

Control measures of a 400-year-old plague epidemic: an example of past efficiency at controlling disease and similarities with current epidemics

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SUMMARY

The plague caused by the bacterium *Yersinia pestis*, provides one of the best historical examples of pandemic infection. It can therefore be considered the first “globalized” disease, thanks also to the crowds that favoured the rebalancing of infectious agents between Europe and the Middle East.

In this paper we analyse all the official documents of the time, highlighting the most effective prevention measures implemented in the city of Ferrara during the Italian plague. Historical mortality data for the 1630 Italian plague in northern Italy are first analysed. In contrast to the high rates recorded throughout the area from Milan to Florence, the mortality rate in Ferrara remained normal over the period. From the city's documents it emerged that the authorities, from the 16th century onwards, had already understood that the spread of the contagion could also occur through domestic animals, although rats are never mentioned. The strength of Ferrara's response to the “plague emergency” stems from an efficient and emergency-ready health control system, financed and supported by the “permanent surveillance team of the city and the Pontifical Legation of Ferrara - Azienda Sanitaria Pubblica” even in times of great economic difficulty for the State. Among the various measures that the city of Ferrara

adopted to deal with the plague the following should be mentioned: guards at the city gates, lazarettos, safety of doctors, self-isolation and treatment of every suspicious case as if it were a real case of plague, measures to support the poorer classes of the population, veterinary and hygiene standards for the city and for housing, management of Catholic religious functions and the precepts of the Legation of Ferrara, which was under papal control, closure of churches to avoid mass gatherings, and limitations of all kinds of social and economic relations within and outside the population. The broad regimen, laid down in the 16th century, contains extremely modern health rules which are very much in line with those recommended by the WHO and the health authorities of each individual state in the current COVID-19 pandemic, even starting with hand-washing. The fight against epidemics of the past, especially the history of the plague in the 17th century, anticipates very important and valid concepts, and represents a wake-up call for the recent epidemics of emerging pathogens.

Keywords: Plague epidemic, Congregazione della Sanità, Reggimento, Epidemics, Health Measures, Self-Isolation, Northern Italy, COVID-19.

INTRODUCTION

The plague caused by the bacterium *Yersinia pestis* provides one of the best historical examples of pandemic infection. It was so dev-

astating that, with rapid spread and mortality, it decimated 1/3 of the European population (1347-1351) in just five years. It was called the “most serious biological catastrophe of humankind”. It can therefore be considered the first “globalized” disease, thanks also to the crowds that favored the rebalancing of infectious agents between Europe and the Middle East. For the first time, the world experienced microbiological

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unification: East and West were involved to the same extent.

Because of its destructive force, the plague became the 'black death' in the collective imagination, a disease that has accompanied humankind over the centuries and for this reason has often been present in the great works of art. In fact, its history began with the first written texts that have come down to us and ended not long ago with the discovery of the bacterium responsible for the great epidemics that upset the world: *Y. pestis*, transmitted by a micro-parasitic, a flea (*Pulex irritans*), which with its bite, excrement or eggs, infects a variety of animals including the black mouse (*Rattus Rattus*), different from the common mouse.

The plague has never been completely eradicated; "the plague microbe never dies", Camus makes his narrator say, and can "stay dormant for decades, but it doesn't disappear" [1].

During the sixteenth century, various epidemics either of real plague and other types of diseases, occurred several times in our regions and in other parts of Europe. In this century, a different trend of contagion has been observed: from a semi-endemic modality characterized by close episodes sometimes every four or five years (*i.e.* Milan was affected 18 times during the 16th century), there was a shorter series of violent outbreaks, more spaced out in time, culminating in the two epidemics of 1630 and 1656. In 1630 the plague began in Northern Italy, in Piedmont and Lombardy, and from here it quickly spread everywhere. The causes of this scourge were believed to have been the offenses caused to God by the many sins with which mankind had been stained; for others, however, many celestial phenomena were blamed, such as the unfavorable astral conjunctions of Saturn and Jupiter in the sign of Pisces, eclipses and comets; still others believed that it was the unclean animals (such as snakes and toads) and the putrid fumes coming from the ground, which dampened the air, thus making it harmful.

■ THE ITALIAN PLAGUE (1629-1631) - MORTALITY IN NORTHERN ITALY

In the baroque age the contagion passed from a semi-endemic and creeping form to a violent form of two episodes spaced in time (1630 and 1656).

Beyond that period, the trend reversed, and the last attack took place in 1749, limited only to the area between Messina and Reggio Calabria. After that episode the plague finally disappeared from Western Europe.

Between the years 1629 and 1631, when the plague hit Milan¹, very strict measures were taken in Ferrara, as reported in the *Legazione di Ferrara, Memorie*. The entire Northern Italy included Florence, which was affected by the epidemic. Only some cases in Ferrara were stopped almost immediately.

As we can read from the mortality data reported by Corradi in the *Annals of the Italian epidemics* (Table 1), it is clear that the plague also cut down over 50 percent of the population in some cases [3]. However, the data reported by historians are sometimes discordant as it was difficult to record all the deceased. Milan, as reported by Tadino e Cusani counted 86,000 deaths out of a population of 150,000 (57%) [4]. The plague raged in the cities near Ferrara. While Nani's estimate is 60,000 victims in Venice, Frari's and Casoni's data shows the same amount: 46,490 and 46,536 deaths on a population of 150,000 inhabitants, which reached 94,236 and 82,175 also including Murano, Malamocco and Chioggia. According to Nani, 500,000 people died on the mainland, according to Casoni 600,000 [5, 6]. We had 32,895 deaths in Verona (61% of the population) and 16,000 deaths in Padua out of 31,000 and 12,000 in the area. Small cities like Cento and Lugo, belonging to the Legation of Ferrara on the border with Bologna, to the south, counted 6,000 victims each [7]. The population of Bologna in the year 1624 included 61,691 inhabitants and decreased to 46,747 in the year 1631 with a loss of 24% [8]. In Modena 12,000 inhabitants died out of 20,000.

