HISTORIES OF DISEASES AND EPIDEMICS: FROM PLAGUE MASKS TO COVID-19 ROBOTS

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Histories of diseases and epidemics: from plague masks to COVID-19 robots

Histórias das doenças e epidemias: das máscaras da peste aos robôs da COVID-19

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ABSTRACT

The history of humanity is also the history of its epidemics and pandemics, whose impact on human populations is sometimes devastating. The ways in which societies have coped with such events have undergone significant changes over time, particularly linked to the evolution of explanatory models for human illness. From this perspective, this essay aims to: (1) present brief historical notes on epidemics and pandemics, highlighting the Plague of Athens, the Black Death and the Spanish Flu; (2) briefly outline the COVID-19 pandemic; and (3) comment on the use of robots to deal with SARS-CoV-2 infection.

Keywords: COVID-19; epidemics; pandemics; robots.

RESUMO

A história da humanidade é, também, a história de suas epidemias e pandemias, cujos impactos sobre as populações humanas são por vezes devastadores. Os modos pelos quais as sociedades enfrentaram tais eventos sofreu significativas modificações ao longo do tempo, particularmente articuladas à evolução dos modelos explicativos do adoecimento humano. Desde esta perspectiva, o presente ensaio tem por objetivos: (1) apresentar sucintas notas históricas sobre epidemias e pandemias, com destaque para a Peste de Atenas, a Peste Negra e a Gripe Espanhola; (2) delimitar brevemente, a situação da pandemia de COVID-19; e (3) comentar acerca do emprego de robôs para o enfretamento da infecção por SARS-CoV-2.

Palavras-chave: COVID-19; epidemias; pandemias; robôs.

INTRODUCTION

Careful observation of historical processes – in order to perceive phenomena and events similar to those experienced today – helps us to understand the present and draw perspectives for the future. The term epidemic can already be found in the Corpus Hippocraticum, bringing the idea of an increased incidence of cases of a particular disease (Hippocrates, 1839-1861). In turn, pandemic first appears in Plato's text – Das Leis – applied with a more generic meaning, referring to any situation capable of affecting the entire population. Subsequently, these terms were reframed until they acquired their current connotation; Indeed, according to DeCS (Health Sciences Descriptors), epidemic refers to a "*sudden outbreak of a disease in a country or region that was not previously recognized in that area, or a rapid increase in the number of new cases of a previously existing endemic disease*" and pandemic refers to "*an epidemic of an infectious disease that has spread to several countries, often more than one continent, and usually affects a large number of people*" (DeCS, 2017). Epidemics – and pandemics – have plagued human communities since ancient times.

These events have been understood and dealt with in different ways throughout history, taking into account the worldviews – and possible response repertoires – of the communities affected. When we investigate past epidemics, such as the Plague of Athens, the Black Death and the Spanish Flu, we are reminded of the overwhelming consequences that these health crises had on our societies (Fig. 1). Studying these historical events reveals not only the destructive power of infectious diseases, but also the human and scientific responses that have, over time, shaped our understanding and ability to manage such threats.

While exploring the epidemics of the past, parallels are drawn with present-day experiences, where the COVID-19 pandemic, caused by the SARS-CoV-2 virus, has afflicted the world. The rapid spread of the disease is challenging humanity to rethink its response strategies to global health threats. As the pandemic unfolded, new speculations emerged about the tools needed to deal with this scourge. Will technology be the great ally for the survival of the *Homo sapiens* species?

Figure 1. A look at epidemics/pandemics, from Greek Antiquity to modern times. Illustration by Ademir Nunes Ribeiro Júnior. Theoretical conception of the image proposed by Rodrigo Siqueira-Batista.

Based on these preliminary considerations, this article – characterized as a narrative literature review, a publication that "*consists of a critical analysis of the literature published in books and articles in electronic or paper-based journals*" with a view to describing and discussing "*the state of the science of a specific topic or theme from a theoretical and contextual point of view*" (ROTHER , 2007,p. vii) – has the following objectives: (1) to present brief notes on epidemic and pandemic moments – the Plague of Athens, the Black Death and the Spanish Flu – with a significant impact. vii) – aims to: (1) present brief notes on epidemic and pandemic moments – Plague of Athens, Black Death and Spanish Flu – with a significant impact on the history of Homo sapiens; (2) briefly contextualize the current SARS-CoV-2 infection pandemic; and (3) discuss the uses of robots to deal with the current COVID-19 scenario.

EPIDEMICS AND PANDEMICS: HISTORICAL NOTES

In approximately 430 BC, in the polis of Athens, Greece, a disease known as the Plague of Athens killed more than a quarter of the population, including the troops who were in conflict with the warriors of Sparta in the legendary Peloponnesian War. It is believed that the spread of the disease was strongly influenced by the siege of the city promoted by the adversaries, which left the Athenians confined in precarious sanitary and social conditions. Thucydides' text – History of the Peloponnesian War – shows that the healers were unable to do much for the

sick, apart from providing care, as there was no knowledge of the causes of the illness. What's more, these workers – who were responsible for caring for the sick – also fell ill and died as a result of their constant contact with the dying. Studies show that the Plague of Athens was probably an epidemic of typhoid fever.

