'Twas Ever Thus: How the Public Health Measures to Combat COVID-19 Are Rooted in the Past

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Abstract: *Background:* Scientific advances have ensured that when a clinical syndrome caused by a novel coronavirus (SARS-CoV-2) was detected at the end of 2019, the full genomic sequence of the virus was deciphered and a test for its detection manufactured within weeks. As infection with the virus spread worldwide public health measures had to be introduced to reduce person to person transmission. Even after vaccines effective against the virus were developed, these measures continued to be required. *Method:* A literature search was performed to identify public health measures that had been implemented throughout history from the arrival of the plague in Europe in the sixth century CE. *Results*: Quarantine was introduced throughout Mediterranean states in the 14th century CE to minimise the spread of the plague. The regulations imposed during the Great Plague of London in the 17th century reveal elements of case detection, lockdown, isolation, social distancing, the restriction of large gatherings and the use a form of personal protective equipment. The plague led to the realisation among physicians that some diseases could spread from person to person and smallpox became recognised as being highly contagious. However, the contagionist view was strongly opposed by those who believed in the miasmic theory of disease and was hotly contested during the sanitary reform of the 19th century. After mid-century public health measures to prevent the spread of disease concentrated on the management of infected individuals including compulsory isolation for sufferers of smallpox and compulsory removal infected people to hospital. During the smallpox epidemic in Birmingham, UK in the 1870s patients admitted to the workhouse were kept in total isolation and visiting by relatives and friends was strictly prohibited, even when the patient was dying. The erection of extra buildings and the creation of temporary fever wards was necessary to accommodate patients during outbreaks of infectious disease. The technique of introducing smallpox pus into a scratch in the skin was practised in 10th century China becoming the standard method of inoculation until Jenner introduced the safer method of vaccination using cowpox or vaccinia virus in the early 18th century. A strong anti-vaccination movement arose at this time and the arguments put forward by the anti-vaxxers were strikingly similar to those of modern-day vaccine opponents. *Conclusion:* None of the public health measures used to combat COVID-19 are novel and all have their roots in the past.

Keywords: Pandemic, COVID-19, Quarantine, Self-isolation, Lockdown

1. Introduction

The outbreak with a novel betacoronavirus, SARS-CoV-2, was reported first in the city of Wuhan in the Hubei province of China in December 2019. Infection with the virus results in the syndrome of COVID-19 that could progress to acute respiratory distress similar to that produced by SARS-CoV in 2003 and MERS-CoV in 2012. The new virus spread rapidly throughout the city and in late January 2020 Wuhan became the first city to go into lockdown. Strict measures were employed involving the closure of all non-essential businesses and all public transport. To combat the ensuing overcrowding of Wuhan's hospitals with sick individuals, the Chinese authorities erected the new two-storey Huoshensan Hospital with 1,000 beds in ten days and staffed it with 1,400 medical personnel [1]. By mid-January infection had spread to other Chinese provinces putting many cities in lockdown and thereafter to the majority of countries in Asia. Worldwide air travel ensured its spread to other continents. The first confirmed cases in Europe were two Chinese tourists in Italy at the end of January. Around the same time a Chinese student returning to study in York and one of his relatives were the

first to test positive in the United Kingdom.

Those countries that had experienced SARS responded quickly imposing strict measures to curtail public freedom and introducing mass testing and intensive contact tracing. For example, South Korea adopted a strategy of testing those with suspected infection, identifying contacts and enforcing strict isolation. Schools were closed and working from home introduced with the wearing of face masks made compulsory. These measures supported by the use of information technology avoided a full lockdown. Travellers arriving in the country were quarantined for fourteen days [2]. Many countries banned travel from China early except for returning nationals who were required to self-isolate in hotels. Italy introduced temperature testing at airports for all arrivals, but as infection spread throughout the country, towns in Lombardy and Veneto initially were put into lockdown, followed by the rest of the country in early March.

