

Individual and Communal Medicine
During the Black Death of 1347-1351

Meagan Selby Allen

Advisor: Frederick McGinness, Medieval Studies

Table of Contents

1. Timeline-----	3
2. Abstract-----	5
3. Note on Sources-----	7
4. Chapter 1: An Introduction to the Study of Plagues-----	8
5. Chapter 2: The Infection Cycles of <i>Yersinia pestis</i> -----	24
6. Chapter 3: The Signs and Symptoms of the Plague-----	42
7. Chapter 4: The Not-So Conflicting Origins of the Plague-----	51
8. Chapter 5: The Practice of Medicine in Christian Communities--	70
9. Chapter 6: Christian Religious Treatment of the Plague-----	101
10. Chapter 7: Plague Medicine in Christian Societies-----	109
11. Chapter 8: Medicine in Islamic Societies-----	124
12. Chapter 9: Treatment of the Plague in Muslim Societies -----	148
13. Conclusions-----	160
14. Literature Cited-----	163

Timeline

5th Century – Rome falls, beginning the Middle Ages

541 – First outbreak of the Justinianic Plague recorded in Constantinople

698 – Another round of the Justinianic plague attacks Constantinople

747 – Last round of the Justinianic Plague to reach Constantinople. In all, there were 18 outbreaks in 210 years

750 – Abbasid Caliphate overthrows the Umayyad Caliphate

1258 – Abbasid Caliphate is overthrown by the Mongol invasion

Early 1330s – Black Death emerges in China

1338 – Black Death reaches Lake Issyk Kul in modern-day Kyrgyzstan

1346 – Plague enters Kaffa as bodies are thrown into the city in an early example of biological warfare

1360s – Resurgence of plague in Europe

1370s – Plague re-emerges in Europe

1380s – Plague re-emerges in Europe

15th Century – End of the Middle Ages, beginning of the Renaissance

1885 – Third plague (Manchurian Epidemic) pandemic begins in china

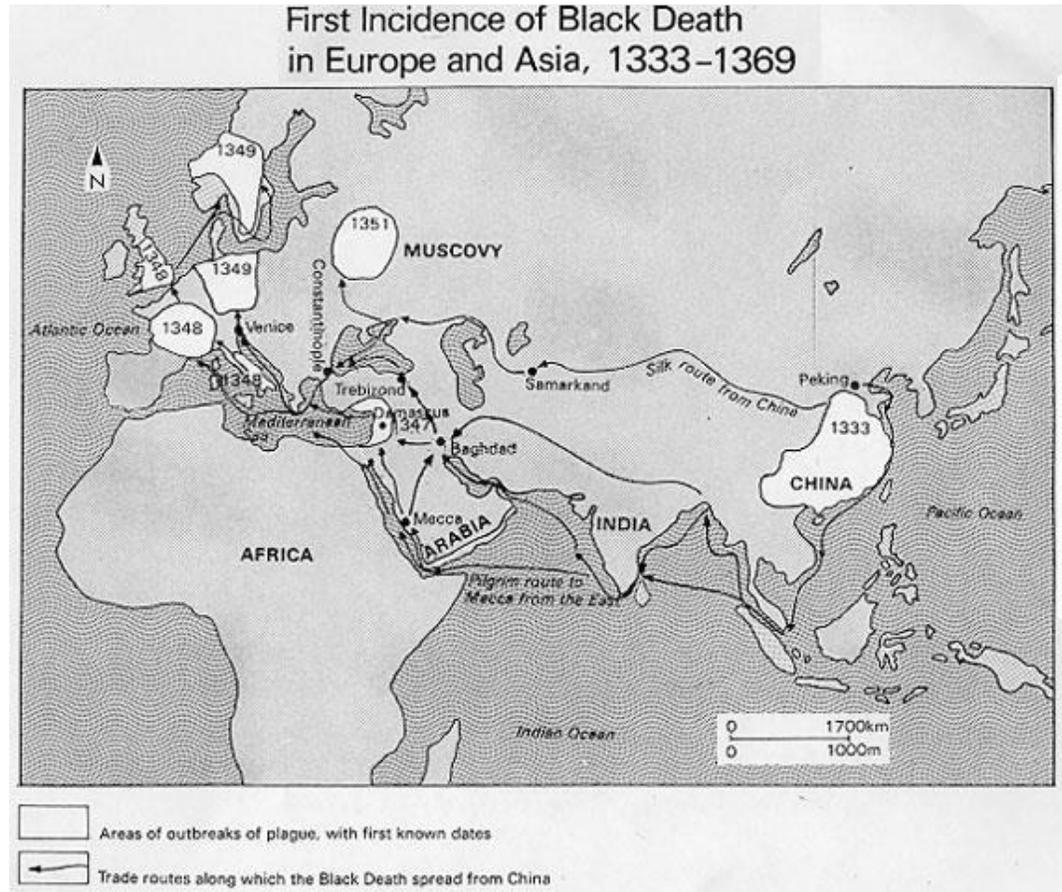


Image courtesy of Medieval Maps at Choate Rosemary Hall and Brown University

Abstract

In the four years between 1347 and 1351, an outbreak of the bacteria *Yersinia pestis*, the causative agent of bubonic plague, killed between one quarter and one third of Europe's population during a pandemic often referred to as the Black Death. Despite the swiftness with which the disease traveled, societies were not entirely helpless, for physicians had many surgical and medical procedures at their disposal to aid their patients.

In this thesis I examine the types of medicine used by physicians in Christian and Muslim societies, both prior to and during outbreaks of bubonic plague. By exploring how the body and its functions were understood by medieval scholars, I attempt to explain why certain medicines were more popular than others in treating the plague, and how the popularity of a single treatment could vary across time and geographic region. I explain the diversity of the medical procedures utilized by demonstrating that there was a significant disagreement between the scholars of Muslim and Christian communities as to how the plague originated and why its effects on population were varied.

I have found that the physicians in Christian Europe recorded more medicines effective in treating the plague, as well as relying less on religion, than their counterparts in Islamdom. I argue that this is because at the time of the Black Death, religious officials in the Mamluk Caliphate were trying to incorporate more religious and traditional treatments into the practice of medicine, whereas

universities in Europe were actively excluding clergy and their religion from the medical fields, creating a division in religion and medicine. Despite their differences, many of the treatments recorded were utilized in both Western Europe and the Middle East. Though not always effective, such medicines were able to save many infected patients who would have died without treatment.

Though not a comprehensive examination of the medicines used by physicians during the Black Death, this paper is meant to provide evidence that physicians of the Middle Ages were active practitioners of medicine with evolving theories on the body and disease, and not the superstitious quacks the modern reader often makes them out to be.

A Note on Sources

Many of the sources cited in this text, such as Rosemary Horrox's The Black Death and John Aberth's The Black Death: The Great Mortality of 1348-1350: a Brief History with Documents, are collections of translated texts dating to the fourteenth and fifteenth centuries. Others, including Lester K. Little's Plague and the end of Antiquity: the Pandemic of 541-750, are a collection of essays by different authors all relating to the theme of plague. To facilitate an easier reference process for the reader, I have decided to use the editor's name in the in text citations.

Chapter 1: An Introduction to the Study of Plagues

In 1346, the invading Mongol army was attempting to capture the city of Kaffa, which at the time was held by the Genoese. The Genoese were the least of their worries, however, for the Mongols were facing a much worse enemy: an incredibly virulent disease that was destroying their ranks faster than any warfare the Genoese could devise. In an early form of biological warfare, the Mongols loaded their catapults with the bodies of their fallen soldiers and heaved them into the barricaded city, thus infecting the Genoese. The siege of Kaffa ended in 1347, and the few remaining Genoese returned to Europe through the various port cities in the Mediterranean. Unbeknownst to them, however, they were carrying more than just their possessions. Individuals who harbored the disease but did not yet display symptoms boarded the ships to Europe, along with rats carrying the infected fleas. By 1348, this disease had reached mainland Europe, and would sweep through cities and towns, killing almost a third of the continent's population in only three years. Today, we refer to this pandemic as the Black Death, the most memorable outbreak of the bubonic plague.

The study of the Black Death as we know it began in 1894, when Alexandre Yersin positively identified the then-unknown Gram negative bacteria *Yersinia pestis* as the causative agent of plague.¹ In the same year, Shibasaburo Kitasato, a student of the preeminent bacteriologist Robert Koch, came to the same conclusions about the identity of the infectious agent.² Using an early classification system, *Y. pestis* was placed into the family Pasteurellaceae. For the next 80 years, until the sufficient advancement of DNA-comparing technologies

such as bioinformatics, *Y. pestis* would be referred to as *Pasteurella pestis*. During the period in which *Y. pestis* was incorrectly categorized, plague research was characterized by what Jo Hayes refers to as “Gothic Epidemiology.”³ Put simply, “Gothic Epidemiology” was the study of the Middle Ages through direct contrast to the Renaissance period. Instead of viewing the later medieval period as a gradual shift into the Renaissance, academics argued for an abrupt change in culture and attitudes in the fifteenth century. This often biased their scholarship, for as the Renaissance was seen as a time of enlightenment, the Middle Ages were therefore be seen as a time of no progress, or even reversed progress, in the areas of science and medicine.

Scholarship of the Black Death became more popular in the early 20th century as plague reentered daily life with the Manchurian Epidemic of 1910-1911; an outbreak that started in China, then traveled across the Pacific Ocean, reaching as far as San Francisco. By the 1960s, though the “Gothic Epidemiology” approach was losing its hold, it was still prevalent in some aspects of academia. By this time, it had been almost conclusively determined that the Justinianic Plague, which was a series of 18 pandemics from roughly 542-750, were also cases of Bubonic Plague and were therefore also caused by *Pasteurella (Yersinia) pestis*.⁴ As the end of the Justinianic Plague roughly correlated with the breakdown of antiquarian societies and the rise of the so called “Dark Ages,” most historians were more than willing to believe that these outbreaks were single-handedly responsible for the change in European society and structure. According to them, it was these infections alone that weakened the Roman

defenses, allowing the Slavs to enter Europe.⁵ Other events which we now know played significant roles in the periods of shifting power, such as the rise of the Muslim Caliphates, were seen as unimportant.

A prime example of the influences of gothic epidemiology on plague scholarship from the mid-20th century is Geoffrey Marks' work The Medieval Plague: The Black Death in the Middle Ages (1971). In the short 200 or so pages, Marks attempts to cover all matters relating to the Black Death, from the microbiology of *P. pestis* itself to the ways in which it was treated by physicians. His book shows a clear understanding of the basic methods of transmission of *P. pestis* between its vector, the oriental rat flea *Xenopsyllia cheopis*, its primary host, the black rat, and its secondary host, the human. He spends a good portion of the book describing the different modes of transmission and expression between the three major forms of plague, namely: bubonic, pneumonic, and septicemic.⁶ While the rudimentary knowledge of plague infection is present in his work, other factors of scholarship are severely lacking (although some of this has more to do with a lack of laboratory technology than academic bias). As are many other mid-20th century scholars, Marks is more than willing to attribute *P. pestis* to every other historical or pseudo-historical outbreak, including those mentioned in the Bible.⁷ Because the Old Testament specifically calls the two diseases it discusses "plagues", Marks assumes that they must be caused by *P. pestis*. This is problematic because the term plague did not represent what it does today. While we use plague when referring only to a certain type of infection, "plague" was used much more loosely in the ancient and medieval periods, and often simply

referred to a disaster or a general epidemic.⁸ Therefore, just because a source mentions “plague”, we cannot assume that it is an infection of *P. pestis*. Marks’ research also falls short when dealing with the social context of the Black Death. When he does eventually begin to discuss the ways in which plague was treated – one of the shortest sections of his book – he focuses mainly on the religious understanding of disease and medicine. What little research he has done on the medical practice of the Middle Ages serves only to emphasize his point that most individuals were superstitious and uneducated. He paints a picture of inept doctors who were unable to do anything for their patients except help them die sooner, and a university system more invested in astrology than the church.⁹ While religion, astronomy, and the natural sciences certainly played a role in the understanding of disease and treatment, it was far from the quackery that Marks’ background in gothic epidemiology leads him to seek out.

Between 1967 and 1971, the bacteria *P. pestis* itself was re-examined. Upon closer inspection, biologists noticed marked similarities in its DNA and that of *Escherichia coli*. Based on those similarities, it was determined that pestis was not actually a member of the family Pasteurellaceae, but of Enterobacteriaceae.¹⁰ In 1971 it was reclassified to the new family and renamed *Yersinia pestis* in honor of its discoverer. Further information has been gleaned about the evolution of *Y. pestis* and its relation to other enterobacteria, which I shall cover in the next chapter. Suffice it to say for now that the reclassification of *Y. pestis* had a profound impact on the study of historical plagues.

While the scholarship of the early and mid-twentieth century had been characterized by certainty through textual research, the research of the late twentieth century was filled with emerging doubt surrounding the causative agent of the plague, based on new laboratory technologies that often yielded conflicting results. As microbiology and ancient DNA tests were incorporated into the study of history, scholars became more reluctant to take contemporary accounts of plague at their word. Though contemporary accounts had been the main source of information regarding the bubonic plague, new scientific techniques gave scholars the luxury of believing that these accounts were often greatly exaggerated. While historians continued to base their research in the textual accounts, scientists and epidemiologists turned towards the physical evidence provided by archeology, which was often contradictory to the information provided in texts.¹¹ This led to the understanding of diseases as biological, not social, constructs, and the humanist understanding of plague was pushed to the background.

This came to a head in 1984, when Graham Twigg proposed that *Y. pestis* was not the causative agent of the Justinianic Plague or the Black Death. Instead, based on symptoms often shown in more contemporary epidemics, he suggested that it was Anthrax, a disease caused by the bacteria *Bacillus anthracis*, or smallpox, an infection by the Variola virus.¹² When an individual contracts Anthrax or smallpox, they can develop skin lesions or carbuncles. These hardened areas of flesh are often swollen, necrotizing, or oozing pus.¹³ Because of their superficial resemblance to buboes, Twigg believed that this was simply a case of mistaken identity. There are, however, several faults with this argument. Most

importantly is the location of the buboes and the carbuncles on the patient's body. Accounts from both the Justinianic Plague and the Black Death specifically state that the pustules were located on the neck, armpits, and groin.¹⁴ Today, we know that these places correspond to the major lymph nodes. As bubonic plague occurs when *Y. pestis* accumulate in the lymph nodes, it makes sense that these are the areas that exhibit symptoms.¹⁵ Anthrax carbuncles and smallpox lesions, however, can occur anywhere on the body. When these lesions, especially those caused by *B. anthracis*, appear on or near the lymph nodes, they are generally painless, while those associated with plague are painful.¹⁶ Even without examining the placement of the lesions, other evidence proves that neither anthrax nor smallpox were responsible for the Black Death. In Twigg's study on plague victims in Mumbai from which he created this hypothesis, only 3% of the buboes had similar physical characteristics to lesions caused by anthrax or smallpox.¹⁷

Another serious problem with posing *B. anthracis* or the Variola virus as the causative agent of plague is the differing methods in which they and *Y. pestis* are transmitted between hosts. While pneumonic plague can be transmitted directly from person to person through the inhalation of infected mucus or spit, Bubonic plague is dependent upon arthropods for transmission.¹⁸ As we will see in more detail in the next section, bubonic plague is mainly a disease of fleas and rodents. An infected flea regurgitates *Y. pestis* bacterium into the rat's blood stream when it feeds. The bacteria begin to colonize until a threshold level is met. An uninfected flea then feeds from the diseased rat, and *Y. pestis* enters the flea gut through the rat blood. The cycle is then repeated with more fleas and rats.

Humans become infected when the rat population declines and fleas are forced to feed off of humans instead. There are several traits characteristic of any infection spread through an arthropod vector. As discussed above, bacteria transmitted by an arthropod require both a vector (the arthropod itself), and a host, usually a mammal. If the mammal does not travel far, as in the case of the black rat, the infection is characterized by patchy outbreaks, rather than an evenly distributed infectious zone.¹⁹ These patches of intense infection, surrounded by areas of relatively low infection, are described in accounts of the Black Death.²⁰

Unlike *Y. pestis*, the Variola virus' only known host is the human.²¹ According to the Centers for Disease Control, not only is smallpox not known to be carried by insects or animals, but it must be spread through either direct contact with infected fluids or through prolonged face to face contact.²² In other words, in order for a person to contract smallpox, they must spend a significant amount of time in the vicinity of an individual who is not only infected, but also in the contagious phase, which comprises only about half of the infection cycle. It can therefore be ruled out as the true form of plague, as many accounts from the Black Death state that some individuals were around plague victims constantly and never became sick, while others who had no exposure to infected individuals suddenly fell ill themselves, as could be the case when the plague entered a new area.

Anthrax can also be discounted in a similar manner. Like smallpox, but unlike *Y. pestis*, *B. anthracis* cannot be transmitted by an arthropod. Instead, it can be passed on via inhalation of particle containing spores, entry of spores or

vegetative bacteria through a break on the skin, or through digestion.²³ Again, these first two methods of transmission would require individuals to be in close contact with each other, contrary to what the sources tell us. While it is possible that symptoms of gastrointestinal anthrax were mistaken for those of plague, its transmission across all of Europe seems unfeasible. In order for gastrointestinal anthrax to be passed on, an individual must eat meat from an infected herbivore such as a cow or deer.²⁴ It seems highly improbable that the majority, or even a significant number, of farm animals all across Europe and the Middle East became simultaneously infected with anthrax.

Several years later, Susan Scott and Christopher Duncan also proposed a different causative agent for plague, arguing that the “epidemiology of the historical plague epidemics in Europe is incompatible with the epidemiology of the third pandemic [the Manchurian Plague].” They hypothesized that the Black Death and the Justinianic Plagues were caused by an entirely unknown virus. Scott and Duncan proposed that the unknown viral agent was related to and acted in a similar manner as the modern Ebola virus, and caused a “hemorrhagic plague” instead of a bubonic plague.²⁵

Other scholars were eager to point out that there were two major faults with this theory. The first is that the transmission and infection areas of the Ebola virus are different than that of plague. As a respiratory infection, this supposed virus should create an area of infection without differing concentrations of victims, inconsistent with what the records tell us about plague.²⁶ Robert Sallares states it best: “The plague’s patchy occurrence is ‘inconsistent with the patterns of

major viral infectious diseases that are transmitted directly from person to person by the respiratory route...and the virus hypothesized by Scott and Duncan should have behaved in this way if it spread by direct interpersonal transmission, as they suppose.²⁷ The second argument against this explanation is less of a scientific discrepancy and more of a matter of practicality. The swollen buboes of bubonic plague and the bloody sputum of pneumonic plague were almost identical to the symptoms recorded in contemporary literature. Therefore, it seemed foolish to go searching for an imaginary infectious disease. Sallares voices the concerns of many historians and biologists when he says: "There is no need to invent a new virus with bizarre properties to explain historical plague epidemics."²⁸

In 1998, a team in Marseilles, France, positively identified remains of *Y. pestis* in the bodies of an early modern mass grave. They used PCR, a technique that amplifies copies of DNA, combined with sequencing to identify the bacterial genome from the dental pulp of unerupted teeth. The results were striking; multiple individuals in the grave had evidence of *Y. pestis* DNA in their dental pulp.²⁹ This experiment was then repeated in Montpellier, where 23 samples from teeth were extracted from a mass burial dating to the fourteenth century. Again, the results of sequencing and PCR provided fragments of *Y. pestis* DNA.³⁰ While this seemed conclusive evidence that *Y. pestis* was the causative agent, many scientists were not willing to accept it as definitive proof, for there were problems with the evidence. Not all of the individuals exhumed from the grave had remnants of bacterial DNA in their teeth. In many cases, the dental pulp was too degraded to perform an accurate analysis, but in other instances, even when the

teeth provided good samples, no bacterial DNA could be isolated.³¹ When this experiment was repeated at a lab in Oxford University that specialized in analyzing ancient DNA samples, the technicians were unable to replicate the results.³² It should be noted, however, that the corpses tested in Marseilles and Oxford were from late medieval and early modern individuals exhumed from different suspected plague graves.

Plague scholarship of the late 20th century was also influenced by the shifting attitudes toward the Middle Ages. While the previous decades had based their understanding of history on “gothic epidemiology”, historians began to argue that the changes experienced after the fall of the Roman Empire and throughout the medieval period to the Renaissance were much more gradual than previously believed. Instead of being seen as the major event that catalyzed the advent of the “Dark Ages”, the Justinianic Plague was merely a small step in a continuously evolving world. This change, I believe, allowed scientists and historians to look at the medieval period with less prejudice. Gothic epidemiology necessitated that the period between the Roman Empire and the Renaissance be negative, with little or no enlightenment. When viewing the world as continually evolving, however, academics were able to focus on the progress made within that millennia without contradicting or devaluing that which was made in another period. This reimagining of the Middle Ages brought the history of medieval science and medicine to the forefront of research. Gone were the days when scholars like Geoffrey Marks focused only on the religious and superstitious medicine used by communities during the Black Death. Instead, historians made a

conscientious effort to distinguish between religious superstition and actual medicine.³³

As the identity of the causative agent was being debated, scholars began to focus on what prompted the two massive plague pandemics. Why did the Justinianic Plague begin when it did, and why did it suddenly disappear almost exactly two centuries later? Why did it go dormant, only to reemerge in the mid-fourteenth century, just as deadly as it had been 600 years earlier?³⁴ The occurrence of unusual natural phenomena in the decades immediately preceding the two pandemics were an obvious starting point. Historical records and geological surveys have shown that in the year 536, there was a dust veil.³⁵ This veil would have blocked sunlight, perhaps leading to poorer health and crop failures. Another event that has been hypothesized as having a connection with the onset of the Justinianic Plague was the impact of a comet in the late 530s.³⁶ Although there is no direct evidence, these theories, favored by D. Keys and M. Bailey, respectively, could help explain why the populations of Europe and North Africa were so susceptible to disease.³⁷ Currently, the most popular explanation is that these disasters caused a famine, which in turn weakened the immune systems of those who would eventually be in the path of the plague.

As plague scholarship moved through the first decade of the 21st century and up to the present day, academics have come to agree that a multi-disciplinary approach is the best way to study the plague. According to Lester Little, “A 21st century perspective requires understanding of history, archeology, and molecular biology.”³⁸ This is not to say, of course, that the gap between the humanities and

the hard sciences has been completely bridged. There is still controversy as to how to proceed, as scientists favor looking at the biological evidence, while historians are generally more apt to taking the words of the past at face value. Currently, there is a debate as to whether the plague, and historical diseases in general, should be viewed as a biological or a social construct.³⁹ Many historians argue for the social constructionist view, as they assert that the overuse of laboratory techniques forces us to lose sight on the disease itself and how it was seen by its contemporaries.⁴⁰ Scientists, however, tend to favor the evidence provided by a laboratory. However, there is dissent even within the scientific community over the correct types of laboratory procedures. There are many techniques that can be used to identify and examine ancient DNA, but they all have their drawbacks, and testing one set of data may contradict results gleaned from another set.⁴¹

While scientists and historians do not always agree on the amount of importance that should be placed on the epidemiology of plague, both groups generally agree that archeology is an important tool for understanding the social and biological repercussions of plague. Archeology is critical in plague scholarship because it is the best source of evidence about population, growth, and death rates.⁴² Medieval and ancient writers were often inaccurate with their numbers, such as when a Venetian scribe wrote that 90% of Constantinople died during the Black Death,⁴³ and large numbers were generally used to emphasize a point, rather than give a contemporary reader an accurate idea of what was happening. An archeological study is not as imprecise. Little argues that the best

understanding of population can be gleaned from looking at the evidence of building and the rates at which it occurred. Equally as significant as the number of buildings erected is the relative amount of construction not done. This “negative evidence”⁴⁴ can imply that not only was the population declining and there was therefore no need to build more residences, but also that the city’s funds were being directed toward another project, such as treatment.

It is not insignificant that archeology has made this advance to the forefront of plague study recently. Since the 1970s, standard archeological practices have vastly improved, especially in the area of bioarcheology. In previous decades, for example, scientists were often unwilling to accept *Y. pestis* as the causative agent of plague because its transmission required a primary rat host. The procedures used often prevented them from finding rodent remains, leading them to believe that the rat population in Europe was too small to have been an efficient host for *Y. pestis*.⁴⁵ Newer techniques now enable archeologists to find skeletons of small mammals, and historians are putting together a much better estimate of the rat population⁴⁶ – one that theoretically could have facilitated the spread of *Y. pestis*.

