

Unveiling Milan's hidden cases of plague occurred in autumn 1629, before the great 1630 epidemic

Riccardo Nodari^{1,2}, Luca Fois³, Ester Luconi⁴, Folco Vaglianti⁵,
Francesco Comandatore⁶, Massimo Galli⁴

¹Department of Pharmacological and Biomolecular Sciences, University of Milan, Italy;

²Romeo and Enrica Invernizzi National Institute of Molecular Genetics (INGM), Milan, Italy;

³Department of the Humanities, Section of Historical and Geographical Science, University of Pavia, Italy;

⁴Department of Biomedical and Clinical Sciences, University of Milan, Italy;

⁵Department of Historical Studies, University of Milan, Italy;

⁶Department of Biomedical and Clinical Sciences, Pediatric Clinical Research Center "Romeo and Enrica Invernizzi", University of Milan, Italy

Article received 12 June 2024, accepted 23 July 2024

SUMMARY

In the summer of 1630, Milan experienced the most devastating plague epidemic in its history. In this study, addressed to investigate the earliest phases of the epidemic in the autumn of 1629, a set of unpublished and only partially known primary sources produced by the city's *Officium Sanitatis* was consulted and compared for the first time. Including those of two foreigners who died in the Lazzaretto, it was possible to ascertain a total of 39 cases of plague occurred in Milan between 9 October 1629 and the first weeks of 1630, of which 29 (74.4%) ended in death. Seven deaths presumably occurred at home were not recorded in the *Liber Mortuorum*, in which at least three other deaths caused by

plague were deliberately attributed to a different cause. In particular, the case of the *Vicario di Provisione* in charge, Alfonso Visconti, probably the first death from plague occurred in Milan that year, was deliberately concealed for political reasons. Nevertheless, the spread of the disease remained limited in autumn 1629 and it was probably stopped until the following spring more by climatic factors than by the interventions of public health officials.

Keywords: *Yersinia pestis*, bubonic plague, Milan's plague epidemic, hidden cases.

INTRODUCTION

In 1629, northern Italy was ravaged by severe famine and the consequences of the War of the Mantuan Succession. By 19 September the plague, brought by the imperial troops descending from the Valtellina on their way to the siege of Mantua [1, 2] (Figure 1), had already struck various villages on the east coast of Lake Como [3, 4]. On 23 Oc-

tober, to the *Tribunale di Sanità* (the city health office) asking to stop the descent of German troops from the Alpes, the new governor, Ambrogio Spinola answered that the route had to stay open for the imperial army at whatever cost [5]. In the meantime, the plague had already reached Milan, although the number of reported cases remained small and the disease disappeared during the winter [1, 2].

The aim of this study is to describe the cases of plague observed in Milan between October and December 1629, evaluate the features (and failings) of the official response, and discuss the reasons for the limited spread of the autumn epidemic.

Corresponding author

Massimo Galli

E-mail: massimo.galli@unimi.it

Sources of historical data

The main narrative source concerning the Milanese plague of 1630 is the *Raguaglio dell'origine et giornali successi della gran peste contagiosa* [1], which was published in 1648 (several years after the events) by Alessandro Tadino, the physician who was in charge as *Conservatore del Tribunale di Sanità* during the years of the epidemic. Pages 51-54 of the book provide a detailed description of four plague clusters that occurred between October and December 1629 and triggered infections in different parts of the city. To verify and extend the information provided by Tadino, the following other primary sources, never previously compared each other, were also used:

- the register of Milan's Lazzaretto of St. Gregory (RLM), a handwritten list of admissions and discharges [6];
- Milan's *Libri Mortuorum* (MML), a large corpus of handwritten registers covering the years 1450-1801 [7-8] that were compiled daily by physicians or state-appointed surgeons and provide detailed information (name, age, place and cause of death) concerning everyone who died in the city and its immediate outskirts, except those dying in hospitals, convents, or the Lazzaretto;
- a miscellaneous collection of sources (MS): letters, chronicles, and reports containing the impressions and assessments of various Milanese officials that were written for private or public use during the plague and are now preserved in a private archive [9].