The United Kingdom went into a full lockdown on 23 March with only essential services left open and social contact severely restricted by the instruction to stay at home, enforceable by law. From early May there was a gradual easing of restrictions that varied among the four nations as health was a devolved area of responsibility. When non-essential services were allowed to restart in England in early July, Leicester remained in full lockdown because of the high prevalence of the virus in the city. Increasing rates of infection in other areas of England resulted in the resumption of local restrictions. In early October a system of four tiers of restriction in England and five levels in Scotland was introduced, but as these failed to contain the virus a full nationwide lockdown was imposed once more at the end of the month. A further period of lockdown became necessary in December due to increasing rates of infection with variant strains of the virus. To increase bed capacity for the expected number of hospital admissions in the early stage of the outbreak spaces in existing buildings such as conference centres were converted into hospital facilities in seven cities in England and one in Scotland. Vaccines became available towards the end of the year and a national programme of vaccinations was organised in all four countries of the kingdom.

Despite the benefits of increased scientific knowledge that identified the genome of SARS-CoV-2 and the mode of transmission of the virus and produced tests for detecting its presence in the body, this article will argue that the public health measures to contain the spread of the virus are rooted in the past.

2. The Plague and the Beginning of Quarantine

Although the term plague was used in early history to mean any type of epidemic, the first outbreak of bubonic plague is attributed to the plague of Justinian which began in Egypt in 541CE. It continued to flare up at regular intervals around the Eastern Mediterranean for a further 200 years [3, 4]. When an epidemic disease affected a whole city necessary action took place on a civic rather than individual level, most commonly a religious response [3]. The second cycle of plague, known as the Black Death, spread rapidly from Asia through the Middle East and Northern Africa reaching Europe between 1347 and 1353. Episodes continued to sweep through Europe in the fourteenth and fifteenth centuries with occasional outbreaks thereafter, the last of which was in Marseille in 1720-22 [4]. Plague spread to England in 1348 by which time the City of London had been employing medical practitioners to bar infected persons from entering the city gates by checking them for signs of disease [5].

In 1377 the Venetian colony of Ragusa, now the modern city of Dubrovnik, passed civic measures to detain travellers from plague infected areas on a nearby island for 30 days. When this period proved ineffective it was raised to 40 days in 1397. From the Venetian word for forty, *quaranti*, we get the term quarantine. This is thought to be the world's first mandatory public health measure. In the early fifteenth century Venice built two permanent plague hospitals or *lazzaretti* that remained in use in plague free years and subsequently developed a coordinated system across all its territories [6]. Other Mediterranean states followed suit and by the mid-1770s there was a permanent network of quarantine stations across Europe [4, 7, 8]. Such measures were not restricted to the Mediterranean. At the port of Leith in Scotland ships and their cargo were put into quarantine for 40 days by taking them to one of the islets off the coast of Leith in the Firth of Forth or the Isle of May in the North Sea before being allowed to dock at the port [9].

The Great Plague of London of 1665-66 killed between one fifth and one quarter of the population. We can get a picture of the measures used to contain its spread from Daniel Defoe's *A Journal of the Plague Year*. Although a semi-fictional narrative it is based on actual accounts of the time and his setting out in formal fashion of the 'Orders Conceived and Published by the Lord Mayor and Aldermen of the City of London Concerning the Infection of the Plague, 1665' suggests it is a reliable account [10]. A number of officials dedicated to controlling the infection were appointed, the most significant being examiners of health. They were responsible for detecting residences where an ill person was present and commanding that the house was 'shut up' and access restricted. People living in a house where someone was infected could not leave without a certificate from the examiners confirming they were disease free. The head of a household was ordered to report to the examiners within two hours if anyone within it showed any sign of the plague or became ill for any obvious reason. Houses where a resident was found to be infected with the plague were to be shut for one month and if someone had visited that house, their residence was also to be shut for a period of time at an examiner's discretion. Watchmen were appointed to guard houses that were shut; one during the day and one at night to ensure no-one went in or out. They could also do errands for the household for necessary supplies, but were required to lock the house while they were away and take the key with them. Infected houses were marked with a red

cross in the middle of the main door. Female 'searchers' aided by 'chirurgeons' were employed to confirm whether the illness or death of an individual was due to the plague and were barred from any other employment. Assemblies of people were 'utterly prohibited', including plays, games and the 'singing of ballads'. Meals at the equivalent of restaurants and cafes were forbidden and drinking in taverns and coffee-houses restricted to no later than nine in the evening [10]. We can see in these regulations the elements of case detection using the facilities of the time, as well as lockdown, isolation, social distancing and the restriction of large gatherings.