If the biological construct view of plague study is to be taken, then the life cycle of *Y. pestis* is equally as important. In May of 2013, a paper was published that conclusively proves that *Y. pestis* was not only the causative agent of the Black Death and Manchurian Plague, but of the Justinianic Plague as well.⁴⁷ Now that we have this information, we can better understand how *Y. pestis* was able to infect so many people in such a short span of time by looking at modern cases.

Currently, for example, the exact number of individuals that died of the Black Death is unknown, although most historians estimate that it was between $\frac{1}{4}$ and $\frac{1}{3}$ of Europe's population.⁴⁸ We can get a better estimate of this number by examining the mortality and morbidity rates of more recent outbreaks.⁴⁹ This identification also allows scientists and historians to more accurately pinpoint the roles of the different types of plague. By observing the ways in which plague was transmitted between individuals in India during the 1996 epidemic, epidemiologists now hypothesize that because pneumonic plague spreads quicker than bubonic and can be transmitted from one person to another directly, an outbreak of plague would enter a region as pneumonic, and then revert to the bubonic form once a significant bacterial population had been established and enough rats and fleas were infected.⁵⁰

The conclusive identification of *Y. pestis* allows scholars to examine the evolutionary relationships between *Y. pestis* and its closest relatives, *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*, the only other two infectious species in the genus *Yersinia*, and the relationship between the three biovars, or strains, of *Y. pestis*. While we will discuss the evolution of *Y. pestis* from *Y. pseudotuberculosis* in the next chapter, it is sufficient to say for now that newly developed methods of genetic analysis have shown that *Y. pestis* evolved quite recently. This dating was done by looking at the amount of mutation and conserved DNA sequences between *Y. pestis* and *Y. pseudotuberculosis*. As DNA mutates over time, the amount of mutation in a chromosome can be used to date said chromosome. There are few changes between *Y. pestis* and *Y.*

pseudotuberculosis, and even fewer between the three biovars, suggesting the relative youth of *Y. pestis*.⁵¹

The study of plague has come full circle in the 120 years since Alexandre Yersin first identified *Y. pestis*. Despite decades of dissension over the identity of the “plague” and its causative agent, we now know for certain that it is a bacterial infection of the lymph nodes caused by *Y. pestis*, and that this was the cause in all three major plague pandemics. By tracing the evolutionary relationship of the strain implicated in the Black Death, *Y. pestis mediaevalis*, scientists and historians alike agree that it emerged in the early fourteenth century around the steppes of Central Asia, from where it spread west via the Mediterranean to infect all of Europe.⁵²

¹Rachel C. Abbot and Tonie E. Rocke. *Plague*. (National Wildlife Health Center. US Geological Survey, Reston, Virginia. 2012) 4

²Abbot. *Plague*. 4

³Lester K Little. *plague and the end of antiquity: the pandemic of 541-750*. (Cambridge. Cambridge University Press in association with the American Academy in Rome. 2007), 55

⁴Ibid, 232

⁵Ibid, 125

⁶Geoffrey Marks. *The Medieval Plague: The Black Death in the Middle Ages*. Doubleday. 1971. 7-9

⁷Marks. *The Medieval Plague*. 14

⁸The Holy Bible. New Revised Standard Version.1 Samuel 6:4

⁹Marks. *The Medieval Plague*. 56, 81

¹⁰Abbot. *Plague*. 4-5

¹¹Little. *Plague and the End of Antiquity*. 87

¹²Ibid, 237

¹³Centers for Disease Control. Last updated January 17, 2014. <http://www.cdc.gov/anthrax/>

¹⁴Little. *Plague and the End of Antiquity*. 4

¹⁵Abbot. *Plague*. 4

¹⁶Centers for Disease Control. <http://www.cdc.gov/anthrax/>

¹⁷Little. *Plague and the End of Antiquity*. 237

¹⁸Ellen A. Lorange, Brent L. Race, Florent Sebbane and B. Josph Hinnebusch. *Poor Vector competence of Fleas and the Evolution of Hypervirulence in Yersinia pestis*. , *The Journal of Infectious Diseases*. 2005.

¹⁹Little. *Plague and the End of Antiquity*. 258

²⁰Rosemary Horrox. *The Black Death*. (Manchester. Manchester University Press. 1994), 170

²¹Centers for Disease Control. <http://emergency.cdc.gov/agent/smallpox/index.asp>

²²Ibid

²³Centers for Disease Control. <http://www.cdc.gov/anthrax/>

²⁴Ibid

- ²⁵Little. *Plague and the End of Antiquity*.255
- ²⁶Horrox. *The Black Death*.53
- ²⁷Little. *Plague and the End of Antiquity*. 258
- ²⁸Ibid, 261
- ²⁹Ibid, 294
- ³⁰Ibid
- ³¹Ibid
- ³²Ibid, 295
- ³³Andrew Wear. *Medicine and Society: Historical Essays*.(University of Cambridge Press. Cambridge. 1992) 76
- ³⁴Little. *Plague and the End of Antiquity*. Introduction
- ³⁵Ibid, 100
- ³⁶Ibid
- ³⁷Ibid
- ³⁸Ibid, 17
- ³⁹Ibid, 33
- ⁴⁰Ibid, 45
- ⁴¹Ibid, 295
- ⁴²Ibid, 89
- ⁴³John Kelly. *The Great Mortality: An intimate history of the black death, the most devastating plague of all time*. (New York. Harper Perennial. 2005) 81
- ⁴⁴Little. *Plague and the End of Antiquity*. 15
- ⁴⁵Ibid, 268
- ⁴⁶Ibid
- ⁴⁷Harbeck et.al. *Yersinia pestis DNA from Skeletal Remains from the 6th Century AD Reveals Insights into Justinianic Plague*.
- ⁴⁸Marks. *The Medieval Plague*. 5
- ⁴⁹Little. *Plague and the End of Antiquity*. 114
- ⁵⁰Ibid, 242-44
- ⁵¹Mark Achtman, et.al. *Yersinia pestis, the Cause of Plague, is a Recently Emerged Clone of Yersinia pseudotuberculosis*. Proceedings of the National Academy of Sciences of the United States of America. 1999
- ⁵²Marks. *The Medieval Plague*. 1-5

Chapter 2: The Infection Cycles of *Yersinia pestis*

The placement of *Y. pestis* within the *Yersinia* genus and its evolutionary relationships with other members of the genus are integral components in understanding how *Y. pestis* infects its victims, as well as its role in historical epidemics. Of the 11 members of the genus *Yersinia*, only three are pathogenic to humans. These are: *Y. pestis*, *Y. pseudotuberculosis*, and *Y. enterocolitica*.¹ Though all three infect humans, *Y. pestis* is unique in that it is the only one that requires an arthropod vector in order to infect a host organism.² Both *Y. pseudotuberculosis* and *Y. enterocolitica*, which shared a common ancestor several million years ago,³ are passed through the oral-fecal route, like many other gastrointestinal pathogens.⁴

Of the three infectious species, *Y. pestis* is more closely related to *Y. pseudotuberculosis*.⁵ Recent genetic testing has revealed that major portions of the genome are conserved across both species.⁶ Given the amount of time that passes during a single cell cycle and the rate of mutation, scientists have determined that *Y. pestis* evolved from the much older *Y. pseudotuberculosis* somewhere between 12,000 and 2,000 years ago. This does not mean, however, that all ancient pandemics were caused by *Y. pestis*, for the term “plague” was often used for any massive pandemic that could have been caused by any number of ancient bacteria.⁷ With the constant evolution of microorganisms, it is possible that the pathogen involved in these outbreaks is not currently present, although that is an argument for a different paper.

Once the genetic relationship was determined between *Y. pestis* and *Y. pseudotuberculosis*, research focused on the genes that had evolved only in *Y. pestis* to make it a more effective pathogen. The most important of these evolutionary products are the plasmids pFra and pPla.⁸ A plasmid is a circular chromosome containing a set of genes that are not found on the bacterial chromosome itself. Plasmids can mutate and evolve quickly, and have the added advantage of being replicated and passed laterally between bacterial cells, at which point they can integrate themselves into the host genome. Unlike humans, which need to receive all of their genes from their two parents at conception, bacteria can take up a new plasmid during its lifecycle. The plasmids pFra and pPla are especially important because they contain the genes that enable *Y. pestis* to utilize an arthropod vector, thus freeing it from the oral-fecal route of transmission utilized by its ancestors.⁹ One protein encoded by the pPla plasmid, Pla protease, enables the spread of *Y. pestis* by breaking down blood clots. A host organism will often create clots in the blood stream to trap *Y. pestis* colonies, preventing them from spreading to other areas of the body. Pla protease breaks down the components of these clots, allowing the bacteria to travel.¹⁰

Two other key proteins not found on the plasmids, yet involved in the infection mechanism are the Yops, or Yersinia outer proteins, and F1.¹¹ Similar to Pla protease, F1 protein is a part of a defense mechanism to protect the bacteria from the host's immune response. Specifically, it prevents the bacteria from undergoing phagocytosis by confusing the receptors on the white blood cells, thus disguising the bacteria.¹² Similarly, Yops proteins are injected into the host's

white blood cells by a specialized syringe-like appendage. The addition of Yops to a white blood cell prevents the cell from mounting an inflammatory response. In this way, the host cells are tricked into believing that tissue damage is not occurring, and the bacteria grow without restriction.¹³ After the lymph nodes, the liver and spleen are infected, and eventually the bacteria enter the blood stream and circulate throughout the body.

Once an individual is infected with *Y. pestis*, the symptoms are different depending on where and how the infection first enters the body and where it first localizes. According to the CDC, 79% of plague cases in the United States originate through the bite of an infected flea, while 19% and 2% occur from direct contact with animals and inhalation of infectious respiratory fluids, respectively.¹⁴ Other modes of infection more common outside of the United States include the ingestion of infected animal meat and the direct contact with bodily fluids of another infected individual. If a patient becomes infected through a flea bite or a bite or scratch from an infected mammal, they will most likely contract bubonic plague, whereas inhalation of another's bodily fluids is generally responsible for pneumonic and pharyngeal plagues.¹⁵

Bubonic plague is the most common form of plague, as well as the most recognizable and easily treatable. Of the symptoms, the most well-known is the bubo. A bubo is an infection of the lymph node and occurs when the bacteria localize there.¹⁶ There they colonize and reproduce, necrotizing the flesh and causing the easily recognizable black buboes. This is why true buboes, as opposed to raised patches of inflamed skin and flesh caused by other types of infection

such as anthrax, are only located in areas containing major lymph nodes, such as the groin, neck, and armpits.

Other symptoms of bubonic plague are more generalized to bacterial infections and therefore less indicative of plague. These include, but are not limited to, fever, headache, chills, muscle pain, fatigue, nausea, vomiting, and diarrhea.¹⁷ Without the characteristic buboes, it is often hard to determine whether a patient is suffering from plague, as many of these symptoms are general immune responses that the body uses to defeat multiple forms of infection. In the case of fever, raising the temperature of the body can often denature bacterial proteins necessary for their survival and reproduction. Nausea, vomiting, and diarrhea are also generic methods the body utilizes for flushing harmful bacteria out of the host's system.

Once the bacterial colonies reach a certain level, they leak from the infected organs and lymph nodes into the blood stream, causing septicemic plague.¹⁸ Less common and more dangerous than bubonic plague, septicemic plague, a poisoning of the blood stream by *Y. pestis*, is characterized by symptoms similar to those of bubonic plague, such as fever, chills, and headache, but also by tissue necrosis. As the blood becomes infected, clots composed of antibodies, bacteria, and blood cells hinder circulation, despite the bacteria's attempts to destroy them. As a result, limbs and extremities become deprived of oxygen and begin to exhibit gangrene. If septicemic plague progresses for too long without treatment, limbs may be amputated.¹⁹

Of the three most common forms of plague, pneumonic is the most dangerous. If not treated appropriately and timely, the fatality rate is 100%.²⁰ Unlike bubonic and septicemic plagues, which require entrance into a host's body through a break in the skin, pneumonic plague occurs when the bacteria settle in the lungs and respiratory passages. Once in the lung tissue, *Y. pestis* colonizes and the surrounding flesh begins to deteriorate, causing symptoms similar to those of pneumonia or a standard chest cold. One to three days after the initial infection, patients begin to display flu-like symptoms including coughing, chest pain, and bloody sputum.²¹ This sputum itself carries thousands of bacteria, which can infect another individual if inhaled. If left untreated, the patient's condition will deteriorate and they are at risk for entering respiratory failure or shock, either of which can quickly cause death. Pneumonic plague can also be caught if a case of bubonic or septicemic plague goes untreated and the patient survives. In this case, the bacteria traveling throughout the body localize in the lungs, and the pneumonic form begins.²²

Though the three major forms of plague have become common in bacterial literature, there are two minor forms of plague that are often overlooked. These are pharyngeal and meningial plague.²³ Pharyngeal plague is similar to pneumonic in that it is an infection of the respiratory tissue that occurs through the inhalation of infected bodily fluids. Unlike pneumonic, however, pharyngeal plague is mainly an infection of the pharynx, not the lungs, and is not as serious itself as pneumonic plague, although it can progress into pneumonia if left untreated.²⁴ Meningial plague occurs when *Y. pestis* cross the blood-brain barrier

into the brain. There, they infect the tissues surrounding the brain (the meninges), causing them to swell with the massive importation of antibodies and put enormous pressure on the brain and brain stem, thus creating a potentially fatal condition referred to as meningitis.²⁵ Though interesting, neither of these forms of plague were implicated in either the Justinianic or medieval pandemics.

Y. pestis itself can be identified by several techniques, both in a laboratory and in the field. The first method of identification is a Gram Stain.²⁶ By using a sequence of dyes and alcohol washes, bacteriologists are able to determine which one of the two categories a bacteria can fall into: Gram Negative or Gram Positive. Gram Positive and Gram Negative bacteria differ in their cell wall structure. The basic unit of a bacterial cell wall is a compound called peptidoglycan. It is formed when “sugar” glycan strands become cross-linked with peptide bridges. The glycan strands are themselves composed of two alternating molecules: N-acetyl glucosamine (NAG) and N-acetyl muramic acid (NAM). While both NAM and NAG are linked to each other through enzyme-resistant beta-bonds, only the NAM molecules have the peptide cross bridges. This resistant, yet dynamic shell is the basis for bacterial cell walls, both Gram Negative and Gram Positive.²⁷

The difference between Gram Negative and Gram Positive bacteria lies in how they position and utilize this peptidoglycan layer. Gram Positive cells have an inner cellular membrane beneath a coating of peptidoglycan several layers thick. In addition to being linked with peptides, the NAM molecules in Gram Positive cell walls are also bound to teichoic acids, which give the cell wall an

overall strongly negative electric charge.²⁸ In contrast, a Gram Negative bacterial wall has more components. Immediately surrounding the cytoplasm is a thin inner membrane, much like that of a Gram Positive. Outside of that is the peptidoglycan layer, which is much thinner than in its positive counterpart. This is surrounded by an outer membrane containing a lipopolysaccharide leaflet. This leaflet, among other functions, provides the bacterial cell with a certain amount of protection against the host cell's immune response.²⁹ In the case of *Y. pestis*, this outer membrane is rough and allows the bacteria to withstand attacks from the host's immune system.³⁰ To determine if a bacteria is Gram Negative or Gram Positive, indigo, saffron, and iodine dyes are used to stain the cell in conjunction with an alcohol wash. In Gram Positive cells, the indigo dye creates a firm bond with the peptidoglycan, and the cells are stained purple. Gram Negative cells, however, are unable to form such a bond with indigo, and saffron and iodine become the primary visible dyes, turning the cells pink. When a Gram stain is performed on *Y. pestis*, the cells turn pink instead of purple, indicating that it is a Gram Negative bacteria.³¹

While a Gram Stain is useful in determining whether a sample is Gram Negative or Positive, it cannot be used to positively identify a bacteria. Other tests are more useful in identifying *Y. pestis*. Wright's Stain, however, can be used to determine the presence of *Y. pestis*. When it is subjected to a Wright's Stain, most of the dye collects at the two poles of the cell. Under the microscope, this gives the bacteria a safety-pin like appearance that is characteristic of the *Yersinia* genus.³² This distribution of dye is due to the somewhat unusual shape of the

bacterial cell. Generally, bacteria can be classified as one of three types: vibrioid (corkscrew or curved in shape), coccus (spherical), or bacillus (rod).³³ *Y. pestis* is neither entirely a coccus nor a bacillus, and as its form is somewhere between a rod and a sphere, it is classified as a coccobacillus.³⁴

While the aforementioned stains can be useful in a diagnosis, especially in preliminary eliminations, more direct tests that target *Y. pestis*' genome are required for a definitive diagnosis. PCR, or polymerase chain reaction, creates thousands of replicas of a specific section of the isolated bacteria's genome,³⁵ allowing scientists to look for a particular gene unique to *Y. pestis*. If a live sample of the bacteria is available, it can be identified by its reaction to a bacteriophage.³⁶ Bacteriophages are viruses that specifically target a certain species or genus of bacteria. Because they do not have their own cellular machinery, bacteriophages infect bacterial cells and hijack their host's machinery to reproduce. Once the viral progeny have been assembled, the host cell lyses, releasing the newly created viruses into the system to infect other bacteria. As a bacteriophage can only infect and kill members of a particular bacterial genus or species, observing the reaction of a suspected colony of *Y. pestis* with its known bacteriophage can determine the identity of the unknown species.

While phage lysis can only be used on living specimens of bacteria, the newer Rapid Diagnostic Test can be used on unhealthy or dead samples.³⁷ This test works by detecting the F1 antigen, which is the protein that the host's immune system recognizes to trigger an immune response. As this protein is specific to *Y. pestis*, a Rapid Diagnostic Test gives a definitive identification.³⁸ It

also has the advantage of being both fast-acting and strong. Problems that traditionally would alter results in such a test, such as sample deterioration, contamination, or the addition of antibiotics will not skew the results of a Rapid Diagnostic Test. And while the average PCR test for *Y. pestis* identification takes 3 to 5 hours to complete, the test produces reliable results within 10 to 15 minutes.³⁹

Once it has been determined that *Y. pestis* is the causative agent in an infection, patients are immediately started on antibiotics. While many antibiotics are available and have ranging effects on *Y. pestis* infections, it is generally agreed that the best course of action is treatment with Streptomycin or Chloramphenicol.⁴⁰ Chloramphenicol is a wise choice for antibiotic treatment because unlike many other commercially available antibiotics, it is able to cross the blood-brain barrier, allowing it to treat colonies that have migrated into the brain and have become a risk for causing meningial plague.⁴¹ When these are not available or the patient is not responding, other drugs such as tetracycline and gentamicin can be administered.⁴² The use of correct antibiotics in treating plague is quite important; correct treatment can greatly decrease the mortality rate, while incorrect treatment such as dosage, choice of drug, and duration of therapy can increase a patient's chances of contracting a secondary form of plague.⁴³ When treated correctly, the mortality rate of bubonic plague decreases from 60% to only 5%, and septicemic from 50% to 30%. Most individuals suffering from pneumonic plague survive if treated quickly, but if antibiotics are delayed for more than 24 hours after the first appearance of symptoms, it is always fatal.⁴⁴

While the study of *Y. pestis* and its interactions with a human host is of primary importance in understanding the Black Death and its treatments, it is also important to understand how *Y. pestis* enters a human population. To do this, we must examine its relationships with its primary vector, the rat flea *Xenopsylla cheopis* and host, the black rat *Rattus rattus*.

As stated above, the rat flea *X. cheopis* is generally considered to have been the primary vector in the bubonic plague, and today is the vector in most cases of plague in Asia and Africa.⁴⁵ A flea becomes infected when it feeds off of an infected mammal and ingests bacteria at a concentration of at least 1 million organisms per milliliter of blood. If the amount of bacteria ingested is below this threshold level, the flea will not make a suitable vector.⁴⁶ Once the flea is infected, it can transmit bacteria to a new host using one of two methods. The first method to be described and generally held to be more common, especially among *X. cheopis*, is foregut blockage.⁴⁷ The alternative mechanism is early phase transmission, and is found in the ground squirrel fleas *Oropsylla montana*.⁴⁸ In the foregut blockage mechanism, the bacteria multiply in the flea's gut. There, they produce a clump that cannot be passed further into the digestive tract. Although the flea continues to feed, the blood cannot pass around the clump, and the flea begins to starve. As it starves, it feeds more and more in an attempt to survive. This massive influx of blood cannot pass, however, so the flea regurgitates the bacteria-ridden blood into the new host that it is feeding on. If the levels of bacteria in this infected blood are over 10 million organisms per milliliter, then an infection site will be established in the new host, which can then be passed on to

another vector.⁴⁹ Foregut blockage is not a perfect mechanism for delivering *Y. pestis* to a new host, however. Though individual cases vary, it generally takes around five days for a flea to develop a large enough foregut blockage to necessitate its regurgitation and for the bacteria to reach a critical level. Therefore, individuals bitten before that time can escape infection.⁵⁰ Even when the flea is actively transmitting bacteria, it has a limited time in which to do so, as it is starving to death. Often, the practical period of infection from a flea experiencing this blockage is only a few days. During the time that a flea is infectious, however, it can travel to many different hosts, infecting each of them.

Despite its success in transmitting *Y. pestis*, not all fleas undergo foregut blockage. The ground squirrel flea, *O. montana*, the primary vector in North America, can spread *Y. pestis* through early phase transmission.⁵¹ In this mechanism, there is no incubation period during which the flea is not infectious. After as little as three hours, a flea carrying bacteria can infect a new host, although it usually takes one to four days. The bacteria remain in the esophagus of the flea, and are passed into the host's bloodstream when the flea bites and regurgitates, much like in the foregut blockage. Unlike foregut blockage, no clots form in the flea's esophagus, so it does not starve and is consequently not forced to continue to feed.⁵² It is overall less effective than foregut blockage, because the amount of bacteria carried by the flea decreases over time, until eventually the point is reached where it can no longer inject the threshold amount of bacteria into a new host. Not all vectors undergo only one form of transmission. *X. cheopis*, known for generally transmitting through foregut blockage, can occasionally take

part in both transmission routes.⁵³ If the circumstances are correct, a flea infected will be infectious the first day after ingesting bacteria, and will transmit through early phase until the bacteria have time to form a clot in its esophagus, at which point it begins to starve and switches over to the foregut blockage route.⁵⁴

As implied by their names, the primary hosts of the Oriental rat flea and ground squirrel fleas are rodents. The main host of the oriental rat flea, the black rat, is considered to be the major source of bubonic plague in historical epidemics.⁵⁵ As a primary host, the black rat can sustain a population of *Y. pestis* without interactions with any other mammalian species. This ability to sustain the plague in rat populations is not indefinite, however. In order for plague to be maintained and propagated in a rat population, between 25% and 50% of the population must be susceptible to infection, and there must be a sufficient number of fleas to transfer *Y. pestis* to new hosts.⁵⁶ According to the Centers for Disease Control, if more than 80% percent of the rat population is susceptible to infection, it becomes possible for them to transmit bacteria to a nearby human population, in what is known as an epizootic, or interspecies, outbreak. The risks associated with an epizootic outbreak increase the more ill the rats become, as the fleas must find a new host to replace the dying rats, and are forced to feed on humans. If, however, the percentage of susceptible rats is below threshold, then a plague outbreak is limited to one location, or focus, and does not spread to nearby human or rodent populations.⁵⁷

In the United States, prairie dogs have become a common primary plague host.⁵⁸ The last known case of *Y. pestis* transmission from a rat in the United

States was in the 1920s. Even though such rodents are colonized by *Y. pestis*, they will often not die from the infection.⁵⁹ This has both positive and negative consequences for the bacteria. Because the hosts are not actively dying, the fleas have no need to search for a new meal, and the bacteria are not transmitted to a new host. On the other hand, these populations provide an ideal place for *Y. pestis* to grow and reproduce. Because the bacteria are constantly present but do not kill off the hosts, a plague focus can be maintained indefinitely.⁶⁰ This explains why there are foci, such as those found in the Southwestern United States, where plague is always present in certain colonies of rodents but is never transmitted to surrounding human and rodent populations.

