



REVIEW

# The concept of quarantine in history: from plague to SARS

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**Summary** The concept of 'quarantine' is embedded in health practices, attracting heightened interest during episodes of epidemics. The term is strictly related to plague and dates back to 1377, when the Rector of the seaport of Ragusa (then belonging to the Venetian Republic) officially issued a 30-day isolation period for ships, that became 40 days for land travellers.

During the next 100 years similar laws were introduced in Italian and in French ports, and they gradually acquired other connotations with respect to their original implementation.

Measures analogous to those employed against the plague have been adopted to fight against the disease termed the Great White Plague, i.e. tuberculosis, and in recent times various countries have set up official entities for the identification and control of infections.

Even more recently (2003) the proposal of the constitution of a new European monitoring, regulatory and research institution has been made, since the already available system of surveillance has found an enormous challenge in the global emergency of the severe acute respiratory syndrome (SARS). In the absence of a targeted vaccine, general preventive interventions have to be relied upon, including high healthcare surveillance and public information. Quarantine has, therefore, had a rebound of celebrity and updated evidence strongly suggests that its basic concept is still fully valid.

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## Introduction and definition of quarantine

The concept of 'quarantine' is radically embedded in local and global health practices and culture, attracting heightened interest during episodes of perceived or actual epidemics. The term, however, evokes a variety of emotions, such as fear,

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resentment, acceptance, curiosity and perplexity, reactions often to be associated with a lack of knowledge about the origins, meaning, and relevance of quarantine itself.

Historically quarantine has been defined as the detention and segregation of subjects suspected to carry a contagious disease. More recently, the term quarantine has come to indicate a period of isolation imposed on persons, animals or things that might spread a contagious pathology.<sup>1</sup> Nowadays the word quarantine should be used to refer to compulsory physical separation (including restriction of movement) of groups of healthy individuals who have been potentially exposed to a contagious disease.<sup>2</sup> The term 'isolation' must be kept separate from the term quarantine, since the former denotes the separation and confinement of subjects already known to be infected with a contagious disease to prevent them from transmitting disease to other people; the latter, essentially the same procedures but with *suspected* transmitters of disease.

## Health interventions on the population in the ancient past

From ancient times different populations have adopted varying strategies to prevent and contain disease. One of these is exactly what we would now call isolation. The Old Testament evidences how individuals affected by diseases were separated from others, and people with leprosy, as *Leviticus* informs, had to live isolated all their lives. In the New Testament, too, leprosy continues to be considered a reason for social discrimination, and is represented as curable only through the phenomenon of a divine intervention. The isolation, temporary or otherwise, of sick people has thus always been extensively used as one of the approaches to limit the spread of disease.<sup>3</sup>

Another strategy was the establishment of a time limit to the manifestation of diseases. In the V century B.C. Hippocratic teaching had established that an acute illness only manifested itself within forty days. The case of plague was representative with respect to this; since a disease manifesting itself after 40 days could not be acute, but chronic, it could not be plague. In the ancient past the term *pestis* (plague) was used in a broad way to indicate every epidemic characterised by high mortality, and magical practices were implemented to fight different diseases since the idea of preventive instruments (such as quarantine) was still not present.<sup>4</sup> With regard to the real plague (the

disease caused by *Yersinia pestis*), one may remember the first great pandemic wave of the Greek-Roman period, and the recurrent epidemics throughout Europe in the VI and VII centuries A.D. Against acute, fatal diseases such as bubonic plague attempts were made by healthy communities to prevent entry of goods and people from infected communities. In the VII century A.D. armed guards were stationed between plague-stricken Provence and the diocese of Cahors.<sup>5</sup> Particularly virulent was the impact of the disease on the whole of Europe in the middle of the XIV century, when the plague spread from southern Europe to Germany and Russia, causing the death of more than 30% of the European population.<sup>6</sup>