Physicians at the time used a form of personal protective equipment consisting of a long cloak, gloves, hat and mask. The long beak-like nose piece of the mask was filled with aromatic substances. Not only would they counteract the unpleasant smell associated with the plague, but it was believed they would absorb elements of the disease that were carried in the 'corrupted' air according to the miasmic theory of disease generation [8]. It was appreciated that infected individuals could pass on the disease to others, although the mode of transmission was assumed to be through the air. However, the apparel may well have given protection from fleas that are now recognised as passing on the disease from infected rats.

In 1745 the physician and nonconformist minister, Theophilus Lobb, a member of the Royal College of Physicians in London, whose MD degree was awarded by the University of Glasgow, and a Fellow of the Royal Society, claimed the plague could be transmitted directly from person to person. He attributed the disease to 'pestilential particles' that invaded the body, transformed elements of the blood into themselves and multiplied. These particles, he argued, could be emitted from the body and be carried through the air to infect others, but also could be passed on via the clothes of those who attended on sick individuals. He laid down a long list of rules to control the spread of infection in urban populations. These included setting up 'pest-houses' for the reception of the sick. Instead of houses being shut up as in 1665, healthy individuals from infected households should be allowed to go about outside freely, but carry a white stick to signify they were living in an infected household. This would allow others to keep at whatever distance from them they wished. However, sick individuals were to be prevented from leaving home by watchmen standing at their door. In his view healthy contacts should be subjected to social distancing rather than isolation. Watchmen were also to be appointed to prevent large assemblies of people. He recommended houses should be ventilated by opening windows for three to four hours each day and subsistence should be provided for those whose employment and income were affected by the epidemic [11].

3. Contagionists and Anti-Contagionists

During the sixteenth century the conceptualisation of diseases as distinct individual entities rather than a bodily imbalance of the four humours began to emerge. Attempts to track outbreaks of plague by collecting and reporting mortality data led to the realisation that some diseases could spread from person to person and the concept of contagionism gained increasing medical support. During the second half of the eighteenth century the belief in some form of contagion increased rapidly in Britain. According to historian Margaret Delacey, it was 'upstart Edinburgh graduates' who established British contagionism as a separate movement. Along with others educated elsewhere in Scotland they fostered a research community to enhance their concept of fevers as separate entities. They collected and analysed clinical information relating to infectious diseases and created a network of medical research. Their work was underpinned by the nosology of disease developed by William Cullen, professor of the Institutes of Medicine at the University of Edinburgh. As they came to believe that febrile epidemic diseases could spread from person to person, they maintained that simple hygienic measures and the protective effect of fresh air could control or eliminate transmission. Thus, cleanliness along with quarantining in institutional facilities could arrest epidemics. They realised that curtailing epidemics meant controlling the behaviour of a large section of the population and called for government action to remove infected individuals from their homes. However, this consensus view held by most Scottish graduates remained controversial in the profession as a whole [12].

John Haygarth, who had studied under Cullen, was one of the leading contagionists of his generation. He initially studied mathematics at Cambridge University, then spent three years at Edinburgh Medical School, but obtained his medical degree from Cambridge. After his appointment as physician to Chester Infirmary in 1766, he carried out a survey of the health and mortality of the citizens of the town using Cullen's classification based on his theory of disease transmission to tabulate his data. His observations and those of his correspondence network on the spread of the influenza epidemic of 1775 led him to conclude that influenza was a contagious disease. Certain that the smallpox epidemic in Chester in 1774 could be controlled by human intervention, he developed a plan for the inoculation of poorer citizens. He met an American physician who confirmed that the residents of Newport, Rhode Island had reduced the spread of smallpox by means of strict quarantine, sending all infected individuals to a small offshore island. This convinced Haygarth that the disease was highly contagious, but could only be spread by close proximity to an infected person. He directed that those suffering from smallpox should not go to public places and healthy individuals should not enter infected houses. He called for new national public health measures to control the spread of infectious diseases, but these were never taken up. His call for new institutions and separate wards in hospital to treat those who became infected had more success as evidenced by the growth of fever hospitals at the turn of the century [12].