■ RESULTS

The Lazzaretto of San Gregory

Between October and the end of December 1629, 78 admissions (40 males and 38 females) were recorded in the RLM. These included 34 foreigners or non-city residents (16 from Germany, three each from Spain and Burgundy, two each from Lorraine and Sicily, one each from Cremona, Flanders, and Bohemia, and five of unknown origin), 27 of whom were released after an average of 24 days (median 17 days). It is therefore likely that the Lazzaretto was used to quarantine outsiders, most of whom would have been asymptomatic. Of the 44 Milanese citizens, 14 died in the Lazzaretto after an average of 21.6 days (median 18 days), and 30 were discharged after an average of 72 days (me-

dian 99 days) after admission. Among all of these people, some possible cases of plague are unrelated to the four clusters reported by Tadino [1], such as that of a certain Francesco Panzino and his wife Cattarina, who were admitted to the Lazzaretto on 6 December and respectively died on 8 and 28 December.

The 1629 register of the *Liber Mortuorum*.

The 1629 MML recorded 5,993 deaths [10], of which 1,455 (24%) occurred between 1 October and the end of the year. In all cases, the health officials in charge specifically certified the absence of plague by means of the abbreviation *s.p.s.* (*sine pestis suspicionem*): i.e. with no suspicion of plague. Nevertheless, 531 of the deaths recorded in the last three months of 1629 (36,5% of the total number) were attributed to fever with no described organ involvement and no mention of a rash or external lesion of any kind [10].

The case of the *Vicario di Provvisione*, *Perillustrissimus Dominus Alfonso Visconti*

The death of Alfonso Visconti, which occurred on 9 October 1629, was recorded in the MML as follows: "*P. Vercellina, Parr. Sancte Marie ad Portam. Perillustrissimus Dominus Alfonsus Vicecomes I.C. collegiatus annorum 55 vel circa, ex febre acuta et maligna obiit s.p.s., iud. Carcani phisici collegiati.*" (*Porta Vercellina*, parish of *Santa Maria alla Porta*, the most illustrious nobleman Alfonso Visconti, a member of the college of lawyers aged about 55 years, died due to an acute and malignant fever, with no suspicion of plague, in the judgement of Carcano, collegiate physician). Alfonso Visconti was the *Vicario di Provvisione*, a highly placed administrative position responsible for duties that today are attributed to the city mayor. Writing a few years after the plague, a prominent Milanese doctor, Senatore Settala, affirmed in his chronicle that *alli 9 ottobre 1629 morse il vicario di provvisione signor Alfonso Visconte, homo di gran bontà e satisfatione universale. Morse di febbre pestilenziale con segni morelli et neri et un segno morello di forma lunare sotto la assella sinistra, senza però alcuno rilievo; non essendovi ancor cominciato la peste si disse non essere peste* (On 9 October 1629, died the *Vicario di Provvisione*, Alfonso Visconte, a man of great goodness who was universally well-liked. He died of pestilential fever with dark and black marks and a dark, moon-shaped mark under the left armpit, but without

any swelling; as the plague had not yet begun there, it was said that he did not have the plague) [9]. It seems evident that Settala believed that the *Vicario di Provisione* had died of plague and considered the attribution of his death to a non-pestilential malignant fever to be merely a political diagnosis.

Plague clusters reported by Alessandro Tadino

Tadino's account identifies four distinct plague clusters occurring between 22 October and 25 December 1629.

Cluster 1: The House of the Goldsmith

According to Tadino, the first case of plague in Milan (Figure 1) involved a certain Pietro Paolo Lovato or Lovati, an infantryman who had bought (or stolen) some clothes from some German soldiers garrisoned in Lecco that he intended to sell in Milan. On 22 October, shortly after arriving in the city, he fell ill and was taken to Milan's principal hospital *Ca' Granda* where he was diagnosed as having plague with buboes in his left armpit and died on 30 October. Three members of the hospital staff who fell ill after taking care of him recovered without consequences. Senatore Settala revealed in his chronicle that, for reasons of expediency, he had prudently preferred to judge the case suspicious but unconfirmed at the time [9].

Before being hospitalised, Lovati had lived in a building in *Porta Orientale* (San Babila parish, Figure 2) called *Ca' de l'Oreves* (the *House of the Goldsmith*) in the Milanese dialect. On the day of his death, two of Lovati's relatives, Dionisa de Nazari (his mother or, more probably, his grandmother, the sources contradict each other in this regard) and his little sister Teresa Lovati were confined to the Lazzaretto, their rooms were closed, and all of their possessions were seized and burned as a precautionary measure. They fell ill starting from the beginning of November with buboes in the groin, but recovered thereafter and were in good health at the beginning of March 1630 [9]. Carlo Colonna, the 28-year-old landlord of the *Ca' de l'Oreves* who had received some clothes from Lovati in payment of the rent, fell ill on 16 November, 24 days after the onset of Lovati's symptoms, and died at home on 20 November with clear signs of plague. A brief note written by the *protofisico* Lodovico Settala says he had acute fever, pain in his right groin, and other symptoms [9]. Like that of Lovati, Colonna's death was not recorded in the MML. The diagnosis of plague was deliberately kept uncertain with the excuse that he also suffered from syphilis, which could make the interpretation of his symptoms doubtful. Interestingly, he fell ill just after returning from Monza (not far from Milan), where he had gone to watch the army passing through