## Medieval laws, Renaissance health achievements and XVI-XVIII centuries overview

The concept of (modern) preventive quarantine is strictly related to plague and dates back to 1377, when the Rector of the seaport of Ragusa, today called Dubrovnik (Croatia), officially issued the so-called 'trentina' (an Italian word derived from 'trenta', that is, the number 30), a 30-day isolation period. Ships coming from infected or suspected to be infected sites were to stay at anchor for thirty days before docking. This same period of time became 40 days for land travellers, probably because the shorter period was not considered sufficient to prevent the spread of disease, and precisely from the Italian number forty ('quaranta') comes the term quarantine.<sup>7</sup> Furthermore, the chief physician of Ragusa, Jacob of Padua, also advised establishing a place outside the city walls for the treatment of sick (or suspected to be infected) citizens.<sup>8</sup> The imposition to remain 30-40 days in an isolated site was determined not only by health reasons, but also by economic necessity, since the quality and safety of the trade network needed to be protected from the Black Death. The attention dedicated by the Ragusan rulers to the plague was, therefore, responsible for the creation of the first 'official' quarantining as a legal system aimed at defending both health and commercial aspects.<sup>9</sup> The following were the main tenets of the 1377 law of Ragusa: visitors from areas where plague was endemic would not be admitted into Ragusa until they had remained in isolation for a month; whoever did not observe this law would be fined and subjected to a month of isolation; no one from Ragusa was allowed to go to the isolation area; people not assigned by the Great Council to care for

quarantined persons were not allowed to bring food to isolated people. In 1423 Venice set up one of the first known 'lazaretto' (quarantine station) on an island near the city, and the Venetian system became a model for other European countries.<sup>3</sup>

During the next 100 years similar laws were introduced in Italian ports (Pisa) and in French ones (Marseilles), and they gradually acquired other connotations with respect to their original implementation in the context of the Middle Ages.<sup>10</sup> One such connotation was the institution of a social body to provide the necessary isolation structures (dispositions, facilities, implementation of the laws themselves); another, of more intellectual and medical content, was the gradual acquisition of the essential mechanisms of contagion. In effect, even during the early Renaissance, physicians did not have a clear idea of infectiousness, though many waves of epidemics had succeeded one another in the course of the previous centuries.<sup>11</sup> It was only during the XVI century that Girolamo Fracastoro defined and empowered the concept itself, through the hypothesis that small particles were able to transmit disease.<sup>4</sup> This led the medical profession to integrate previously adopted remedies, simple and insufficient, with more precise quarantine interventions (even if not at an international level) that, however, became the remote bases for modern epidemiology and health sciences.<sup>12</sup>

In the XVI century the quarantine system was expanded through the introduction of bills of health, a type of certification that the last port visited by travellers was free from disease. A clean bill, with the visa of the consul of the country of arrival, entitled the ship to the use of the port without quarantine.<sup>5</sup>

In the course of the XVIII century the practice of quarantine had become, on the one hand a notable nuisance, and on the other, a source of abuse. With regard to the former point, the periods of quarantine were variable across different countries, so that there was no certainty concerning the time needed to implement the quarantine itself. As consequence, not only delay, but perplexity was caused to travellers. With regard to the latter question, instances of bureaucratic and restrictive implementation of quarantine regulations were rife, and the disinfection of correspondence was used as an excuse for political espionage.<sup>5</sup> The upshot of this diffused dissatisfaction with quarantine measures was the emergence of the awareness of the need for a shared standardisation, which, in turn, led to the call for XIX century international conferences.

## XIX century quarantine politics

From a scientific-epidemiological point of view the concept of quarantine had come to be defined quite precisely in the course of the XIX century, but the contemporaneous health organisation was not systematic and capillary enough to confront bursts of epidemics across Europe in an organic way. The mid-XIX century cholera epidemics, for example, evidenced the scantiness of international uniformity in quarantine practices. Even if France had proposed, already in 1834, a meeting for the discussion of the international standardisation of quarantine,<sup>13</sup> it was only in 1851 that the First International Sanitary Conference took place in Paris. Collaboration at the international level was hard to achieve since quarantine policies mirrored not only health organisation views, but also national trade protection issues that varied from state to state.<sup>14</sup> Open negotiation on quarantine was strongly limited by economic and political agendas, as documented by the 1885 Rome conference, where a proposal regarding the inspection of quarantine of ships from India, using the Suez canal, produced a violent discussion between Britain and France based not on health questions, as much as on the extent of British dominance over the canal.

With regard to the United States of America, protection against imported pathologies had always been retained a local issue, and so handled by the single states. Only sporadic attempts had been performed to impose quarantine requirements until repeated and serious yellow fever epidemics led to the passing of Federal Quarantine Legislation by Congress in 1878, a set of laws that paved the way for Federal involvement in quarantine activities. In 1892 the arrival of cholera from abroad prompted a reinterpretation of these laws so as to endow the Federal Government with more authority in the imposition of quarantine requirements.<sup>13</sup>

It was only in 1893 that, after a number of conferences held in the second half of the XIX century, an agreement was achieved both in Europe and in the United States, concerning the notification of disease and other issues. After this achievement conventions and regulations began to be ratified regarding, in particular, relevant principles for the standardisation of quarantine measures. In the United States, as local authorities realised the benefits of Federal involvement, local quarantine stations were gradually turned over to the government; in Europe established periods of detention were fixed with special reference to cholera, yellow fever and plague.<sup>14</sup>

