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## More Than Microbes: Using Seemingly Gratuitous Data for More Effective Public Health Response

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### Cover Page Footnote

Professor Pinnow, What's one more paper?

# More Than Microbes: Using Seemingly Gratuitous Data for More Effective Public Health Response

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## **Abstract**

Communicable disease, specifically the Black Death outbreak of the fourteenth century, has always posed a great threat to mankind, forcing masses into early graves. Despite the horrible outcomes, these events aren't entirely negative. Through these events the world has learned how to better respond to future outbreaks. Amid another pandemic it is vital to continue this practice. COVID-19 responses have failed in that the overarching public health policy does not consider individual differences and how they impact people's ability to adhere to said policy. This failing leads to the continuation of public health policy and actions that are simply ineffective. By collecting and including seemingly extraneous data regarding individual differences including language differences and family structures a more effective public health response to communicable disease is possible.

*Keywords:* Black Death, Non-Microbial Data, Pandemic, Disease Response

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## **Introduction**

Tragedy and death are inherent to human life, however, when present in excess it is human nature to use our agency to preserve vitality. As alluded to by Dante Alighieri, mankind's

free will enables us to defy God and set our own path (Alighieri, 1472, p.321). Sickness and death demand innovation in medicine to fuel this innate human drive. For instance, the Black Death enabled Giovanni Boccaccio to develop Contagion Theory which has benefited medicine for the past 700 years. Now more than ever, the COVID-19 pandemic displays that communicable diseases continue to pose a threat to human health. The biomedical response to COVID-19 have failed to account for individual differences and daily life, resulting in guidelines that are too broadly applied and consequently ignored. The reductionist nature of public health policy quantifies human life in a manner that discounts individual idiosyncrasies and uniqueness. This shortcoming in our health system has resulted in undue death. Through my personal experience as a contact tracer I have recognized the difficulty in the application of public health policies to individuals such as language barriers, non-descriptive data, and regional differences. The application of previously de-emphasized data to better understand disease is highly effective in the reduction of morbidity and mortality. The utilization of non-microbial data will create a more effective disease response.

### **Pale Horseman's Sword**

Between 1348 and 1352 a bacterial outbreak brought the Eurasian continent to its knees. The Black Death killed an estimated 50 million people and along the way forever changed those who lived through it and their understanding of health and medicine (Benedictow, 2004, pp. 63-74). Similar to contemporary pandemics the Black Death spread to a global level because economic and social globalization allowed it. The rise of intercontinental trade routes, international conflicts, and the highly infectious modes of exposure enabled this outbreak to go beyond a regional spike and become a world-altering event (Benedictow, 2004, pp. 63-74). This phenomenon of globalization leading to more threatening outbreaks can be seen in every recent

pandemic, from the Spanish Influenza of 1918/19 to COVID-19. The faster humans are able to travel between regions of our world, the faster disease can spread. The Black Death is a prime example of globalization creating an opportunity for faster and more widespread outbreak as it resulted from the establishment and eventual siege of Caffa as described below.<sup>1</sup> The connection of formerly separate worlds has enabled disease to take hold and threaten at never before seen levels.

The first European reference to the Black Death can be found in the description of the various medieval sieges of Caffa, a city in modern-day Crimea, which borders the Black Sea (Wheelis, 2002, pp. 971-5). Genoese merchants were allowed to establish this port by various Mongol Khans, using its convenient location to trade between the East and West (Wheelis, 2002, pp. 971-5). Due to various trade disagreements, the European and Mongol relationship eventually faltered, leading to Mongol forces besieging the city (Wheelis, 2002, pp. 971-5). During the sieges, sickness fell on the Mongol forces. Inadequate shelter and infected food sources left the Mongol Horde with discernible symptoms of the Black Death (Wheelis, 1346, p. 972). The Mongol military leaders resorted to hurdling infected cadavers over the siege wall into Caffa, infecting and laying waste to the Genoese trading post (Wheelis, 1346, p. 973). Following the siege, those travelling along the trade routes leading into and out of Caffa enabled the largest epidemic of the medieval era, spreading disease under the banner of international trade. Without this clashing of worlds and the intercontinental commerce that began it the Black Death would have remained a regional outbreak, eventually losing the necessary numbers of healthy hosts (at-risk population) to continue spreading (Cohn, 2012, pp. 195-212).

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<sup>1</sup>Known today as Feodosia, Ukraine

Once west of the Urals a more concrete spread pattern of the Black Death can be seen as chroniclers such as Ibn al-Khatīb, Gentile Da Foligino, and Giovanni Boccaccio describe the scourge entering their respective regions and killing thousands. In conjunction with contemporary pathology and epidemiology, these chroniclers' stories clearly show that the development of urban settings, compounded with the multiple modes of exposure associated with *Yersinia pestis* is to blame for its rampant spread in western Eurasia and Ottoman regions.

### **Black Death: Modes of Exposure**

The cause of the fourteenth century mass is known to be *Yersinia pestis*, however the method in which this bacterium entered the human population remains contested. There are three prominent theories surrounding human transmission. The nature of these modes of exposure defined the Black Death and the impact it had on the world.