In addition to *Y. pestis*' primary hosts and vectors, it can also grow and reproduce many more secondary hosts and vectors. The CDC defines these vectors are arthropods that have been shown experimentally to transmit *Y. pestis* between two hosts, despite there being little or no documented cases of their transmission in the wild.⁶¹ In one experiment, scientists found that the human body louse, *Pediculus humanus corporis*, was able to infect rabbits. When the lice fed on infected rabbits, they consumed bacteria which multiplied in their gut. This bacterium, instead of directly infecting the louse itself, was then excreted in the louse's feces. When the louse deposited its feces on other rabbits, those rabbits became infected.⁶² Not surprisingly, a similar experiment performed with the body louse's close relative, the human head louse *Pediculus humanus capitis*, showed that this arthropod too had the ability to transmit *Y. pestis* to uninfected mammals.⁶³ A third experiment was performed with two types of ticks: the hard-

bodied ixodid *Hyalomma asiaticum asiaticum* and the soft-bodied argasid *Ornithodoros tartakovskyi*. Scientists discovered that both species could infect camels, a known secondary host of *Y. pestis*.⁶⁴ This was an especially important breakthrough, as there has been an increase in the number of human deaths from plague involving camels. In one famous case that occurred quite recently, several men in the Middle East died from bubonic plague after eating infected camel meat.⁶⁵

Though the camel is a prime example of a secondary host, other animals are also considered secondary and pose a threat to humans through epizootic transmission. Secondary hosts, though susceptible to infection and death, are defined as being unable to sustain plague without aid from primary hosts.⁶⁶ In all, the CDC lists over 200 mammalian species that can be infected by *Y. pestis* with varying consequences. Some species can be infected by *Y. pestis* but never become sick, while others that are infected will develop a non-fatal form of plague. Still others are enormously sensitive to infection, and have a high fatality rate, increasing the chances for human infections.⁶⁷ Primates, possibly because of their high genomic conservation with humans, are highly susceptible to plague. Their symptoms are very similar to those exhibited by humans, and most cases of plague result in death. Domestic and wild cats too are often killed by infection. Though their symptoms are not as similar to a human's as a primate's are, many infected felines will develop swollen buboes near their necks.⁶⁸ Cats are especially dangerous when it comes to spreading plague, for they often live in close proximity with humans. In the early 2000s, a veterinarian in the United

States died after having treated a cat infected with *Y. pestis*. The vet did not know that the cat was infected and did not take proper precautions, which resulted in his contraction of the plague when he inhaled some of the respiratory fluid coughed up by the cat.⁶⁹

Not all secondary hosts infected with *Y. pestis* die or become seriously ill. Canines can be carriers of *Y. pestis*, but generally only exhibit a mild infection. Because of this, health organizations such as the CDC often use wild canines such as coyotes as sentinels. They will show symptoms soon after infection, but will not die, so scientists are able to determine that there is a primary vector and host in the vicinity and that people are at risk for an epizootic outbreak. Even though canines have relative immunity to *Y. pestis*, this does not mean that they are not a danger to humans. A bite or scratch from an infected canine can be just as devastating as a bite from a flea that recently fed on an infected rat. It is important for people living in plague-susceptible areas to understand that even though an animal may not show signs of infection, if it is carrying *Y. pestis*, it is still a threat to other species.⁷⁰

Because there are many different combinations of host and vector that can occur from all of the different species involved in plague transmission, the CDC has created two different types of cycles: Domestic and Sylvatic.⁷¹ While both involve primary hosts and vectors, the major difference between the two is the inclusion of a secondary host in the domestic cycle. Specifically, a domestic cycle is one in which *Y. pestis* is transmitted among a rodent primary host population that lives in the vicinity of a human population. Once the amount of bacteria

reaches a critical level, as stated above, the vectors pass into the human population, and both mammalian species become infected. In contrast, a sylvatic cycle occurs when the bacteria remains contained in the primary host and vector population and does not spread to any other species, human or animal. It is this cycle that creates the foci of plague mentioned above, for the bacteria are unable to move outside of the defined colony.⁷² It is the focus created by the marmots and their fleas in Central Asia and Mongolia present even to this day that is thought to be the origin of the Black Death. In this instance, it is believed that the marmots somehow infected a rat population, possibly due to a massive ecological disturbance occurring in the 1330s, and these rats migrated to a human population, beginning a domestic cycle.⁷³

In the United States specifically, the sylvatic cycle has been further divided into two subcategories: the enzootic cycle and the epizootic cycle. Both cycles involve only animals and do not affect humans specifically. An enzootic cycle is defined by the limitation of *Y. pestis* to maintenance hosts only. In maintenance hosts, individual members within one species will display a heterogeneous response to infection with varying responses. Individual life experiences and genetics determine if an animal will be susceptible to disease. Common maintenance species include deer, mice, and voles. An epizootic cycle is different in that the hosts involved are amplifying hosts. These species, which include prairie dogs, ground squirrels, chipmunks, and wood rats, are incredibly susceptible to plague. Infection of a population will result in a period of high mortality, followed by a sudden decrease in death rates as the bacteria levels drop.

It is these species, and this type of cycle, that can result in human infection, hence the term “epizootic”.⁷⁴ It should be mentioned, however, that the categories of epizootic and enzootic cycles have been highly debated in the past several years. While some scientists believe that the sylvatic cycle is clearly split into these two groups, others argue that the two types are not nearly as well defined as this model would lead us to believe, and instead all of the above species exhibit a mix of both enzootic and epizootic traits.⁷⁵ Further investigation into a comparison between the relationships among classical “enzootic” and “epizootic” hosts is needed to clarify this dilemma.

¹Abbot. *Plague*. 4

²Lorange. *Hypervirulence in Yersinia pestis*.

³Atchman. *Yersinia pestis is a clone of Yersinia pseudotuberculosis*.

⁴Abbot. *Plague*. 4

⁵Atchman. *Yersinia pestis is a Clone of Yersinia pseudotuberculosis*

⁶P.S.G. Chain et al. *Insights into the evolution of Yersinia pestis through whole genome comparison with Yersinia pseudotuberculosis*. Proceedings of the National Academy of Sciences of the United States of America. 2004

⁷The Holy Bible. New Revised Standard Version. 1 Samuel 6:4

⁸Abbot. *Plague*. 5

⁹Ibid, 5

¹⁰Ibid, 6-7

¹¹Kim Orth, et.al. *Disruption of signaling by Yersinia effector YopJ, a ubiquitin-like protein protease*. Science. 2000, and Arthur M. Friedlander et.al. *Relationship between virulence and immunity as revealed in recent studies of the F1 capsule of Yersinia pestis*. Clinical Infectious Diseases. 1995

¹²Friedlander et.al. *F1 capsule of Yersinia pestis*.

¹³Abbot. *Plague*. 7

¹⁴Ibid, 21

¹⁵Ibid, 22-23

¹⁶Ibid, 7

¹⁷Ibid, 22

¹⁸Ibid

¹⁹Ibid

²⁰Ibid

²¹Ibid

²²Ibid

²³Ibid, 23

²⁴Ibid

²⁵Centers for Disease Control. Last Modified April 1, 2014.

<http://www.cdc.gov/meningitis/index.html>

²⁶Ibid, 30

²⁷Jacquelyn G. Black. *Microbiology: Principles and Explorations*. (John Wiley & Sons. 2008) 88

- ²⁸Ibid, 85
²⁹Ibid, 97
³⁰Abbot. *Plague*. 6
³¹Ibid, 1
³²Ibid
³³Black. *Microbiology*. 81
³⁴Ibid, 1
³⁵Ibid, 30
³⁶Ibid
³⁷Ibid
³⁸Ibid
³⁹Ibid
⁴⁰Ibid, 56
⁴¹Ibid, 23
⁴²Ibid, 56
⁴³Ibid, 23
⁴⁴Ibid, 22
⁴⁵Ibid, 5
⁴⁶Ibid, 8
⁴⁷Ibid, 5
⁴⁸Ibid
⁴⁹Ibid, 7
⁵⁰Ibid, 5
⁵¹Ibid, 5
⁵²Ibid
⁵³Ibid
⁵⁴Ibid
⁵⁵Ibid, 31
⁵⁶Ibid, 32
⁵⁷Ibid, 32-5
⁵⁸Ibid, 35
⁵⁹Ibid, 32
⁶⁰Ibid, 72
⁶¹Ibid, 27
⁶²Ibid
⁶³Ibid
⁶⁴Ibid
⁶⁵Ibid, 20
⁶⁶Ibid, 35
⁶⁷Ibid, 18
⁶⁸Ibid, 28
⁶⁹Ibid, 29
⁷⁰Ibid, 47
⁷¹Ibid, 31
⁷²Ibid, 31-35
⁷³Kelly. *The Great Mortality*. 114
⁷⁴Abbot. *Plague*. 38-9
⁷⁵Ibid, 39

Chapter 3: The Signs and Symptoms of the Plague

“The victims did not linger long, but died on the second or third day.”¹

Surprisingly, the medieval physicians spoke relatively little about the actual event of death in their records, preferring to focus on symptoms instead. I have only found two passages relating to the cause of death on its own, both of which say that if a person died, it was because the heart fell under attack and was not able to rid itself of the poison.² When death was mentioned, it almost always only in passing, and to show that the plague was strong enough to kill within several days of infection. The death of a patient is talked about in two terms: to refer to the mass deaths that occurred in the cities, by which the authors attempted to illustrate the scale of the plague, and in relation to the symptoms which distinguished plague from other common diseases of the period.

Why were the symptoms of plague more important to physicians than how their patients died? As any modern physician will attest to, the symptoms of a disease are the principle ways in which doctors diagnose a disease, and from that diagnosis treatment proceeds. So it was with the doctors who practiced during the time of the Black Death. If a person did not display the characteristic symptoms of a bubonic plague infection, or the doctor did not know how to recognize those symptoms, the remedies for plague which the doctors worked so hard to develop could not be utilized effectively. The most important of these symptoms, both because of its uniqueness to infection by *Y. pestis* and its appearance on almost all individuals infected with the bubonic form of plague, was the characteristic bubo. A bubo forms when bacteria migrate to the nearest lymph node and multiply,

causing it to swell.³ Without our understanding of microbiology, medieval physicians rationalized other reasons for the appearance of the swellings. Most of these theories derived from the prominent ideas of humoral medicine. In his Major Surgery, Gui de Chauliac (d. 1368) writes: “Those humors collected and became apostemes. Fevers and bloody coughs appear while the tumors formed in strange ways. When the disease appeared in a person, nature tried to expel it through the emunctories, especially at the axillae and the groins and caused the buboes and other apostemes, which are really external manifestations of internal apostemes.”⁴ He expands on his definition of buboes, categorizing them into several types. The buboes found in plague infections were sites where the body could expel materials from inside it, which were referred to as emunctories. The theory of emunctories, which derived from Galenic medicine, is as follows: lymph nodes at the neck were the emunctories of the brain; the lymph nodes in the armpits were those to the heart, and the nodes at the groin corresponded to the liver.⁵ Gabrielle de Mussis wrote about the “swellings in the armpit or groin caused by coagulating humors.”⁶ Little else is written about how the buboes arise, although ibn Hindu (d. ca. 1030) does differentiate between “pestilential” buboes (ta’un) and general abscesses (khuraj).⁷ This is an important distinction to make, because abscesses, pustules, and other skin diseases such as scrofula were not uncommon in the Middle Ages.⁸ As for the sources from which medieval physicians acquired their information on buboes, only Avicenna and Hippocrates talked about their origins, stating that they could be classified by the type of matter that they contained and that they were formed from corrupt matters within

the body which rose to the surface.⁹ The scholars from the time of the Justinianic plague described the buboes,¹⁰ but did little in terms of postulating their origins. It is not surprising that the medieval experts did not have much to write on the formation of buboes, given the dearth of information from classical physicians. What was most important about the appearance of the buboes is that they could be used as a definitive marker of plague.

This is not to say that physicians did not talk at all about the buboes at all. In fact, most accounts of the plague, by both physicians and laymen, include descriptions of them. These descriptions provide an excellent catalogue of symptoms, and likely helped future doctors in identifying new cases of plague. Most, such as this line from John V. Kantakouzenos' History, describe their location and distinguishing features. "Great abscesses were formed on the legs or the arms, from which, when cut, a large quantity of foul-smelling pus flowed and the disease was differentiated as that which discharged much annoying matter."¹¹ Michele de Piazza describes the progression of the buboes and their influence over other members of the body as the patient worsened, writing: "These were at first the size of hazelnuts, and they appeared along with a chilly stiffness [of the limbs]...Whereupon these glandular swellings grew to the size of a nut, then to the size of a goose egg and become quite painful, and by putrefying the humors, the forced the said human body to spit up blood."¹² Piazza was not the only one to associate buboes with other parts of the body; ibn Khatima argued that buboes were almost always accompanied by other symptoms such as fever, skin chills, bloody sputum, and internal pain.¹³ While some physicians do record the

appearance of pustules covering the entire skin, occasionally in different colors,¹⁴ it must be noted that buboes always appear at the lymph nodes – a distinction that sets them apart from every other type of abscess, with the exception of scrofula.¹⁵ What made these swellings so important to the medieval physician was that they generally signified the threat of impending death.¹⁶ The association between the buboes and the plague became so prevalent that each culture had its own term for them. While the physicians and scholars referred to them as buboes or apostemes, the lower classes in Italy named them “antrachi” or “gavoccioli”, and the English called them “pokkes.”¹⁷

Death was not guaranteed for all those who displayed buboes. We shall cover this fully later in the chapters which deal exclusively with plague medicine, but it will suffice to say for now that recovery was not unheard of. A fifteenth century treatise reports that “if the man has a strong constitution, nature can expel the poison through ulcers, and if the ulcers putrefy, are strangled and fully run their course the patient will be saved.”¹⁸ This can be tied back to the theory that plague was caused by poisonous humors in the body, due perhaps to the corruption of the air which caused an unhealthy reaction to occur in the patient. It would make sense to the physicians, therefore, that if the cause of the plague was bad humors, and the humors manifested themselves in the buboes, if those buboes were to be relieved or healed, that the patient would recover. Once a person had recovered, it is recorded that they were immune to the next round of infection.¹⁹ Though not necessarily relevant to the medicine practiced by the medieval

physician, it does provide an insight into acquired immunity to *Y. pestis* – a line of inquiry very appealing to modern physicians and bacteriologists.

Buboes, though the most common symptom of the plague, were not the only sign of infection physicians relied on for diagnosis. Cases of pneumonic plague, which could be acquired primarily from another individual or secondarily after bubonic plague progressed to the lungs, were generally characterized by bloody sputum. Boccaccio notes that in the east, everyone who died bled from the nose first, but this sign was not shown by the people of Italy.²⁰ There are no other records of people bleeding from the nose: all others refer to the coughing of blood from the lungs. As pneumonic plague kills its victims faster than bubonic, the characteristic coughing of blood was generally associated with a swift death when discussed on its own. One doctor wrote that “when the bloody sputum reached the throat from the infected lungs, [this was a sign] that the whole human body was putrefying.”²¹ Louis Sanctus, speaking on behalf of the medical profession, said that “Indeed, dissections were carried out by doctors in many Italian cities, and also in Avignon by order and command of the Pope, so that the origin of this plague might be known...and it was found that all who die so suddenly have an infection of the lungs and spit up blood.”²² From these reports, it can be gathered that spitting and coughing of blood, though not as unique to plague as the buboes on the lymph nodes, could possibly have been feared more than its aforementioned counterparts.

Individual doctors often associated other symptoms with plague as well, but it is difficult to tell if these were widely accepted, as they were not written

about nearly as much as buboes and bloody coughs. This lack of written evidence could be taken as evidence that they were not commonly taught symptoms.

Nevertheless, they are important to consider briefly, for some doctors did use them as an aid in diagnosis. Ibn Khatima, for example, advocated that “anxiety, depression, and arterial craps are the first indication of the disease.”²³ This claim is not entirely unique to Khatima, however, for many physicians believed that the state of a person’s mind could influence whether or not they felt sick, to the extent that cities banned the tolling of bells and other death symbols in an attempt to keep their citizens happy.²⁴ Other symptoms occasionally mentioned by physicians included fainting, vomiting, and drowsiness.²⁵ While these symptoms could not make a definitive diagnosis for a physician, for they can be indicative of many illnesses, there is nothing to suggest that physicians who did believe in these signs did not begin preventative treatment as soon as an individual began to display these.

“And death and sickness came by imagination, or by contact with others and consequent contagion; for a healthy person who visited the sick hardly ever escaped death” – Jean de Venette.²⁶ Modern medicine prides itself on its understanding of contagion, how an illness can be passed from one individual to another. Today, we know that this is the basis for how pandemics arise. While medieval cultures did not understand bacteria and had varying views on contagion, often based on religion, most people understood that the plague could be transferred from one individual to another.²⁷ What they disagreed upon was how the disease spread. Many people, especially those in government positions,

advocated that plague was spread by traveling foreigners.²⁸ To combat this danger, the cities of Gloucester and Neuberg both enacted bans against travelers, especially merchants.²⁹ Boccaccio wrote that physicians claimed that an infection could be contracted by touching the goods of anyone who had already been sick, or had been in a place where people were sick.³⁰ Gui de Chauliac said that it was the coughing of the blood which made patients a danger to others.³¹ Perhaps the most farfetched argument by today's standards was that speaking with a sick person was enough to make one sick as well. Michele de Piazza's Chronicle reports that travelers to a new city "brought with them a plague that they carried down to the very marrow of their bones, so that if anyone so much as spoke to them, he was infected with a mortal sickness which brought on an immediate death that he could in no way avoid."³² This was not an uncommon theory; many individuals of varying levels of education suggested this could be possible.³³ Despite the numerous supposed methods of transfer, most did not claim to know the mechanism by which a person was able to infect another, only that contact with a sick person was almost destined to make one ill as well.

As we have previously discussed, there are multiple forms of plague. Though all are caused by the same bacteria, they have different trajectories of infection, depending on the point of entrance.³⁴ Though medieval physicians could not have understood the mechanical differences between the bubonic, pneumonic, and septicemic forms of plague, they evidently understood that there were multiple forms of the disease. In a letter to an unnamed recipient, Louis Sanctus said that there were three forms, one which struck the lungs and killed

within two days without presenting hope of escape, a second where tumors appear on the armpits, and a third which affects both men and women with tumors near the groin.³⁵ The Papal Court agreed with this categorization into three types of plague, and that the infection of the lungs was the most lethal type.³⁶ Gui de Chauliac combined them into two distinct types, and grouped them both by when they appeared during the course of the pandemic, and what types of symptoms they displayed. He wrote “and it took two forms: the first lasted two months, accompanied by continuous fever and a spitting up of blood, and one died within three days. the second lasted the rest of the time [five months] also accompanied by continuous fever and by apostemes and antraci [carbuncles] and one died within five days.”³⁷ From this account and others like it, we now believe that the pneumonic plague traveled throughout Europe first, and was followed swiftly by the bubonic form, which could often progress into the septicemic form.

¹Roger French. *Medicine from the Black Death to the French disease*. (Brookfield, VT. Ashgate Publishing. 1998) 6

²Horrox. *The Black Death*.194

³Abbot. *Plague*.4

⁴E. Nicaise and Leonard D Rosenman. *The major surgery of gui de Chauliac: surgeon and master in medicine of the University of Montpellier*. (Philadelphia. Xlibris Corporation. 2007). 250

⁵Ibid, 246

⁶Horrox. *The Black Death*. 17

⁷Aida Tibi. *The key to medicine and a guide for students (miftah al-tibb wa-minhaj al-tullab) by Abu al-Faraj ‘Ali ibn al-Husayn ibn Hindu*. (Reading. Garnet Publishing Limited. 2010). 93

⁸Nicaise. *The Major Surgery*.214

⁹Ibid, 246-47

¹⁰Little. *Plague and the End of Antiquity*.69

¹¹John Aberth. *The Black Death: the great mortality of 1348-1350: a brief history with documents*. (Boston. Bedford/St. Martin’s. 2005). 35-6

¹²Ibid, 30

¹³Ibid, 61

¹⁴Horrox. *The Black Death*.81

¹⁵Nicaise. *The Major Surgery*.214

¹⁶Aberth. *The Black Death*.16

¹⁷Horrox. *The Black Death*.31, 63

- ¹⁸Ibid, 194
¹⁹Aberth. *The Black Death*.35
²⁰Ibid, 31
²¹Ibid, 30
²²Ibid, 33
²³Ibid, 60
²⁴Horrox. *The Black Death*.197
²⁵Ibid
²⁶Ibid, 55
²⁷Ibid, 56
²⁸Ibid, 59
²⁹Ibid, 81
³⁰Aberth. *The Black Death*.32
³¹Nicaise. *The Major Surgery*.249
³²Aberth. *The Black Death*.29
³³Ibid, 81
³⁴Abbot. *Plague*. 22
³⁵Aberth. *The Black Death*.33
³⁶Horrox. *The Black Death*.42
³⁷Nicaise. *The Major Surgery*.249

Chapter 4: The Not-So Conflicting Origins of the Plague

In both Christian and Islamic communities, one of the most popular theories to explain the origin of the plague was that it was caused by the corruption of the air.¹ Almost every physician in Europe and the Middle East believed that the plague was in some way derived from polluted air. In his treatise Medicine of the Prophet, in which he tries to reconcile the teachings of the Prophet Muhammad and the fatwas of the Qur'an with the scientific understandings of disease, health, and contagion, ibn Qayyim (d. 1350) claims: "In short, corruption of the air is one part of the overall effective causes of plague, and corruption of the essence of the air is the prerequisite to the occurrence of pestilence."² Scientists were so meticulous in their studies of the natural phenomena that they even claimed to understand why the air had become poisonous. Again, ibn Qayyim writes:

The reason is that the sharp, bilious superfluities and other collect during the summer season, and they are not dissolved at the end of the summer. In autumn, the miasma occurs because the air is cold, and the vapors and superfluities which were wont to dissolve freely during the summer now become thick and murky. Thus they are constricted, become heated, and putrefy, bring about the putrid diseases.³

The Paris Medical Faculty agreed with ibn Qayyim that the poisonous air was the cause of the plague. They wrote a lengthy treatise on behalf of the Pope, who had asked them to discover a cause and a treatment for the devastating disease. In this treatise, they explain how air can become corrupted, at what times of year it is most likely to be dangerous, and how the impure air reacts with the body to cause disease.⁴ Due to its popularity among the physicians in both Islamic and Christian societies, the idea of the dangerous air spread to the learned non-medical

communities, who adopted it and incorporated it into their own beliefs of how the plague began. Petrarch, for example, wrote much about the plague, and how he was convinced that it was a punishment from God for man's sins. Even he, in his staunch support of the divine causation, was willing to believe that the air played at least some role in the health of an area, as when he wrote a letter to a friend, saying: "Now let me turn to your kind and thoughtful invitation to join you in your home, that healthy spot at the base of the alps, far from this Milan air, once so esteemed, but now tainted with some infection."⁵ Even local governments went so far as to establish new city rules to prevent the further contamination of the air. Thomas Knighton recounts that in London, all those who had dumped waste, refuse, and animal carcasses on city land were ordered to pick up their garbage and remove it to a suitable place under pain of 20 pounds, to be paid to the king.⁶ The idea that pollution of the air caused disease was not a new idea, however. In the seventh century, Isidore of Seville, a prolific scholar who composed a lengthy text containing many works of Christian and Arabic medicine, stated that pestilence was defined as: "when caught by one, it has already passed on the others because it comes from impure air and penetrates the body."⁷ Therefore, scientists of the fourteenth century were not imagining new and creative ways from which the plague came upon them, but were in fact greatly expanding upon much earlier understandings of contagion and plague.

