

Quinto Tiberio Angelerio and New Measures for Controlling Plague in 16th-Century Alghero, Sardinia

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

The Black Death, a huge wave of epidemics of bubonic plague, spread across Europe during 1347 through 1353 CE. As detailed in nearly 200 local mortality studies relating to Southern and Western Europe, at least half of the population died of plague. The Black Death was the first outbreak of the second plague epidemic that occurred repeatedly until 1750 CE. Most likely it originated in wild rodents, stretching across the northwestern shores of the Caspian Sea into southern Russia.

Kaffa, the far-outlying Italian trading station in Crimea, also was a source of infection. During spring 1347, Italian galleys fleeing Kaffa brought infection to Constantinople, where the plague began raging in the summer. From Constantinople, ships carried plague to ports along the Mediterranean littoral so the infection fanned out from several epicenters, acquiring new momentum from these new centers as it spread.

Stimulated by earlier observations that epidemic diseases were transported by ships, the notion of quarantines began being developed in the early 14th century. Accordingly, a genuine quarantine was set up in 1377 in the Venetian trading station at Ragusa, present-day Dubrovnik. Thirty-day isolation was imposed for ships from areas that were infected or suspected of being infected and 40-day isolation for land travelers from these areas.

During the 15th and 16th centuries, quarantine and sanitary cordons were imposed. Contacts and trades with infected regions were banned, and towns' gates and states' frontiers were closed, which prevented free movement of humans and merchandises to avoid the risk of spreading the contagion.

The first *lazaretto*, plague hospital or infirmary, was set up in 1423 in Venice. This institution soon became a model for isolating infected patients and preventing the spread of the epidemics. The *lazaretto* reflected the development of epidemiology and increasing administrative skills in Renaissance society.

During 1350 through 1520, about 100 plague tracts were published. They shared a view of epidemic diseases: the final cause was God's anger over his human subjects' sins, and epidemic disease was His punishment. The means of punishment, the pathogenic causal agent, was miasma, a notion of Greek Hippocratic–Galenic medicine. Miasma was corruption or pollution of the air by noxious vapors containing poisonous elements caused by rotting putrid matter. Medieval medical theory added geophysical and astrologic elements; miasma also could be let out from the ground by volcanic activity or particular constellations of planets. Miasma was spread by wind and therefore could spread speedily; it could enter humans by inhalation and through the pores of the skin.

The theory was that miasma was the only cause of epidemic disease. The variety of epidemic diseases and their clinical and epidemiologic manifestations were explained by miasma's ability to evolve into agents with different pathogenic properties, so a mild disease could develop into plague. According to miasmatic theory, plague patients were contaminated by the most dangerous type of miasma; air of the room also was contaminated by it.

The plague tracts warned all persons, including physicians, not to enter the rooms of plague patients or perform clinical examinations of such patients. Patients should be contacted from a distance. Thus, clinical elements mentioned in plague tracts were not empirical observation but based on hearsay. Some of this hearsay was consistent, especially that plague buboes developed in plague patients; most often these were visible on the neck because patients were not physically examined.

Not until the Renaissance, in the decades around 1500, was the theory of miasma expanded to include the idea that healthy persons could be infected by touching infected persons or objects contaminated by them with miasma. This was the *Fracastoro* miasmatic–contagionistic theory of cross-infection and epidemic spread. The basic tenets of miasmatic–contagionistic theory governed the actions and epidemic countermeasures of governments and municipal councils and their medical advisers. This theory explains why measures, such as quarantines, sanitary cordons, isolation of persons with and suspected to have plague and with objects used by them, disinfection of houses, and disinfection of textiles were implemented beginning in the early 1500s.

Consequently, through special laws, administrative institutions were created to manage the organization of the sanitary system during plague outbreaks. The most efficient system of prevention and control was established in north-central Italy by the cities of Venice, Genoa, Florence, and Milan during the 14th and 15th centuries.

However, in Sardinia, in the late 14th–early 15th centuries, health systems were considered mediocre. From the arrival of the Black Death in Sardinia in 1348, plague epidemics required day-to-day organization. No social or political measures were pursued to control and prevent the plague outbreaks.

Despite the lack of organization in the Sardinian health system, in 1455, King Alfonso V of Aragon established and imposed improvements. The royal ordinance created and imposed the so-called Office of the *Protomedicus* of the Sardinian Reign in Cagliari. Although this institution was already operating in the Catalan–Aragonese region, it represented an innovation for the island. The *Protomedicus*, a person belonging to the upper class and possessing a medical degree, superintended the medical practice and selected persons to certify to perform as physicians. Together with the municipal authorities, the *Protomedicus* coordinated prophylaxis and therapies.

The Catalan–Aragonese sanitary system of the second half of the 15th century had a Health Guard or Plague Guard, also called *Morber*. A *Morber* was also installed in Sardinia at that time. The *Morbers*' task was to watch over the sanitary conditions of the ships and docking at the island's harbors by halting the disembarkation of persons with or suspected to have plague and to assist the *Protomedicus* during the plague outbreaks.