Figure 1

A report of the first case of plague in Milan [14], which says:

"On 16 November 1629, a soldier named Pietro Paolo Lovato left Chiavenna and came to Milan, arriving at the house of Collona in the borough of Porta Orientale where his mother, Sabetta Lovatta, lived. The said soldier fell ill and was taken to Ospedale Maggiore, where he was found to have a contagious disease. Within two days, he passed away. At the same time, Collona fell ill with a bubo in the groin and [died] three days later. The rest of his family was taken to the Lazzaretto Maggiore, and this is the first case that occurred in Milan."

Figure 2
 Historical map of Milan showing the indicative locations of the four plague outbreaks occurring at the end of 1629. The locations were determined on the basis of Alessandro Tadino's description of the episodes [1], and the historical map has been superimposed on a modern map using QGIS [12-14].



and he had bought some clothes from the soldiers. According to Tadino, after his death, the infection spread rapidly throughout his family and his household, and subsequently to the rest of the building. His wife, Marta Avogadro, their three children and a servant, Elena Morroni, were confined to the Lazzaretto on 21 November. They were joined by another person, Francesco Venturino, on 23 November, and then by two women who had cleaned the corpse of Carlo Colonna: Geronima Melegnani (with her two children) on 27 November and Apollonia Ripamonti on 7 December. On the same day, Prassede Pirola (known as *la Cartera* or paper maker), a neighbour who was in Colonna's house during his illness (and had probably stolen some clothes from him) was confined with her daughter Paola after the deaths of another child and her husband on respectively 2 and 4 December. The members of another family living in the *Ca' de l'Oreves*, Francesco Varese and his wife Livia Vimercata, also died on 7 December, the day that saw their relatives, Giovanni Pietro, his wife Marta (nicknamed *la Saviettera* or towel maker), and their five children entering the Lazzaretto. Eight of the people of the *Ca' de l'Oreves* who were confined in the Lazzaretto died (Table 1). Marta Avogadro-Colonna and six other remained healthy and symptom free throughout their quarantine; Giovanni Colonna was briefly ill with fever; Prassede Pirola had symptoms but slowly recovered from the beginning of January; and Marta

Varese and her daughter Isabella had the plague but fully recovered (according to a report dated 7 March, Marta Varese was the last to fall ill but returned to health by the end of January). All of them were released on 29 March 1630.

Cluster 2: Geronimo Redaello and relatives

Geronimo Redaello, known as *Maghino* (little wizard), fled from Merate (a small town north-east of Milan on the road from Lecco), entered Milan on 22 November using a forged health licence [1, page 53], and was hosted in the home of his brother-in-law, Bernardo Bellano, a *strazaro* (ragman), near Porta Vercellina (Figure 3). He died within two days of his arrival with buboes and carbuncles on his right buttock according to health officer Michele Drisaldi [1, page 53], although another health officer, Camillo Vianone, recorded his death in MML as being due to a long fever *sps* (*P. Vercellina, Parr. Sancte Marie ad Portam. Hieronimus Redaellus annorum 16, ex febre longa obiit s.p.s., iud. superscripti*). A few days later, the *strazaro* fell ill with pestilent fever, delirium and buboes in the groin, and died within five days on 15 December. Once again, although the *protofisico* Lodovico Settala, his son Senatore, and Tadino examined his corpse and declared him plagued, the *physicus* Castiglioni recorded in MML the cause of his death as a simple acute fever. On 9 December, Lucrezia Redaella (*Maghino's* sister and Bellano's wife) gave birth to a son who died of the plague four days later, on

Table 1 - The tenants of the *Ca' de l'Oreves* who died of plague or were confined to the Lazzaretto. The outcomes are those reported in Tadino's book [1] and/or recorded in the register of the Lazzaretto.