The Black Death is a bacterial infection caused by the bacteria *Yersinia pestis* entering human hosts. How it did so during the fourteenth century remains a matter of debate today. *Yersinia pestis* can be spread to humans in three distinct, and deadly manners. The first mode of exposure, known as Bubonic Plague, is spread through zoonotic infection. The Black Death outbreak is traditionally blamed on the combination of this mode of transmission and urbanization across Eurasia in the fourteenth century (Hays, 2009, pp. 37). Based on modern knowledge, shared living quarters enabled *Yersinia pestis* to be carried by fleas living in black rat's fur to make the jump to humans (Perry, 1997, pp. 35-66).

Septicemic Plague is another zoonotic transmission of the Black Death. This bacterial infection moves directly into the bloodstream and is therefore more quickly fatal than its Bubonic cousin. Septicemic Plague infects human hosts in two manners, the first by the disease spreading from buboes to the bloodstream, and secondly when the soon-to-be sick comes into

direct contact with the blood of hosts infected with *Yersinia pestis* (Perry, 1997, pp. 35 -66). Septicemic plague is fatal once an infected individual experiences shock, organ failure, and extreme difficulty breathing (Perry, 1997, pp. 35-66). The final, and most contagious route that *Yersinia pestis* reaches its victims is known as Pneumonic Plague. This mode of transmission is a respiratory infection in which an at-risk individual inhales respiratory droplets containing *Yersinia pestis* from infected hosts. This infection quickly develops into pneumonia, and again becomes fatal once the bacteria have entered the bloodstream (Perry, 1997, pp. 35-66). Pneumonic plague largely explains the outbreak of the fourteenth century. Without respiratory transmission, a pandemic at the proportions of the Black Death in the fourteenth century are unlikely.

The fourteenth century outbreak has often been blamed on one or another mode of transmission, but in truth all three are plausible explanations. Although we cannot know the mode of transmission for every Black Death victim, it is likely that a combination of the three is most accurate. A theory combining the three modes of transmission only logical as environments and conditions differed across the Eurasian continent in which the Black Death flourished.

### **Contagion Theory Development**

Leading up to the Black Death, Eurasian medical thought regarding disease combined two theories. Prominent among Abrahamic religions, the first of these pre-Black Death conceptualizations was Divine Punishment: the belief that disease comes to the world and is placed on individuals by God (Carr, 2014, pp. 110-127). The second widespread theory of disease prominent in pre-Black Death Eurasia is miasmatism. As old as Hippocrates himself, miasma theory is the concept that disease is brought about through corrupt foul-smelling air remained a dominant theory until the nineteenth century (Snowden, 2019, pp. 184-203).

As the Black Death outbreak spread westward from the Steppe to the British Isles medical masters from across the continent began to investigate its origins and spread pattern among human populations (Campbell, 1931, pp. 34). Out of this scholastic observation of the Black Death came about a new conceptualization of disease spread. Known as Contagion Theory, this theory explained the relationship between an individual's proximity to disease and its spread. In simplest terms, this concept claims disease spreads through contact with those people and things that carry the ailment in question. For us today, this seems to be an obvious statement, but this was a major leap in medical thought that is vital to the development of modern medicine. Specifically, this jump took place in the writings of Giovanni Boccaccio, in his series of satirical tales entitled *The Decameron* (Boccaccio, 1353, pp.16). Writing after the Black Death outbreak, Boccaccio created fictional tales of how Florentine society reacts to a disease outbreak. In doing so, he included observations of how Florence responded to the Black Death five years earlier. As Boccaccio sat in his window overlooking Florence being torn apart by the Black Death, he put contagion theory, the crux of modern medical thought, into writing for the first time. The first place Boccaccio does so is in *The Decameron's* introduction, where he describes the contagious nature of the Black Death. He states, “whenever those suffering from it mixed with people who were still unaffected, it would rush upon them with the fire racing through dry or oily substance that happened to come within its reach” (Boccaccio, 1353, pp. 06). Following his description of the Florentine arrival of the Black Death Boccaccio describes the death spreading to non-human populations and in doing so clearly defines Contagion Theory. He does so in his description of the death racing through hogs feeding on the corpse of a Plague victim:



Of this mine own eyes (as hath a little before been said) had one day, among others, experience on this wise; to wit, that the rags of a poor man, who had died of the plague, being cast out into the public way, two hogs came up to them and having first, after their wont, rooted among them with their snouts, took them in their mouths and tossed them about their jaws; then, in a little while, after turning round and round, they both, as if they had taken poison, fell down dead upon the rags with which they had in an ill hour intermeddled. (Boccaccio, 1353, Introduction to First Day)

Through Boccaccio's description of his first-hand account of the Black Death spreading from humans to hogs the author outlines his novel theory of contagion: disease being spread through contact between the healthy, and the infected. His observations of how the disease spread led to arguably the most pertinent concept added to medical thought in the medieval era, written not by a medical scholar but a chronicler, and poet. Before Boccaccio ever uses the word contagion he describes the theory, and how it seems to explain the enormity of the Black Death. Contagion Theory's ability to explain the overarching size of the Black death drove its validity as dominant theories of the time were unable to do so. Specifically, Divine Punishment's reliance on individual sin made explaining a worldwide scourge difficult and Miasmatism fell short in rural areas with plenty of fresh unadulterated air. Through his observations of a dying Florence, Boccaccio puts into words the theory that enabled contemporary medicine. The sick, dying, and dead carry the Black Death on their bodies, and in their possessions, only to be spread by healthy hosts coming into contact with infected bodies, and objects.