During the 15th and 16th centuries, Sardinian literature that focused on the history of medicine was poor and attests to the extreme backwardness of the medical culture and the sanitary structures. During the 16th and 17th centuries, only a few qualified physicians, selected by the *Protomedicus*, were practicing in Sardinia. Because of the absence of local universities, upper class students willing to perform medical studies completed their education in universities in Spain or Italy and seldom returned to Sardinia. Even after the foundation of the Universities of Sassari in 1617 and Cagliari in 1626, the situation remained almost unchanged because a rigorous faculty of medicine that was still lacking.

The deficient professional background of the Sardinian physicians was reflected in poor communal organization of the sanitary structures. Those limits affected any attempt to prevent and contain the plague outbreaks that lashed the island from the time of the Black Death onward.

Quinto Tiberio Angelerio, *Protomedicus* of Alghero, provided a breakthrough in the fight against the 1582 through 1583 plague epidemic by introducing novel prophylactic measures. Angelerio's scientific background was influenced by Galen's miasmatic theories and by Fracastoro's contagionistic theories. In addition, Angelerio had experience with plague before coming to Alghero. He had practiced in Messina, Sicily, during the 1575 through 1576 plague epidemic. At that time, the *Protomedicus* of the Sicilian Reign, Giovanni Filippo Ingrassia, was successfully battling the plague outbreak that was spreading in Palermo.

Ingrassia had introduced useful prevention measures against plague, which included the isolation of persons with and suspected to have plague and of convalescents in 3 different isolation centers; the disinfection of the houses in which plague-related deaths had occurred; and use of dry heat to eliminate the "seeds of contagion" from everyday objects, thus anticipating the concept of modern sterilization.

No historical sources provide evidence of direct contact between the 2 physicians. Nonetheless, Angelerio's observations in Sicily formed his notions of how to combat such epidemics. To stem the spread of the contagion, Angelerio established a set of sanitary and prophylactic instructions that showed strong analogies with those previously adopted by Ingrassia.

The paucity of contemporary documentary records and the discrepancies between their information made a death rate difficult to estimate. Death registers were kept only from 1677 onward.

Because of the absence of burial registers for this period and a gap from November 26, 1581 through November 10, 1584 in marriage registers, the demographic reconstruction of the population's profile has to be based only on baptismal registers. In 1582, a total of 158 children were baptized. When we account for the annual mean of 154 baptisms in the 5 previous years and the fact that the effects of the plague epidemic on the population can be estimated only for the following year, the monthly distribution of baptisms in 1582 appears to be normal: unaffected by plague.

This growth resulted from a strong increase in marriages and consequent increase in conceptions and births because young adults could easily find jobs and housing vacated because of the plague and, for the same reason, immigration by young adults into the town from the surrounding countryside.

After the 1528 through 1529 outbreak, Alghero remained free of the plague for about 60 years. The first new casualty attributed to plague in Alghero was registered on November 19, 1582. The epidemic lasted 8 months and ended in June. After June 14, 1583, no new cases of contagion were registered.

Angelerio immediately recognized the clinical manifestation of the infection, buboes and delirium, in a sailor who had disembarked from the ship docked during 1 night at the beginning of November 1582. A sailor on a ship from Barcelona was thought to have been the initial harbinger of the infection. At that time, however, plague was almost absent from Spain while ravaging France. More likely, the sailor disembarked from a ship coming from Marseille, where the plague had raged since 1581.

After the sailor's death, 2 women, a widow named Cifra and her mother, Grazia, who was assisting her at Alghero's Sant'Antonio Hospital, died in succession. With the help of a priest, Angelerio tried to convince the Bishop, Andrea Baccallar, and the Magistrates to contain the focus of the contagion because he recognized the small punctuate bruises in the 2 deceased women. The Magistrates were indecisive, however, and on the morning of November 20, 1582, Bishop Baccallar asked the Senate to isolate the ill patients. However, the senators did not take Angelerio's report seriously, and Angelerio was accused of having an apocalyptic vision of the future. Meanwhile, the son of the widow Cifra died from plague. His death was followed by those of a crippled woman, an old woman, and a young daughter of a widow.

Because Angelerio was unable to persuade the Magistrates, he turned to the Viceroy, don Michele De Moncada. Angelerio explained that the forthcoming plague outbreak would have devastating effects on the population. Furthermore, he detailed the rules and sanitary measures needed to contain the epidemic.

Convinced by Angelerio's arguments, the Viceroy De Moncada gave orders to block all commerce from and to Alghero. A triple sanitary cordon was established, and triple barriers were built around Alghero's boundaries. Horse guards checked the city walls.

The cessation of commerce was taken badly by the inhabitants. Angelerio was loathed by the population, who wanted to lynch him. However, when the contagion spread from the core of the old town to the whole city, Angelerio was finally entrusted with the task of containing the epidemic.