<i>Name</i>	<i>Age (years)</i>	<i>Appearance of symptoms</i>	<i>Confinement to the Lazzaretto</i>	<i>Date of death</i>	<i>Date of discharge from the Lazzaretto</i>	<i>Outcome</i>	<i>No. of days between confinement and death</i>
Pietro Paolo Lovati		22/10/1629	–	30/10/1629	–	Died in hospital	–
Dionisa de Nazzari-Lovati		?	30/10/1629	–	Alive 07/03/1630 (29/03/1630?)	Survived*	–
Teresa Lovati	6 (or 9)	?	30/10/1629	–	Alive 07/03/1630 (29/03/1630?)	Survived*	–
Carlo Colonna	28	16/11/1629	–	20/11/1629	–	Died at home	–
Giuseppe Colonna		?	21/11/1629	08/12/1629	–	Died	17
Marc'Aurelio Colonna		?	21/11/1629	26/12/1629	–	Died	35
Marta Avogadro-Colonna		?	21/11/1629	–	29/03/1630	Survived	–
Giovanni Colonna		?	21/11/1629	–	29/03/1630	Survived*	–
Elena Morroni		?	21/11/1629	–	29/03/1630	Survived	–
Francesco Venturino		?	23/11/1629	05/01/1630	–	Died	43
Apollonia Ripamonti		?	07/12/1629	09/12/1629	–	Died	3
Geronima Melegnani		?	27/11/1629	21/12/1629	–	Died	25
Giovanni Melegnani		?	27/11/1629		Alive 07/03/1630 (29/03/1630?)	Survived	–
Laura Melegnani		?	27/11/1629		Alive 07/03/1630 (29/03/1630?)	Survived	–
Carlo Antonio Pirola		?	–	04/12/1629	–	Died at home	–
Prassede Pirola		?	07/12/1629		29/03/1629	Survived*	–
Paola Pirola	3	?	07/12/1629		29/03/1629	Survived	
Prassede Pirola's son		?	–	04/12/1629	–	Died at home	–
Francesco Varese		?	–	07/12/1629	–	Died at home	–
Livia Vimercati		?	–	07/12/1629	–	Died at home	–
Giovan Pietro Varese		?	12/12/1629	29/12/1629	–	Died	18
Marta Varese		?	12/12/1629	–	29/03/1630	Survived*	–
Camilla Varese		?	12/12/1629	05/01/1630	–	Died	25
Melchiorre Varese	16	?	12/12/1629	26/01/1630	–	Died	46
Isabella Varese	18	?	12/12/1629	–	29/03/1630	Survived*	–
Margarita Varese	11	?	12/12/1629	–	29/03/1630	Survived	–
Giovanni Battista Varese	9	?	12/12/1629	–	29/03/1630	Survived	–

*infected

the same day that saw the death of Vittoria Cattanea, an 8-year-old servant who had attended Bernardo Bellano during his illness [1, page 53] although, like that of her master, her death was attributed to fever *sps* in the MML entry dated 14 December. Lucrezia never fell ill but was confined to the Lazzaretto on 17 December, together with her son Gerolamo, her servant Caterina Cattanea (the mother of Vittoria), and Caterina's daughter Persedia, all of whom having symptoms. Gerolamo died on Christmas Eve, Caterina on 27 December, and Persedia on 11 February, whereas Lucrezia was released on 29 March.

Cluster 3: Caterina Herbei

According to Tadino, a woman named Caterina Herbei, who lived in the *Borgo degli Ortolani* (green-grocers' borough) in the immediate outskirts of *Porta Comasina* (Figure 2), died on 16 December, three days after developing pestilent fever, pain under her right arm, and a bubo in her right groin, and that her post-mortem examination revealed another bubo behind her left ear and some black marks on her abdomen [1, page 53]. The RLM reports on 17 December the entry in the Lazzaretto of three people with the surname *Arpei* or *Arperi* (a father, mother, and daughter). An anonymous report dated 7 March 1630 has allowed us to identify these as Ambrogio Cozzo, his wife Paula, and his daughter Maddalena and Caterina Herbei as the Cozzo's mother and probably the 45-year-old Caterina Nava recorded in the MML as having died on 15 December in the parish of *S. Protasio Foris*, which included the lower part of the *Borgo degli Ortolani* [9]. According to the surgeon Michele Drisaldi, her death was due to "long fever" *sps* but the fact that her family was confined to the Lazzaretto suggests that this was another convenient diagnosis and that the health authorities were convinced otherwise. Her daughter-in-law experienced some of the symptoms of plague in January 1630, and she underwent the incision of a bubo on her shoulder; however, she recovered, and all of the family were released on 29 March.