## The XX century and the most recent developments

It is interesting to observe how measures analogous to those employed against the plague have been adopted to fight against the disease that, not by chance, has been termed the Great White Plague: we refer to tuberculosis (TB).<sup>15</sup> Before the tubercle bacillus was recognised as the causative agent of the disease, sanatoria had been set up as the only remedy for sufferers from tuberculosis; this may be considered as an application of the broad concept of 'preventive-therapeutic' quarantine. Sanatoria constituted a simple and inexpensive tool to break the chain of transmission of the disease, since they guaranteed isolation. They, therefore, had a precise role in controlling tuberculosis, and it is for this reason that, between 1880 and 1930, sanatoria spread across the whole of Europe and North America. Even during the 1950s, although streptomycin was already on the market (1947), TB hospitals were considered important for tuberculosis therapy as sites dedicated to the isolation of TB patients, as recommended by quarantine practice.<sup>16</sup>

In the scenario of contagious diseases of the past, the so-called 'health officers' deriving partly from medieval and renaissance predecessors and partly from figures created by the Schools of Hygiene, acquired fundamental importance. Among their various functions were those of furnishing the single national health systems with appropriate corporate entities and legislative organisms, as well as obviously caring for the health of the whole population. In many European countries, including Italy, these 'officers' represented, even in the second half of the XX century, the basis of all public health organisation devoted to the monitoring and control of infectious diseases.

**In the first 30 years of the XX century, a deep medicalization of quarantine measures occurred.** In 1903 the term 'lazaretto' (used especially for plague) was substituted by that of 'health station', since **in Europe, particularly in France and in Italy, the distinction among sick, suspectedly sick, and healthy people, began to acquire a real medical value.** Four years later an International Office of Public Health was established, and more than twenty nations adhered to it in less than 2 years. Variola and typhus were added to the three (plague, cholera and yellow fever) historical quarantining diseases in 1926, and 2 years later this same International Office imposed a set of quarantine rules targeted to all kinds of travellers (by land, sea

and air). When the World Health Organisation replaced the International Office of Public Health the expression 'quarantining diseases' disappeared, and pathologies controlled by international health laws (such as plague, cholera and yellow fever) or pathologies under surveillance (such as poliomyelitis, recurrent fever and typhus) appeared.<sup>17</sup>

In the face of this resurgence of attention towards infectious diseases, tuberculosis was again made the object of specific measures, which, however, served to monitor and control other diseases. Consequent to the high transmission and seriousness of tuberculosis in the Europe of the nineteenth century, various countries set up official entities for the identification and control of infections. In the United Kingdom a government-funded agency, the Medical Research Council (MRC), was created in 1913 in the hope of finding scientific solutions to the illness. Its activity was specifically directed to research. With reference to the other side of the Atlantic, in the twentieth century (1967) quarantine measures became the task of the National Communicable Disease Centre, at present called the Centre for Disease Control (CDC) and Prevention, an organisation, already equipped, in the sixties, with more than 50 quarantine stations located at every port and international airport, and, in the seventies, shifting its field of action from routine inspection to problem management, intervention and regulation.<sup>10</sup>

More recently (2003) the proposal of the constitution of a new European monitoring, regulatory and research institution was made, since the already available system of surveillance, set up in Europe to control the onset of epidemics, came up against an enormous challenge in the global emergency of the severe acute respiratory syndrome (SARS).<sup>18</sup> In the absence of a targeted vaccine, general preventive interventions had to be relied upon, including high healthcare surveillance and public information. Quarantine has, therefore, had a rebound of celebrity, as witnessed by the 'Fact Sheets' prepared and published by the CDC, in which one may read that 'Quarantine is medically very effective in protecting the public from disease'.<sup>19</sup> **The 'modern' quarantine for SARS is a 10-day period (the incubation period of SARS is in fact 2-9 days) and, like the quarantines of the past, has been applied to persons who have been exposed to the disease and who may be infected, while, once again, isolation has been implemented to separate healthy people from sick ones.**

As mentioned above, the health emergency of SARS has constituted a real challenge for health systems. However, it has also put into discussion the real effectiveness of quarantine measures, for,

precisely as for every other health intervention, quarantine has limits of application of which the medical and social community should be perfectly aware.<sup>20</sup>

A recent paper proposing a compartmental model for the geographical spread of infectious diseases shows how this scheme may be adopted to address the effectiveness of human quarantine. The model itself was applied to data deriving from a Canadian historical record regarding the time period of the so-called Spanish influenza pandemic (1918-19). Information on the daily mobility patterns of subjects engaged in the fur trade throughout central Canada before, during and after the epidemic were used to establish whether rates of travel were affected by informal quarantine policies, and then the same methodology was adopted to analyse the impact of observed differences in travel on the diffusion of the epidemic. This same model has suggested that quarantine effectiveness varies depending on when the limitation on travel between communities is applied, and on how long it lasts.<sup>20</sup> An operative template of such a type appears particularly interesting from our historical-scientific point of view since it links historical features to current scientific epidemiological evidence.