The most dramatic situation was in Mantua, where deaths were no longer counted during the Mantuan succession war after the arrival of the Landsknechts. According to Corradi's sources, 50,000 people died. The inhabitants of the countryside found refuge in the city. Part of them moved to the villages bordering Ferrara along the Po River. According to Capilupi, at the end of the outbreak, there were 8,000 inhabitants out of 35,000 in the city [9]. In Ferrara, according to documentation from the Diocesan Historical Archives,

¹ As written by Alessandro Manzoni in his "Promessi Sposi".

Table 1 - Mortality in Northern Italy during the Italian plague as reported by A. Corradi [7].

| Area | Town | Inhabitants died | | References reported by Corradi |
|---------------------|-----------------------------------|--|---------------------|--|
| | | Town | Dominion | |
| PIEDMONT | | | | |
| | Turin | 3,000 (out of 11,000 inhabitants) | | Fiochetto |
| | Alessandria | 4,000 | | Ghillini |
| | Chieri | 4,500 | | Month |
| LOMBARDY and VENETO | | | | |
| | Milan | 86,000 including deaths from other diseases | | Tadino |
| | Mantova | 50,000 | | Capilupi, Amadei |
| | Cremona | 25,000 | 80,000 | Bresciani, Robolotti |
| | Verona | 32,895 including deaths from other diseases (61% of inhabitants) | | Poma |
| | Bergamo | 9,550 | 47,347 | Calvi, Ghirardelli, Benaglio |
| | Brescia | 14,000 | | Bembo, Odorici |
| | Abbadia nel Polesine di Rovigo | | | Tirelli |
| | Venezia | 60,000 (94,236, de Frari) | 500,000 | Nani |
| | Vicenza | 11,000 | 80,000 | Imperiali |
| | Padova | 16,000 (out of 31,000 inhabitants) | More than 12,000 | Barbato |
| | Portogruaro | | | Palladio |
| | Sorriva (Feltre) | | | Dal Pozzo |
| | Treviso | 1,023 | | Bonifacio |
| | Bassano | 2,302 | | Montini |
| EMILIA | | | | |
| | Parma | 16,000 | | Colleg. Med. Parma. mss, B.Parmense |
| | Piacenza | 20,000 | | Morando |
| | Guastalla | 2,104 | | Affò |
| | Bologna | 13,398 | 16,300 | Torelli e Moratti |
| | Budrio (Bologna) | 1,764 | | Golinelli |
| | Cento (Legation of Ferrara) | 6,000 (6 physicians) | | Erri |
| | Modena | 12,000 | | Anon. Mod. |
| | Imola | | | Alberghetti, and Mss.Arch.Munic. |
| | Lugo (Legation of Ferrara) | 6,000 | | Bonoli |
| TUSCANY | | | | |
| | Florence | 12,900 and 1,600/1,800 | | Rondinelli |
| | Pistoja | | | Salvi |
| | Lucca | 10,000 (13 physicians) | 15,010 | Tommasi |



Figure 1 - Benedetto e Cesari Gennari, copy of the Guercino's work. San Rocco who implores the Virgin to free Ferrara from the plague, 1668 Pinacoteca of Ferrara.

the mortality rate in that period was 20 deaths per week [10], absolutely regular for 32,000 inhabitants (Figure 1).

■ THE SETTING OF FERRARA: PLAGUE TRANSMISSION BY PARASITE VECTORS AND THE AIRBORNE TRANSMISSION

From a preliminary study of Ferrara's documents, it emerged that Ferrara, already in the 16th century, had already understood that the spread of the plague contagion could occur through domestic animals including cats, pigs, chickens, dogs that carry the plague from one house to another [10]. These animals can host vectors such as human flea *P. irritans* (which may colonize short haired mammals such as pigs), *Ctenocephalides felis* (the

fleas of cats), *C. canis* (dogs) and *Synopsyllus fonquerniei* (chickens). Recent studies claim that human ectoparasites, such as *P. irritans* or body louse (*Pediculus humanus humanus*), caused the rapidly spreading epidemics and were primary vectors of the plague during the second pandemic, including Black Plague (1346-1353). Ultimately, the hypothesis that the plague in Europe was predominantly spread by rats is now contradicted [11]. In Ferrara rats have never been mentioned among the "dirty" animals [10]. Currently, the above-mentioned vectors and guests are recognized as responsible for the spread in areas of the world where the plague is still active, such as Tanzania, Madagascar, Uganda [12-16].

In Ferrara city, a sort of "integrated empirical management of the disease" was carried out, using remedies that included compounds with antiparasitic and repellent activity (galenic), and technical strategies that included the prevention of possible plague carriers [10]. Sanitization of the house, exposure to fire and sun, ventilation, temperature and humidity, are in fact effective in vector control [17, 18]. The parasites could be present in materials of animal origin. Particular attention was also paid to animal skins as a possible means of transmission of the plague. In fact, the trade routes on which the various plague epidemics could occur, are supported by important studies on ancient DNA. In this context, a study describing the arrival of the Black Plague through the trade of furs and skins from the *Land of Darkness* is particularly suggestive. A great variety of furs (sable, ermine, fox, sable, fitch, marten, wolf and deer skins) were introduced in Sarai, traded in the Black Sea ports and then in Europe [19, 20]. For this reason and to avoid the possible transmission of the hides by air, they had to be sent immediately to the tanneries after slaughter. The primary "pulmonary" transmission through the droplets could only occur under particular environmental conditions, such as during specific temperature (T°) and different humidity ranges, poor ventilation, and high-density housing [21-23]. In this setting, Ferrara was a large city (Addizione Erculea), with no residential crowd. The above climatic factors were effective in controlling the pneumonic transmission. In fact, the high T° and low humidity have a negative effect on the developmental stage of the flea species.

■ AIM OF THE RESEARCH AND SOURCES

The city of Ferrara, one of the most beautiful European capitals of the Renaissance, was badly affected by deadly plagues during the dominion of Este. 20,000 people perished in 1528.