Cluster 4: Giuseppe Bonfante and the Betolino of the Saints Gervasio and Protasio

On 24 December, a young man, Giuseppe Bonfante succumbed to the plague after three days of illness in the inn of Saints Gervasio and Protasio, in the *sestiere* of *Porta Comasina*. Tadino reports that the

innkeeper, the surgeon Michele Drisaldi, and other officials deliberately concealed his death to take possession of his belongings (some gold coins and luxury clothes) and avoid the forced closure of the inn by the *Tribunale di Sanità*. [1, page 53]. The body was anonymously interred, and Drisaldi falsified the recording in the MML by treacherously adding it at the bottom of the page dated 8 November and declaring fictitious symptoms (fever and catarrh) as the cause of death (*P. Cumana, Parr. Sancti Carpophori. Ioseph Bonfantus annorum 28, febre laborans deinde cattaro suffocatus obiit s.p.s., iud. Suprascripti Drisaldi* – *Porta Comasina*, parish of *S. Carpophorus*. Giuseppe Bonfanti, 28 years old, suffering from fever and then died suffocated by catarrh, with no suspicion of plague in the judgement of the above-written Drisaldi). Unfortunately for the plotters, the brother of the innkeeper and the inn's cook fell ill on Christmas Day. The cook was transferred to *Ca' Granda* hospital, where he was recognised as having the plague. On 31 December, his case was reported to *Protofisico* Lodovico Settala who, on 1 January personally inspected the inn, accompanied by Tadino. Francesco Gregorio, the innkeeper, was found plagued with a bubo in his right groin. He died that very night. Settala ordered the immediate closure of the inn and decided that Giovanni Battista Gregorio, the brother of the innkeeper, three servants, two waiters and a porter and two other people who were possibly guests of the inn should be transferred to the Lazzaretto. Except for Giovanni Battista Gregorio and one case of fever during the first days of confinement, they remained healthy and symptom free. All of them were released at the end of March 1630. The cook (Pietro Martire della Torre), who had been transferred from the hospital to the Lazzaretto on 1 January, died on 11 January according to the RLM. No trace of the death of the innkeeper was found by us in the MML or RLM.

DISCUSSION

Including those of two foreigners who died in the Lazzaretto, a total of 39 cases of plague occurred in Milan between 9 October 1629 and the first weeks of 1630 were found in the consulted sources, of which 29 (74.4%) ended in death. However, the records of plague-related deaths were (probably intentionally) inaccurate. There seems to be no doubt that there was a conscious decision to hide

the real cause of the death of the *Vicario di Provvisione*. Comprehensibly, it would have been scandalous and potentially dangerous in terms of public order if it were declared that the very first case of plague in Milan affected one of the city's highest administrative authorities. Alessandro Carcano, the doctor who took on the task of writing his death certificate in MML, was a nobleman and a senior physician who had been a member of the College of physicians since 1605 [15]. During 1629 he registered in the MML other 64 deaths mostly of members of the nobility or secular clergy. In other words, he was a doctor of rich people and a trusted member of the political establishment of the city. The fact that MML contains no trace of several people with the plague who died at their homes suggests a deliberate wish to conceal the presence of the disease in the city for as long as possible. The attributions of the deaths of Bernardo Bellano and Vittoria Cattanea to a fever and those of Geronimo Redaelli and Caterina Nava to long fever, *sine pestis suspicione*, are plainly false. Given that the plague was presumed to fatal within a period of a few days, a diagnosis of long fever was conveniently used to reinforce the exclusion of a diagnosis of plague (particularly by the *cerusici della Sanità*) when there was no other information about the clinical history of the dead [10, 16–18]. Finally, the case of Bonfanti is such a clear episode of corruption that it raises serious concerns about the integrity of the health officials.

The apparent absence of any geographical or temporal connection between the four outbreaks reported in the city suggests that there were multiple and independent entries of the disease into the city. Intriguingly, the House of the Goldsmith outbreak itself may have been due to two successive introductions as Carlo Colonna fell ill 22 days after the last possible contact with Lovato but just a few days after he had bought some more clothes from the soldiers near Monza. The incubation of bubonic plague is 2–6 days after the flea bite [19–21]. It is possible to hypothesise the unusually long survival of an active vector in the clothes that Lovato gave him, but it is more likely that Colonna was infected at the time of the second visit to Monza. Colonna *morì nella quarta* (died of the fourth day) but, according to the RLM, only his family was confined to the Lazzaretto immediately after his death on 21 November; the other tenants were not sent to the Lazzaretto until December (about a

fortnight after Colonna's death), and the large Varese family were not sent until 12 December, five days after the death of Francesco Varese, probably occurred at home. The intervention of the *Tribunale di Sanità* was not as rapid as Tadino claimed – *di subito forno d'ordine del Tribunale mandate tutte quelle famiglie al Lazzaretto* (all of those families were immediately sent to the Lazzaretto by order of the *Tribunale*) [1, page 52] – and it is likely that the order was given to each family only after the disease had appeared in one of its members.