## Conclusions

Similar to other effective health measures, quarantine is not a panacea, and has its limits. This is highlighted by the recent risk of bioterrorism, where a potentially large and diverse number of agents may be implicated.<sup>21</sup> In addition, other recent epidemics, such as the acquired immuno deficiency syndrome (AIDS), cannot be considered quarantine-able not only because of medical but also because of ethical and legal issues.<sup>22</sup>

However, good quality evidence overall suggests that the basic concept of quarantine is still fully valid, and that the implementation of correct quarantine procedures must be tailored according to single health, social and geographical conditions.<sup>20,23,24</sup>

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## References

1. *Oxford English dictionary*. 2nd ed. Oxford, England: Oxford University Press; 1989. p. 983.
2. Barbera J, Macintyre A, Gostin L, et al. Large-scale quarantine following biological terrorism in the United States. *JAMA* 2001;**286**:2711–6.
3. Sehdev PS. The origin of quarantine. *Clin Infect Dis* 2002;**35**: 1071–2.
4. Lippi D, Baldini M. *La medicina: gli uomini e le teorie*. Bologna: CLUEB; 2000.
5. Knowelden J. *Quarantine and isolation*. 15th ed. *The new Encyclopaedia Britannica*, Chicago: Helen Hemingway Benton; 1979.
6. Slack P. The black death past and present. 2. Some historical problems. *Trans R Soc Trop Med Hyg* 1989;**83**:461–3.
7. Stuard SM. *A state of deference: Ragusa/Dubrovnik in the medieval centuries*. Philadelphia: University of Pennsylvania Press; 1992.
8. Cosmacini G. *L'arte lunga. Storia della medicina dall'antichità a oggi*. Bari: Editori Laterza; 2001.
9. Frati P. Quarantine, trade and health policies in Ragusa-Dubrovnik until the age of George Armmenius-Baglivi. *Med Secoli* 2000;**12**:103–27.
10. Mafart B, Perret JL. History of the concept of quarantine. *Med Trop* 1998;**58**:14–20.
11. Lippi D, Conti AA. Plague, policy, saints and terrorists: a historical survey. *J Infect* 2002;**44**:226–8.
12. Matovinovic J. A short history of quarantine (Victor C. Vaughan). *Univ Mich Med Cent J* 1969;**35**:224–8.
13. Maglen K. Politics of quarantine in the 19th century. *JAMA* 2003;**290**:2873.
14. Fidler DP. *International law and infectious diseases*. Oxford: Oxford University Press; 1999.
15. Gensini GF, Conti AA. The evolution of the concept of 'fever' in the history of medicine: from pathological picture per se to clinical epiphenomenon (and vice versa). *J Infect* 2004; in press.
16. Booker MJ. Compliance, coercion, and compassion: moral dimensions of the return of tuberculosis. *J Med Humanit* 1996;**17**:91–102.
17. *International sanitary regulations*. 3rd annotated ed. World Health Organization, 1966.
18. Ho W. Guideline on management of severe acute respiratory syndrome (SARS). *Lancet* 2003;**361**:1313–5.
19. <http://www.cdc.gov/ncidod/sars>. Severe acute respiratory syndrome. Fact sheet: Isolation and Quarantine, 2004.
20. Sattenspiel L, Herring DA. Simulating the effect of quarantine on the spread of the 1918–19 flu in central Canada. *Bull Math Biol* 2003;**65**:1–26.
21. Inglesby TV, Dennis DT, Henderson DA, et al. Plague as a biological weapon: medical and public health management. Working Group on Civilian Biodefense. *JAMA* 2000;**283**: 2281–90.
22. Musto DF. Quarantine and the problem of AIDS. *Milbank Q* 1986;**64**(Suppl 1):97–117.
23. Kilwein JH. Some historical comments on quarantine: part one. *J Clin Pharm Ther* 1995;**20**:185–7.
24. Kilwein JH. Some historical comments on quarantine: part two. *J Clin Pharm Ther* 1995;**20**:249–52.