The call to the city of a Spanish physician Pedro Castagno was decisive. In the *Reggimento contra peste* (Regimen against the plague: the first manuscript, then printed from 1572 in numerous editions) (Figure 2, 3), he dictated the rules and the provided remedies [24-26]. He was more famous for the oil against the plague, *Olio contro la peste*, with a secret recipe (most probably very similar to the best-known oil from Mattioli). Galenic preparations have also been recommended in the Regimen, as their antibacterial, antiparasitic and repellent activity on plague vectors has finally been demonstrated.

Castagno warns against domestic animals (dogs, cats, chickens, pigs) that can spread plague from one house to another. He does not mention rats. Perhaps, in this way, Ferrara was saved from the plague in 1576. The previous ordinances against the plague of 1576 which saved the city in 1630 had been lost. At that time Ferrara was the only place to survive the plague if compared to the nearer cities, (*quelli particolari co' quali Ferrara si difese sola tra le circonvicine Città l'anno 1576, s'erano smarriti nella diuoluzione dello stato*). The Este family was forced to leave the city by the Pope at the end of the sixteenth century, so they retired to Modena, bringing with them also important documents.

In 1630 the Authorities based themselves on Orders and warnings about suspects of plague (*Ordini e avvertimenti in caso di peste*) of 1623, which once again have the Regimen, *Reggimento*, as a cornerstone [27].

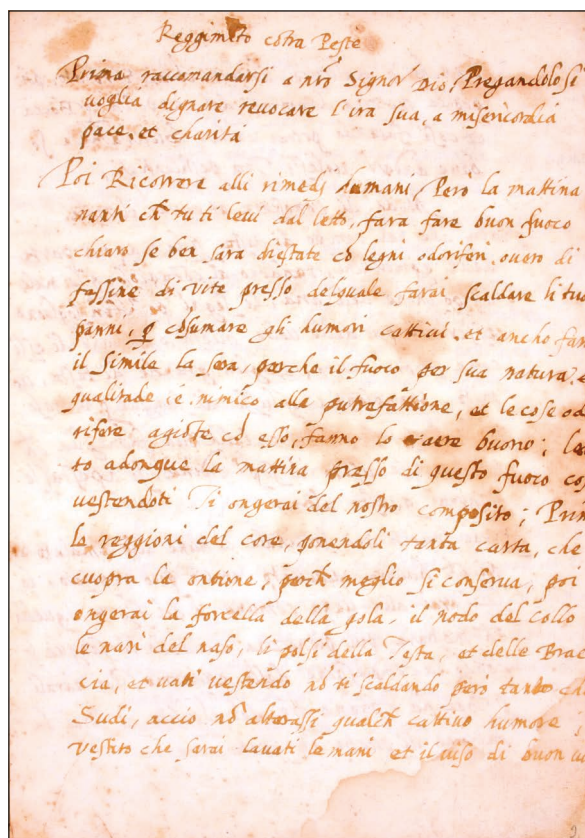


Figure 2 - Castagno Pietro, *Reggimento contra la peste*, XVI sec., Classe I 402. Biblioteca Comunale Ariostea di Ferrara.

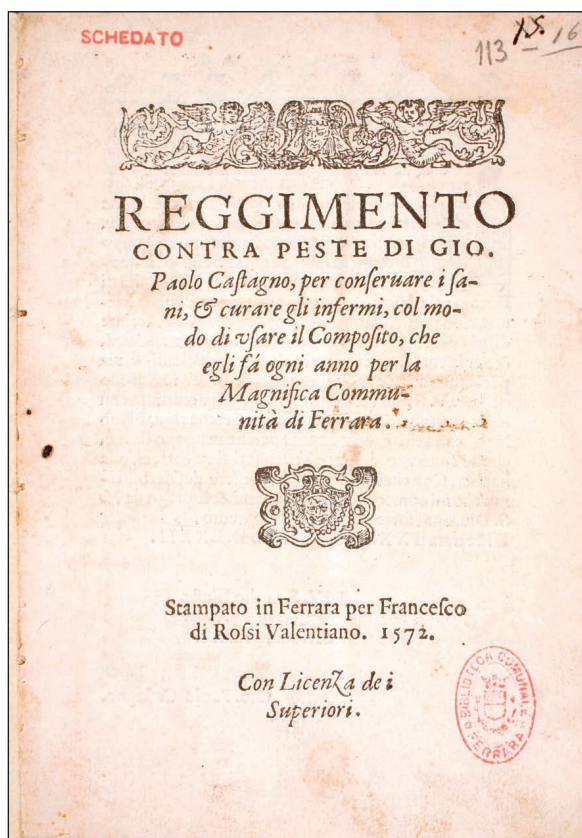


Figure 3 - Castagno Giovanni Paolo, *Reggimento contra peste di Gio. Paolo Castagno*. Ferrara, 1572. Biblioteca Comunale Ariostea di Ferrara MF 113.16.



Figure 4 - *Memorie di quanto s'è fatto per preseruazione dalla peste a Ferrara l...i ne gli anni 1629 1630 1631.* Ferrara, 1632. Biblioteca Comunale Ariostea di Ferrara, MF 124.11.

At the end of the epidemic, the Authorities published a Report about what had been done to protect Ferrara from the plague in the years 1629, 1630 and 1631 (*Memorie di quanto s'è fatto per preseruazione della peste a Ferrara ... ne gli anni 1629, 1630, 1631*) (Figure 4) [28].

In this paper all the above-mentioned Ferrara documents are analysed, highlighting the most successful prevention measures implemented in the city of Ferrara during the Italian plague.

■ MAIN HEALTH MEASURES ADOPTED IN THE CITY AND THE LEGATION OF FERRARA

The *Congregazione della Sanità*, a permanent Congregation for Health, was composed of two Presidents (on duty for two years, the elder member was replaced), Pope's Legate, Judge of Savi (wise man), eight gentlemen, physicians, the apothecary of the Hospital and trader expert in foreign

countries, borders and suspected cases of plague. There were four alert levels with a raising of the guard level to the only two gates left open, *Porta San Giovanni Battista* and *Porta San Paolo*, near the Po river.

| Alert levels as reported in <i>Ordini e avvertimenti in caso di peste</i> [27]. | | |
|---|------------------------|---|
| Attention level | Plague Suspicion level | For each city gate |
| 1 st level | low suspicion | a Deputy |
| 2 nd level | higher suspicion | a Deputy and two Gentlemen or Honorable citizens |
| 3 rd level | very high suspicion | particular alert issued to river and sea ports and passages |
| IV th level | danger near | a physician also present at the city gates |

Gate guard levels

The *Fedi* were proofs for each traveler certifying their passage in localities free from suspicion of plague. The gate of entrance and the name of Control Officer was reported.

