



EXPLORING EPIDEMIOLOGY

#2: Observation Without Understanding

In the first part of Exploring Epidemiology, we met early thinkers like Hippocrates, Thucydides, and Ibn Al-Nafis, who began connecting observation to disease. But observation is not always enough. In the mid-14th century, the Black Death was sweeping across Europe. Towns emptied, mass graves replaced cemeteries, and within just a few years, an estimated one-third of the continent's population was gone. It remains one of the most devastating epidemics in human history; for those who lived through it, nothing would ever look the same. And yet, out of that terror and uncertainty came some of the most important public health innovations ever developed – some still in practice today.

A Horror Nobody Could Explain

The Black Death, a devastating epidemic of bubonic plague, struck Europe in October 1347, when 12 trading ships arrived at the port of Messina, Sicily. People were excited to greet the sailors on the docks, but what they discovered was a horrifying sight. The arriving seamen were gravely ill, covered in black boils oozing pus. Inside the ships were countless bodies of those who had succumbed to the disease, whatever it was. The sailors were loaded back onto what became known as the “death ships” and ordered out of port immediately, but it was too late. Within months, the plague traveled into mainland Italy. Within two years, it had swept across much of the continent.

Before the ships arrived, the people of Europe had heard rumors of the “Great Pestilence” arriving by trade ship and leaving a trail of death. Those affected had dark swellings oozing blood and pus, fever, vomiting, diarrhea, aches, and pain. The bodies on the ships in Sicily confirmed the “Great Pestilence” was more than just a rumor.

We now know this disease as bubonic plague, a condition that attacks the lymphatic system, causing swollen lymph nodes, called buboes, which gave the disease its name. We also know that the disease is caused by the bacterium, *Yersinia pestis*, which spreads primarily through the bites of infected fleas carried by rats. A second form of the plague, called pneumonic plague, affects the lungs and spreads through respiratory droplets. In the crowded, unsanitary conditions of medieval cities, this airborne form of the pathogen moved quickly. It was almost always fatal.

Since the time of Hippocrates, the belief that “bad air” (miasma) caused disease had dominated medical thought. In 1348, the University of Paris medical faculty issued a report, requested by King Philip VI, blaming the Black Death on astrological events. Physicians prescribed potions, fumigations, bloodletting, and herbal creams. People burned aromatic woods to purify the atmosphere. Others fled to the countryside, but none of it made any difference. That same year, the plague struck Paris, Bordeaux, Lyon, and London.

As the disease continued to spread, animals became infected, food supplies dwindled, doctors refused to see patients, and shopkeepers closed their doors. Amid this terror, some people were observing. And sometimes, observation alone is enough to drive significant action – even if the reasons behind what is happening remain obscure. The Black Death made this critical principle of epidemiology devastatingly clear: tracking who gets sick, where, and when can reveal patterns that shape our response to disease long before we understand its cause.

Keeping Score: The Birth of Disease Surveillance

Civic authorities in European cities began keeping records of the dead, which, at the time, was revolutionary. As early as 1348, Venice, one of the wealthiest trading cities in the medieval world, was among the first to keep death records. The Venetian observers not only tracked how many people were dying, but also their location within the city. They also tried to record the cause of death, distinguishing plague deaths from those caused by other illnesses to understand what proportion of all deaths could be attributed to the epidemic.

Florence, which ultimately lost an estimated 60% of its population, developed similar records, as did other Italian cities. The death records these cities kept were crude by modern standards. But, by tracking where and when deaths occurred, authorities could see where outbreaks were worsening, identify which neighborhoods were hardest hit, and decide where to focus limited resources. They were doing what epidemiologists still do today: gathering information about what's happening during an outbreak to determine the best way to respond.

Counting, recording and mapping remain a large part of disease surveillance today. In the 14th century, it meant tallying deaths by neighborhood. Today, it means gathering laboratory-confirmed case counts, genomic sequences of pathogens, hospital admissions data, and wastewater monitoring data. The tools have changed dramatically, but the approach hasn't – every modern outbreak response begins with observation and information collection to inform an understanding of what is happening.

Forty-Day Lockdown

Counting the dead told authorities how bad things were, but it didn't stop the plague from spreading. For that, they needed something else. In 1377, a small coastal city on the Adriatic Sea, called Ragusa (modern-day Dubrovnik, in Croatia), tried something different.

Observing that the disease was arriving with travelers on ships from affected regions, officials in Ragusa issued one of the first official plague quarantines. The ordinance required people traveling from plague-infected cities to self-isolate for 30 days before they could enter the city. Ships were required to anchor at a nearby uninhabited island, called Mrkan, for 30 days before anyone could disembark. People who showed signs of illness were isolated and cared for on the island. Those who stayed healthy could enter once the waiting period had passed. Seeing that this worked, other cities implemented similar measures. Venice later expanded the isolation period from 30 to 40 days. Indeed, these efforts in 1377 gave us the term “quarantine,” which is derived from the Italian *quaranta giorni*, meaning 40 days.



In 1423, another wave of plague hit Venice. To contain the spread of disease, they established the first plague isolation hospital, *lazaretto*, on the island of Santa Maria di Nazareth. If people survived, they could leave. If they attempted to violate the rules and re-enter Venice while ill, they were stopped by guards stationed at city gates, turned away, and fined. Some cities prohibited outsiders almost completely. Over the next 100 years, cities across Europe erected plague hospitals and isolated merchants at ports to maintain separation between those with the plague and the rest of the city's population.

Once quarantine measures and plague hospitals were established, the decreased spread of disease allowed for some measure of control. From then on, countries around the world adopted the practice of isolating the sick, a concept still practiced today, albeit without sending the infirm to uninhabited islands.

From Chaos to Structure

The Black Death did not slow in the 14th century. Plague returned to Europe repeatedly from the 1300s to the 1500s. Each outbreak reinforced the earlier lessons learned, and gradually, responses became more organized.

Italian cities, such as Venice, began building permanent public health infrastructure. Quarantines involved large-scale surveillance and intervention. Those entering cities were inspected for signs of disease. Along with isolating the ill, those who had been exposed were also quarantined even if they were asymptomatic.

Venice established one of the first permanent public health boards in Europe to routinely monitor and respond to disease, rather than only conducting surveillance during outbreaks. They also developed systematic ship inspection protocols with designated “plague doctors” inspecting incoming vessels before docking. And, they began routinely keeping records of the sick and the dead by neighborhood.

In Sum

Permanent institutions, systematic surveillance, separation of the sick from the exposed, and government-funded care are part of modern-day epidemiology and public health. Centuries later, scientists didn't have to build a public health system from scratch. It was already there, assembled over generations, in the shadow of the Black Death, by people who were wrong about almost everything except the most important thing: that organized observation informing action could make a difference.

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Think about it

1. What patterns do you think authorities noticed that led them to quarantine the sick before disembarking the trade ships?
2. Medieval Europeans began counting the dead to try to track the disease. In what ways do you think tracking deaths can help public health officials combat an infectious disease outbreak?
3. Did the Black Death protection measures remind you of other instances when these measures have been used to combat an infectious disease?