However, even assuming that the registered cases were underreported, it is unlikely that the spread of the autumn epidemic in Milan extended significantly beyond the four outbreaks described by Tadino. This view is supported by the limited number of people in the Lazzaretto, which is where the families of an afflicted subject would have been sent. The MLR mentions only two possible plague outbreaks other than those reported by Tadino, occurring in late November and early December and each involving only a single family. It is also interesting to note that the only case involving a foreigner was that of a certain Domenico Masmati from Burgundy, who entered the Lazzaretto on 21 November and died there on 10 December. However, his death is not mentioned by Tadino, and it possible that it was not due to plague.

The idea that the autumnal spread of the plague was significant is also contradicted by the number of deaths recorded in the MML or the months of October, November, and December 1629, which is not significantly higher than the average of the number deaths recorded in the same months during the previous 28 years [10, 22]. Although it is probable that a certain number of cases were deliberately hidden, this would have been possible only if the overall number of cases was small and remained so when autumn passed into winter.

The cases occurring in Milan in 1629 were clearly cases of bubonic plague. As a member of the *Tribunale della Sanità*, most of them were directly observed and diagnosed by Tadino, who described the sites of the buboes and other plague-related lesions in each of the cases he saw. For example, Carlo Antonio and Paola Pirola died with *buboni sotto le braccia* (buboes under their arms), and Francesco Varese, Livia Vimercata, Appollonia Ripamonte and Geronima Melegara, died with *li medesimi segni pestilentiali* (the same pestilential signs) [1, page 52].

Given the biological cycle of its major vector, the flea, bubonic plague can only be sustained at epidemic levels if the temperature is 10-25°C and relative humidity is high [23]. The oviposition of the main vector in Southern Europe, *Xenopsylla cheopis* (the black rat flea) is inhibited when the temperature is less than 18°, and temperatures of less than 7°C can be deleterious for all but the adult stage of development [24]. The synthesis of the extracellular polysaccharide matrix surrounding *Y. pestis* cells, which consolidates them into a cohesive mass that enables the durable attachment and blockage of the flea foregut is optimal at temperatures ranging from 21°C to 24°C [25-27]. Consequently, in temperate areas, bubonic plague is a disease of the warmer months, and the containment and extinction of autumn outbreaks in Milan were probably mainly due to climatic reasons. However, in the Middle Ages, plague epidemics were reported even in the winter in cold places such as Norway, Sweden, and Scotland, a phenomenon for which a role in the transmission of *Yersinia pestis* has been proposed for the louse that, unlike the flea, remains highly active even in the winter [28-30]. Large concentrations of people can also play a role in amplifying plague epidemics that are difficult to explain in terms of an exchange of ectoparasites, which is more likely to occur in close co-habitation. Our recent analysis of plague deaths in Milan in 1630 confirmed an amplification of the epidemic after the 11 June procession with the Saint Carlo Borromeo body [12]. Airborne transmission was long considered inefficient and as only occurring from patients with overt pneumonic plague, who are less than the 3% of the total reported cases [31]. However, in 1924, two patients with secondary pneumonic plague in Los Angeles could spread the infection to 32 other people in only three days and, more recently, in 2017, the 78% of the cases reported in Madagascar epidemic had pneumonic plague [32-34]. Airborne transmission may therefore be more frequent than previously thought and arise from even asymptomatic or pauci-symptomatic subjects, which may explain the rapid transmission of the disease at the inn of Saints Gervasio and Protasio. Interestingly, the RML data also confirm that the Lazzaretto was used to quarantine healthy foreigners for a median of approximately two weeks, whereas the contacts of people with the plague and symptomatic cases were confined for much

longer, sometimes for months. It can be assumed that this policy was adopted to minimise the risk of contagion, which was believed to last for well beyond forty days. This seems to have been the view of Tadino who, in the passage referring to Colonna's wife Marta Avogadra, mentions that she had charitably donated many clothes before being moved to the Lazzaretto and, although many were intercepted and burned by the Sanità, it was possible that many clothes remained hidden in the houses of the neighbourhood, and they could cause a great slaughter of mortality in the coming spring [1, page 52]. Indeed, the concealment of clothes and goods belonging to plague victims was viewed as a major health concern by authorities [35,36]. In response to this threat, many cities implemented rigorous measures including the purging and sequestering of all items associated with plague victims [37].