Though many believed that the corrupt air caused illness when it was inhaled by an individual and went to the heart, others suggested that it could make one ill by having a negative effect on the food that one ate. The Paris Medical

Faculty claimed that although illnesses which one caught through infected air were more dangerous, disease could easily be acquired through food.⁸ Plant-based foods, especially fruits, were at risk of incorporating the poisonous atmosphere and mists into their flesh, which would then poison whichever individual ate them.⁹ One doctor wrote that foods which had not ripened properly would cause illness because they “draw the blood into the liver, which inevitably causes sickness and poisoning. This corrupt matter often forms a windy ulcer.”¹⁰ As we shall see later, this became incorporated into the standard preventative and therapeutic regimens of many doctors, who believed that the foods that their patients ate would play a large role in whether they recovered – an idea perhaps based on the belief that as the seat of the body, a poorly treated stomach was the source of all infection.¹¹

Though it is evident that many people believed that the plague had to be caused by the air because it was so widespread, others maintained that individual susceptibility had a role to play in whether a person fell ill or not. The Paris Medical Faculty wrote that “The susceptibility of the body of the patient is the most immediate cause in the breeding of illnesses, and therefore no cause is likely to have an effect unless the patient is susceptible to its effects.”¹² One such “individual” factor was the possible corruption of the blood. In his work Medicine of the Prophet, ibn Qayyim writes: “It [the plague] is caused by bad blood which tends to putrefaction and corruption, and transforms into a poisonous substance.”¹³ It does not matter to Ibn Qayyim how the blood has become corrupt, only that it is this impure substance in the body which is causing the present

affliction. This is significant, for, as we shall see, humoral medicine and the understanding of the four major humors which comprised the human body, was central to both Christian and Islamic medicine for many centuries.¹⁴ As the humors were critical in the medieval understanding of disease, physicians believed that all humors, not just blood, could be responsible for influencing whether an individual was infected. It was understood that humors played a role in determining the condition of the body, and in that way determined an individual's risks.¹⁵ The Paris Medical Faculty determined that: "The bodies most likely to take the stamp of this pestilence are those which are hot and moist, for they are the most susceptible to putrefaction. The following are also more at risk; bodies bunged up with evil humors...However those with dry bodies, purged of waste matter, who adopt a sensible and suitable regimen, will succumb to the pestilence more slowly."¹⁶ Even outside of Latin Christendom, the idea that humors were in part responsible for the mass deaths was common. Ibn Khatima stated "But it does not suffice that the active agent does its work on its own; there has to be a disposition in man to make its work possible."¹⁷ Both Christian and Islamic physicians agreed that without these predispositions, most individuals would be safe – or at least become infected less quickly – than those around them.

While Islamic and Christian scientists, physicians, and laymen alike were willing to agree that the plague was perhaps caused by the corruption of the air and the individual susceptibility due to one's bodily humors, they were less likely to agree on how the air became corrupt. One popular idea was that the air was influenced by the conjunctions of the planets Saturn, Jupiter, and Mars in the sign

of Aquarius.¹⁸ This was an exclusively Christian conception – I have found no mention of it in plague treatises (or any other treatises of disease, for that matter) from Muslim writers. It is worth mentioning that this ideology was again much older than the Christian physicians who were arguing its effects: the Paris Medical Faculty cite passages from Aristotle’s text *The Elements* which state that “mortalities of men and depopulation of kingdoms happen whenever there is a conjunction of two planets, namely Saturn and Jupiter, so that on account of their interactions disasters are magnified threefold to the third power.”¹⁹ But how did the proponents of this theory believe that a planetary conjunction could have such an effect on life on earth? According to the French surgeon Gui de Chauliac, the conjunction worked by converting a person’s humors into poisonous substances, which it then pulled to the interior of the body.²⁰

The Paris Medical Faculty argued that Jupiter, being a hot and wet planet, pulled up the bad air from the earth. Because it was in alignment with Mars, which they considered to be hostile to Jupiter, the air became noxious and dangerous for human ingestion.²¹ Similarly, Simon de Covino called upon the moist nature of the planet Jupiter, but he varied in claiming that by nature, Saturn is dangerous to humans (being cold and dry), and because the natures of Saturn and Jupiter were conflicting, the lower atmosphere became poisonous and pestilential. This cold air from Saturn in Aquarius prevented the poisonous vapors created in the human body to escape, and the person therefore fell ill.²² Through the popularity of the conjunction theory among the medical professionals, it

became common “knowledge” that the planetary alignment was likely cause of the plague.

Geoffrey de Meaux developed this idea even more than both Covino and the Medical Faculty when he described in detail how the alignment of the planets could not only be the cause for the plague, but could also explain why some regions were affected more than others, and why certain groups of people were more at risk of infection. According to his reasoning, which he took from Ptolemy, the reason that the northern hemisphere was more affected than the southern was because astrologically, Saturn controlled the eastern half of the world, Mars controls the western half, and Jupiter rules the northern half.²³ Similarly, to explain why certain areas of a city were affected more than others, he writes: “Each city, town, and home has fixed stars and planets ruling it, as Ptolemy testifies in the Centilogium. Therefore wherever the rulers of these places agree in power and effect with the planets and stars bringing the general mortality, those subject to them will have been made ready to receive celestial influence upon their bodies...Not all streets were affected in the same way... because they do not have the same influences or rulers, and therefore the impact of the heavens cannot affect them all equally.”²⁴ Meaux also used astrology to explain why the wealthier fared better than the lower classes. Each star had an assigned magnitude, and the level of magnitude it carried determined which class of people it ruled over (first order of magnitude controlled the highest classes, etc.). Because the stars in the sign of Aquarius were not of the highest magnitude, they controlled the common people, who were then more susceptible to the plague.²⁵

Like the belief that poisoned air was causing people to fall ill, there were precedents in which the motion of the planets were cited as a reason for why people became sick. During the Justinianic Plague pagan astrologers from Antioch claimed that the plague was caused by the movement of the stars²⁶ – an idea already common to medical literature, as seen in the works of Ptolemy.

“Another possible cause of corruption, which needs to be borne in mind, is the escape of the rottenness trapped in the center of the earth as a result of earthquakes” – The Paris Medical Faculty.²⁷ While corruption of the air and the conjunctions of the planets were the two main “natural sources” of plague, there were less popular ideas that persisted, even without the backing of many influential groups. One such theory was that the plague was caused by earthquakes. While much of what has been recorded about earthquakes as a source of plague was written by an unnamed author from the area that is modern Germany,²⁸ that preeminent body of scholars, the Paris Medical Faculty, did acknowledge that if people believed that planetary conjunctions were not responsible, then earthquakes could theoretically cause plague as well.²⁹ This unknown author suggests that the plague arose from earthquakes because planetary alignments occurred far too frequently to be considered the cause of anything dangerous. According to the logic of the conjunctions, a plague should appear every time Saturn, Mars, and Jupiter (or any other planets opposite in nature) align, but that does not happen.³⁰ He also rejects the theories of Geoffrey de Meaux, claiming that such a large scale event should have an equal effect on the entire world’s populations, but it does not, so therefore the plague cannot have

resulted from it. Whether one believed plague came from a planetary conjunction or an earthquake, however, the ultimate cause of plague came back to the corruption of the air. The earthquakes acted by poisoning the air, for “it is the vapor and corrupted air which has been vented in the earthquake which occurred on St. Paul’s day, 1347, along with the corrupted air vented in other earthquakes and eruption, which has infected the air above the earth and killed people in various parts of the world.”³¹ He believed that because not all of the air was poisoned, there had to have been a more local source for its contamination, but on a large enough scale to affect many places at once. The only reasonable answer, therefore, is that it was caused by earthquakes, a claim that the writer then supports by citing that plague only appeared in Germany and the areas “beyond the alps” after a series of earthquakes had occurred.³²

There we have the main theories of how plague was caused by natural elements, both by Muslim and Christian physicians. There were, however, other ways in which plague was believed to have arisen. Though it does not appear in Islamic societies, there was a popular belief among the uneducated lower classes of Western Europe, particularly in regions of Germany and Spain, that the plague was caused not by any natural phenomena, but by the poisoning of the wells and water sources by Jewish communities.³³ Though obviously driven by deep anti-Semitism, many reasons were drawn up as to why the Jews would wish to poison their Christian neighbors. Some thought that the Jews wished to “destroy the Christian religion”, for: “Once the people of the Christian religion are dead, the kingdom of the Jewish race and their status as the Lord’s anointed may be

restored, which was taken away from them by the world of God, that is, by the only begotten flesh of God”³⁴ – Konrad of Megenberg. Proponents of this theory argued that members of the Jewish community would place sacks filled with poison into the wells that were frequented mostly by Christians, or by smashing vials filled with a gaseous poison to corrupt the air.³⁵ Though the more educated classes held fast to the idea that there was a natural cause for the plague that did not involve malicious acts by Jewish communities, the mob mentality often overrode reason, and hundreds of Jews were tortured and confessed under duress to such acts. In retaliation, mobs throughout Germany demanded the mass execution of Jewish communities, often by burning. Even without the blessing of the local authorities, mobs would lock entire communities in a building, and then set it ablaze in an attempt to free themselves from the grip of the plague.³⁶

It must be understood that the majority of individuals who believed that the plague was caused by the malice of Jewish communities throughout Europe were uneducated people. Perhaps surprisingly, the most vocal opponents of this theory were members of the Christian clergy. Pope Clement himself called out the perpetrators of these violent attacks, claiming that there was no basis to their argument and that they were only attacking the Jews out of their own greed and desire to be rid of them.³⁷ Pedro IV of Aragon, a devout Christian, proclaimed that it was illegal to attack any Jewish person, and provided the Jewish quarters of the city with guards to protect them from the violence of the misguided mobs.³⁸ One of the most prolific writers on the subject, Konrad of Megenberg, brought reason into the picture when he argued that the Jews could not have been causing

the plague, for the simple reason that proportionally, just as many Jews were dying as were Christians. He makes equally as good of an argument against the poisoned wells theory when he writes: "Even after all the Jews in many places have been killed and completely driven out for nearly two years prior, the death now first strikes these same places with a strong hand."³⁹ Therefore, there could be no way in which the Jews were responsible for the plague, for they would primarily not endanger themselves, but also could not engineer it from beyond the grave. Jean de Venette also calls into question the scale of the plague, which he says was far too great to have been caused by the miniscule actions of men, and therefore had to have originated from a universal source.⁴⁰ It is important to mention that there is no evidence of this paranoia existing in areas where Muslims and Jews lived side by side.

The general conception today about the Middle Ages and the people's understanding of natural disasters is that they only believed that such events were the work of God. I hope I have shown that the reality was, in fact, quite the opposite. Though we may have a better understanding of contagion today, thanks to microscopes and imaging techniques that allow us to visualize bacteria and other unicellular organisms, the science of the medieval period was not very different from our own, with laws and theories that were tested to the best of the contemporary scientist's abilities. It was not the unenlightened period which we are so often more than willing to describe it as. That being said, no discussion of the medieval understanding of the origin of plague would be complete without addressing those theories which did involve God, Satan, and other supernatural

elements. For while many scientists, physicians, and literate individuals firmly believed the theories of planetary conjunctions and noxious vapors in the atmosphere, many Christian clergy, and even more Muslim scholars, Imams, and populations in general were convinced that the plague ultimately arose from God's will.

Concerning divine origins for the plague, the most common theory was that God was sending the plague to punish humans for their sins, as He had done with the flood, only to a lesser extent.⁴¹ Pope Clement stated that Christians were misguided in believing that the Jews were the cause of the plague, for it was obviously sent by an angry God.⁴² Other clergy followed on this train of thought. John of Burgundy also blamed the sins of man for the plague,⁴³ and the Prior of Christchurch and William Edendon both blamed the pride of the English and their rampant sins of sensuality for the disaster that befell them⁴⁴. Thomas Brinton said that it had to have been created by God and not by a natural event because

“Let those who ascribe such things to planets and constellations rather than to sin say what sort of planet reigned at the time of Noah, when God drowned the whole world except for eight souls, unless the plant of malice and sin...or what sort of planet, unless that of sin, reigned at the burning of the Sodomites...or what sort of planet reigned at the time of David, when thousands of men were killed by plague, unless the planet of sin...it is because of the evil deeds of men that the world is afflicted with famine and pestilence.”⁴⁵

This type of logic made sense to many individuals, and the idea that God was sending the plague in retribution became popular among other groups. In Knighton's Chronicle, he writes that the Scots, upon hearing of the plague attacking the English, saw it as a sign from God and proceeded with their attack. It backfired, however, as God attacked them just as brutally as He had the

English.⁴⁶ Giovanni Boccaccio wrote in his introduction to the *Decameron* that it was useless to flee, for the hand of God would find and kill people no matter where they ran to,⁴⁷ and Petrarch lamented that it was unfair that of all the generations, theirs should be punished the most by God with this awful plague, even though the people of the previous centuries had committed offenses just as grievous as their own. Despite his complaints, however, he says that it is not his place to ask why, for it is all a part of God's will, which is unknown to man.⁴⁸ Perhaps the most surprising supporter of this theory was the group which we know to be one of the most important in developing ideas of natural origins: the Paris Medical Faculty. They once wrote that: "We must not overlook the fact that any pestilence proceeds from the divine will, and our advice can therefore only be to return humbly to God."⁴⁹ It is impossible to say for certain, but it almost appears as if this was an afterthought, added because the report was commissioned by the Pope. In the end, it may not matter whether it was what the Medical Faculty believed, but what does matter is that it was accepted by many people and therefore indicative of the perceived relationship between God and plague.

Islamic societies also believed that the plague was a form of punishment to chastise people for sin. According to legend, the Prophet Muhammad said of plague that it was "a punishment which was sent upon a group of children of Israel, or upon those before them."⁵⁰ This was not unique to plague; the Prophet said that all diseases were punishments from God to former nations that had remained on earth in case any individual should resume their unholy activities⁵¹.

By the time of the Black Death, poets and historians such as ibn al-Wardi were arguing that contagion did not exist – a theory which we shall discuss later – and that plague was created by God, and that God “has subsequently reconstituted it in each individual case.”⁵² This is indicative of the anti-contagion views taken up by many Islamic physicians, and will be looked at in further detail when examining the treatments used both before and after infection of plague and other contagious diseases.

Less common than the idea that God was sending the plague as a punishment for the sins of man was the theory that He was sending it as a gift. In the Islamic societies, this stemmed from a quote originally from the Prophet, who said that “the plague is a martyrdom for every Muslim.”⁵³ Similarly, another piece of wisdom was passed down from the ancestors who stated that calamities in life are a test through which character is determined and is a way for pious Muslims to enter into the kingdom of Heaven after the judgment day.⁵⁴ Though this originated during the Justinianic plague, it was carried through to the Black Death and expanded upon by other Muslim philosophers. Al Wardi used this philosophy to reconcile the massive amount of deaths occurring all over the world by claiming that it could be both a punishment and a gift. “This plague is for the Muslims a martyrdom and a reward, and for the disbelievers a punishment and a rebuke. When the Muslim endures misfortune, then patience is his worship. It has been established by our Prophet, God bless him and give him peace, that the plague-stricken are martyrs.”⁵⁵ Even without death, the plague could still be a gift to pious Muslims, for al Wardi says that it would force them to examine the work

that they have done on earth and correct any mistakes that they have made, thus becoming better individuals and more pleasing to God.⁵⁶

While the Muslims mainly saw their gift of the plague as occurring through the act of dying or after one's death, the Christians who saw it as a gift believed that its benefits were to be experienced on earth while alive. Since God had promised never to destroy the human race again after the flood of Noah, Christians reconciled this message by believing that "Almighty God, who does not desire the death of a sinner, but that he may be converted and live, first threatens and secondly strikes to reform the human race, not to destroy it" – Cortusii Patavini,⁵⁷ and was therefore only meant to bring people back to their faith. This plague could also have been seen as ushering in the New Jerusalem, in which the faithful would live and walk with God, as described by a vision seen by a Cistercian monk in Tripoli.⁵⁸ William Zouche wrote that "For almighty God sometimes allows those He loves to be troubled while their strength is perfected in weakness by an outpouring of spiritual grace."⁵⁹ As with many other theories of plague origin, the concept of plague as a gift from God to cleanse his people and prepare them, either for a better life or for immediate acceptance into Heaven was not a new one. During the eighth century, as the last waves of the Justinianic plague were reaching out across the British Isles, the Venerable Bede wrote a great deal on the plague. Though he never says outright that it is a gift from God to his people, the way in which he describes the infections of the clergy such as Aethylthryth strongly imply that he saw the plague as attacking good individuals to either make them even better individuals and therefore more suited to serve

God on earth, or by scourging whatever small sins they may have committed before they die so that upon death, they can immediately be accepted into Heaven.⁶⁰

Though God was generally thought to have sent the plague, for whatever reasons which could not be agreed upon by religious scholars, a very small minority did think that the pandemic was evil in nature and had to be controlled by Satan. Here again, there is a notable discord between Muslim and Christian theologians. Though the Muslim scholars who wrote on this subject did believe that the spirits were the immediate cause of the plague, they were quite clear about the fact that they were given control over humans by God Himself. In his treatise Medicine of the Prophet, ibn Qayyim states that plague is caused by spiritual beings which can gain control over a person's body and influence their constitution and make them ill. Describing these spirits, he writes "God, praised be He, can give these spirits power over the bodies of the sons of Adam, during the occurrence of infection and through corruption of the air. In the same way, he gives them power to act in the predominance of unhealthy substances, which produce an evil condition for souls, especially in the disturbance of blood, black bile, or semen."⁶¹ When Christians speak of the role of spirits in the plague, however, they are either ambiguous in origin, or worse, under the control of Satan. In his description of the decimation of the city of Messina, Michele de Piazza writes that there were demons that took the form of dogs, and these spirits infected the population.⁶² A fifteenth century statement from an unknown author states that although the immediate cause of infection is the corruption of the air, it

becomes corrupted when Satan releases his poison into the air through the rising of the sea.⁶³ The Muslim belief in spirits dates back to pre-Islamic times, when the Arabic tribes believed in the power of spirits,⁶⁴ but there is less information as to why certain Christian groups would be so intent on spreading the idea that God was not responsible, for although it does share a superficial resemblance with the story of Job,⁶⁵ neither Christian author references it.

Just as scientists and physicians could trace the genealogy of their natural origin theories back to Greco-Roman scholarship, scholars in the fourteenth century could cite examples of early Christians claiming that God was responsible for all diseases. In the 4th century, Basil of Caesarea said that although the immediate cause of plague was impure air, that air was created by God to remove the sins of man and to remind them of their Christian duties,⁶⁶ and that it did not occur by chance. Anastasius of Sinai tried to bridge the gap between the natural and the divine origin parties by arguing that there were multiple forms of disease, and that some diseases were caused by God, and were therefore unavoidable, while other diseases were natural in origin and could be treated and prevented.⁶⁷ Both the Carolingian monarchy and the Abbasid Caliphate claimed that God had sent the Justinianic plague because he was unhappy with how governments were being run on earth, but since they had assumed power, the plague had stopped, which was evidence of God's divine support of their rule.⁶⁸

While we may have difficulty reconciling the theories of natural cause with those of divine punishment, this may not have been a problem for fourteenth century populations. In fact, many scholars claimed that there was no discrepancy

between the two origin theories, for they could both be correct at once. When one believes that God can control the natural elements which cause the plague (an idea that again goes back to at least Bede, which he writes about in his book On the Nature Things),⁶⁹ one can easily incorporate the two into a comprehensive theory of how plague began. Geoffrey de Meaux summarizes this belief, writing “Ptolemy on chapter four of the third book of his Quadripartitum cites Plato and Aristotle in support of the contention that God first created the heavens and the stars, and endowed them with the power to rule all earthly matters, and because of this it can be said that everything which befalls us happens at the will of God; for it is God himself who moves the heavens and whatever is in them, and it is through this motion that there come all the chances of generation and corruption.”⁷⁰ Speaking on behalf of God, Gabrielle de Mussis wrote “Next, at my command, let the planets poison the air and corrupt the whole earth; let there be universal grief and lamentation...let the innocent perish with the guilty and no one escape.”⁷¹ Though the number of individuals who wrote about God’s control over the natural elements were relatively small, it is probably safe to assume that the vast majority of people believed that there was some truth to this theory, even if they did not write about it, for it would have made the most sense in a time when religion was very much a part of science.

¹Penelope Johnstone. *Medicine of the Prophet by ibn Qayyim al-Jawziyya*. (Cambridge. Islamic Texts Society. 1998). 29

²Ibid

³Ibid

⁴Aberth. *The Black Death*. 43

⁵Morris Bishop. *Letters from Petrarch*. (Bloomington. Indiana University Press. 1966). 194

⁶G.H. Martin. *Knighton’s Chronicle: 1337-1396*. (Oxford. Clarendon Press. 1995). 523-25

⁷Lawrence I. Conrad and Dominik Wujastyk. *Contagion: perspectives from pre-modern societies*. (Burlington. Ashgate Publishing Company. 2000). 190

- ⁸Horrox. *The Black Death*.160
- ⁹David Priest and James G. Clark. *The Chronica Maiora of Thomas Walsingham: 1376-1422*. (Woodbridge. Boydell & Brewer Ltd. 2005) 213
- ¹⁰Horrox. *The Black Death*.183
- ¹¹Johnstone. *Medicine of the Prophet*.91
- ¹²Horrox. *The Black Death*. 163
- ¹³Johnstone. *Medicine of the Prophet*. 27
- ¹⁴Conrad. *Contagion*.173
- ¹⁵Aberth. *The Black Death*.65
- ¹⁶Horrox. *The Black Death*.163
- ¹⁷Aberth. *The Black Death*.56
- ¹⁸Ibid, 41
- ¹⁹Ibid, 42
- ²⁰Ibid, 65
- ²¹Horrox. *The Black Death*. 160
- ²²Ibid, 164-66
- ²³Ibid, 170
- ²⁴Ibid
- ²⁵Ibid
- ²⁶Little. *Plague and the End of Antiquity*.108
- ²⁷Horrox. *The Black Death*. 161
- ²⁸Ibid, 177
- ²⁹Ibid, 161
- ³⁰Ibid, 177
- ³¹Ibid, 177-78
- ³²Ibid
- ³³French. *Medicine from the Black Death to the French Disease*. 6
- ³⁴Aberth. *The Black Death*.155
- ³⁵Horrox. *The Black Death*.223
- ³⁶Ibid, 208
- ³⁷Aberth. *The Black Death*.159
- ³⁸Ibid, 142-43
- ³⁹Ibid, 158
- ⁴⁰Horrox. *The Black Death*.57
- ⁴¹Aberth. *The Black Death*.159
- ⁴²Ibid
- ⁴³Rebecca Totaro. *The plague in print: essential Elizabethan sources, 1558-1603*. (Pittsburgh. Duquesne University Press. 2010). 5
- ⁴⁴Horrox. *The Black Death*. 114-16
- ⁴⁵Ibid, 146
- ⁴⁶Martin. *Knighton's Chronicle*.101
- ⁴⁷Aberth. *The Black Death*. 31
- ⁴⁸Bishop. *Letters from Petrarch*. 74
- ⁴⁹Horrox. *The Black Death*. 163
- ⁵⁰Johnstone. *Medicine of the Prophet*.27
- ⁵¹Ibid, 258
- ⁵²Conrad. *Contagion*.177
- ⁵³Johnstone. *Medicine of the Prophet*.27
- ⁵⁴Ibid, 145
- ⁵⁵Aberth. *The Black Death*. 112-13
- ⁵⁶Ibid
- ⁵⁷Horrox. *The Black Death*.34
- ⁵⁸Ibid, 83
- ⁵⁹Ibid, 111

- ⁶⁰Allen. *Bede and the Resurgence of the Justinianic Plague in Anglo-Saxon England*. Unpublished. 2013
- ⁶¹Johnstone. *Medicine of the Prophet*. 28-9
- ⁶²Aberth. *The Black Death*. 102
- ⁶³Horrox. *The Black Death*. 16
- ⁶⁴Conrad. *Contagion*. 165
- ⁶⁵The Holy Bible. New Revised Standard Version
- ⁶⁶Little. *Plague and the End of Antiquity*. 107
- ⁶⁷Ibid
- ⁶⁸Ibid, 25
- ⁶⁹Allen. *Bede*
- ⁷⁰Horrox. *The Black Death*. 168
- ⁷¹Ibid, 15

Chapter 5: The Practice of Medicine in Christian Communities

As a rule, God played little role in the practical application of medicine during the fourteenth century, as well as the few centuries preceding it. This is because for the most part, God's will was not implicated as the immediate cause of the disease. In general medicine, which I have defined for the sake of this paper as medicine not relating to the plague, I have found no instances where doctors or their affiliates suggest that disease has a divine origin. Hildegard von Bingen suggested in the 12th century that a person could become leprous due to lust, but it is implied that this condition arises from some pollution in the body, not from a divine punishment.¹ The only instances that I have found in Christian literature that directly ascribe generic diseases, pains, and afflictions to God are from the writer Petrarch. When speaking of an accident which befell him and caused him great pain, he wrote: "Perhaps someone else, not a physician, will ascribe my troubles to my sins. If this is true, I thank God, who purges with slight punishment the filth of my abundant crimes."² This statement is important for two reasons: first, it shows that Petrarch fully believed that any injury resulted from God and was chastisement for sin, and that other people not educated in the sciences may have believed that as well, but also that physicians did not believe that God was involved in the occurrence of small injuries or illnesses.