The contagionist view was strongly opposed by those in the medical profession who believed in the miasmic theory of disease transmission. They held that influenza was caused by

atmospheric causes such as sudden changes in the weather or sudden exposure to cold. They could point to the fact that not all those in contact with an ill person went on to develop the disease and that some who succumbed to an infection had had no obvious contact with a sufferer. Their arguments were aided by the rules of contagion being applied to diseases such as typhus and cholera, infections that were not strictly contagious. Furthermore, to accept that a disease was contagious meant accepting restriction of personal activity and the possibility of government intervention in domestic activities. It meant the imposition of quarantine to which there was great opposition because of the loss of trade. Anti-contagionists feared that quarantine would result in greater poverty and unemployment that would promote greater spread of disease and that it could be used as a political tool in conflict between states. Some physicians considered that the fear of contagion was more damaging than contagion itself and that measures to control infection would set up division within a community. By the end of the century only around one third of physicians could be described as contagionists [8, 12, 13].

4. Nineteenth-Century Public Health Reform

The nineteenth century is renowned as the great age of sanitary reform. It was kick-started by the seminal *Report on the Sanitary Conditions of the Labouring Population of Great Britain* in 1842 by Edwin Chadwick while he was secretary to the Poor Law Commission. The report was instrumental in the founding of the General Board of Health, the first modern public health agency, set up by the Public Health Act of 1848 with Chadwick as secretary [13]. The board's first report on quarantine took a strongly anti-contagionist stance, dismissing outright contagion as a source of disease, and recommending all existing quarantine establishments should be discontinued [14]. *The Lancet* and the Royal College of Physicians in London took great exception to the report as medical opinion was more finely balanced over the issue of contagion, although by mid-century there was general adherence to the concept. In addition, the board had opposed the setting up of cholera hospitals as recommended in the College's report on the disease.

After 1850 a more scientific approach was to define public health measures to prevent disease spread with a move to the management of infected individuals under the direction of medical experts utilising epidemiological surveys and statistics [8, 17]. In the 1860s John Simon, Medical Officer to the Privy Council (equivalent to today's Chief Medical Officer), called for an effective system of disease notification and isolation to combat infectious disease, although little in the way of government action resulted. Frustrated by the failure of sanitary measures to contain the spread of the highly contagious scarlet fever, later that decade he called for a strict quarantine system and the establishment of quarantine hospitals. However, little action was taken by local authorities

over the following 30 years [13]. One place where compulsory isolation for sufferers of smallpox was enforced was Leicester along with quarantining of those who had been in contact with an infected person and disinfection of the sufferer's home. In place by 1877, it became known as the 'Leicester method', and replaced a programme of vaccination, as the town was a prominent centre of antivaccination resistance [13, 17].

Leicester's method would not have worked without incorporating compulsory prompt notification of smallpox cases by medical practitioners. Despite opposition by local doctors, the town council proceeded to get it passed into law in 1879 by including it in a local bill [17]. Huddersfield and Bolton had been the first towns to introduce notification two years before and as the number of towns following suit grew, pressure for national legislation increased [13, 17]. However, the Infectious Disease (Notification) Act in 1889 only made it compulsory in London leaving it optional elsewhere. Compulsory notification was introduced in Scotland in 1897 and two years later throughout England and Wales [13, 17]. It was an important policy development as it facilitated the isolation of individuals. Although the 1866 Sanitary Act had allowed Medical Officers of Health to remove infected people to hospital, it had made no provision for disease notification. However, notification would have limited effect if the lack of local isolation facilities prohibited removal of individuals. The Local Government Board in the early 1880s had resisted bringing in notification as hospital space was insufficient to accommodate large numbers of infected patients [17]. Despite acts in the 1860s and 1870s empowering sanitary authorities to build hospitals and permitting compulsory isolation of patients in institutions, local authorities outside London were slow to erect isolation hospitals with only one-fifth making any provision by the 1890s [13, 18]. The Isolation Hospitals Act of 1893 stimulated local governments to finance building from public funds, but the geography of hospital provision remained very uneven across the country and most fever hospitals were small with around 70 beds [19]. The majority of voluntary hospitals refused admission to anyone suspected of having an infectious disease and those that would admit them only had around 10 to 20 beds. Thus, the task of coping with the admission of patients with infectious disease especially during epidemics fell to the poor law authorities and the workhouse remained the last resort when no other facilities were available.