The people confined in the Lazaretto certainly did not live in safe conditions. For example, Marc' Aurelio Colonna died 35 days after beginning his confinement but only 18 days after the death of his brother Giuseppe, thus suggesting that one brother might have infected the other while they were in the Lazzaretto. Camilla Varese, Francesco Venturino, Melchiorre Varese and Presedia Cattanea also died respectively 25, 43, 46 and 56 days after admission.

Governments frequently failed to report cases of the plague in order to avoid public panic and the economic repercussions of a ban on trade [38]: two of many examples of such reluctance are those of Venice in March 1576 (see pages 31 and 49 of [39]) and Prato in August 1630 (see page 103 of [40]). It should also be remembered that, in the midst of an ongoing war, it was in the interests of the Spanish government to conceal the epidemic and any news concerning the plague; it is therefore plausible that some of the numerous cases of acute fever documented in the MML may actually have been plague victims.

In conclusion, a deliberate effort was made to conceal some of the cases of plague occurring in Milan from October 1629. However, the spread of the disease in autumn remained limited and it was probably stopped by climatic factors more than by the interventions of public health officials.

Conflict of interest

None to declare.

Funding

None to declare.

Authors' contributions

RN and LF contributed equally.

REFERENCES

- [1] Tadino A. Raguaglio dell'origine et giornali successi della gran peste contagiosa, venefica, & malefica seguita nella Città di Milano, & suo Ducato dall'anno 1629. sino all'anno 1632. Milano, per Filippo Ghisolfi; 1648.
- [2] Ripamonti G. Iosephi Ripamontii cononici scalensis chronistae urbis mediolani de peste quae fuit anno MDCXXX: Libri V: desumpti ex annalibus urbis quos LX. decurionum auctoritate scribebat. Apud Malatestas, Regios ac Ducales Typoraphos; 1640.
- [3] Marioni PA. Dispatch of 24 October 1629 in Mutinelli F. Storia arcana ed aneddotica d'Italia. Page 37. Vol. 4. 1855.
- [4] Pandolfini D. Dispatch of 21 October 1629 in Nicolini F. Peste e untori. Pages 80-81. 1937.
- [5] Archivio di Stato di Milano (ASMi), Atti di Governo, Sanità Parte Antica, 282.
- [6] Atti di Governo, Popolazione, parte antica, bb. 118-119.
- [7] Vaglianti F, Cattaneo C. A medieval contribution to the history of legal medicine: the first European Necroscopic Registry. 2010;
- [8] Luconi E, Boracchi P, Nodari R, et al. Spatial and Temporal Analyses of the Event of Death for 1480 in Milan Using the Data Contained in the Sforza's Registers of the Dead. *Int J Environ Res Public Health*. 2023 Feb 4; 20(4): 2783.
- [9] Spiriti A, Facchin L, Settala I. L'arte, la scienza e la peste. Da Federico Borromeo ad Alessandro Manzoni. *AlboVersorio*; 2023.
- [10] Galli M, Oreni L, Ridolfo AL, et al. Milan's forgotten epidemic of summer 1629, a few months before the last great plague: An investigation into the possible cause. *PLOS ONE*. 2023 giu; 18(6): e0279218.
- [11] Archivio Storico Civico e Biblioteca Trivulziana, Milan, Materie, b. 349 [Epidemie].
- [12] Galli M, Nodari R, Perini M, et al. A spatiotemporal reconstruction of the 1630 plague epidemic in Milan. *iScience*. 2023; 26(5): 106704.
- [13] Blaeu J. Nouveau théâtre d'Italie, ou, description exacte de ses villes, palais, eglises, &c. et les cartes géographiques de toutes ses provinces. P. Mortier Libraire; 1704.
- [14] QGIS Development Team. QGIS Geographic Information System. <http://www.qgis.org>. 2022;
- [15] Processo per l'ammissione di Alessandro Carcano al Collegio dei fisici di Milano. Archivio Carcano 44.9, busta 153, sottofasc. 138.9.