In the fourth alert level they had to contain not only the name and surname of the person, but also the age, height, hair and father's name. Gallows were present at the gates for the most serious transgressions. Police measures were being implemented against the attempts to evade and to force blockades.

Against those who dared to enter the city by other roads or without proofs (*Fedi*), people were called with the sound of bells to cause a stir. The risk was to be chastised even with life. The killers would not incur any punishment².

Local governors and *Podestà* (Chief Magistrate) and four or six Keepers of Health (*Signori Conservatori*) managed the borders control of the Papal Legation.

Flags of the city at the gates were clearly visible

² *Nessuno ardisca entrare in questo Stato per altre strade, [...] che s'entreranno per altri luoghi, che per gli ordinari, e dove saranno guardie sopradette, sarà loro a suono di Campane sollevato dietro il Popolo, e venendo presi, saranno severissimamente castigati, anche nella vita, oltre, che potranno in tal caso esser ammazzati senza che gli uccisori incorrano in pena alcuna.*

to warn people (*Bandirole alla diuisa della Città da tenere sopra i Rastrelli, in modo che fossero da lontano riconosciute*).

Infantry (*Guardie di Soldati a piedi*), cavalry and armed boats guarded the border.

*A city ready for emergency: the origin of Lazarettos*³

The planned and operative lazarettos in Ferrara were the following:

- *Isola del Bonello* (Stienta) - at the first sign of the epidemic in November 1629, the island of *Po grande* was identified as a possible lazaret.
- *Borgo San Luca* (outside the south city walls) - It was activated from May 1630, to isolate the first suspected case of plague. It was operative for the whole duration of the emergency.
- *Arsenali delle galere* (Ship dockyards) - The ship dockyards were adapted to rooms suitable for hospital use (*Sale atte ad uso d'Ospitale*), ready in case of need.
- *Monastero di San Giorgio* (Monastery of the Olivetans in San Giorgio) - It was made available by the Olivetan monks. It was equipped with hundreds of beds, ready in case of spread of the epidemic.
- *Pontelagoscuro* (about 5 Km from the city walls) - It was planned as support for the S. Luca lazaret. Three enclosures were set up: for suspects, infected and convalescents. It was fundamental during the Pontelagoscuro emergency in August 1620.

³ The continuous epidemics over the centuries pushed large and even small towns to identify places outside the urban core to isolate the infected and suspects. It was in Venice that the first lazaret was born (S. Maria di Nazareth, 1423) and also the quarantine, a period of observation and monitoring of the state of health of people and decontamination of goods. The conception and implementation of these measures were natural in a city that, due to its geographical position, was among the most devoted to trade at the time. Over time, Lazzaretto Vecchio was joined by Lazzaretto Nuovo and San Lazzaro degli Armeni. Following the model of Venice, other cities, in case of emergency, activated the old lazarettos or created new ones according to the urban development of the city and the seriousness of the situation. The lazarettos were efficient structures that guaranteed isolation/separation even inside (suspected, infected, convalescent), but also the reclamation of the rooms (e.g. the little houses had thatched roofs so that they could be reclaimed with the effectiveness of fire).

Safety of the physicians

Physicians were among the guards at the gates of the city at the moment of maximum alert.

In suspect cases of plague inside the city, other health personnel (*Barbieri, Cirusici*) were sent for preliminary diagnosis. Doctors could not enter the lazaret (Cento lost six doctors) where *Cirugici di giudizio* and experienced religious of this profession were enough ([...] *Medico consulente del Lazaretto; dico consulente perché fu prouato inutile il mettere Medici dentro, e che seruiuua solo per infettargli, e restarne priua la città*).

Tele incerate, ò di Sangallo (robes made of oilcloth) were used as personal protective devices.

People reaction to the first Plague suspect case

The first reactions were: to retire to their houses making provisions as for siege (*ritirarsi nelle case prouendendouisi come per assedio*), withdraw from the city (*fuggirsene ben presto, e lungi, e di ritornar tardi*). The example of serving the homeland prevailed, the eight *Conservatori* were doubled in order to field more forces and better control the city.

Business safeguard

The strictness of treating suspected cases as a real plague was certainly effective, albeit the provisions helped to relieve the unrest among the traders (*si mormorava di tanta diligenza, in particolare da Mercanti*).

The first case that had occurred in May 1630, (Bartolomeo Rossi) was very thorny.

If this had been treated as plague and then it was not the case, it would have meant losing trade with the neighboring cities, as well as appalling people at the same time⁴.

Opinions were different. It was preferred to transfer the family to a lazaret for suspected syphilitic bubo (Rossi was considered like drinker and "whoremonger", *beuante e puttaniere*) rather than letting him cry from relatives in the house and spread the infection (*per bubone come diceva alcuno (Gallico) che farlo piangere nel lasciarlo infettare*).

In the territory of the Legation, border towns were more attentive to trade, risking public health. The cities of Cento and Lugo and surrounding area recorded 6,000 deaths each (Corradi) each [3].

⁴ *Se si governava questo caso come di peste, quando non fosse, era perdere à bel diletto il commercio delle Città vicine, e come atterrire il Popolo.*

In August 1630, in Pontegagoscuero, a suspicious case was concealed for commercial reasons.

150 people died (a quarter of those locked in the Lazaret of Pontelagoscuero). The parish priest (*Curato*), his successor, the apothecary (*Speziale*), health workers (*Barbieri*) and gravediggers (*Sotterramorti*, usually persons imprisoned for life) died.

Treatment of any suspicious case as a real plague

May 2, 1630, an old man suspected of plague died, even if without signs of plague (probable false proof from Badia, village near territory of Verona).