In the 14th century, the world experienced what is considered to be the most overwhelming pandemic to date, the infamous Black Death – named after the black gangrene that formed on the skin – which killed 40% of the European population, with more than 100 million deaths worldwide. The plague (which means disease in Latin) was caused by a bacterium – *Yersinia pestis* – transmitted by fleas, *Xenopsylla cheopis*, which mostly took up residence in rats. The main factor in the spread of the pandemic was trade, both via maritime routes – the Black Sea and the Mediterranean – and via the Silk Road (Alfani; Murphy, 2017). Many believed that the Black Death was a divine punishment – which can be seen in Ingmar Bergman's film classic The Seventh Seal (1956). Others believed that it was the work of certain groups of the population – as in the case of leprosy, then considered a disease of foreigners and Jews – which increased the chaos, generating behaviors such as self-harm, floggings and even murder. The pandemic subsided, but outbreaks of the disease continued for centuries, decimating populations.

In the 17th century, plague doctors – famous for their duck-billed masks, which contained herbs to minimize the smell of putrefaction and which, it was assumed at the time, were capable of providing protection against miasmas (the belief that diseases were transmitted by malodour) – were civil servants hired by cities to treat the sick, count the dead and notify the population about outbreaks of the disease (Siqueira-Batista et al., 2007). The concept of miasmatics was one of the factors in reducing the impact of the disease, because in an attempt to minimize the stench, the population took measures that improved sanitary conditions, thus reducing the spread of the disease (Castañeda Gullot; Ramos Serpa, 2020).

The Spanish Flu was the deadliest pandemic of the 20th century, caused by the influenza virus and transmitted from person to person, from fluids containing the pathogen – spread mainly by respiratory secretions – which made the use of masks and other biosafety measures more explored (Alfani; Murphy, 2017). Despite the name "Spanish", there are hypotheses about the origin of the disease that point to the United States – in Kansas, a rural region where one of

the main US army bases was located – and France – in Étaples, located on the coast of the English Channel, where one of the most important British military bases was located – as the probable place(s) of emergence of the pathogen. In both locations, there were crowds of people – due to the presence of soldiers –, close proximity to animals – such as pigs in the barracks – and precarious sanitary conditions (Coelho; Oliveira; Rodrigues, 2022). Due to Spain's neutrality in the war, the press was free and, in turn, disseminated more accurate information about cases of the disease, unlike the other countries, which were concerned with maintaining an ideal image vis-à-vis their adversaries, which meant that the country carried the stigma of the disease and, subsequently, had its name associated with the pandemic.

The factor that most contributed to the rapid spread of the Spanish Flu was the First World War, because there were poor hygiene conditions on the fronts and in the trenches, a high number of people in barracks, constant transit of military personnel, associated with a fragile population in a situation of misery caused by the conflicts. In addition to the war, another factor that boosted the spread of the flu was the second Industrial Revolution, with the expansion of railroads and the use of ships, the increase in world travel and the expansion of trade. The Black Death epidemic took approximately three years to migrate from Italy to Denmark, while the Spanish Flu was present almost everywhere in the world within a few months. In two years, approximately 500 million people were infected – a quarter of the entire world population – but the number of deaths is difficult to pinpoint, as they were often not even counted, given the high number of deaths in some cities, and mass burials were even carried out. Among the thousands of fatalities were public figures such as the president of Brazil, Rodrigues Alves, the prime minister of South Africa, Loise Botha, and the German philosopher Max Weber. For a long time, this pandemic did not receive the attention it deserved, as most of the impacts and deaths were related to the consequences of the war. Despite all the damage done to society at the time and with the advancement of science, it was possible to adopt biosafety measures, which contributed to controlling the pandemic. In Brazil, for example, the parasitologist Carlos Chagas obtained permission from the government to implement public health measures. Among the measures taken were: compulsory notification of cases, the imposition of quarantine on ships, the creation of health posts and hospitals with an increase in emergency care, as well as social distancing measures, such as a reduction in church masses,

the closure of schools, theaters and some businesses. There was also an interruption in sports competitions, such as soccer.