Not surprisingly, there is also little written about how God could be involved in the healing process. Again, almost all of what is said comes from Petrarch, who, it should be noted, had an intense disliking of physicians and would likely argue the best thing to do for an ill person was exactly the opposite

of what the doctors had prescribed.³ In that context, it is not strange that he should claim that God is the best healer. When ill, he did not call upon the physicians, but instead he: “relied upon the celestial physician and on a young man in my service, who has taken his degree, you might say, with my wounds.”⁴ While his views certainly seem radical in light of the medical thought of the period, upon closer inspection one finds that he was not so much opposed to medicine as a rule, but as to how it had been corrupted by humans after having been received from God. In what seems contradictory to his previous statement on medicine, Petrarch admits that: “What has been defined by so many great minds must certainly be something. I don’t doubt that medicine exists, and that it is something great. In the Bible it is said to be created by God, and in profane literature it is consecrated as an invention of the immoral gods, and ascribed to Apollo and his son Aesculapius. I know that if no single mortal should survive, medicine and the other arts would exist in themselves.”⁵ In this statement, Petrarch’s views closely mirror those of the Paris Medical Faculty, who insisted that people not turn away from the treatments of doctors during the plague, because even though the doctors were human, medicine was a creation of God which he had allowed people to have access to through the physicians, and that He cured the sick through such people.⁶ This is the extent of what is written on the role of God in general medicine, suggesting that by the time of the Black Death, the spheres of religion and medicine were beginning to separate, especially in the eyes of those who had been trained in the Hippocratic and Galenic traditions.

So what did people think of those men who practiced the medical art? Much negative rhetoric was published against them, but almost all of it came from Petrarch. He had several complaints against doctors, such as their general uselessness in healing people, their fickleness, and their ability to pose an outright danger to their patients.⁷ Instead of medicine, he often advocated putting trust in God to heal.⁸ The vast amount that he wrote against doctors and medicine compared to the scarcity of all other complaints, however, suggests that his writings stemmed from personal feelings, and were not indicative of society at large. Still, it is worth examining what he said, for he had many influential friends, and if he had such strong feelings, it is entirely possible that others with his level of education felt similarly.

Despite his belief in the ability of prayer to cure any ailment, including his broken leg, Petrarch does consider some medicines to be useful. When he breaks his leg by dropping a copy of Cicero on it, he orders his servant to make him a poultice which he remembers as having once been useful. He does not tell us what was in it or how he applied it, only that it worked many times and he was always satisfied with the results.⁹ Though more often used for the maintenance of health, rather than the healing of poor health, Petrarch recommends both blood-letting and proper dining. He is convinced that if he did not bleed himself twice a year, his condition would not be nearly as good in his old age as it currently is.¹⁰ As for food, Petrarch argues that eating the correct foods at the correct times is vital for keeping one's health.¹¹ Though many physicians seem to have prescribed that their patients not drink water, as this passage suggests: "I can hear you say, with

the concurrence of doctors everywhere, that the principle, if not the cause [of his declining health at age 66] is water drinking,”¹² Petrarch is convinced that water is beneficial to the human body, while wine, especially when consumed in large quantities, is detrimental. The timing of one’s meals is as important as what one consumes. While fruits, vegetables, and meats are good in moderate amounts, they must only be consumed during a single meal per day,¹³ as is recommended by Ibn Battuta.¹⁴ Here Petrarch and many of the Italian doctors once again disagree. While Petrarch believes in fasting and eating only one meal a day so that people do not “tease the appetite or expose oneself to sensual pleasure [too often],”¹⁵ the doctors recommended that people not fast, and that their meals “be spread out...into a dinner and a supper.”¹⁶ Believing the facts of the human body to support his conclusions, Petrarch obstinately refuses to give up his old habits, no matter how many times he is visited by doctors.

In discussing the physicians themselves, his rhetoric is filled with such vitriol, one is almost forced to envision the medieval doctor as a murderous monster. What is it about physicians that Petrarch does not approve of? First, he complains, they can never agree on anything. When he was ill, one consulting doctor told him not to eat fruits, but a different doctor told him that fruits were fine, but that he should avoid vegetables and greens at all costs.¹⁷ Furthermore, he says, they are too biased by their own experiences. According to him, the doctor who told him not to eat any more fruits did so only because he did not like them and therefore found them to be useless.¹⁸ Similarly, the doctors enjoy drinking wine, so they advise that their patients should only drink wine, or wine mixed

with water, but never water alone.¹⁹ When it comes to blood-letting, Petrarch says it is the doctors who are faint and of “low vitality” who order that no one should draw blood.²⁰

Not only does Petrarch not believe that they have the ability to cure people, but he also thinks that, as a profession, they are fundamentally untrustworthy. It is for this reason that when he falls ill, he “decided to banish the doctors and await the outcome...to entrust myself to God...rather than these sawbones trying out their nostrums on my illness.”²¹ To him, the doctors are only charlatans, men who prey on the fears of the sick and dying in order to make money. He claims that the science that they use isn’t science at all, but just a screen to hide their ignorance from behind which they knowingly lie to the public and claim to have all of the cures. In fact, he writes, they cannot cure anything, and evidence of their fraudulence can be found when one looks at how they conduct their lives. “If a doctor’s life were consistent with his advice, or his advice were consistent with his life, he would suffer either in his health or his pocketbook”²² for “when we see how doctors themselves live...we may well suspect that this thing called medicine...is yet among mean a certain art of deception, invented to man’s peril, to enrich a few and endanger many.”²³ To prove his point that doctors are untrustworthy, Petrarch quotes a friend of his, who happens to have once been a doctor. According to this man, whose name remains unmentioned, “if half of them [men fallen ill of a certain disease] should follow the prescriptions of our contemporary doctors, and if the other half should be guided by their natural instinct and common sense, with no doctors at all, I

have no doubt that the latter group would do better.”²⁴ This statement would seem to imply that other learned individuals aside from Petrarch shared this disparaging view of doctors and medieval medicine. It is far from being definitive proof that all, or even most, of the fourteenth century Italian population felt this way about medicine. Indeed, Petrarch reprimands Giovanni Boccaccio quite strongly for having sent him a letter in which he places all the success of his recovery from illness in the doctors, a belief that he finds to be quite vulgar.²⁵ It would therefore seem that ideas about medicine in the literate circles of Italy were divided, rather than being uniform.

Why does Petrarch hate the doctors so? It would appear from his writings that one reason for his disliking is that he feels they are trying to usurp the role of God in determining who lives and who dies. I believe Petrarch sees the doctors this way because they follow the teachings of Aesculapius, who was held as a god during his own time, because he gleefully recounts how this “false god” was “smitten down by a lightning bolt from a greater God.”²⁷ Petrarch also claims that the Bible states that it was God who created medicine, but today the people have corrupted it and it is now seen as an invention of the “immoral gods” Apollo and Aesculapius.²⁸ Medicine does exist, Petrarch writes, and it would exist without humans, being an immortal art, but was designed by God, and therefore people should turn to God for help when they are ill, not to the followers of the pagan corruptors. Through God’s direction, the body will do what is necessary to preserve itself, for that is what is natural.²⁹

While he spends much ink complaining about the uselessness of doctors, occasionally, Petrarch describes them as something worse than a waste of time. Sometimes, the prescriptions of doctors are downright harmful, increasing his distrust of them. He says that when the doctors go against what is natural for the body, they actually aid the disease.³⁰ He writes: “the least harmful of them hold to the middle ground and wait to see how the illness will turn out. They are the most truthful and trustworthy of their trade; they are spectators watching for the outcome, ready to jump with fortune.”³¹ Generally, however “they kill most plausibly, with the most convincing explanations, whether it is due to chance or madness or some mental quirk, they know all subjects better than the one tread they profess.”³² Again, one man’s voice is not an accurate description of the opinions of everyone in fourteenth century Italy, or even the entire educated classes in Italy, but it does suggest that this was a known viewpoint. If so, it implies that many other people during the time of the Black Death would have been resistant to the orders of doctors, which might explain why even if physicians had some remedies that worked, the overall death rate was greater than need be due to a general distrust.

Up until now in this paper, I have been referring to those who practiced medicine as either doctors or physicians. This classification does not display the full range of individuals who were able to practice medicine. According to Katherine Park, medical practitioners could be classified into two main groups: academically trained individuals, and non-academically trained personnel who

would often undergo some form of apprenticeship. Of the latter group, five categories can be created:

“General surgeons, who treated wounds, sores, abscesses, fractures, and other external disorders of the skin and members; barbers or barber-surgeons, who in addition to shaving and cutting hair, performed minor operations, including bleeding and cupping, applying leeches, and pulling teeth; apothecaries, who sold various compound medicines as well as their ingredients and who offered medical advice on the side; empirics, who often specialized in treating a single surgical condition, such as fractures, cataracts or hernias; and professional midwives, who appear in city records only in the 13th century.”³³

Most of these practitioners had some form of training by the university lecturers, and were often members of a guild or were under the nearest college’s jurisdiction,³⁴ suggesting that all facets of medicine were highly regulated. It is important to make this distinction now, because the attitudes towards physicians and surgeons could be very different. Petrarch, for example, who we have seen held physicians in very low regard, was quite complimentary of the surgeons, and believed that their art was a worthy one, not at all dangerous to the patient, for their work is done outside of the body or near the surface, where they can see what they are doing, while physicians work deep inside the body and the effects of their treatments cannot be visualized.³⁵ For the rest of this paper, when I refer to physicians or doctors, I will mean that in the sense which Petrarch uses the terms: individuals who work with medicines which provide their effects internally. When referring to individuals of the other practices, I will specify which they are and use these terms to identify them.

Now that we have discussed the types of physicians and how they were viewed by some of their more outspoken contemporaries, we must examine where

the need for physicians came from. Like today, being a doctor was often a lucrative business. While doctors could be hired by individuals or families, they were often employed by the city councils. In an early system of public health care, towns would hire the physicians and pay them to treat all members of society, especially those who would not otherwise be able to afford treatment.³⁶ Even those who were not poor were able to see the town or city physician. This arrangement could pay off quite well, for the poorest neighborhoods were often the first to fall ill, and treatment of those individuals could potentially slow the spread of infection throughout the rest of the city. Therefore, during the plague outbreaks, it was often in the best interests of the city to employ such doctors. However, even the best of physicians understood that their power over disease was not absolute. Gui de Chauliac, personal physician to the Popes Clement, Innocent, and Urban, said “As my master Raimond of Montpellier said, nothing is absolute; while some things are quite certain, a physician cannot always offer relief or achieve a cure.”³⁷ That being said, it was the job of the physician to aid their patients when able, and they strived to do their best.

With an understanding of the role of the physician, it is possible to examine the medical practice of Christian communities. In the centuries immediately preceding the Black Death, beginning in the mid-11th century, medical theory and practice changed drastically to base medicine on classical natural philosophy, especially Aristotelian philosophy.³⁸ At the same time, Katherine Park notes that the field of medicine began to become more specialized and exclusive. She writes: “The period after about 1050 witnessed two processes

that were to transform the practice of medicine. The first was a series of moves to limit the number and variety of healers by excluding certain groups from legitimate medical practice; the second was a process of differentiation among the practitioners themselves.³⁹ This differentiation continued for several centuries, and treatises were published listing which individuals were considered acceptable health providers and which were frauds. One of the most effective blocks to a particular group was the prevention of clergy from practicing “medicine”. This was a significant change, for in the early Middle Ages, the clergy constituted a large portion of the medical profession. This movement to prevent non-medically trained religious practitioners from practicing medicine helped to decrease the role that God and religion played in medicinal treatment. Instead, as the university system gained popularity across Europe in the 13th century, medicine was being shaped by “scholastic culture,” for “There is the strong link between scientia and teaching, thanks to which what counts as authentic knowledge is what can be transmitted according to the well-defined institutional procedures and structures of teaching.”⁴⁰ In most places, the only medicine that the universities taught was “physica”, which was practiced by the physician and included internal medicines and diet. Only in Italy was surgery covered in university lectures, but surgeons did not have to attend lectures or receive a degree in order to practice. There is occasionally evidence of physicians not receiving degrees either. In one notable case, the name of one Guglielmo da Saliceto is listed as a doctor with Bologna University, although there has never been any record of his medical degree. This transition did not always progress smoothly: there was strife between the

physicians and other medical providers during this period of change. While the university tried to push the idea of the educated man with a university degree as the only acceptable health care provider, in reality the surgeons, barbers, and apothecaries were far greater in number than the physicians. Without the presence of a university, physicians often faced overwhelming resistance from these groups.⁴¹ It is difficult to say how the general population viewed these different groups in relation to each other, but all appear to have been in great demand.

By the fourteenth century, medicine had changed to completely incorporate the teachings of the classical physicians, such as Hippocrates, Galen, and Aesculapius. Doctors would often quote large sections of their treatises, and many treatments were applied exactly as they had been written, without any editing on the part of the medieval physician.⁴² This not only created a great shift away from religion as medicine, but also an improved understanding on how the body worked. Most of the classical scholars, for example, believed that there was a connection between the human body and the planets and their elements,⁴³ as evidenced by the belief that the plague was caused by the conjunction of Saturn, Jupiter, and Mars. Hippocrates said that “no one ought to be put under the care of any physician who is ignorant of astrology.”⁴⁴ This focus on the natural elements allowed doctors to better understand what composed the body and how those parts interacted. According to the medieval physicians, the three most important parts of the body were the heart, the liver, and the brain.⁴⁵ Each of these had different temperaments, so their treatments were different. The heart was the most important organ of the three and was dry, the liver was warm and moist because it

was composed of sanguine humors and was attached to many arteries, and the brain was cool and moist, for it was formed from semen.⁴⁶ They also had their own emunctories, or places where any excess humors or poisonous matters could drain. All were glandular, and were located in the armpits, the groin, and the neck, respectively.⁴⁷ It was important that doctors understand this correspondence, for seeing where an emunctory was inflamed was a sign as to where the original infection was occurring and which treatment should be used. In the case of disease caused by poisoned air, John of Burgundy says that the corrupt air first travels to the heart, as it is the most important organ. If it cannot reach the heart, then it moves to the liver, and if it cannot reach the liver, then it attacks the brain.⁴⁸ It was also important to know the veins and the arteries connected to the emunctories, for they were used in phlebotomies. Medieval physicians believed that the arteries originated in the heart and the veins started at the liver, and that they were always found in pairs.⁴⁹ By using the above information on emunctories, physicians knew which veins or arteries to draw blood from in order to maximize healing.

Humors were another important part of classical medicine that the medieval physicians adopted and utilized in their treatments. There were four main humors, phlegm, blood, black bile, and yellow bile (also called cholera and melancholy).⁵⁰ Each of these had different characteristics associated with them, and could have different effects on the body if they were corrupted. If all of the humors were natural and in balance, then it was believed that the person was in health. If the humors changed, however, a person would fall ill. “A natural humor

became non-natural in several ways: by corruption of itself; by mixing with another humor; by solidifications or liquefactions.⁵¹ Pus and virulence were two unnatural humors: pus was created when blood putrefied or when the natural heat of the body badly affected crushed tissues; virulence was a thin liquid matter that was derived from the aqueous humors. The humors and their characteristics were what most internal medicine was based on, as physicians used items with known qualities to counteract those of the corrupt humors.⁵²

Medicines used in general illnesses consisted of items such as herbs and plants, non-digestible precious stones, helpful foods, and surgical procedures. There were also a group of medicines which were classified not by their components, but by the effects which they produced in the body.⁵³ Repercussives were medical compounds which: “act in two ways. They usually repel, cool, thicken, obstruct, and comfort. Although repercussive repel and arrest, they arrest by cooling the matter, that is, by thickening it.”⁵⁴ Repercussives could further be broken down into constrictives, interceptors, and restives, all of which repelled the flow of humors. Attractives, which have warm complexions and are a liquid state, worked to pull poisonous matter out from the interior of the body to the surface, where they would then form apostemes or be released at the emunctories. Though their effects were exactly the opposite of the repercussives, Gui de Chauliac writes that they can be used after the application of a repercussive. Similar in nature to the repercussives were the resolutives, and Chauliac advocates their use when a repercussive has failed. Like repercussives, they can also be used in conjunction with attractives, and work by opening the pores so

that the “bad matter” can escape. Next in importance are the softeners, which are used when “the resolutes fail and when the residue is hard.” Because of their ability to destroy hardened matter, they were often used in the treatment of abscesses, glands, and other protrusions. The maturatives, also called suppuratives, are used exclusively on apostemes when they begin to suppurate and drain. They work because: “It heats the abscess to exceed that of the limb, and it robs the limb of some of its moisture. That hardly affects the limb, but it causes the matter to suppurate. Suppuration, therefore presents a change unlike that caused by natural heat...here the source of heat is the matter itself, the pus.”⁵⁵ As they are meant to bring heat to the limbs, maturatives must have a warm nature and be viscous, so as to aid their ability to be applied to the aposteme. Finally, the mondificatives, or detergents, are used to reduce pus and necrotic tissue, as well as diminish swellings on the body. They are used immediately after an abscess is drained to cleanse and reduce swelling, and often contain ingredients such as barley and egg yolks, which are staples in medieval medicine and play a prominent role in plague medicine.⁵⁶

As noted above, food was an important part of medicine due to the belief that as the seat of the body, the stomach was the origin for all illnesses. Therefore, many foods were considered therapeutic to eat during illness, while others were dangerous for consumption, either during times of plague, or at all times. As early as the 12th century, Hildegard von Bingen advocated that diet was an important component of reclaiming health, stating that if one was ill, one should eat fish from the pure areas of the mid-sea or mid-river.⁵⁷ Because the fish lead a healthy

life and eat only plants from unpolluted waters, any person ingesting them should benefit from their purity. Two centuries later, when Petrarch wrote his letters, the doctors of his day still believed that a person could heal themselves if they changed their diet and eliminated harmful foods.⁵⁸ Foods that people should stay away from, for they would either cause a healthy person to fall ill or augment an illness in a sick person included animals that eat each other and have multiple offspring, such as pigs and wolves, for because humans do neither of those things, the animals that do them have conflicting natures that would weaken a human.⁵⁹ Many doctors also forbid drinking plain water. Instead, water should be mixed with something such as wine or vinegar. Petrarch writes that many doctors believed that drinking water on its own was the reason why older people began to decline in health. Finally, some doctors advised their patients to stay away from uncooked fruits and vegetables, although this seems to have been more of a personal choice than a standardized ideology, and during plague outbreaks, it stemmed from the fear that the air was contagious and could therefore pass on this poison to the growing plants,⁶⁰ as was suggested by the Paris Medical Faculty in the discussion on the theories of the origin of the plague. If all of these dietary changes should prove ineffective, then the patient should attempt to help the stomach by purging and getting rid of bad food.⁶¹

Though medicines which had internal effects on disease and the body were quite popular, there were many surgical procedures that could be employed to treat individuals. Of these, the most popular was bleeding. According to Gui de Chauliac: "Phlebotomy is an incision in a vein to evacuate blood and its humors.

Avicenna described it as the most effective general evacuation (Book 1, Part 4). In Part 3 he described it as the common evacuant for all humors.”⁶² There were very specific rules for blood-letting: it had to be performed at a certain time of year – generally under the signs of Aries, Taurus, Libra, and Sagittarius - and in a certain place on the body, depending on the condition that was being treated. If attempting to treat a phlegmon in the early stages, then one should bleed from the opposite side of the body to attract the humors. If the lesion is chronic or in the later stages, however, then blood should be let from the same side from veins as close to the lesions as possible.⁶³ There were also set rules for how to draw blood. “Albucasis described three methods: for most cases in the axis of the vein (i.e. lengthwise); for special cases, incise across the vein; for arteries use ligatures and cauteries.”⁶⁴ During outbreaks of plague, even more is written about the benefits of bleeding. Although we shall examine it in more detail in the chapter dealing with plague medicine, there were physicians who claimed that people had been healed from the plague through blood-letting alone. This implies that blood-letting was a regulated treatment that was held in very high esteem for its ability to cure many ailments.

Despite its evident popularity, blood-letting was not the only surgical technique practiced during the time of the Black Death. Chauliac classified the procedures in this way: “There are three types of procedures: the separation of continuity (incisions), the restoration of continuity, and the riddance of redundancies. Phlebotomy and scarification are in the first category. Closure of wounds and the reduction of fractures and dislocations are in the second.

Ablations of tumors such as apostemes and glands are in the third.’⁶⁵ Of the three, only the first and third types are relevant in plague treatment. Related to scarification and phlebotomy was cupping, which involved placing a heated cup on the skin in order to draw up humors to the surface of the body, but as it is less powerful than the other two, it only works when the humors are already close to the surface.⁶⁶ As for the third category, this was often done with surgical incisions. These were not done without careful consideration, however, as the surgeons and doctors recognized real threats to their patient’s health if something went wrong. This worry is demonstrated when Chauliac says: “Sometimes the exitures will resolve, although more likely it will drain. The opening may come about naturally, and that is better than a surgical procedure; but when such is required, the knife is better than the use of caustics. Avicenna said that surgical drainage may exacerbate the virulence, contaminate the region and cause a fistula. However, when there is no other way, you have no choice but to act.’⁶⁷ If an incision has to be made, Chauliac recommends that it be only large enough to allow the poisonous matter out, but not large enough to let it out all at once. After it has drained entirely, it should be covered with detergents and consolidatives.⁶⁹

The last two sections of this chapter will describe the typical treatments for fever, skin, and lung diseases, and why they were considered effective. These are especially important compared to all other illnesses which physicians treated in the fourteenth century, because these three are the conditions which exhibit symptoms similar to those of plague. The treatments of fevers differed, depending on which type of fever the patient exhibited. If suffering from ague, or cycles of

fever and chills, such as from an infection of malaria, then the only remedy I have found was provided by Hildegard von Bingen. She advised to grind the root of the meddlar tree into a powder, and ingest this powder with wine several times a day, especially at meals.⁷⁰ For people with an unbreaking fever, the treatment was slightly different. Individuals would still ingest plants, spices, and other edible materials, but there is no mention of the meddlar root,⁷¹ suggesting that physicians understood that there was a difference between these fevers in their interaction with the body. Instead, those with a continuous fever were advised to cinquefoil, because of its hot nature, and opium and mandrake, because their cold nature thickened the humors and allowed them to putrefy, thus relieving the illness.⁷² Other remedies called for grinding the bone of a camel hump and drinking it in water.⁷³ A third group of medicines utilized non-digestible substances, such as stones. Hildegard von Bingen drew greatly on the belief that stones possessed healing powers, so she ordered that anyone who had access to onyx: “should place onyx in vinegar for five days. Then, having removed the onyx, he should prepare and season all his foods with that vinegar, and so eat them. The fever will cases and swiftly vanish, because the good heat of onyx, mixed with the heat of vinegar, chases away the noxious humors which give rise to fevers.”⁷⁴ If one did not have onyx, then one could hold chrysolite over warmed wine, then drink the wine and hold the stone in his mouth for a short period of time. After several repetitions, the person should expect his fever to break.⁷⁵ Though the items used in the listed treatments differ, there is one notable pattern. All items had to be ingested, suggesting that the physicians knew that the cause of the fever was internal.