May 13, 1630. A postal employee, Bartolomeo Rossi, died with signs of plague. The housemates of the dead were isolated in San Luca lazaret; seven in the house died and one of the two porters who carried the transport over the course of a month. The neighbours were not infected even in isolation. Food, furnishings and clothes were provided at public expense.

September 20, 1630. A new suspected case of a dead child (*Putto*). Even if turned out to be unfounded, the schools closed. The *Putti's* houses were isolated, having had contact with the dead in the same school. They were supplied for every need, visited by Authority, twice a day by *Gentilhuomini* deputies and more than once by the Judge *de Savi* and some *Conservatore*.

September 25, 1630, S. Anna Hospital. An early intervention stopped the infection. Fortunately, it did not concern the rooms of the patients, but a whole family of ministers who were sent to the S. Luca lazaret. Other ministers had contacted them, and the sick were quarantined at public expense. Two horticulturalists (*Ortolani*) were also involved. For the decontamination of the rooms, people imprisoned for life (not for cases of theft or robbery), were employed.

A plague principle was then discovered among the guests of the home of a Courier (*Corriero*) in Venice. They were immediately transferred to the Lazaret but five of six died, and only one recovered.

November 1630. The latest case, discovered during the inspection of the District Deputy (*Cavaliere deputato al Quartiere*) in the home of a Venetian craftsman, often visited by soldiers of the Guard-house of the Piazza. Seven of eight died, two at home and five at the Lazaret.

Measures to avoid concealing suspicious cases

– *Deputati di Quartiere* (District Deputies)

Announcements were made in the Legation villages (*Ville*) and in the city (*Bandi* 72 and 83) in order to avoid the hiding of suspected cases. Various people were appointed to monitor the area with visits and to report suspicious cases. The Minister of the Health Office (*Uffizio della Sanità*) kept books where all the people were recorded *Villa* by *Villa* and of the city itself district by district (in alphabetical order) so that they could easily retrieve names of sick, the dead and those who lived with them.

– *Refunds from the government*

It was better to spend public money rather than risking disobedience to save money (*Fosse meglio spender del pubblico, che con risparmio mettersi a rischio delle disubbidienze.*). To prevent suspicious cases from being hidden, burial and house sanitation costs were incurred and the value of burnt furniture was reimbursed at public expense.

Measures to support the poorest bracket of the population

A *Sbirro* (police officer) was in charge of identifying the poor in the city and accompanying them to rich convents available to host them, receiving a *Giulio* (Ferrara currency) from the Municipality of his commission for each one. The poor terminal people, considered to be a target for infection (*materia atta al contagio*), were welcomed at public expense in a hospital built in the structure of a church thanks to Abbot Badoero. In these places no one was admitted without a physician's visit, as done in the other hospitals in the city, respecting a few quarantine days before joining them with the other patients (*Bando* 59, 14 luglio 1630, *Deputazione de Medici e Barbieri per li poveri ammalati della Città, con altre provvigioni per essi*). The poor foreigners were, if possible, extradited to their countries of origin. Gypsies and beggars were not allowed into the city.

Police measures against looting and trade in used clothes and goods

Call 88 October 14, 1630, (*caso successo in Ferrara, d'esser stato rubato in una casa sequestrata*) refers to a case that happened in Ferrara, of having been stolen in a seized house. Looting and trade in suspicious goods were possible. Thirteen people were hanged for transgressions of the health rules. The

Ufficiali del Monte di Pietà (pawnbrokers) and Jewish bankers were ordered to keep old pawns separate from the new ones that could be suspicious.

Veterinary and hygiene measures

Checking goods entering the city

- Check that no illegal goods such as used things and clothes were hidden. They were more than once under hay and straw carts found things that were not allowed to enter.
- Control of the origin and state of health of incoming slaughter animals, livestock and swine (*Bando 9, 14, November 1629*)
- Prohibition to eat dead beast meat and order to bury them; that they do not slaughter them, that they do not introduce or eat dead animals themselves (*Bando 20, March 28, 1630; Bando 22, April 6, 1630*). There had been cattle deaths, in fact, for example in the territory of Mantua. Butchers were ordered not to sell meat from animals not previously visited by a person qualified for this task (*non prima visitate da persona perita a questo effetto deputata*).
- Control of edible items (meat and fish) in shops and markets. The police of slaughterhouse, fish market and square (*Macelli, Pescaria e Piazza*) were assigned to *Signori Consoli* with particular attention in the shops to the bad quality of edible things (*mala qualità delle cose commestibili*). Six police officers (*Sbirri*) in the square ready to intervene by order of the authority (*Conservatori*).

The public *Dozze* (conduits or canals that conduct water) had to be well maintained.

Checking animals as possible hosts of plague vectors

In a preliminary research we have demonstrated the anti-parasitic and repellent activity of galenic preparations in use in Ferrara. Dogs, cats (carrying the plague from one house to another), chicken and pigs were identified as guests of the plague carriers. The silkworms breeding, which caused poor hygiene in the houses, was also prohibited.

It was proposed to poor people already employed in the Fortifications to remove rags (to be burned without touching) and carrion of dead dogs, cats and poultry (to be buried) off the streets.

The ordinances (*Bando 53, 6 July 1630*) concerned stray dogs, *sopra l'andare di cani sciolti*. It was forbidden to keep swine and unclean animals (*animali immondi*) in the city (*Bando 58, 13 July 1630*).

City and housing cleaning

The hygiene rules contained in Pedro Castagno's Plague Regiment and in the Regulations of 1623 were applied: cleaning of the city, houses and personal care (see previous research). Careful inspections were foreseen in houses to see people living conditions. *Che siano visitate senza ostacolo le case, per vedere come s'abita* (*Bando 40, 10 June, 1630*) entrusted to *Deputazione di Gentilhuomini* (*Bando 41, 11 June, 1630*) with particular attention to the Jews.

Prisons also were often cleaned.