CHRONICLE OF MANY DEATHS FORETOLD: SARS-COV-2 AND COVID-19

The year 2020 can be characterized as a genuine "Pandora's Box", announced throughout the 21st century (Cheng et al., 2007; WHO, 2019) and opened in 2019. In fact, in December of that year, in the city of Wuhan, Hubei province, China, there was a growing increase in cases of pneumonia of unknown etiology, which attracted the attention of the World Health Organization (WHO). In less than a month, in January 2020, Chinese researchers managed to isolate and identify the etiological agent. It was a new type of coronavirus – currently called SARS-CoV-2 – that causes the disease, named COVID-19, which has become the most current pandemic. Given the widespread trade and ease of international travel, the disease spread rapidly and was considered a pandemic less than three months after the first case was reported in China, becoming a threat to the health of the world's population. In Brazil, the first case was identified in São Paulo, by a traveler from Italy, on February 25, 2020. The main form of transmission of SARS-CoV-2 among humans is by droplets and aerosols expelled by the infected individual's respiratory tract – through sneezing, coughing and even talking – as well as by contact – placing hands on surfaces contaminated by the virus and then touching mucous membranes, such as those lining the eyes, nose and mouth (Siqueira-Batista et al., 2020). More attention has recently been paid to the possibility of transmission by aerosols, particles that remain suspended in the air and can infect people over much greater distances. Much still needs to be studied about the new pathogen, but it is already certain that ways of preventing infection and biosecurity measures are being reviewed in an effort to reduce the spread of the disease. Healthcare institutions have generally established new protocols for care, aimed at safety and preventing infection by droplets and aerosols: the use of impermeable clothing and cloaks, the use of masks associated with goggles and face shields, improving the flow of services and increasing the distance between patients. In addition to the actions carried out by health organizations, many countries have implemented social distancing measures for the population, keeping only essential services in operation.

TECHNIQUE AND CARE: ROBOTS COME INTO PLAY

The COVID-19 pandemic has shown how much technological evolution can help in health care and disease control. To put this into context, it should be noted that since the creation of endoscopic devices, the use of machines has become more common and their functionalities increasingly complex. More recently, machines capable of performing autonomous, semi-autonomous or remotely controlled functions have helped with various procedures and made it possible to carry out new actions, which often go beyond any human limitations (Wang et al., 2023). These machines are called robots, and every day the world becomes aware of their ability to collaborate with human beings in the most diverse tasks. In technical language, human-robot interaction.

In a historical context, these robots could initially serve as eyes for professionals, but today they can even be arms. The Da Vinci robot is an example of this evolution, with the ability to expand surgeons' skills to perform delicate procedures with more dexterity, without the need for this professional to come into direct contact with the patient during the procedure (Siqueira-Batista et al., 2016). Therefore, due to the pandemic, robotic procedures are an important tool for maintaining patient care and minimizing the risk of contagion for team members (Nas et al., 2020). With this aim in mind – safeguarding frontline professionals – a robot provides initial care for patients arriving at the University Hospital in Antwerp, Belgium. Equipped with artificial intelligence (AI), the device is able to detect and recognize occlusion regions on the face of a human being, thus ensuring that a person is wearing a mask and that it is worn correctly. In addition, the robot is able to measure temperature, analyze and evaluate the data obtained (Presse, 2020). In a similar vein, an American robotics engineering company, together with healthcare organizations, has been testing the use of its mobile robots (Spot) to carry out part of patient care. In this case, the robotic agents move around to carry out telecare – the healthcare professional can see and talk to the person being cared for via tablets –, measure vital data – body temperature, respiratory rate, pulse rate, peripheral O_2 saturation and blood pressure – and some types of deliveries (especially food and medicines). When humans are not present, these robots can even disinfect environments using UV-C light (Statt, 2020). It's worth noting

that in addition to these activities, robots can also be information disseminators, as is the case in Times Square, New York, United States, where they interact with the population by transmitting educational information and raising awareness about COVID-19.

Similar initiatives have been adopted in Brazil, including an artifact created by a startup in Curitiba, Paraná, focused on facilitating safe contact between the sick and their families through video calls. This robot is also being used – in the city of Ribeirão Preto, São Paulo – to monitor hospitalized patients. There is no doubt that the use of such machines contributes to maintaining care actions for people in a context of minimizing the risks of transmission of SARS-CoV-2 (G1, 2020).

FINAL CONSIDERATIONS

History has shown, especially in the last two hundred years, that science can become a great ally of humanity, since scientific knowledge and technological development have helped overcome the most diverse plagues and diseases. It is important to emphasize this perspective, especially at a time when Brazilian society is being hit by a wave of obscurantismo, in which the anti-vaccine movement and the denialism of the COVID-19 pandemic represent, unfortunately, only a few shades of gray. Dark times. What can we expect in the days to come? That techno-scientific *poiesis* and ethical *praxis* can come together for the benefit of all people – and not just traditionally favored groups – and that the use, production, improvement, propagation and sharing of well-being are encouraged, perhaps in an increasingly technologically responsible society. In this scenario, if technology really is the destiny of *H. sapiens* – as Martin Heidegger proposed – then may human civilization, combining science and ethics, build the best configuration of what is to come.

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