### **Give or Take 700 Years: Medical Thought Development Following the Black Death**

Because Contagion Theory was developed outside of the established medical hierarchy, it was forced to the outskirts of health theory. Centuries later, the innovative nature of the

Renaissance enabled medical theorists such as Girolamo Fracastoro to help Contagion Theory progress to the center of medicine. According to Contagion Theory, an individual can only fall ill based upon their actions or of those around them. These actions are determined by their own free-will, which rejects the notion that divine bestowment or large-scale natural events inflict disease. Between 1348 and present-day, medical leaders and practitioners have responded to disease outbreaks through the creation of new and more effective medical ideas that span from spontaneous generation to causation theory (Wilson, 1995, p. 145). Similar to these early communicable disease theories, the implementation of natural science to medicine known as biomedicine was founded out of a culmination of theories and practices that were developed over a seven-hundred-year period of response to sickness and death. The biomedical approach has enabled more effective healthcare and disease response, however public health should not be complacent because sickness and death are inherent to life. Mankind must continue to learn from mass death.

### **Biomedicine and its Failings: The Botch that is COVID-19 Response**

Amidst a global outbreak we must continue the tradition of learning from disease and the threat it poses. We find ourselves in a situation similar to the Black Death we must again utilize the practice brought forth by this threat and improve our understanding and response to disease. How to do so is the difficult portion. While the next step is difficult and there are lessons to be learned, the inclusion of non-microbial and previously de-emphasized data, as proposed by Paul Farmer and various Global Health departments at American universities, will positively impact overall disease response.

The movement for the consideration of data beyond that of epidemiology and pathology in the fight against disease has most recently been led by Paul Farmer. As Chair of the

Department of Global Health and Social Medicine at Harvard Medical School, Farmer has led this thought shift through the publication of various works that examine health inequalities and their impact on population health. In his book, *Infections and Inequalities*, Farmer describes the seemingly superfluous factors that led to disease outbreaks in regions across the world (Farmer, 1995, pp. 36). One jutting example is the late twentieth century HIV outbreak among rural women in Haiti. The inclusion of data in regard to the socio-economic status of at-risk populations and hosts enabled a better understanding of this outbreak, therefore producing a more nuanced response. Specifically, the data collected from an examination of seemingly extraneous factors enabled rural Haitian women to become more cognizant of the risks surrounding engagement of sexual activity with mobile carriers such as truck drivers and soldiers. Without this detailed research into various determinants of health such as socio-economic status, and internal migration an effective response and change in social practices would have been impossible (Farmer, 1999, pp. 134).

As a recent graduate of a Global Health program, I have learned that health and well-being extend beyond clinical factors and are influenced by cultural, social, and economic determinants. As a COVID-19 contact-tracer I have found my academic perceptions of these factors' impact to be an underestimation. Public health is utilitarian in nature and consequently falls short in the acknowledgement of individual circumstance and reality. The disregard for the turbulence of the human experience in public health dehumanizes healthcare and therefore detracts from the preservation of life.

If all public health guidelines were followed, the outbreak would be contained. However, this is a shortsighted approach. Human beings inherently operate under their own guise. Only through the inclusion of data that assesses the human experience of those affected, will a more

effective disease response be possible. The inability to comply with public health guidelines is prominent. Often, the circumstances of individuals being traced makes following guidelines impossible. To condemn these people is counterproductive, rather a response that takes human life into consideration is the only response that will succeed.

This practice will be difficult and, in some instances, impossible but the more information regarding these differences that is included in disease response the more effective said response will be. This practice will require a more personalized understanding of why people are being exposed and by what means can they be contained. Active state-wide COVID-19 tracing systems are archaic and ineffective because we as the public health response have not taken the step to include this type of individual data. Examples of this include language barriers not being clearly demarcated in contact tracing systems to families with different last names not being listed as neighbors. Those two examples alone have in my experience as a contact tracer made the representation of how the disease is spreading inaccurate. These are a plethora of other examples of de-emphasized data not being included and therefore clouding our understanding of this disease and its spread. Going forward disease response must include these factors that make us individuals, otherwise we will continue to fight disease blindly and therefore continue to lose.

Disease has always been a learning experience for mankind, the Black Death is a prime example of this phenomenon. The Black Death enabled an opportunity for society to learn how to better respond to disease. COVID-19 is another opportunity for this growth to take place. The current disease outbreak can teach us many lessons but the most effective is the inclusion of seemingly extraneous data in disease response. The world can and therefore must learn from the constant threat of disease, by including seemingly gratuitous data regarding individuals this

threat can be reduced. The only way to improve disease response is through the inclusion of data that is rooted in the pursuit to understand individual life and circumstance.

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