In *Bando 92, March 27, 1631 "Nuove provvigioni, & Ordini per tener netta la città"* were reported orders to keep the city clear, easy to be applied in the city like Ferrara. Projected in the Renaissance by Biagio Rossetti, first architect in the history of urbanistics, Ferrara had aroused the admiration of Michel Eyquem de Montaigne who so wrote in his *Viaggio in Italia 1580-81*: Numerous buildings, wide and straight for most of the streets ... here they serve fruit on the plates. The streets are all paved with bricks.

Management of Catholic religious functions and precepts in the Legation of Ferrara, territory under papal control

Orders for celebration in infected villages (*Ville*) of the Legation:

- remove the benches from the churches
- Masses were celebrated in portable chapels made to do with all the necessary things at the expense of the government.

Celebrations and processions were held in the city.

Orders for religious operating in the area:

- Shifts were allowed in the territory, certified day by day on the proofs (*Fedi*) by the parish priest (*Curato*) of the villages they had been to; contacts with foreign religious were prohibited.
- Caution for confessors and parish priests in administering the Sacraments to the sick, especially in poor hygiene conditions (*in amministrare Sacramenti agl'infermi, in particolare gl'abitanti sporcamente*).
- for suspected plague cases (*in caso di sospetto*), Theatine Father (*un Padre Teatino pieno di carità e zelo*) was available to administer the Sacraments (Blessed Sacrament and Holy Oil). He was always available and in self-isolation in the rooms of the Church of S. Antonio where he celebrated with the door ajar.

Financial resources recovery

The economy was scrupulously managed from the beginning, (*economia accurata, che non si risparmiò ma non si gettò anco alcun denaro*). Money was not spared neither wasted.

The expense was huge, already reaching thousands of *Scudi*. The Pope was asked for authorization to set up in Ferrara a *Monte* in order to manage good money (*buona moneta*) locally and to avoid changes of the remittances, from bank coupons and more.

A tax was imposed on olive oil and salt, light for the rich and not that burdensome for the poor. The contribution of money by wealthy people was encouraged, repaid by privileges granted by Rome and by a six-month advance of six percent. Healthcare costs reached 50,000 *Scudi* in twenty months.

The Report concludes that the result of the contagion containment was to consider each suspect case as contagious (*il credere per contagioso ogni caso, che sia capace di sospetto, unico rimedio all'estinzione del medemo male*).

■ DIFFERENCES IN THE FIGHT AGAINST PRESENT AND PAST EPIDEMICS

During the pandemic plague of the 17th century, Ferrara prepared itself for the possibility of being unable to stem the disease by setting up numerous preventive measures carried out in a similar, if not superior, way to the current ones. These included: 1st, the preciousness of doctors.

With the arrival of COVID-19, more than 170 doctors and medical personnel have died in Italy. And this is because at the beginning of the epidemic there was no adequate protection for all health personnel, citizens and residences for the elderly. In the first inspections of suspected cases and in the lazarettos (small or large lazarettos with hundreds of beds), only supportive healthcare staff worked, but doctors were not allowed to enter. Since that time, the authorities and doctors were equipped with personal protective devices which consisted of clothes made of *oilcloth* (*tele incerate*) because of the famous beak masks were unknown in Ferrara at that time. Instead, scented ball made of perforated cypress or ash wood containing a sponge soaked in a mixture of (now proven) antibacterial substances and rose water, wine and vinegar were used. They could be held

in the hand and smelled, or beaten on the hands, then passed the liquid over the face [24-26, 29]. They could also use sponges soaked in vinegar in front of the nose and mouth.

The beak masks, however, become in vogue later when doctors themselves, in addition to people, believed in the ability of the mask to purify poisoned air; 2nd, each suspected case was considered and treated as a plague case. If a person was sick or even dying, everyone would come in isolation. The state also intervened with financial interventions to divert them from the temptation to hide the evil. The isolation of the sick to avoid the spread of contagion is a practice that dates back at least to the fourteenth century, and in particular to the experiences lived in cities like Venice and Milan with the first plague epidemics. The current “social distancing”, as the *self isolation* of the population, is much older than we think and is not the only strategy we have inherited from the pandemics of the past. For example, to contain the plague in the city of London, King Charles II in September 1666, relied on a council of experts, marking the beginning of a scientific renaissance. The doctors experimented with quarantine (the quarantine, already experimented during the bubonic plague of the 14th century, was distributed in an increasingly systematic way during the Great Plague), sterilization and social isolation [30]. Once reopened, the government recommended sterilizing houses with lime: “doctors believed that bubonic plague was caused by “smells” in the air, so it was always recommended to clean them. They had no idea that it was also a good way to get rid of the ticks and fleas that were actually spreading the contagion; 3rd, as today, in times of modern epidemics, a register of inhabitants by districts had already been set up so that contacts could be quickly identified, and isolation could be carried out. Pepys reports that during the London plague “some civil servants, called ‘researchers’, identified new cases of plague and quarantined the sick together with all those who shared their homes [30]. The people calling the guardians painted a *red cross* on the doors of quarantined houses, along with a written notice that read “LORD HAVE MERCY UPON US” (in capital letters)”. We could call it an early experiment in contagion tracking. The government was also in charge of providing food for the people locked up at home. After forty days, the

red crosses were replaced by white ones, a sign that the house was no longer affected by the disease. Attention was paid to the poor in conditions patients with chronic illness and the dispossessed (homeless); 4th, a period of quarantine was carried out before admission to the community or hospital; the houses were continuously checked by the authorities to verify the state of hygiene. The people of Ferrara, and not only them since the time of the plague, had understood that the hygiene of hands, clothes and things was very important, as it is today. With the galenic preparations (solutions) they sprinkled their hands and face and even sponged on the body. In addition, they kept a reserve of vinegar (today, the *amuchina*) as a preventive measure, even in times of non-emergency (Reggimento) [24-26]. The rule of hand, face and person hygiene recommended in this pandemic is not new. The Regiment, which has similarities with the present, was written in the 16th century. It recommended the constant use of galenic formulations which had proven antimicrobial activity [10]. This was associated with the hygiene of clothes, beds, the house, the city. Even as far as water was concerned, it had been present since the time of the Este family. Ferrara was a refined and cultured court; Lucrezia Borgia, for example, constantly washed her hair and took great care of her her person [31]; 5th, all people's movements was checked both in and out of the city, for business, seasonal work, or as religious (records of movements on faiths); 6th, restrictions on religious practices (despite being under the dominion of the Papacy) in infected suburban areas in order to avoid mass gatherings. As it was at that time, in the COVID-19 era, churches have been closed by the Italian State with the agreement of the religious authorities, but not without bad moods, protests and controversy.