5. Smallpox Epidemic in Birmingham

A good example of how poor law institutions handled epidemics is the way the smallpox outbreak in the early 1870s was dealt with in Birmingham workhouse. There were five smallpox epidemics with *Variola major* throughout the nineteenth century in Britain. The one in 1871-72 afflicting mostly young adults was the most virulent with a fatality rate of 66% in the first year and 77% in the second and it affected those who had already been vaccinated. The first case to arrive at Birmingham workhouse in March 1871 was a local servant girl, followed the next month by four children from London. A

steady flow of admissions began in the autumn and increased rapidly at the beginning of 1872 with 109 in January. From October 1871 to January 1873, 298 patients were admitted of whom 145 died. The greatest number of patients in the wards at any one time was 94 on one day in April and two days in June. They were nursed initially by a nurse from the female infirmary who was replaced by two appointed nurses. The guardians also appointed a temporary medical officer in place of the workhouse medical staff and he was prevented from seeing private patients unless they had smallpox. When he commenced duties on December 1871, there were 21 patients in three wards, but, by May the next year, this had increased to 75 patients in seven wards and the time spent treating them had increased from two and a half hours per day to between four and five hours. The patients were kept in total isolation and visiting by relatives and friends was strictly prohibited, even when the patient was dying. All staff and most patients conformed with the regulations as only one man absconded and another patient misbehaved [20].

6. Accommodating 'Fever' Patients

So how did the poor law guardians in Birmingham cope with the flood of admissions during the smallpox epidemic in 1871-73? In the mid-1860s they had converted two straw sheds and several stone-breaking sheds at the rear of the workhouse into wards because of the threat of a cholera epidemic that did not materialise. They were used for the initial smallpox cases, but became overcrowded within ten months of the first admission. In co-operation with the Borough authorities, building began on an additional ward, but before it was ready, there were more than enough cases to fill it. A further one was agreed with a similar result. The two buildings to hold 30 acute cases were completed within one week, although several of the workmen contracted smallpox. In addition, two wards for convalescent smallpox patients were erected. This was not the first time that the guardians had had to make extra facilities available due to the demand for isolation. In the 1846-47 typhus epidemic they initially converted premises near the workhouse to provide 35 places and then had to convert property they owned to give an additional 120 places, as almost two-thirds of workhouse patients were suffering from typhus. When these proved insufficient, they explored three possibilities to open as a Fever Hospital, namely the White Lead Works, the New Town Brewery and Dr Church's late residence. Unfortunately, we don't know which if any they chose. One of the district surgeons, three nurses, seven pauper assistant nurses and the schoolmaster all died of the infection [20].

Guardians at Coventry also needed to erect temporary fever wards to accommodate patients during the typhus outbreak and those at Warwick built a temporary shed for 12 patients [21]. When the cholera epidemic in 1865 hit Salford, the guardians decided to erect wooden sheds in the workhouse grounds, though they were not ready for use in time. However, they came into use in the smallpox epidemic of the early 1870s for the admission infected patients [18]. Following a sharp

increase in the number of fever patients admitted to Wolverhampton workhouse in the summer of 1847, sheds were converted into fever wards with canvas curtains as walls instead of board. When they became full three months later the guardians erected temporary sheds covered with calico. During a cholera outbreak in 1849 they bought land to erect a cholera hospital in co-operation with the Committee for Health of Wolverhampton. After the epidemic subsided at the end of the year, they ordered the cholera hospital to be demolished. In anticipation of further outbreaks, they agreed a joint plan with the town council to keep cholera victims at home and provide houses of refuge for non-infected members of their household [20].

7. Vaxxers and Anti-Vaxxers

Smallpox was the only one of the major epidemic diseases that was controlled by means of a medical discovery and a successful public health campaign [13, 22]. Vaccination may be thought of as a modern concept, but the idea of achieving protection from an infectious disease by inducing a mild form of it into the body dates back to at least tenth-century China where scabs from the skin of sufferers were ground into a powder that was inhaled. The technique of introducing smallpox pus into a scratch in the skin spread across Asia and in the early eighteenth century came to the attention of Lady Mary Wortley Montague, wife of the British ambassador in Constantinople. This method came to be known as inoculation or variolation. She had her young son inoculated while abroad and her daughter on her return to England where the practice soon became widespread [4]. It was usually carried out by the arm-to-arm technique that involved taking lymph from pustules on a previously inoculated person and introducing it into several incisions in the skin using a lancet. However, it carried a 1-3% risk of death, depending on the exact method used [22-24]. Following the work of Edward Jenner toward the end of the century, vaccination using cowpox or vaccinia virus to produce a mild infection was a safer procedure, but as it did not provide life-long protection, re-vaccination after a few years was necessary.