If a patient suffered from a lung disease, physicians relied both on the use of plants and herbs, as they had in fevers, but also on foods. According to Hildegard von Bingen: “One whose lungs ail in any way should avoid fat foods and abstain from uncooked food as well as food infused with much blood. These create putrefaction around the lungs.”⁷⁶ If the person was coughing up blood, then he was actually ordered to abstain from using medicine, for the medicine might frighten the blood and cause it to come out even more. When the bleeding subsided, however, he was permitted to cook sage in wine and drink that.⁷⁷ This information is critical, for it may explain why physicians during the time of the plague wrote little on how to treat pneumonic cases. By the publication of the *Tabula Antidotarii*, a text compiled in the early fourteenth century, the treatment of lung diseases had progressed a little. If a disease to the throat arose from phlegm, a cold humor, then the patient should drink hot wines with the hot and dry plant horehound before they went to bed to counteract the effects of the phlegm. However, if the condition was deeper in the lungs and derived from a hot and dry irritation, then the patient should do the exact opposite and ingest a cold substance. In this case, it was recommended that they take tragacanth, because it was “cold and wet in the first degree, gluey, thickening, and soothing.” It was made into a pill which would rest under the tongue until it dissolved, and would be followed up with a licorice decoction.⁷⁸

Compared to lung diseases and fevers, medieval physicians wrote a great deal about skin diseases. One common skin condition was referred to as leprosy, though it was likely not always a reference to the disease we call leprosy. Though

many people today believe that medieval physicians thought that leprosy was caused by some sin that an individual had committed, it was actually rarely attributed to God. Hildegard von Bingen goes into the most detail of all the Christian writers on how to alleviate it, and her solution does not involve religion in any way. She says that one should simply rub the juice of a tamarisk on the patches of hardened skin, and this will make it smoother.⁷⁹

Though we have no records on how many people were actually infected with leprosy, the amount that was written about it in contrast with other diseases, such as scrofula, would suggest that it is not as prevalent as we would first assume. Scrofula is a condition similar to plague buboes, where the lymph nodes in the neck are inflamed due to an infection from *Mycobacterium tuberculosis*.⁸⁰ Treatment for scrofula can be broken down into two categories: medicines that were applied topically and medicines that were ingested. Hildegard von Bingen advocated for eating raw columbine, cakes made of bread and catnip, meygelena, and the pulverized liver of a hamster in broth or with bread. The ingestion of all of these substances should be enough to diminish the scrofula's presence, or heal it entirely. On the other hand, eating eggs should be avoided, because that can aggravate scrofula or cause it to develop in an uninfected individual. To dry out scrofula, one should make a powder from dried vinegar and apply that to the sites of infection. Other topicals include warmed myrtle wood tied into the shape of the cross, dried leech blood, a powder made from pulverized vulture livers, and other fatty tissues from various animals. As with lung afflictions, stones could also be used, for a crystal tied to the scrofula overnight supposedly helped a great deal in

relieving it.⁸¹ When describing the origin of scrofula and other skin protrusions, Gui de Chauliac said: “Glands, scrofules, nodes, lupus, turtles, lipomas (nactes), hernias, goiters, and hard masses in the groins (buboes fuguilis), wherever they appear in the body, all share some phlegm. Roger said so and I agree. Although they may evolve into hard melancholic tumors, they have phlegm at the onset.”⁸² Therefore, it makes sense that as they shared certain characteristics, the treatments were similar, though not identical.

Though scrofula was a condition of the lymph nodes, there is nothing to suggest that medieval physicians confused it with plague. This may be for several reasons: scrofula only appears on the lymph nodes of the neck, while buboes can arise at any of the major lymph nodes, and it does not appear to have been nearly as virulent as plague. Consequently, no modern historians have suggested that the plague outbreak was actually a large outbreak of scrofula instead. A comparison of anthrax and plague, however, creates doubts as to the uniqueness of the plague in the eyes of the fourteenth century medical community. In his Major Surgery, Gui de Chauliac wrote extensively about identifying and treating carbuncles, the skin lesions that arise during an anthrax infection. When it comes to determining that a skin lesion is a carbuncle, he says: “One must not read the signs wrongly, because the lesions [carbuncles] are partly venomous. Although at the onset they may not resemble ulcers, they all end as such and will be treated as such. In that sense carbuncles resemble the lesions of plague.”⁸³ This suggests that carbuncles caused by anthrax and buboes caused by the plague are two distinct types of lesions that arise from different causes and should not be confused. These

carbuncles are formed when the blood is heated for a long time and becomes venomous.⁸⁴ However, William of Saliceto, whom Gui de Chauliac quotes in his section on anthrax, says that the anthrax carbuncles can also be called buboes, for they are evil and threaten the lives of those infected.⁸⁵ This opposing statement suggests that physicians did not see a difference between plague and anthrax, believing them both to be contagious and pestilential. The matter is further confused when Chauliac notes that: “Anthrax lesions are more common during epidemics of the plague.”⁸⁶ Because there were specific treatments for anthrax, it is important to determine what the relationship was between plague and anthrax. Chauliac sets out four main ways to treat anthrax: “First, attend to the general regimen (i.e. life style). Second, comfort the heart. Third void the bad humors. Fourth, attract and eliminate the conjoint matter.”⁸⁷ For the general regimen, the patient should be kept active and awake in a clean living space, and should consume only liquids for the first four to five days of their infection.⁸⁸ This in itself suggests that anthrax could not have been considered the same as plague, for most plague patients were dead by the fifth day. To comfort the heart, a theriac should be taken. To eliminate bad humors, phlebotomy is to be performed near the lesions, and to remove the “conjoint matter”, attractives are applied on top of the lesion itself, while repercussives and coolants are placed around the lesion. Alternatively, topicals can be applied to the carbuncle which will cause it to erode.⁸⁹ Theodoric suggested that a solution made of egg yolk and salt will destroy the anthrax,⁹⁰ while Janvier advocated a plaster made of “apium, scabious, a geranium, marrubium, wheat flour, linseeds, honey, oil, wine, and aged lard.”⁹¹

Here, it appears that the most useful remedies for anthrax are pastes that are placed on top of the infected area and deal locally, rather than with the entire body, a technique also used in plague buboes. Despite their similarities in appearance and treatment, I believe that the medieval physician did understand the difference between plague and anthrax. Not only were their phlebotomies performed in different areas, but the statement that anthrax patients have a first five days of infection strongly implies that they were not the same.

We have now discussed how Christian physicians treated skin lesions associated with diseases. There were, however, many lesions which the doctors did not attach to a disease, but still felt necessary to treat. These could be generic disease symptoms indicative of many illnesses, or they could be wounds with a single area of infection. The most common types of lesions were the apostemes. Gui de Chauliac describes the apostemes, saying: “As defined by Galen in Maladies and Symptoms, Part 1, and Avicenna in Canon Part 1, an aposteme is any of three types of lesions consisting of an accumulation...a malady is a general term, and an excess makes it different from other composite maladies as Galen described them”⁹² and “Halyabbas in his royal book, 8th sermon, part 1. He wrote “an aposteme is an abnormal swelling in which enough matter has accumulated to fill and distend it. Call it a tumor if it is large, if is small it is a complication.”⁹³ They arise when substances are rejected from the liver and instead of being removed from the body by sweat or urine, collect and become raised masses on the body.⁹⁴ Chauliac claims that the most important thing for the medical professional to know is how to recognize an aposteme and differentiate it from

other swellings, such as from joint dislocations or injuries where no humors are present. To do this, one must recognize the different categories of apostemes. Based on the works of his predecessors, including Avicenna and Galen, Chauliac grouped the apostemes into three major categories. They are: sanguine, warm, and cool. Sanguine apostemes can be caused by natural blood and non-natural blood. Those made from natural blood are phlegmons. Non-natural blood can result in carbuncles, furuncles, Persian Fire, malignant pustules, and malignant anthrax carbuncles. Similarly, warm apostemes can be broken down further into categories, namely choleric and phlegmatic. Choleric apostemes include gangrene, St. Anthony's Fire, and herpes, whereas phlegmatic ones are edemas, scrofulas, loupes, turtles, goiters, hernias, melicerides, steatomas, and lipomas. Finally, the cool apostemes are all melancholic, and are comprised of sclerosis and cancers.⁹⁵

Chauliac cites Halyabbas for more in-depth information on how apostemes are formed. While rheum and congestion are what actually cause apostemes to form, there are specific causes as well, which are: "the forceful entry of humors, the inability of the affected part to reject it, the passages that transmit it, the proximity of the source, the quantity of the matter, and the availability of a lower region to receive it."⁹⁶ Congestion occurs when nutrition is not properly digested, and eventually becomes an aposteme. Therefore, it is important to eat foods that are healthy and will not make one sick or aggravate an illness.⁹⁷ Once it is created, there are four recognized stages of an aposteme. The first is onset, which is characterized by a swelling as harmful matter accumulates in one area.

The second is increase, during which the aposteme enlarges and matures. In the third stage, the stable state, the aposteme does not increase or decrease in size. In the final state, the decline, the aposteme either begins to decrease in size or exhibits other changes. During these four stages, not only the exterior appearance of the aposteme, but also the material inside of it changes. It is important for doctors to recognize these stages, for the treatments of an aposteme vary, depending on which stage it is in. It is also important to realize that while all apostemes progress through these stages, one can also undergo complications, and the resulting changes from the complications will be different than any exhibited change during the natural progression.⁹⁸

As for treatment, apostemes could either be treated with medicine or resolve naturally. If they resolved by themselves, Chauliac wrote that: “The final stage ends either by invisible resolution, by suppuration, by necrosis, or by induration. Galen (unequal dycrasia) said that a cure by spontaneous resolution is better than others, and that suppuration is better than hardening, and that putrefaction [necrosis] is the worst outcome.”⁹⁹ This suggests that unlike plague buboes, sufferers from apostemes did not suffer from lethal conditions and generally survived their infection. If the aid of a doctor was required, then the best course of action was to determine what type of aposteme an individual suffered from, for that would determine what kinds of treatments should be used. For example, if an aposteme arose from congestion, then the first act to do would be to relieve the congestion and cause the matter to flow again through the use of

topical ointments.¹⁰⁰ From this, I suspect that the general treatment for an aposteme was to apply a substance which had the opposite nature as the aposteme.

Finally, there were medicines that one could take to reduce or cure generic lumps that had appeared on the body. As with previous medicines for skin diseases, they could be either ingested or applied. According to Hildegard von Bingen: “If a person has glands on his neck that are contracted or more distinct than usual, and if there is no ulcer or tumor, he should put the same prepared [peach pit] paste on them. If the neck were ulcerated or tumescent, this paste would make it worse.”¹⁰¹ Other remedies for swellings on the neck and throat included lovage and ground ivy boiled together, and warmed vervain tied to the neck under a cloth until the swelling decreases.¹⁰² If the tumor was not on the neck, but appeared somewhere else on the body, then they: “should cover the lump with a piece of rye bread, either warmed on the fire or broken from a piece taken from the oven. He should repeat this until the lump disappears. The warmth will destroy the lump and make it vanish.”¹⁰³ Other common ingredients for pastes included flour, fennel seed, woundwart, egg yolks, alum, linseeds, yeast, and dove droppings. If none of those work, or the patient does not have access to them, then Bingen suggests using precious metals and semiprecious stones as cures. Gold warmed in the sun and amethyst covered in saliva, if placed on the tumor, would supposedly cause them to diminish and eventually disappear.¹⁰⁴ If all else failed, Chauliac advocated for drainage of the tumors with a knife or through similar surgical procedures. Whether it was through topicals or surgery,

however, Chauliac insisted that tumors and other nondescript lumps should be drained, unlike the apostemes.¹⁰⁵

If topical medicines were not practical, then medicine could be ingested, although it was not preferred. In this case, mulberries should be dissolved with licorice and white poppy to relieve swellings of the throat and a fallen uvula, due to their hot and wet nature.¹⁰⁶ Similarly, black hellebore, which was considered to be both hot and cold, should be eaten by any person whose humors rose up on a limb and signaled death. If they ate it constantly, there was a chance that they could survive. Both of these medicines work the same: they counteract the innate coldness of the tumors, which causes them to disappear and the patient to recover.¹⁰⁷

The final component of Christian medicine which we must examine before discussing how plague was treated is the idea of contagion. By the 12th century:

“The notion of contagion, still used by Giles of Corbeil at the end of the twelfth century, belongs to the same category as infection, corruption, or putrefaction; it is applied to the internal and pathological process in which the body slowly becomes impregnated with venomous humor, leading to the destruction of a whole edifice... while the recognition of transmissibility from one person to another supposes an abstract separation between the disease and the body or individual who carries it.”¹⁰⁸

This idea has evolved when the Black Death arrives, for Jean Jacme says that the buboes of plague victims are contagious because they release infectious humors in the form of vapors, and these vapors infect the air around the person. If a healthy individual were to enter the area where the air had been poisoned, then they too would fall ill.¹⁰⁹ Other doctors agreed that contagion referred to the passing of a disease from person to person, but they did not agree on how it could be spread.

During the plague, some doctors thought that looking at an individual was enough to pass the disease on. As evidence of how far the ideas of contagion had progressed, many cities employed strict measures during pandemics to prevent the spread of illness through their population. The city of Pistoia enacted many harsh laws, which forbid, among other things, travel to or from Pisa or Lucca, trading of old cloths, movement of a dead individual without first having been sealed in a box and covered with a cloth, movement of a corpse into the city, and the entering of a house where a person has died. The penalty for any of these actions were varying amounts of money to be paid as fines to the city.¹¹⁰ In another city, Bernabo Visconti placed harsher punishments for anyone who violated the statutes and risked harming members of the population. If a person showed signs of the plague, he or she was forced out of the city into the woods, left alone to either die or recover. If they had someone to attend to them, then that person had to wait ten days after their patient died before they could return to the city. Perhaps the strictest, however, was the decree that: "Parish priests shall examine the sick to see what the illness is, and shall immediately notify the designated searchers under the pain of being burnt alive."¹¹¹ It is interesting that the priests were called on to determine if an individual was ill, rather than the physicians. Though Bernabo Visconti does not give a reason for using the priests instead of the physicians, it is evident that everyone was knowledgeable in the symptoms of the plague, if not its treatment. This reaction suggests to me that contagion was understood as the ability for a disease to pass from one person to another, and that

cities were taking great measures to prevent what they saw as a very serious threat.

¹Priscilla Throop. *Hildegard von Bingen's Physica: the complete English translation of her classic work on health and healing*. (Rochester. Healing Arts Press. 1998) 61

²Bishop. *Letters from Petrarch*. 278

³Ibid, 215

⁴Ibid

⁵Ibid, 282-83

⁶Horrox. *The Black Death*. 163

⁷Bishop. *Letters from Petrarch*. 251

⁸Ibid, 279

⁹Ibid, 215

¹⁰Ibid, 250

¹¹Ibid, 284

¹²Ibid, 278

¹³Ibid, 279

¹⁴Gibb, H.A.R. *Ibn Battuta's Travels in Asia and Africa: 1325-1354*. (London. George Routledge & Sons, LTD. 1929) 218

¹⁵Ibid, 284

¹⁶Ibid, 279

¹⁷Ibid, 250

¹⁸Ibid

¹⁹Ibid, 280

²⁰Ibid, 250

²¹Ibid, 215

²²Ibid, 251

²³Ibid, 283

²⁴Ibid, 250

²⁵Ibid, 248

²⁷Ibid, 277

²⁸Ibid, 282-83

²⁹Ibid, 284

³⁰Ibid, 249

³¹Ibid

³²Ibid, 251

³³Wear. *Medicine and Society*. 80

³⁴Ibid

³⁵Bishop. *Letters from Petrarch*. 283

³⁶Garcia-Ballester, Luis. *Practical Medicine from Salerno to the Black Death*. (Cambridge. Cambridge University Press. 1994). 2

³⁷Nicaise. *The Major Surgery*. 118

³⁸Katherine L. Jansen, Joanna Drell, and Frances Andrews. *Medieval Italy: texts in translation*. (Philadelphia. University of Pennsylvania Press. 2009) 328

³⁹Wear. *Medicine and Society*. 76

⁴⁰Garcia-Ballester. *Practical Medicine*. 60

⁴¹Wear. *Medicine and Society*. 81

⁴²Nicaise. *The Major Surgery*. 183

⁴³Horrox. *The Black Death*. 170

⁴⁴Ibid, 185

⁴⁵Ibid, 188

⁴⁶Nicaise. *The Major Surgery*. 138

⁴⁷Ibid, 246

- ⁴⁸Horrox. *The Black Death*. 188
- ⁴⁹Nicaise. *The Major Surgery*. 142
- ⁵⁰Tibi. *The Key to Medicine*.22
- ⁵¹Nicaise. *The Major Surgery*. 189
- ⁵²Ibid, 609-623
- ⁵³Ibid
- ⁵⁴Ibid
- ⁵⁵Ibid, 613
- ⁵⁶Ross E. Dunn. *The Adventures of Ibn Battuta: A Muslim Traveler of the 14th Century*.(Los Angeles. University of California Press. 1986) 273
- ⁵⁷Throop. *Hildegard von Bingen 's Physica*.159
- ⁵⁸LFP Bishop. *Letters from Petrarch*. 277
- ⁵⁹Throop. *Hildegard von Bingen 's Physica*. 205
- ⁶⁰Priest. *The Chronica Maiora*.213
- ⁶¹Nicaise. *The Major Surgery*. 48, 250, 595. And Horrox. *The Black Death*. 194
- ⁶²Nicaise. *The Major Surgery*.572
- ⁶³Ibid, 578-79
- ⁶⁴Ibid
- ⁶⁵Ibid, 119
- ⁶⁶Ibid, 584
- ⁶⁷Ibid, 183
- ⁶⁹Ibid, 187
- ⁷⁰Throop. *Hildegard von Bingen 's Physica*. 115
- ⁷¹Ibid, 69
- ⁷²Michael McVaugh and Lola Ferre. *The tabula antidotarii of Armengaud Blaise and its Hebrew translation*.(Philadelphia. American Philosophical Socitey. 2000) 148
- ⁷³Throop. *Hildegard von Bingen 's Physica*. 206-07
- ⁷⁴Ibid, 141
- ⁷⁵Ibid, 146
- ⁷⁶Ibid, 15
- ⁷⁷Ibid, 37
- ⁷⁸McVaugh. *The Tabula Antidotarii*.58
- ⁷⁹Throop. *Hildegard von Bingen 's Physica*. 130
- ⁸⁰Centers for Disease Control. Last updated September 7, 2004.
<http://emergency.cdc.gov/agent/plague/trainingmodule/3/06.asp>
- ⁸¹Throop. *Hildegard von Bingen 's Physica*. 154
- ⁸²Nicaise. *The Major Surgery*.214
- ⁸³Ibid, 195
- ⁸⁴Ibid, 196
- ⁸⁵Ibid
- ⁸⁶Ibid
- ⁸⁷Ibid, 197
- ⁸⁸Ibid
- ⁸⁹Ibid, 198
- ⁹⁰Ibid
- ⁹¹Ibid
- ⁹²Ibid, 177
- ⁹³Ibid
- ⁹⁴Ibid, 164
- ⁹⁵Ibid, 198
- ⁹⁶Ibid, 180
- ⁹⁷Throop. *Hildegard von Bingen 's Physica*. 216
- ⁹⁸Nicaise. *The Major Surgery*. 182-83
- ⁹⁹Ibid
- ¹⁰⁰Ibid, 180

- ¹⁰¹Throop. *Hildegard von Bingen's Physica*. 111
¹⁰²Ibid, 75
¹⁰³Ibid, 11
¹⁰⁴Ibid, 150
¹⁰⁵Nicaise. *The Major Surgery*. 183
¹⁰⁶Mc Vaugh. *The Tabula Antidotarii*. 52
¹⁰⁷Throop. *Hildegard von Bingen's Physica*. 23, 31
¹⁰⁸Conrad. *Contagion*. 188-89
¹⁰⁹Horrox. *The Black Death*. 175
¹¹⁰Ibid, 195
¹¹¹Ibid, 203

Chapter 6: Christian Religious Treatment of the Plague

“Compared with this all other remedies of doctors are futile and profit little against the plague, which God keeps for the chastisement of sin and which is without remedy save through him and his power” – Dom Theophilus.¹ Some individuals felt that medicine was inadequate in dealing with the plague. Many, such as Boccaccio, believed that medicine was not helping the patients because the practice of medicine had been taken over by those who had not been trained properly, or because they themselves were afraid of catching the disease and did not even visit those who were sick.² Despite their misgivings about the practice of medicine during the plague, they did agree that medicine was of some use, and that people who were treated correctly could recover, and that if more people had had the opportunity to receive medicine, then the effects of the plague could have been far less.³ Further fears arose when doctors were unable to provide treatments for some of the more serious symptoms, such as the vomiting of blood. This led some individuals who had a deep distrust of the medical profession, such as Petrarch, to decide that the best course of action would be to do nothing and await death, however it would come to them.⁴ Despite these doubts, most people believed that doctors had some ways of combatting the plague, although their usefulness and outcomes varied drastically.

Others believed that the problem was inherently within medicine. For these people, the only solution would come from God. These people employed religious services and ideologies to protect themselves from the plague, occasionally wording them in the common medical terms.⁵ The most common

method of preventing plague that did not involve medicine or pseudo-medicine was through supplication to saints. As evidenced by their use in both Christian and Islamic cultures, prayers to saints involving the entire community were quite common. After the plague appeared in one city, Gabrielle de Mussis recounts that: “After having a vision, a certain holy person issued a warning: that people of both sexes in every diocese, city, castle, and region should gather for three consecutive days in their parish church and with great devotion and lighted candles in their hands hear the mass of the Blessed Anastasia... And they should humbly implore mercy of the saint, that they might be delivered from the plague through the merits of the holy mass.”⁶ As we shall see later, a similar story was told by Ibn Battuta in his *Travels in Asia and Africa* when he describes how the plague moved through the Middle East. When the plague arrived in Messina, the inhabitants of the city thought that bringing in the relics of St. Agatha of Catania would cause the it to vanish. This appeared to have worked, for according to Michele de Piazza, “Afterwards, the patriarch came to the city of Messina, bring with him the aforesaid holy water [that had had the remains of Agatha dipped into it], and he cured many and various sick people by sprinkling and touching them with the water.”⁷ This testimony would have convinced people of the effectiveness of prayer and relics as a cure for the plague. As insurance, however, they also prayed to a higher power: the Virgin Mary, and processed with bare feet to the Blessed Virgin of Santa Maria della Scala,⁸ which was located several miles outside of the city.

The veneration of relics and saints to protect cities and cure individuals of the plague was not unique to mainland Europe. There are recorded cases of groups in Scotland performing similar rituals and prayers. While fighting against the English, who were suffering from the plague, the Scottish armies would recite the prayer: "Bless us, oh Lord. May God and Saints Kentigern, Romanus and Andrew keep us safe today and every day from the divine grace and foul death which is destroying the English."⁹ In his Chronica Maiora, Thomas Walsingham wrote that the Scots believed that was sufficient to keep them safe from infection,¹⁰ although this may have been meant to illustrate the foolishness of the Scots and not indicative of their beliefs on how to treat the plague. Even in other regions in the British Isles, prayer became a popular alternative or supplement to medicine, however it focused more on God, instead of on Mary and the saints. In Ireland, great pilgrimages were made to Tech-Moling, where people would bathe in the waters in the belief that it would prevent them from becoming sick.¹¹ Clergy in England, however, favored processions, and called for the people to hold processions with their church every Wednesday and Friday to combat the disease, so the people would be penitent and humble in the eyes of God. These modified masses would also include a daily prayer designed to specifically ask for the remission of the plague.¹² Also believing that penitence would relieve the plague, clerics such as William Edendon urged parishioners to make proper and frequent confessions and to repeatedly recite the seven penitential psalms.¹³ This stemmed from the belief that sin was the original cause of the plague and therefore prayer and confession of sin were the best cures, as written by Thomas

Brinton.¹⁴ Even King Edward III of England sided with these clerics, proclaiming that when: “The people drive out this spiritual wickedness from their hearts, the malignancy of the air and of the other elements will also depart”,¹⁵ suggesting that prayer was considered effective by the learned non-medical and non-clerical individuals.

