of the cholera cemetery of Benabbio with distribution of males and females by age. (Drawing by author, 2015.)

Giannecchini and Moggi-Cecchi 2008). Stature has a genetic basis, but it is influenced significantly by environmental and socioeconomic factors (Steckel 1995; Larsen 2015:14–20). Therefore, it would seem Benabbio's population was otherwise in good health and well nourished (G. Fornaciari 2016).

The skeletal remains also yield information about human activities. The study of entheses (the sites where muscles and ligaments attach to bones) and enthesopathies (pathologic alterations of those sites) can be used to reconstruct human activity in archaeological contexts (Mariotti et al. 2004, 2007; Milella et al. 2012). Musculoskeletal markers of the individuals from Benabbio paint a picture of a peasant society, the members of which were adapted to heavy work. Males exhibit particularly remarkable musculoskeletal markers of brachial triceps, latissimus dorsi, teres major, biceps brachii, pronator teres (upper limbs), and hip adductors, patellar ligaments, and Achilles tendon (lower limbs). These are typically markers related to heavy work, such as the cultivation of rough land and forestry. In females, musculoskeletal markers are less developed and enthesopathies less frequent and severe, suggesting a marked gender division in work, in which the men carry out heavier work (farming and woodcutting) and women engage in more domestic labor.

Osteoarthritis appears to confirm the picture suggested by musculoskeletal markers. Severe joint deterioration is present in shoulder bones, vertebrae, elbows, and hands, as well as in the hips, knees, and feet. Aging contributes to the development of osteoarthritis (Loeser 2017), but in Benabbio samples younger individuals are also affected. Epidemiological findings in contemporary populations are providing important correlations for linking mechanical stress and osteoarthritis, and the bioarchaeological data suggest that the prevalence of shoulder and vertebral osteoarthritis in rural areas reflects exposure to agricultural work (Larsen 2015:179–186).

The large number of periostitis (aspecific infections of the periosteum) is an indicator of a very infectious environment and is characteristic of a rural farming society. The upper limbs are exposed to scratches and minor injuries in an environment that was rich in infectious agents, with poor hygiene and high human density (Larsen 2015:86–96). Finally, the population of Benabbio was subject to traumas (at least 39% of males and 31% of females show a fracture), which can be related to the mountain environment and to the activities linked to agriculture in steep terrain and forests.

## Conclusion

The archaeology of past pandemics allows an understanding of the topography of cemeteries, the morphology of pits, the arrangement of bodies within pits, and the grave goods related to the various types of burial from different pandemic catastrophes. Following the study of the bioarchaeological characteristics also provides information on the mortality demographics of the individuals decimated by the epidemics (A. Fornaciari 2017). The excavation of Benabbio cholera cemetery is the first complete funerary archaeological

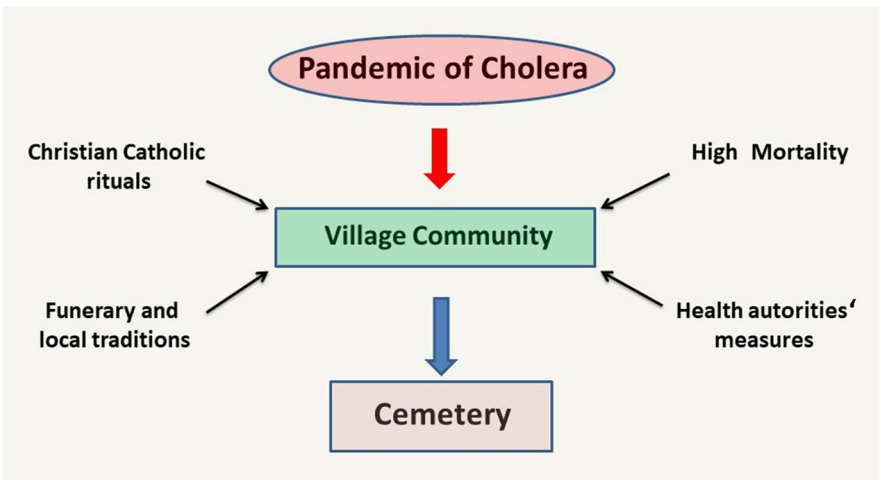


**Fig. 6** The cholera cemetery of Benabbio as the material result of a compromise among conflicting motivations. (Drawing by author, 2021.)

investigation of the disease. The bioarchaeological study of cholera victims offers a cross-section of the rural community of Benabbio. Skeletal indicators (osteoarthritis, periostitis, and musculoskeletal markers) show homogeneity toward the strong wear of joints caused by exposure to heavy work. Ultimately, the case of Benabbio has made it possible to observe the peculiar funerary characteristics of a cemetery that resulted from an exceptional catastrophic event that hit a rural Italian community in the year 1855. It provides an example of the potential offered by the archaeological study of a pandemic cemetery, which allows penetration of the cultural impact of mortality crises on human groups little witnessed by nonmaterial sources.

One of the most evident results is the material verification of the rules imposed by the health authorities that, as has been seen, were only partially applied. This lack of application was probably caused by two concomitant factors: the speed with which burials proceeded and the respect for religious and traditional norms. The cholera cemetery at Benabbio is, therefore, the material result of a compromise between conflicting motivations (Fig. 6). In conclusion, in the interpretation of the funeral anomalies, the possibility that pandemic contagious disease may have influenced the manner of burial must never be underestimated. Historically, cholera led to a sort of watershed in the structuring and management of cemeteries, and, after the lesson given by the disease in 1854–1855, cemeteries were never the same. What is frequently attributed to Napoleon's Edict of Saint Cloud (1806 in Italy), namely the obligation to bury the deceased in excavated cemeteries in fenced and supervised areas away from inhabited centers, actually took place in Italy, especially in the countryside, only after the mortality crisis caused by cholera in the mid-19th century (Tognotti 2000; Tomasi 2001).

**Funding** Open access funding provided by Università di Pisa within the CRUI-CARE Agreement.

**Data availability** Images of human remains and grave goods are available for research purposes and can be accessed online or by contacting the corresponding author.

**Declarations**

**Conflict of interest** The author states that there is no conflict of interest.



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