Among the many "fake" remedies that proliferated at that time (and today), new rules of mass hygiene were also experimented, which were actually useful, such as the habit of many shops to ask their customers to drop coins in trays containing vinegar to sterilize them: a sort of disinfectant gel of 1600 for hands. Even as today, there were transgressors: in April 1665 some people were denounced "for having gathered in the street in a promiscuous way". First recorded case of "aggregation". However, paradoxically, religious processions were not prohibited, even though in the in-

fectured areas of the Legation, the mass was celebrated in the streets with the faithful at the windows. As in the current pandemic, the lockdown introduced in Italy, as was done in China, isolating the inhabitants and cohabitants who may have had contact with suspicious cases, together with the closure of schools and universities, cities and regions, as well as the control of incoming goods and unauthorized products as possible sources of infection, was the only policy that reduced the spread of the pandemic from COVID-19.

■ DISCUSSION

The strength of Ferrara's response is derived from an efficient and emergency-ready health control system, financed and supported even in times of great financial difficulty for the State. Ferrara was at the limit because since 1629 it had suffered three years of famine (the state of the city to the effect of preserving itself was not intimately good, the unhappy harvest of three years continuous) with serious consequences inherent in the lack of income, unemployment and the death of the people. In addition, military expenditure had to be incurred, which was a must for the defense of the city at a critical time in northern Italy. The money was found, thanks to the establishment of a Mount in Ferrara, also facilitated by the support of the Central Authority of Rome.

The institute of health control *Congregazione della Sanità*, counted on an efficient medical staff.

Indeed, there was a consolidated network of information between the states in cases of health emergencies. However, prudence prompted them to secretly send doctors to the site to verify the local situation (*i.e.* to Cremona)⁵. High-ranking people accompanied the guards at the entrance to verify by means of certificates that people did not come from infected areas (*Fedi*) at the entrance, in the maximum level of alert the control was also entrusted to a doctor. Very severe penalties for transgressions, from the fork to "giving the culprit to the people". At the borders of the Legation (corresponding to the current province of Ferrara), there was a real deployment of military forces to control and safeguard the city (isolation "white zone").

⁵ *Cremona, vi fu spedito Medico, che non conosciuto in quella città s'informasse segretamente.*

Evolutionary history teaches us that one must never lower one's guard when faced with the possible appearance of new infectious diseases. Pathogens bloom punctually and constantly from "Pandora's Jar". There are countless examples including the "Spanish flu" in 1918-1919, the Asian virus in 1957, the "Hong Kong" virus in 1968, AIDS in the 1980s, the MERS epidemics in 2002 and 2012 respectively, the Ebola virus in 2014, the multi-drug resistant bacteria and finally the "SARS-CoV-2" infection. The arrival of COVID-19 caught us suddenly also because the China from which the epidemic began, which later became a pandemic, did not notify the WHO in time. However, statesmen and politicians had prophesied the event of a pandemic. In 2005, US President Bush had allocated \$7 billion and said that "in the event of a pandemic, syringes, hospital beds, fans and all medical protective equipment, including disposable clothes and masks, would quickly become scarce".

Human, political and social history teaches us that there are two ways to manage a new epidemic immediately and without hesitation, especially at the beginning [32]. First, the isolation of the sick and the interruption of all kinds of social and economic relationships within and outside the population. Even if it involves a very high economic cost, it must be pursued. If we look at the past, during the plague epidemic in Venice in 1576, "every suspicious case had to be considered contagious", anticipating very important and valid concepts also observed in recent emerging pathogen epidemics. At that time, the definition of a suspicious case was not known.

The Venetian Senate, when the first cases of plague were observed, hesitated to promulgate the quarantine laws already well structured for this type of epidemic, for fear of repercussions on the city's economy. Even at the beginning of the spread of the Italian Plague in Venice, there was an attempt to deny (as in other cities, the so-called deniers) that it was the bubonic form, justifying that, since women were more affected, they were miliary fevers [7]. This hesitation generated the wider spread of the contagion, which led to the death of one third of the population and brought the entire city to its knees. A bit like China before WHO was alerted.

This teaches us that today, in the globalization era and the great movements of peoples on land,

at sea and in the sky, we must not fear economic damage, but must immediately introduce forms of containment and, at the same time, robust forms of "state" support for the economy. All this must also lead, as quickly and intensively as possible, to scientific research into new medicines and the introduction of a possible vaccine.

We must remember that the only infectious disease "eradicated" was smallpox and the first disease against which, historically, an effective vaccine has been introduced.