Returning to continental Europe, the most common saint to pray to was Saint Sebastian, who was considered to be the patron saint of plagues.¹⁶ His association with plague arose from the manner in which he died. In medieval literature and art, plague was often depicted as a rain of arrows coming down from God, infecting everyone that they hit. A Roman soldier who converted to Christianity, St. Sebastian was ordered to be martyred by having arrows shot through his body. Through an intervening miracle, however, Sebastian was healed by a woman and survived, after which he preached about Christianity.¹⁷ This survival from a shower of arrows made Sebastian the perfect model for one who could survive and protect others from plague. People therefore participated in pilgrimages to the Monastery of St. Peter at Nennegau and the Monastery of St. Medard at Soissons, both of which claimed to house the body of Sebastian.¹⁸ For those who could not participate in a pilgrimage, a popular prayer was written and dedicated to Sebastian, asking him to work for them through God to relieve the plague.¹⁹

Despite the popularity of prayer to relieve plague, medicine was still the basic form of treatment in Christian societies. Its popularity is clear in the way Dom Theophilus chooses to word his treatise on the best treatments of plague. In it,

he writes how people can save themselves from plague through prayer, loving Christ, and loathing their sins, but constructs it as if he is writing a recipe for a compound medicine. He writes: "Let him first gather as much as he can of bitter loathing towards the sins committed by him, and the same quantity of true contrition of the heart, and mix the two into an ointment with the water of tears. Then let him make a vomit of frank and honest confession, by which he shall be purged of the pestilential poison of sin, and the boil of his vices shall be totally liquefied and melt away."²⁰ To me, this suggests two alternative possibilities: that he recognized that medicine was very popular and thought that the best way of getting his message across would be to word it in a similar fashion, or, more likely, that he was mocking the medical treatments of plague which he saw as useless. There is something unusual about his work, however: he writes that the best medicine of all is the host, and after taking it, one will die and go to heaven, where they will be happy.²¹ This is unlike any other Christian writing on treatment, religious or medical, because it implies that those who practice it will still not have a chance of recovery, which was the goal of all others.

The most outspoken group arguing for the role of religion in the treatment of the plague were the flagellants. They were a group from northern continental Europe who believed that the best way to end the plague was to show their penitence to God through self-mutilation. They would travel across cities and towns, and when they entered a public space, would strip to the waist and whip themselves repeatedly. This gathered quite a crowd, and for a while, laymen supported them and believed that they were able to do something about the

plague, and often tried to join their ranks. The clergy, however, thoroughly disapproved, claiming that they were nothing but charlatans, and forbade their people from joining, even going so far as banning them from parishes to prevent interest. When the flagellants continued their show and the plague did not cease, however, people no longer believed that they had a power greater than that of the priests, and turned their back on them.²² I have found nothing written by the flagellants themselves; most of what was written was by disapproving priests, urging their flock to stay away from the individuals which many regarded as not only insane, but dangerous as well.

The concept of praying to a divine power to relieve plague was not a new phenomenon. As long as people believed that God could cause disease, they prayed to Him to remove it. During the Justinianic plague, Gallus prayed to God to protect his diocese at Claremont from the disease. According to the legend, an angel appeared and promised that none of his people would die, and true to his word, all the people remained safe during the outbreak.²³ More famous, however, was the story of St. Gregory, who became pope at the end of the sixth century when his predecessor died from the plague. To end the plague, he personally led a procession through Rome. As they reached the church, he saw the archangel Michael standing on top of Hadrian's Mausoleum, holding a flaming sword. Michael then sheathed his sword, signaling to Gregory that the plague was over.²⁴ This scene became incredibly popular during the medieval period, and was the subject of numerous paintings. It was no wonder then that people during the Black

Death thought that when medicine failed, they could turn to prayer and processions to get rid of the plague.

As already evidenced, this does not mean, however, that everyone saw religion as a substitute for medicine. While there was certainly room for religious beliefs and superstitions in medicine, it did not control standard medical practices. Some, such as Thomas Walsingham, were quite critical of equating religious practices with medicine. To illustrate the perils of using religion instead of medicine to treat plague, he tells the story of a man masquerading as a physician during the plague who led people astray. This man sent out a proclamation that all who wanted to avoid the plague should not leave their house until they had recited the Lord's Prayer five times in their room on the eve of the Feast of the Ascension of Our Lord. According to him, when the plague arrived that day, all those who had followed his advice would be saved, but those who had not would fall ill and die. On the following day, however, when people realized that many who had not followed his orders were still alive, and some that had were dead, they turned on him and paraded him on a horse before all of the physicians in the city as punishment.²⁵ The fact that this story was told by a doctor, but by a layman, shows the popularity of medicine over religion in the view of the educated individual.

¹Horrox. *The Black Death*. 149

²Aberth. *The Black Death*. 32, Nicaise. *The Major Surgery*. 249

³Aberth. *The Black Death*. 77

⁴Bishop. *Letters from Petrarch*. 194

⁵Horrox. *The Black Death*. 149

⁶Aberth. *The Black Death*. 100

⁷Ibid, 102

⁸Ibid

⁹Priest. *The Chronica Maiora*. 91-2

¹⁰Ibid

¹¹Horrox. *The Black Death*. 82

¹²Ibid, 111

¹³Ibid, 116

¹⁴Ibid, 147

¹⁵Ibid, 118

¹⁶Little. *Plague and the End of Antiquity*. 28

¹⁷Ibid, 30

¹⁸Horrox. *The Black Death*. 54

¹⁹Ibid, 125

²⁰Ibid, 149

²¹Ibid

²²Aberth. *The Black Death*. 123-25

²³Little. *Plague and the End of Antiquity*. 10

²⁴George Childs Kohn. *Encyclopedia of plague and pestilence: from ancient times to the present*, 3rd edition. (New York. Facts on File, Inc. 2008) 323

²⁵Priest. *The Chronica Maiora*. 182

Chapter 7: Plague Medicine in Christian Societies

“These epidemic diseases take hold in twenty four hours and it is therefore vital to apply a remedy immediately.”¹ Because of the deadliness of the plague and the swiftness with which it infected and killed its victims, physicians agreed that it was better to prevent the plague from infecting a person than it was to provide a remedy after infection.² Therefore, medieval doctors employed many preventative measures during outbreaks. One of the more popular measures, though not strictly medicinal, was to avoid areas in which the plague had been spotted and certain things which could exacerbate its effects. Alfonso de Cordoba warned against consuming food or drink that had the potential of being poisoned, as well as advising people to leave their cities as soon as they heard word that the plague had arrived.³ Boccaccio records that many people agreed with this regimen, although he himself thought that it was perhaps not the best, and certainly not the only method of preservation.⁴ From the point of view of a physician, Gui de Chauliac recommends that those who can leave infected areas, but to also: “use purgative pills of aloes, and undergo some phlebotomies...comfort the heart with a theriac; and apply sweet-smelling items including bol d’armenie that rectify the humors.”⁵ Humors unsurprisingly played a role in other physician’s preventative measures as well: when visiting the sick, Jean Jacme writes that he would soak bread or a sponge in vinegar and then clamp it in his mouth so it was directly under his nose, for he believed that the sourness of the vinegar prevented the poisoned air from entering his body. He claimed that it was this practice which kept him from falling ill when visiting the sick people

of Montpellier.⁶ Another unnamed physician also recommended holding a sponge soaked in vinegar under one's nose to prevent from falling ill, but only during warm weather. If the weather was cold, he should insert rue and cumin into his nostrils to protect himself.⁷

With such a virulent disease as plague, however, it was impossible that these preventative measures could stop all of Europe from falling ill. Therefore, physicians were tasked with finding medicines that would heal their numerous patients. While there was no one specific medicine used to treat plague, the general rules governing medicine that we have already seen created some standards, and physicians often agreed on the types of medicines and procedures that should be employed. One of the most common medicines prescribed during outbreaks of both forms of plague was a theriac.⁸ According to the author of the *Tabula Antidotarii*, a theriac was the best compound medicine for countering poisons or epidemic illnesses. A theriac was thought to be so helpful against poison and diseases which arose from atmospheric poisons, such as plague, because it contained snakeskin as its "active ingredient"⁹. Gentile da Foligno (d. 1348), a great believer in the benefits of a theriac against plague, recommended that his patients take the best theriac two to three times a week with wine until the end of May, at which point it was no longer considered safe to take theriacs because of the summer heat.¹⁰ Gabrielle de Mussis¹¹ and Jacme d'Agramont (d. ca. 1350)¹² also believed theriacs to be especially helpful, including to those whose bodies had already begun to break down and were showing signs of certain death. In his Major Surgery, Gui de Chauliac includes a recipe for his theriac,

which he created by combining recipes from medical masters such as Arnau of Villanova and the faculty at Paris and Montpellier,¹³ suggesting that while some ingredients may have been standard, there was no constant recipe for theriacs used across Europe. His concoction was made of “juniper seeds, cloves, mace, nutmeg, ginger, turmeric, two aristolochias, roots of gentian, tormentilla, betony, oregano, enula, sage, red balsamita, mint, pouliot, chelidone....the heart bone of a deer, bits of ivory, pearls, sapphire, emeralds and red coral,”¹⁴ many of which were used as simple medicines on their own or in smaller compound medicines. This implies that each of these ingredients had a specific effect on plague that the doctors wished to harness. Unsurprisingly, theriacs were quite expensive, and those who were not as well off had to find other substitutes. If a patient could not afford a theriac, then Gentile da Foligno suggested that they consume leeks or scallions.¹⁵ Garlic could also be used as a replacement, but only in the direst of circumstances, because he believed that once it reached the heart, it would become another substance.¹⁶

Other medicines were used besides theriacs. Alfonso de Cordoba mentions that “pestilential pills” were often successful in curing cases of plague, but does not mention what was in them, only that they are effective against the corrupted air.¹⁷ It is possible that he is referring to a theriac, but it is also possible that they were composed of any number of ingredients thought to have an effect on those conditions that resulted in plague. Another possibility is that they were what John of Burgundy refers to as the “pills of Rasis”, which were developed at least by the time of Avicenna and were considered especially effective in treating plague

because they caused corrupt humors to be expelled from the body.¹⁸ In his recipe, John calls for aloe, saffron, and myrrh to be mixed and blended into a fumitory syrup.¹⁹ Another medicine which he does not provide a name for is made from dittany, pimpernel, tormentil, scabious, and water, and was intended for the poor because it did not contain any expensive ingredients. Burgundy also recognized the importance of scabious, and called for it to be drunk in water as an effective treatment for those who could not afford better medicines.²⁰ Other medications listed by John of Burgundy, which contain variations of the same ingredients, include: camphor stirred in water and an “imperial powder” made from St. John’s wort, dittany, tormentil, pimpernel, scabious, Philadelphia, ammoniac, and medicinal earth from Lemnos. He also suggests that the richest of patients should mix violets, roses, sandalwood, tragacanth, camphor, bone from the heart of a stag, pearls, gold, and other precious stones in a box, and this mixture would strengthen the heart and reduce fever.²¹ This is not a strange remedy, given the fact that precious and semi-precious stones were used to treat both skin diseases and fevers.

Though theriacs and the compounds described by John of Burgundy were used to treat plague throughout the entire body, there were medicines designed specifically to use against the buboes. It was important that the buboes be treated immediately, because Gabrielle de Mussis said that if the tumor was internal, there was no hope of recovery, but if it manifested as an external swelling, then the patient had a chance of living.²² Gui de Chauliac recommended that the buboes be matured with a paste made from ground figs, boiled onions, yeast, and

butter. This would cause them to open and drain, and when they had finished draining, the resulting sore could be treated as an ulcer.²³ Galen prescribed that a paste be made from honey, and Avicenna treated “buboes” with a plaster made from lard and the ashes of sea shells.²⁴ Other medicines used to ripen the buboes included marshmallow and the Emanuel paste. Made from wax, pine resin, valerian, ammoniac, the root of the dwarf elder, the root of somerib, seeds of rue and oil of chamomile, the Emanuel paste was thought to draw the poisonous material in the bubo to the surface of the body. Once there, it would harden, or mortify, and would be unable to travel back into the body to cause further harm to the principle organs.²⁵ John of Burgundy said that if a bubo had been mortified, then it no longer posed any danger to the patient and could remain on them for the rest of their life without causing harm, although it could be removed for cosmetic reasons.²⁶

The different categories of compound medicines discussed earlier were also applied for the treatment of the buboes. Chauliac writes that at the beginning of the infection cycle, use alteratives, comfortives, and softeners to prevent the arrival of the humors. If the buboes are accompanied by pain, then mitigatives are to be used, because their warm nature not only relieve the pain, but speed up the maturation process. To finish the process of suppuration, use a tripharmac of boiled wheat-flour, water, and oil. One should not use repellants, however, because they will force the poisoned humors in the buboes back into the body, where they will do more damage to the organs.²⁷

Surgical methods were also used to treat the buboes. Despite his use of medicines, Chauliac implies that those who had the best chances of survival were those who had their buboes drained.²⁸ Geoffrey le Baker supports this conclusion, writing that if the buboes were lanced, individuals had a better chance of surviving.²⁹ Care had to be taken, however, in how the buboes were drained. Chauliac warns that one should not cut open the hard bubo and remove the entire gland, as some physicians do, because then the emunctories can no longer perform their jobs. Instead, one should make a semilunar incision along the long axis of the bubo and allow it to drain without removing any tissue. In this manner, the buboes could be emptied and the patient saved.³⁰

Though not strictly “medicine”, lifestyle was considered an important factor in whether an individual caught the plague, and if they did catch it, if they survived. Therefore, doctors developed strict regimens that they thought would aid their patients. An important aspect of this healthy lifestyle was the foods that one should and should not eat. John of Burgundy says that overall, “diet in these illnesses should be as in the case of fevers, since the illness is always accompanied by fever.”³¹ Most importantly, people were ordered to eat and drink as little as possible during the outbreaks. When one did eat or drink, one should make sure to consume sour foods, such as vinegar, lemons, and other acidic fruits.³² As we have seen above, vinegar was especially important when dealing with other individuals who may be ill. Jean Jacme advises that if a person who is healthy has to be in contact with people during cloudy weather when the vapors are thick, then they should eat bread soaked in vinegar before leaving the house. If

the weather was hot, however, people should take care to eat less than they would during the cold, consuming mostly cold foods, lots of liquids, and white wine mixed with water.³³ The wine must be of a good quality, though, because it will bolster people's spirits and make them happier during the epidemic. Only white wines should be drunk, however, because the sweetness of sweet wine has a greater tendency to putrefy and turn into potentially dangerous bile. If the thirst is extreme or wine is not available, then John of Burgundy recommends drinking cold water mixed with either vinegar or barley.³⁴

As for foods that should be avoided, the most dangerous is fish. Gentile da Foligno³⁵ and Jacme d'Agramont³⁶ say that no one should eat fish, especially those that live in stagnant waters or are slimy. The Papal Court wrote that fish from the sea should also not be eaten, because their flesh has been infected by the corrupted air.³⁷ Other meats were supposed to be avoided as well, except for the least fatty of chickens cooked in water and verjuice.³⁸ Animals with flesh that was considered to be humid, such as pigs and lambs, were to be completely avoided. As for spices and produce, lettuce was considered especially dangerous if it had no color or had been sitting in the cold, but was safe to eat again if its color came back. Spices that were less than a year old were avoided, because they could have been carried on a galley infested with plague, but those over a year old were considered safe to consume.³⁹ Finally, John of Burgundy advises that people should stay away from any foods that generate heat, including garlic, onions, and leeks.⁴⁰ This is contradictory to what Gentile da Foligno said, for he believed that garlic and leeks could be used as a substitute for theriac for poor people. It is not

clear who John is addressing when he says not to eat these foods; it could be that he considered them a danger to people of a higher class, for the lifestyle one lived was thought to greatly influence the inner workings of their body, and therefore dictate treatment. Regardless, it shows that although some things were standard, there were still local variations in the treatment of plague.

Another lifestyle change that people could implement to either remain well or recover from illness was to avoid certain types of winds. As the air was seen as the medium through which the plague traveled, it makes sense that the doctors thought that the winds were dangerous. Jean Jacme believed that the wind in the south was the most dangerous, for “the south wind has two causes of putrefaction. The first is it that makes a man, whether whole or sick, feel feeble in his body. The second cause is as it is written in Aphorisms chapter 3, the south wind grieves the body and hurts the heart because it opens man’s pores and enters into the heart.”⁴¹ Therefore, when the south wind was blowing, he advised that people open the east and north windows to spar against the south, and to remain in their house the entire day.

Finally, people were warned to take great care with their daily activities such as exercise, sex, and bathing. Concerning exercise, it was considered to be very dangerous, especially in large amounts, because it caused people to breathe harder and therefore drew more infected air into the body and towards the heart.⁴² Sex was also to be avoided, although those who name it as one of the activities not to participate in do not give a reason. It is likely that it was a combination of the fact that it involved lust, which should be avoided during the plague, and

because it was a very physical activity on par with exercising.⁴³ Though it goes against what we would consider healthy practices today, bathing frequently was also thought to be a major risk factor for contracting the plague. Jacme d'Agramont said that bathing was dangerous because it opened the pores, and when the pores were open, more corrupt air could enter the body.⁴⁴ John of Burgundy agreed that baths were dangerous for the same reason,⁴⁵ but Jean Jacme added that they were also to be avoided because they were dirty from all of the common people using them, and therefore posed a great risk of harboring something contagious.⁴⁶

The overall mental state of the patient was also considered equally important in preventing the plague. Jacme d'Agramont writes: "but among other influences that must be avoided in such times are especially those of fear and imagination. For from imagination alone, can come any malady. So one will find that some people get into a consumptive state solely by imagination...for this reason also it is recommended that in such times no chimes and bells should toll in case of death, because the sick are subject to evil imaginings when they hear the death bells."⁴⁷ Because of this, many people adopted different attitudes towards the plague. Boccaccio says that some remained sober; while others believed that they should lift their spirits and that the best way to do that was to live in excess.⁴⁸ The majority seemed to fall somewhere in the middle, following the orders of the doctors but trying to remain hopeful, an almost impossible task to accomplish while the rest of the world was swiftly dying.

Aside from medicines, doctors also employed surgical procedures to cure their patients. Of these procedures, the most common was blood-letting. John of Burgundy testified that “Many people have been cured by bleeding alone, performed at the right time, without any other medicine.”⁴⁹ According to his reasoning, phlebotomies worked in curing plague because they rid unhealthy material from the body, and the process of removing blood actually strengthened the heart’s ability to move matter. It was important to John that the bleeding is done as soon as possible, for bleeding should be the first step in treatment, done before plague travels throughout the body. While bleeding within the first hour after symptoms appeared was ideal, if it could not be done immediately, then the patient should not eat anything until he has had a chance to bleed. However, one should take care not to wait longer than twelve hours to perform a phlebotomy, for at that point the poisonous matter no longer travels about the body, but localizes and remains in the same place for the duration of the infection. John believed that the bleeding could easily remove the poison from the bloodstream, but only if it was still moving. If blood-letting is done before twelve hours have passed, then John guarantees that the patient will survive. If more than twelve hours have passed since infection and the patient has not been bled, they may still be bled, although they have a much reduced chance of survival, because “the bad blood will be so clotted and thickened that it will be scarcely able to flow from the vein.”⁵⁰ If the first phlebotomy does not save the patient, which it may not, then John prescribes that small amounts be let in additional rounds, either from the same vein, or from the “seat of infection” if it can be determined.

When it came to performing phlebotomies, there were very strict rules that had to be followed to ensure that the patient did not exsanguinate too much and die. Jacme d'Agramont makes it clear that only a little bit of blood should be drawn at a time, preferably three to four ounces from the median vein.⁵¹ Different veins should also be bled, depending on the desired effect and on the area of the body which is exhibiting symptoms. If there are no buboes present but the patient can feel his blood flowing at an unusual rhythm, then it is advised that they be bled from the nearest vein on the same side of the body as the sensation. However, if the blood could not be felt moving, but the patient felt an "oppression" within his body, then surgeons advised that they let blood from the arms or the feet, whichever is closer. Buboes also directed where phlebotomies should be performed. If the buboes appear in the armpits, then it can be deduced that the heart is infected, and blood should therefore be drawn from the cardiac vein on the same side of the body as the bubo.⁵² John of Burgundy says that it is important that it is removed from the same side of the body, for drawing on the opposite side: "would do double damage: firstly, the good and pure blood on the uncorrupted side would be drained away; secondly, the corrupt and poisoned blood would be thereby drawn to the healthy side of the body, with the result that the blood on both sides would become corrupted."⁵³ The phlebotomy should occur between the first and second toe of the foot on the same side if the buboes appeared in the groin, however, for that indicates that the infection is in the liver, and it would be unwise to draw the blood up past any uninfected regions, such as the heart. Finally, if the buboes appeared on the neck, then blood could be taken

from either the “cephalic vein in the arm on the same side of the body, or from the vein in the hand between the thumb and index finger.”⁵⁴ After the bleeding has completed, John of Burgundy recommends that the principle members be strengthened with an electuary made from candied rose petals, sandalwood, and cold tragacanth.⁵⁵ With the proper application of these procedures, physicians and surgeons believed that their patients had a good chance of surviving the plague.

The final type of medicine used by medieval physicians in combating the plague was not administered to the patient directly, but instead was environmental and tried to combat the origins of the plague. This focused on clearing the air of bad vapors and involved burning fires, often made with sweet-smelling plants.⁵⁶ While Gentile da Foligno⁵⁷ calls for the use of any fragrant plant in the fires, Jacme d’Agramont specifies that they should include rosemary, myrtle, and cypress, and for the richest of patients, Gallia muscata.⁵⁸ For those who could not afford such expenses, they should make their fires from rosemary and juniper, and add incense and myrrh. Other woods that could be used in the fires included wormwort, mugwort, and aloe. D’Agramont claims that the fumes produced are enough to cleanse the air down to its most basic substance, and was therefore one of the most important regimens for maintaining and recovering health. It was especially important to do this on days when the weather was bad and the air was foggy, for then the plague was thought to be at its most contagious.⁵⁹

If one could not burn a fire, then one could instead create bouquets of certain spices and flowers and smell that throughout the day. John of Burgundy says: “Before leaving home in the morning smell roses, violets, lilies, white and

red sandalwood, musk or camphor if the water is misty or the air quality bad.⁶⁰ If these could not be obtained, then people were advised to wash their face and hands in vinegar in the morning, and smell the vinegar on their hands often.⁶¹ Little was written on the benefits of bouquets and sachets of flowers and herbs compared to the other methods of treatment, nor are its effects on the humors documented, suggesting that it was not considered to be a very effective way of warding off plague or stopping its progression to the brain once in the body. Still, it was better than not engaging in any form of protection against the plague.

While not linked to plague in the mind of the medieval physician, it is interesting to examine the treatments used for parasites, for we now know that they are involved in the spread of plague. Though they were not thought of as the vectors of disease as they are today, medieval people were certainly aware of the nuisance involved in a flea or louse infestation. As such, they developed many ways to treat them. Hildegard von Bingen provides several treatments that will kill lice, including smelling lavender and mixing *sysemera* with lard into a paste and applying it to the armpits and neck. If the person is infested with fleas, however, then they should sprinkle dried dirt on their bed and lie on it, because the fleas cannot tolerate the dryness.⁶² It would be interesting to see if this is actually an effective repellent against fleas, the primary vector of plague, and if enough people used it during the Black Death (even without knowing the associations which we now draw between fleas and plague) to have an effect on infection rates. If effective, I suspect that those individuals who followed

Bingen's advice would be slightly more protected from an infection than those who took no precautions against fleas.

“Modern masters are more experienced in treating pestilential epidemic diseases than all the doctors and medical experts from Hippocrates downward. For none of them saw an epidemic reigning in their time, apart from Hippocrates in the city of Craton and that was short lived.”⁶³ As previously documented, the practice of medicine evolved swiftly in the centuries preceding the Black Death. The treatments of the plague, however, have also made it clear that much had been borrowed from the great physicians of antiquity. During the outbreak of the Justinianic plague that occurred in Procopius' lifetime, he makes records of physicians attempting to perform autopsies to discover the cause of the plague, just as the physicians of the high Middle Ages did.⁶⁴ During another outbreak 100 years later, provinces in Gaul practiced a system of isolation and quarantine after hearing of the arrival of the plague in Marseilles. Like many towns in the fourteenth century, these quarantine laws targeted all travelers but focused on merchants.⁶⁵ Despite their similarities, the medicine practiced during the Black Death, as outlined here, was much more sophisticated than that practiced during the early Middle Ages.