Angelerio pioneered the implementation of successful public health measures in 16th-century Sardinia, basing his policies on daily reports of the Alghero population's health conditions and the incidence and location of the plague cases. A general public health framework, including laws for plague control, decrees, institutions, and infrastructures was created. A system of basic welfare guaranteed by the city government was also established to satisfy the population needs in terms of medical treatment and food supplies and to implement disinfection of the houses. The pharmacists had to provide the poorest citizens with the necessary treatments. A list of the supplied treatments and a list of the citizens had to be kept to distinguish between the poorer and the richer. Richer persons would pay for their treatments, and the city government would pay for paupers. The *Morbers* were compelled to completely disinfect the city, house after house. The darkest houses and those lacking aeration had to be whitewashed by painters who had survived the contagion. Bonfires had to be set all around. For the less suspected houses, windows were required to be kept open at all times, perfumes to be sprayed, and all surfaces washed with vinegar. Movements of people and goods to and from the city were strictly controlled during the epidemics.

Angelerio's instructions and measures facilitated interventions and changed the way in which local health officers were selected. The town was divided into 10 wards. Each ward was controlled by a Health Deputy, who was invested with full authority according to the new anti-epidemic health laws, and a Plague Guard. The Health Deputies and the *Morbers* gathered twice a day in the so-called "City House" to follow the course of the epidemic and to transmit the information to the Councilors who were assisted by the physicians.

Angelerio's health policy emphasized disease prevention through isolation of persons infected with or suspected to be infected with the plague. Persons suspected to have plague were isolated at a center, whereas plague patients were housed at a *lazaretto*. The main city hospital, the

Sant'Antonio, also served as a *lazaretto* to isolate the plague patients. Guards ensured isolation of the centers.

Fire had to be set to mattresses, fittings, and furniture from all houses in which cases of plague were registered. When a person was suspected of having died of plague, the physicians or surgeons had to check the corpse to establish whether the deceased person actually had died of plague. If the cause of death was indeed plague, the victim's relatives carried the corpse to the courtyard or left it outside the door.

Plague victims were buried in secluded cemeteries within 6 hours after death; burying plague victims inside the churches was strictly forbidden. Long and deep trenches were excavated, and the corpses were covered with lime to not corrupt the air and release mephitic vapors. Grave diggers were selected from among persons who had contracted and survived plague during a previous outbreak in another town. They lived separately from the rest of the community and far from the hospital and were not allowed to leave their houses until a Health Deputy accompanied them.

Moreover, Angelerio introduced a new method for sterilizing clothes, textiles, and objects according to miasmatic-contagionistic notions. Stoves and ovens similar to those used to cook the flat tiles were kept constantly lighted by an underlying fire. The stove's chamber was filled with the presumed textiles and objects after they had been washed under the *Morbers'* supervision.

The causative agent of plague and its vector, rat fleas, were not known scientifically until the end of the 19th century. However, Angelerio clearly recognized the role of disinfection in controlling plague with dry heat to eliminate the responsible agents. The miasmatic-contagionistic theory implied to Angelerio that miasmatic contagion was present wherever plague patients had been. Therefore, everything they had worn or touched, as well as the place they had stayed, had to be disinfected.

Through the introduction of dry heat, both the elimination of plague bacillus and its vectors, the fleas, were guaranteed. In addition, the vectors' elimination helped prevent the transfer of infected fleas among citizens. Angelerio's intuition, which led to the selection of painters and grave diggers from among persons who had already acquired and survived plague, anticipates the notion that semi-immunity to the bubonic form of plague may develop in long-term recovered patients.

During the plague outbreak in Sardinia during 1652 through 1657, Angelerio's instructions were resumed. The only 17th-century plague tract used in Sardinia, the *Tratado Universal*, written by Juan Núñez de Castro in 1648, specifically refers to Angelerio's instructions. Following his instructions, Núñez de Castro ordered the establishment of sanitary cordons, quarantines, isolation centers for persons with and suspected of having plague and for convalescents, and disinfection of clothes and houses. He also ordered detailed rules for mortuary hygiene. Núñez de Castro's booklet was reprinted in Cagliari in 1652 by the *Protomedicus* Antonio Galcerín.

In conclusion, Angelerio's observations and well-organized public health services contained the epidemic in the city and halted its spread. His modern prophylactic and hygienic measures represent a successful innovation in the sanitary system of 16th-century Sardinia and in the Mediterranean area, and attest to the extraordinary efforts of the city government to prevent the introduction and spread of contagion. The measures he introduced in Sardinia paved the way for

subsequent generations of physicians and enabled them to manage plague epidemics more efficiently.

I've been reading an abridged version of *Quinto Tiberio Angelerio and New Measures for Controlling Plague in 16th-Century Alghero, Sardinia*. You can read the entire article online and in the September 2013 issue of *Emerging Infectious Diseases* at cdc.gov/eid. I'm Reginald Tucker, for *Emerging Infectious Diseases*.

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