■ REFERENCES

- [1] Camus A. La peste. Bompiani, Milano; 2020.
- [2] Archivio Storico Diocesano Ferrara, Fondo documenti episcopali, Busta 10, F1.
- [3] Corradi A. Annali delle epidemie occorse in Italia dalle prime memorie al 1850. Parte Terza dal 1601 to 1700. Tipi Gamberini and Parmeggiani, Bologna; 1870.
- [4] Ripamonti G., trad. Cusani F. La peste di Milano del 1630: libri cinque/cavati dagli annali della Città e scritti per ordine dei 60 decurioni dal canonico della Scala Giuseppe Ripamonti; volgarizzati per la prima volta dall'originale latino da Francesco Cusani. Pirotta e C., Milano; 1841.
- [5] Frari AA Cenni storici sopra la peste di Venezia del 1630-31 per la quale si celebra in questi giorni la festa del secolo votiva con un compendio storico di tutte le altre pesti che afflissero la stessa città estratti da un'opera non pubblicata del c.re F. Con in fine una lettera di Giovanni Francesco Loredano ... Tipografia Graziosi, Venezia; 1830.
- [6] Casoni G. La peste di Venezia nel 1630 origine della erezione del tempio a S. Maria della Salute. Tipografia Alvisopoli a spese di Girardi G., Venezia; 1830.
- [7] Corradi A. Annali delle epidemie occorse in Italia dalle prime memorie al 1850. Parte Terza dal 1601 to 1700. Tipi Gamberini and Parmeggiani Bologna 1870.
- [8] Sabbatani S, Fiorino S, Manfredi R The plague in Bologna in 1527. *Infez Med.* 2020; 28 (2), 278-287.
- [9] Due cronache di Mantova dal 1628 al 1631: la prima di Scipione Capilupi, la seconda di Gio. Mambrino/trascritte, annotate e illustrate con documenti inediti da Carlo D'Arco; dal secondo volume della raccolta di Cronisti e documenti storici lombardi inediti, pubblicata da Giuseppe Müller. Colombo F. editore-librajo, Milano; 1857, p. 77.
- [10] Vicentini CB, Manfredini S, Mares D, Bonacci T, Scapoli C, Chicca M, Pezzi M Empirical "Integrated Disease Management" in Ferrara During the Italian Plague (1629-1631). *Parasitol Int.* 2020; 75, 102046. Epub 2019 Dec 27.
- [11] Dean KR, Krauer F, Walløe L, Lingjærde OC, Bramanti B, Stenseth NC, Schmid BV Human ectoparasites

- and the spread of plague in Europe during the Second Pandemic. *Proc Natl Acad Sci U S A*. 2018; 115(6), 1304-1309. Epub 2018 Jan 16.
- [12] Ziwa MH, Matee MI, Hang'ombe BM, Lyamuya EF, Kilonzo BS Plague in Tanzania: an overview. *Tanzan J Health Res*. 2013; 15, 252-8.
- [13] Ratovonjato J, Rajerison M, Rahelinirina S, Boyer S, *Yersinia pestis* in *Pulex irritans* fleas during plague outbreak, Madagascar. *Emerg Infect Dis*. 2014; 20, 1414-5.
- [14] Moore SM, Monaghan A, Borchert JN, et al. Seasonal fluctuations of small mammal and flea communities in a Ugandan plague focus: evidence to implicate *Aroicanthis niloticus* and *Crocidura* spp. as key hosts in *Yersinia pestis* transmission. *Parasit Vectors*. 2015; 8, 11.
- [15] Gratz N. Rodent reservoirs and flea vectors of natural foci of plague. In: Plague manual: epidemiology, distribution, surveillance and control. <https://www.who.int/csr/resources/publications/plague/whocdscsredc992a.pdf?ua=1> (Accessed 9 October 2019).
- [16] Laudisoit A, Leirs H, Makundi RH, et al. Plague and the human flea, Tanzania. *Emerg. Infect Dis* 2007; 13, 687-693.
- [17] Durden A.L., Hinkle N.C. Fleas (Siphonaptera), in: *Medical and Veterinary Entomology, 3rd edition* (G. Mullen, L. Durden Eds.). Academic Press, Elsevier, San Diego; 2018; 145-69.
- [18] Kreppel KS, Telfer S, Rajerison M, Morse A, Baylis M Effect of temperature and relative humidity on the development times and survival of *Synopsyllus fonquerniei* and *Xenopsylla cheopis*, the flea vectors of plague in Madagascar. *Parasit Vectors*. 2016; 9, 82.
- [19] Namouchi A, Guellil M, Kersten O, et al. Integrative approach using *Yersinia pestis* genomes to revisit the historical landscape of plague during the Medieval Period. *Proc Natl Acad Sci USA*. 2018; 115 (50), E11790-E11797. Epub 2018 Nov 26
- [20] Bramanti B, Namouchi A, Schmid BV, Dean KR, Stenseth NC Out of the Land of Darkness: Plague on the fur trade routes. *Proc Natl Acad Sci USA*. 2019; 116 (16), 7622-3.
- [21] Dean KR, Krauer F, Walløe L, Lingjærde OC, Bramanti B, Stenseth NC, Schmid BV Human ectoparasite transmission of plague during the Second Pandemic is still plausible. *Proc Natl Acad Sci USA*. 2018; 115 (34), E7894-E7895. Epub 2018 Aug 3.
- [22] Kool JL Risk of person-to-person transmission of pneumonic plague. *Clin Infect Dis*. 2005; 40, 1166-172.
- [23] Boisier P, et al. Epidemiologic features of four successive annual outbreaks of bubonic plague in Mahajanga, Madagascar. *Emerg Infect Dis*. 2002; 8, 311-6.
- [24] Reggimento contra peste Ms Cl. I, 402. Ariosteia Library. Ferrara XVI Century.
- [25] Castagno GP, Reggimento contra peste di Gio Paolo Castagno. Rossi F. Ferrara 1572.
- [26] Sperelli A., F Virtù dell'oglio contra peste che si fa ogni anno per l'illustrissima comunità di Ferrara. Da Andrea Sperelli cittadino ferrarese, speciale dell'ospitale di S. Anna di detta città. Suzzi F., Ferrara; 1630.
- [27] Ferrara Legazione Magistrato dei Savi, Ordini e avvertimenti ne' sospetti di peste, stabiliti nella congregazione della Sanità [...] li 10 giugno 1623 e ristampati li 10 marzo 1736. Barbieri G., Ferrara; 1736.
- [28] Ferrara Legazione, Memorie di quanto s'è fatto per preservazione dalla Peste a Ferrara, durante il governo dell'eminentissimo e reverendissimo sig. cardinale Sacchetti legato &c ne gli anni 1629 1630 1631. Suzzi F., Ferrara; 1632.
- [29] Tractato contro la peste cavato de un libro del Manardo de latino in volgare per uno suo discipulo, in Ferrara per Francesco di Russi da Valenza; 1522.
- [30] "The Diary of Samuel Pepys, pepysdiary.com". London; 1825.
- [31] Bradford, S. Lucrezia Borgia: la storia vera. Mondadori, Milano; 2005.
- [32] Contini C, Di Nuzzo M, Barp N, et al. The novel zoonotic COVID-19 pandemic: an expected global health concern. *J Infect Dev Ctries*. 2020; 14 (3), 254-264.