The epidemic of 1837-40 brought about the first piece of legislation against smallpox in England, with the Vaccination Act of 1840. It provided free vaccination for children if their parents wished it, financed by the poor law rates under the responsibility of the guardians. A second act, thirteen years later, made vaccination compulsory in infants within three months of birth. In order to improve compliance a further act in 1871 introduced vaccination officers and the prosecution of parents refusing to allow their children to be vaccinated. Although enforcement of the regulations was gradual, there was a widespread public reaction to compulsion that led to the growth of the anti-vaccination movement [13, 23]. Compulsion was seen as negating the rights of parents to decide for themselves issues relating to their children's welfare. There were also fears that the procedure might be able to transmit other diseases such as syphilis, scrofula, cancer, mental illness and animal diseases or cause the

development of bovine features [17, 26, 27]. Vaccinators were still using an arm-to-arm procedure that involved incising lines into the arm in a scored pattern usually in four sites and smearing them with lymph taken from a blister of a vaccinated child and there was a risk that scarring could result. It was neither a minor nor painless procedure and in itself may have frightened some from complying [26]. Other anti-vaxxers held ideological objections: the violation of the dignity and integrity of the body; the right to individual liberty; state intrusion in personal matters; and the unnaturalness of the vaccine [13, 17]. Resistance to the overriding of local liberties was particularly strong in Leicester which was the leading voice behind the anti-vaccination movement [13]. The town witnessed a massive demonstration against vaccination of 80,000 to 100,000 in 1885 with people from over 50 towns present. It involved a hearse with a baby's coffin with the inscription 'Another victim of vaccination' and the hanging and decapitation of an effigy of Jenner [26, 27]. Although the disease was recognised as highly contagious throughout the nineteenth century, medical opinion in the 1870s continued to be polarised between the anti-contagionists, who believed it resulted from miasma, and the proponents of the new germ theory, who believed a specific infectious agent was the cause [23]. Anti-vaxxers claimed the vaccine was ineffective, selectively choosing statistical data to back their case and refusing to change their stance in the face of scientific evidence of its efficacy. It is manifest that their arguments were strikingly similar to those of modern-day vaccine opponents [27]. The anti-vaccination movement gathered momentum and strength in the final quarter of the century with the anti-vaxxers gaining the upper hand [13]. The Vaccination Acts of 1898 and 1907 allowed parents to decline protection for their children by stating 'conscientious objection' [23]. Although the epidemics in the early 1890s and 1900s were mild, the effect of the decline in vaccine take-up is demonstrated by the 1893-94 epidemic in Birmingham where 33% of unvaccinated children died compared with only 0.5% of vaccinated children [28].

8. Conclusion

Scientific knowledge has progressed to the extent that the full genomic sequence of SARS-CoV-2 could be identified by early January 2020. It enabled the development of a highly specific polymerase chain reaction-based test (PCR) for the detection of the virus in the body within weeks of the first case and the manufacture in due course of vaccines utilising some of the genetic material of the virus [29]. It allowed genetic mutations to be identified giving early warning of the possible secondary waves. The mode of transmission of the virus has been identified as mainly by airborne spread and its transmission rate, the R number, at any one time can be calculated. These scientific advances have enabled a robust programme of testing, tracing and isolating individuals to be put in place. Modelling can predict transmissibility and provide an estimation of the impact of the virus on the population. In the future the collection of information through surveillance and analysis of metadata using machine-learning algorithms may allow targeted measures to be introduced in anticipation of the arrival of a pandemic. However, reliance on quarantine and isolation hospitals will still be necessary [7].

Modern technological methods of communication have offset some of the drawbacks of isolation by allowing home working and remote learning, thus lessening the effect on a country's economy. However, the health versus economy dichotomy is a false premise as those states that locked down early and severely have suffered less damage to their economies and smaller falls in gross domestic product than those that did not, as well as having lower death rates from the virus [1]. To protect against the introduction of infection across a country's borders we still have to rely on quarantining of travellers despite the availability of tests. Although we have more sophisticated means of organising society and detailed knowledge of the pathogen, the public health measures that we rely on to control the spread of infection have been around since the time of the plague.

Financial and Competing Interests

No Conflict of Interest Declared.

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