- [16] Alessandri F. Trattato della peste, et febris pestilenti; 1586. page 44.
- [17] Sennert D. De Febribus Libri IV.: Cui accessit Fasciculus Medicamentorum contra Pestem. Schürer; 1628. page 421.
- [18] Cohn SK. Cultures of plague: medical thinking at the end of the Renaissance. Oxford University Press, USA; 2010.
- [19] Wu L. Plague in the Orient with Special Reference to the Manchurian Outbreaks. An Address delivered at the opening of the Union Medical College, Peking, September 16th, 1921. *National Medical Journal of China*. 1921; 4.
- [20] Butler T. Plague and other Yersinia infections. Springer Science & Business Media; 2012.
- [21] Prentice MB, Rahalison L. Plague. *The Lancet*. 2007; 369(9568): 1196-1207.
- [22] Ferrario G. Statistica medica di Milano dal secolo 15. fino ai nostri giorni. Vol. 2. Guglielmini & Redaelli; 1840.
- [23] Cohn SK. Epidemiology of the black death and successive waves of plague. *Medical History*. 2008; 52(S27): 74-100.
- [24] Twigg GI. The Black Death in England. An Epidemiological Dilemma. In: *Maladies et sociétés (XIIe-XVIe siècles) Colloque*. 1989; 75-98.
- [25] Jarrett CO, Deak E, Isherwood KE, et al. Transmission of Yersinia pestis from an infectious biofilm in the flea vector. *J Infect Dis*. 2004; 190(4): 782-792.
- [26] Hinnebusch BJ, Jarrett CO, Bland DM. "Fleaing" the plague: adaptations of Yersinia pestis to its insect vector that lead to transmission. *Ann Rev Microbiol*. 2017; 71: 215-232.
- [27] Lemon A, Cherzan N, Vadyvaloo V. Influence of temperature on development of Yersinia pestis foregut blockage in Xenopsylla cheopis (Siphonaptera: Pulicidae) and Oropsylla montana (Siphonaptera: Ceratophyllidae). *J Med Entomol*. 2020; 57(6): 1997-2007.
- [28] Benedictow OJ, Slack P. Plague in the late medieval Nordic countries: epidemiological studies. *Bulletin of the History of Medicine*. 1993; 67(4): 715-716.
- [29] Drancourt M, Houhamdi L, Raoult D. Yersinia pestis as a telluric, human ectoparasite-borne organism. *Lancet Infect Dis*. 2006; 6(4): 234-241.
- [30] Barbieri R, Drancourt M, Raoult D. The role of louse-transmitted diseases in historical plague pandemics. *Lancet Infect Dis*. 2021; 21(2): e17-25.
- [31] Kool JL, Weinstein RA. Risk of person-to-person transmission of pneumonic plague. *Clinical infectious diseases*. 2005; 40(8): 1166-1172.
- [32] Meyer KF. Pneumonic plague. *Bacteriol Rev*. 1961; 25(3): 249-261.
- [33] Viseltear AJ. The pneumonic plague epidemic of 1924 in Los Angeles. *The Yale J Biol Med*. 1974; 47(1): 40.
- [34] Randeremana R, Andrianavaoimanana V, Nikolay B, et al. Epidemiological characteristics of an

urban plague epidemic in Madagascar, August-November 2017: an outbreak report. *Lancet Infect Dis.* 2019; 19(5): 537-545.

[35] Tsiamis C, Thalassinou E, Poulakou-Rebelakou E, et al. The Venetian lazarettos of Candia and the Great Plague (1592-1595). *Infez Med.* 2014 Mar 1; 22(1): 69-82.

[36] Barbieri R, Nodari R, Signoli M, Epis S, Raoult D, Drancourt M. Differential word expression analyses highlight plague dynamics during the second pandemic. *Royal Society Open Science.* 2022 Jan 5; 9(1): 210039.

[37] Vicentini CB, Contini C. Control measures of a 400-year-old plague epidemic: an example of past efficiency at controlling disease and similarities with current epidemics. *Infez Med.* 2020; 28(4): 621-633.

[38] Sabbatani S, Fiorino S, Manfredi R. The plague which hit the city of Bologna in the year 1630. *Infez Med.* 2021 Mar 1; 29: 145-156.

[39] Preto P. *Peste e società a Venezia, 1576.* Neri Pozza; 1978.

[40] Cipolla CM. *Contro un nemico invisibile: epidemie e strutture sanitarie nell'Italia del Rinascimento.*