¹Horrox. *The Black Death*. 188

²Aberth. *The Black Death*. 65

³Ibid, 46

⁴Ibid, 76

⁵Nicaise. *The Major Surgery*. 250

⁶Horrox. *The Black Death*. 177

⁷Ibid, 184

⁸Ibid, 25

⁹Aberth. *The Black Death*. 49

¹⁰Ibid

¹¹Horrox. *The Black Death*. 25

¹²Aberth. *The Black Death*. 53

- ¹³Nicaise. *The Major Surgery*. 251
¹⁴Ibid
¹⁵Aberth. *The Black Death*. 49
¹⁶Ibid
¹⁷Ibid, 46
¹⁸Horrox. *The Black Death*. 188
¹⁹Ibid
²⁰Ibid, 189
²¹Ibid, 189-91
²²Ibid, 25
²³Nicaise. *The Major Surgery*. 250
²⁴Ibid, 252
²⁵Horrox. *The Black Death*. 190
²⁶Ibid
²⁷Nicaise. *The Major Surgery*. 252
²⁸Ibid, 249
- ²⁹Horrox. *The Black Death*. 81
³⁰Nicaise. *The Major Surgery*. 252
- ³¹Horrox. *The Black Death*. 190
- ³²Aberth. *The Black Death*. 53
³³Horrox. *The Black Death*. 187
³⁴Ibid
³⁵Aberth. *The Black Death*. 48
³⁶Ibid, 53
³⁷Horrox. *The Black Death*. 45
³⁸Ibid, 190
³⁹Ibid, 45
⁴⁰Ibid, 187
⁴¹Ibid, 175
⁴²Aberth. *The Black Death*. 52
⁴³Ibid, 44
⁴⁴Ibid, 54
⁴⁵Horrox. *The Black Death*. 186
⁴⁶Ibid, 176
⁴⁷Aberth. *The Black Death*. 54
⁴⁸Ibid, 75
⁴⁹Horrox. *The Black Death*. 192
⁵⁰Ibid, 191
⁵¹Aberth. *The Black Death*. 53-4
⁵²Horrox. *The Black Death*. 188-89
⁵³Ibid
⁵⁴Ibid
⁵⁵Ibid
⁵⁶Aberth. *The Black Death*. 49
⁵⁷Ibid
⁵⁸Ibid, 52
⁵⁹Horrox. *The Black Death*. 187
⁶⁰Ibid
⁶¹Ibid, 177
⁶²Throop. *Hildegard von Bingen's Physica*. 226
⁶³Horrox. *The Black Death*. 192
⁶⁴Little. *Plague and the End of Antiquity*. 233
⁶⁵Ibid, 3

Chapter 8: Medicine in Islamic Societies

“We begin by declaring that sickness of is of two kinds: sickness of the heart, and sickness of the body, both mentioned in the Qur’an.”¹ If the sickness is of the body, then the Prophet claimed that no blame should be put upon the sufferer, for it is not their fault. Instead, it is because of unfavorable reactions that occur within the body.² Ibn Qayyim says that while blood is good for the body and nourishes it, if it cocts and turns into phlegm, it can be harmful. Similarly, food can coct in the stomach as well, and when it passes through the intestines, some of the remaining particles can disrupt the stomach, thus causing disease and making the stomach the “site of illness”. Once the disease takes root in the body, there are four stages: “its onset, its increase, its decline, and its end; so the physician has the specific duty of watching carefully over each of the stages of the illness, with the knowledge of what is suitable and appropriate for them.”³ In The Key to Medicine, ibn Hindu writes that: “A person’s body remains healthy and sound as long as there is equilibrium in the things we have described as capable of affecting others and as long as there is moderation in his actions and movements.”⁴ This is because health is tied to the function of the body, which ultimately derives from the presence of the correct humors and their interactions. For this reason, he gives three causes of illness instead of just one: initiating causes which affect the body externally; preceding causes which act internally; and constitutional changes which create disease, such as the appearance of fever from a case of putrefaction.⁵ Ibn Hindu also categorizes diseases based on the parts of the body that they affect. The first type, which includes fever, is located

in the “homogenous” parts of the body. It can be simple or compound, with eight different types in total, and can occur with or without discharge, depending on the type. The second category of disease affects the “instrumental parts”, and includes afflictions such as cranial deformations. The third type occurs in both homogenous and instrumental parts and is characterized by the destruction of the unit, such as a cut which severs a vein.⁶ Diseases could also be categorized based on the properties that they were supposed to have. Ibn Hindu says that: “The body...when it deviates from a state of equilibrium, it is essentially under the influence of one of the four degrees.”⁷ Each degree had a different effect on the body. Agents of the first degree acted by changing the air inside of the body, and therefore had a greater effect on the body than the body had on the causative agent. The second degree substances also had a greater effect on the body than the body had on them, because not only did they alter the air, but they altered the patient’s moisture as well. Substances classified as third degree affected air, moisture, and fat, and therefore had an even more profound effect on the body. Finally, fourth degree items melt the flesh, causing severe damage.⁸ These are the basic principles with which physicians understood disease and its effects on the body.

The understanding of medicines can be broken down in a similar manner. Ibn Hindu creates two categories of medicine: theory, the understanding of medical matters and the practical knowledge needed to practice medicine; and practical, which focuses on how to discover the medical functions of the body. Theory can further be divided into three sub-categories: “the science of the natural

matters which constitute the human body”; “the science of causes”; and the “science of signs and symptoms.”⁹ Conrad says that before the late eighth century, humoral medicine was not popular or widely incorporated into practice.¹⁰ This may explain why in Medicine of the Prophet, ibn Qayyim says that the entirety of medicine consists of only diet and the preservation of health.¹¹ As for the practical application of medicine, ibn Qayyim advised that a physician should always treat a disease with substances possessing the opposite qualities, for more often than not this would entirely cure the disease. He should be careful not to use too strong of a medicine, however, and should build up medicines in strength slowly. If medicine was being used, then the physician should avoid evacuating the humors, because if that was done before they had fully cocted, then it would confuse the constitution and direct its attention away from the medicine and curing the disease. Once the medicine had taken most of its effect and the illness was almost gone, then the physician could evacuate the causes of the disease.¹² There was, however, not a set of standard rules used in the application of medicine, or even to what constituted medicine, as evidenced by the various definitions given by the physicians of the fourteenth century.

“Know that physicians are unanimous about the purpose of medicine – which is to maintain good health. They differ, however, in how to find what is good for health” – ibn Hindu, The Key to Medicine.¹³ There were many different schools of medicine, each of which had their own methods for determining an illness, finding its causes, and treating it. One such group was termed the empiricists. They relied only upon experience, which they said comes from

repetitive interactions with the senses. These interactions, and therefore discoveries, can be of four different types: coincidence, intent, imitation, and transference. Of the four, imitation is the most important, because this is where most of their medicines were derived from. The dogmatists, or rationalists, which included figures such as Hippocrates and Galen, believed that experience must be used with analogy in order to be effective. They argued that there are two types of factors which can affect a person's temperament. These two are inevitable and avoidable, and knowing which type caused the affliction determines how one should treat it. They also assess the seriousness of the disease to further narrow down treatment, and take into account factors such as age and health. The major difference between the groups is that the empiricists use memory and observation to decide on a medication, while the dogmatists choose medication by deduction. Despite their differences in arriving at a diagnosis, both schools agree that only one medicine should be used at a time. The third group was known as the Methodists, and they believed in condensing the medicine that the dogmatists and the empiricists used. They studied only the general principles of disease, which they said were easy to conceptualize. The three principles that they believed responsible for all illnesses were the retention of matter, excessive excretion of matter, or a combination of both. Their treatments included regulating food, exercise, sleep, and medication, which should be given only to combat the worse of the two causes if an illness was from a combination of both retention and excretion. Of the three, ibn Hindu says that the dogmatists are correct, while the

Methodists are too simple and the empiricists ignore medical fundamentals such as anatomy.¹⁴

“The human body has its first origin in the elements, and it has a second origin in the humors created from their elements. That is to say, phlegm corresponds to water, blood corresponds to air, yellow bile to fire and black bile is the correspondent of earth.”¹⁵ Pus was the oily matter in the blood which solidified into fat, yellow bile was foam from blood, black bile was sediment that was deposited out of the blood, and phlegm was partially digested food that, once completely digested, would be converted into blood. These four humors reacted to create the temperament, of which there were nine different types.¹⁶ Ibn Qayyim says that the constitutions also arose from the humors, and that these were different among the three monotheistic religions. He wrote: “[the Muslims] have the sanguineous constitution, while the Jews have the bilious and the Christians the phlegmatic. Thus it is that the Christians’ chief characteristics are gullibility and lack of understanding and of perspicacity; and the Jews are chiefly characterized by grief and anxiety, worry and servility. But the Muslims’ chief characteristics are intelligence and courage, understanding and intrepidity, joy and gladness.”¹⁷ While it is true that constitution was thought to play a large role in a person’s life, especially during times of disease, I have never read of it being connected to religion elsewhere.

Because the body was created from the elements, other substances containing these elements were thought to affect the body in various ways. In reference to the plague, the most important group of objects that could change the

balance of the elements within the body were the planetary beings. Ibn Hindu wrote that: “God has endowed these bodies, in order to bring about the impossible and make the universe complete, bringing forth life, death, health, and illness, so that God’s will and order should prevail.”¹⁸ Therefore, he says, one cannot understand disease without understanding astrology. The acute diseases are connected to the phases of the moon, its position in relation to the sun, and the rotations of the planets, while chronic diseases involve only the sun and the movement of the planets. The countries are also controlled by different stars depending on their position.¹⁹ This is very similar to the belief held by the European scientists and doctors who also believed that the motion of the planets in relation to each other and the sun could cause disease among the countries and peoples that they ruled over, but while this was taken to its full extent in medieval Europe and supported the belief that the plague itself was caused by the alignment of certain planetary bodies, its connection with the arrival of the plague was not implied in Muslim scholarship. This is strange, for there seems to be little differences between the two religions as to what the planets could and could not do in terms of causing non-epidemic sicknesses and controlling the destinies of countries. As both of these ideas extended back to Greco-Roman scholarship, the basis of learning in both Europe and the Middle East, one would expect that there would not be such drastic differences in the understanding of epidemic diseases.

Ibn Qayyim writes in Medicine of the Prophet that: “Many treatments can be more beneficial if the patient believes and accepts them with complete trust.”²⁰ The sentiment that belief and trust in Allah was necessary for complete recovery

was a common one, even among those who were well educated in medicine.

Allah's medicine was the best, for it treated the heart and the soul and built a stronger relationship between Him and the patient.²¹ This "medicine" included: "— all that the fatiha comprises, sincerity of servant-hood, praise of God, commitment of all one's affairs to him, seeking help from Him, complete confidence in Him, and asking Him for all blessings, and guidance which brings down blessings, and repels evil."²² Because it is based on the consistency of Allah, ibn Qayyim claims that it is certain and definitive, whereas the medicine practiced by the doctors was based on guesses and therefore was not always reliable. The prayers are so superior to medicine, he says, that they can be used to cure cases of poison.²³ During the plague, it was rumored that the prayers of the people in Damascus reduced the death toll to 2,000 per day, while the average in Cairo was 24,000 per day.²⁴

This does not mean, however, that medicine was completely rejected by the physicians. In fact, there were varying degrees of combining religious and physical "medicine" to cure a patient. Ibn Qayyim says that: "Treatment of illness by the Prophet was of three types: with natural medicines; with divine medicines; and with a combination of the two."²⁵ This dichotomy likely had its origins in the differing levels of belief among the members of the early Islamic communities. If a person was strong in heart and in good standing with Allah, then the Prophet said that he should be treated through prayer alone. If the patient was weak, however, then he recommended that they supplement their prayer with additional medicines as directed by physicians.²⁶ This may explain the lack of medicine in

Islamic societies, compared to that in Christian ones, for the Christians did not have such as strong ideology against medicine for the bodies of the righteous. By not accepting the medicines of the physicians, Muslims could convince themselves that they were righteous and devout, unlike those who stooped to medicine, as well as being given the gift of a martyr's death, should they die. This is, of course, only conjecture, and will require additional research on the continuing importance of the Prophet's teachings on medicine in the fourteenth century, but I believe it provides some explanation for the lack of medicine provided.

Another explanation for the relative lack of medicine in the fourteenth century in Islamic communities comes from the cultural shifts that were taking place at that time. In the decades prior to the Black Death, the Mongol armies reached Western Asia and destroyed many places of learning. Not only did they destroy libraries, but the materials housed in these libraries were often burned as well.²⁷ Though the Mongol armies never destroyed the Mamluk Caliphate, which was based in Cairo, they were going through social upheavals as well. For centuries, Islamic medicine was seen as superior to that of Christians, and many texts were translated into Latin from Arabic. By the fourteenth century, however, many practicing physicians in Islamic lands were not Muslim. This concerned the religious leaders of the cities, not only because these non-Muslims had access to positions of great power through their practice, but also because they often prescribed prohibited items such as wines as medicines. In response to this perceived threat, the religious authorities attempted to encourage more Muslims

to enter the field of medicine by basing their treatments in religion and traditional therapies. From this shift, treatises focusing on Qur'anic examples of medicine, such as ibn Qayyim's Medicine of the Prophet, began to be produced en masse, further solidifying the role of religion in Islamic medicine.²⁸

Despite the rising popularity of less practical medicine based on the life of the Prophet, some medical professionals believed that medicine should not be shunned, for it had been created by Allah to be used by His people, and as such it was an insult to Him and a danger to His people to deny it.²⁹ They say that those who do not allow the use of medicine mistakenly believe that: “the ability of man to cure diseases and to allay suffering is an infringement of the will of God, the Exalted, and a contradiction of His wishes in regard to mankind.”³⁰ This is incorrect, they claim, for the Prophet once said: “Treat your sick. For indeed God, the glorious One, did not make any disease without making healing for it, except for one disease. In other wording: “God did not send down any illness without sending down any healing for it; the one who knows it, knows it, and the one who is ignorant does not”... These sound hadith contain the command to carry out treatment, and this does not negate trust in God, any more than does the repelling of hunger, thirst, heat and cold by their opposites.”³¹ The motif of medicine helping the body as food helps the hungry is a common one: ibn Khatima uses it as well to debunk the claims of those who say that medicine is contrary to human nature, for it is not contrary to human nature to eat when hungry. Ibn Hindu says that the correct practice of medicine is so highly valued by Allah that when Asclepius died, he was rewarded for his service by being turned into an angel,

despite his religion.³² To them, this was a sign it was extremely dangerous to believe that prayer alone would save someone from an illness, and ibn Hindu mentions accounts where individuals who hold snakes while calling on the Qur'an for help are still poisoned and die.³³ This is a perfect example of the struggle to reconcile the old Greco-Roman medicine used previously with the new, purely Islamic medicine advocated by the government.

Those who believed that religion should play a large role in a patient's recovery devised many ways to incorporate it into forms of treatment. One such way was through incantations by a healthy and righteous person over the body of a sick person. According to ibn Qayyim, this delivered a patient from illness because: "The soul of the person reciting the incantation works upon the soul of the one so treated, and between their souls there takes place an action and a reaction, as there does between an illness and a medicine. So the soul and power of the person recited over becomes stronger through the incantation over that illness, and he repels it by God's permission."³⁴ This practice of incantation over the sick had its Islamic origins in the Prophet, for it is recorded that he would stroke the sick and beseech Allah to remove their illnesses from them.³⁵ If the patient's illness was an abscess, then a talisman could be used in the place of a recitation. On it would be carved a spell, asking that the mountains be converted to dust and that the plains be level again.³⁶

Prayer to Allah for a cure did not have to be done by one who was healthy: it could be done by the sick party as well. Though prayer could be performed anywhere, some thought that it would be more effective for certain diseases if

done in a holy place. Ibn Battuta tells a story about the healing powers of the mausoleum of al-Najaf. According to the legends he has heard, one night each year – the night of life, all those who are crippled and living in the surrounding countries travel to the mausoleum to be healed. They sit by the tomb of Ali and pray, and before the night is over, they walk out of the mausoleum free of disease. If the people cannot get to the mausoleum, or are suffering from some other disease, then they often promise to make a pilgrimage to it and leave a votive once they are well.³⁷ This offering is occasionally made from a precious medal and is crafted to look like the part of the body which once afflicted the patient.³⁸ During the plague, however, there are no accounts of pilgrimages to Mecca, for the Prophet was supposed to have said not to travel during times of plague.³⁹

Of course, all of these “treatments” stem from the belief that Allah was the true healer of disease. According to a Jewish belief that was adopted by the Muslims, Abraham once said to God: “O Lord, from whom comes illness? He replied: from Me. So he asked: and from whom comes the remedy? From Me. He asked: and what is the business of the physician? The Lord replied: someone by whose hands I send the remedy.”⁴⁰ For them, the effects of medicine on the body had little to do with whether or not an individual survived; instead, it was God’s decision whether the person should heal, and without this, no medicine could be effective. Even during the plague, which occurred on such a large scale, Allah would decide the fate of every individual. The poet al-Wardi, notorious for his belief that Allah reconstituted the plague in every individual, said that the only hope of surviving was to put one’s complete trust in Allah.⁴¹

For those who did decide to partake of medicine, either because they believed it was the only course of action appropriate or because they wanted extra insurance in case the prayer did not work, they turned to the physicians. Their treatment should be directed at the source of the illness itself, rather than at the symptoms, according to ibn Hindu, and it should never be something that goes against the patient's nature.⁴² For the most success, he should start by altering the diet and daily regimen of the patient before prescribing serious medicines, so that he does not run the risk of overmedicating and making the condition worse.⁴³ It is these ignorant physicians, ibn Hindu says, that have begun to ruin the practice of medicine, for they no longer associate themselves with the medicine of Hippocrates.⁴⁴ This idea of the degradation of the medical profession seems to be quite common, for he also says that physicians are on par with barbers and are paid less than blood-letters, and as they have no other source of income, are forced to do things that the practice does not approve of.⁴⁵ Ibn Hindu also implies that contemporary physicians are harming themselves by studying disciplines not required by their practice, for he makes a list of the subjects physicians do and do not need to have a firm grasp of. Among those that are useless to the physician are physics, the celestial spheres and their natures, and the conditions of the elements. It is important that they understand astrology, for: "according to Galen, Hippocrates said, "the benefit of astronomy to the profession of medicine is not slight."⁴⁶ It is therefore then surprising that the Muslim physicians did not regard the plague as coming from the alignment of the planets, given this apparent understanding of astronomy. This may be because to believe that the planets

caused the plague would give some credence to the notion of contagion and would undermine the theory that Allah had sent the plague to each person. The reason that the physicians were not required to learn all the theories about nature was probably because they were only one set of professionals called in to deal with an illness. Ibn Hindu said that: "Medicine needs the services of many assistants, such as the pharmacist, the blood-letter, the cupper and the enema specialist. The physician calls on them for help and delegates these responsibilities to them."⁴⁷ It would therefore be impractical to have the physician learn everything when in practice, he would have someone else take care of that portion of treatment.

"Anyone who knows the general rules governing the aforementioned matters [preservation of health, expulsion of harmful substances, and protection from harm] can treat patients, one at a time. This can be done by ascertaining the health or ill health of the patient through the symptoms, restoring the causes of good health if health is absent...and removing the factors perpetuating illness, if illness is detected. Such a person is rightly called a physician."⁴⁸ From this statement, it would appear that the relatively rigorous studying required to become a university-trained doctor in Christian Europe was not utilized in Islamic societies. This is further supported by the statement made by Ibn Hindu, which says that some form of medical knowledge is instinctive and that the only difference between the medical knowledge of a physician and a layman is that the layman's is scattered and can be contradictory, while the physician's is a whole composed of parts.⁴⁹ This leads me to two important conclusions about doctors

and medicine. The first is that it may explain why doctors were not seemingly held in high regard by other groups. Ibn Battuta never talks of the doctors when he mentions the notables of the Muslim cities, and when he does speak of a doctor with whom he is acquainted, he is first described as a westerner and a jurist, then as a doctor, and finally as a man of letters.⁵⁰ If the training and studying were not as intense as for other professions, then it would make sense that they were not spoken as much of. The second conclusion, and more important for this paper, is that if the people did not hold the physicians in as high a regard as the others, such as imams, then it would not be surprising if they did not value their contributions to society as much. This creates another theory of why medicine during the time of the Black Death in Islamic societies seems inferior to that of the Christians: it is possible that the physicians were seen as inferior to the religious leaders in all aspects of life and therefore not as trusted during times of crisis.

Many physicians did their best to counteract these beliefs which I suppose to exist by claiming that their practice was just as fickle as any other and they should not be faulted when a patient did not recover. "The physician is a servant of nature and has no part to play in healing, apart from providing nature with the tools needed to preserve health and to keep away disease. As for regaining health, that depends on a number of factors: nature's strength, the amenability of the body to that influence, the suitability of the tools to the task, and the absence of impediments between nature and the intended aim."⁵¹ Just as the farmer relies on nature for his skills to produce something of benefit, so is the physician entirely dependent on nature. And just as the farmer used the same set of skills as his

predecessor, if a previous physician had not described a medicine as being of use to a patient, then new physicians were strongly discouraged from experimenting with other treatments that might not have an effect.⁵² This is because: “The highest aim of the physician is simply to guard the moisture against putrefaction and other factors which would corrupt it, and guard the heat from factors which would weaken it, and to keep them in the right proportion, whereby the human body is upheld in balance.”⁵³ To me, this further advances the idea that physicians were not held in great esteem and not called on during times of disease as much as they should, for it seems that the physicians themselves do not even take their profession seriously. Compared to the enthusiasm of the Christian physicians, these men seem not to have any confidence in their work. It also helps to explain why little was written about hospitals, although considering not much was written in Europe as well, it may be more to do with the abundance and popularity of hospitals and treating patients outside of the home, as opposed to views on medicine. When Ibn Battuta describes Damascus, he says that a hospital was ordered to be built “for the sick strangers,”⁵⁴ implying that hospitals were for people without a permanent residence in the city, not for the average local patient.

As for the medicines allowed, there were rules about which types to use in cases of different diseases which had to be followed. Unlike their Christian counterparts, who relied on both “simple” and “compound” medicines, the physicians of the Middle East preferred to use only simples.⁵⁵ This came from the teachings of the Prophet, who would only use simple medicines, altering them only to change their strength based on the needs of the patient. Ibn Qayyim

defends this practice by saying that other groups use simples instead of compounds as well, including the Turks, Arabs, and Indians, and the only groups who did stray into the prescription of compounds were the Greeks and the Byzantines.⁵⁶ It is not surprising that these groups were closer geographically to Christian Europe than the others, and therefore may have been of more influence to each other. Ibn Qayyim does recant some of his prohibition of the use of compounds, saying that if the patient resides in the city, then the compounds may be more effective than the simples, because the city-dweller has a more complex lifestyle and diet than the country person. This complex lifestyle causes complex illnesses, which he says are better treated by compounds.⁵⁷ Despite their preferability over compounds, simples were not to be used in excess. Ibn Qayyim issues this warning: “Also, the physician must not be enthusiastic for the administration of medicines; for when a medicine does not find any illness in the body to dissolve, or when it finds an illness for which it is not the appropriate treatment, or finds one which is appropriate, but for which its amount or quality is too great, it clings to the healthy state and impairs it.”⁵⁸ The reason that the medicines were able to have such a beneficial or detrimental effect, depending on the state of the patient, was because they were all given specific qualities, much like the medicines in Europe. Senna was considered by the Prophet to be a cure for all diseases except death, for it was hot and dry, which enabled it to rid the body of black and yellow biles and provide strength to the heart.⁵⁹ These classifications were based on reactions with the body, not properties of the medicine. Ibn Hindu wrote: “When we say that a substances is hot or cold, humid

or dry, we mean that it has an effect on the body of heat or cold, or of moisture or dryness, regardless of whether these qualities actually exist in the medicinal and nutritive substance or not.”⁶⁰ Other medicines popular for their effects on the body included brick and perfumed soap for washing hands for basic hygiene,⁶¹ pounded eel flesh for removing poisons lodged within the body, and palm spathe to relieve blood poisoning and stomach troubles.⁶²

Much like in the Latin West, diet played a large role in treatment as well. Subscribing to the belief that what is simplest and of less change to the body should be used, ibn Hindu says that: “Physicians are agreed that when treatment is possible through diet, there should be no recourse to medicine.”⁶³ If the food was medicinal in nature, then the body would transform it and use its “nutritive features” while it simultaneously transformed the body.⁶⁴ al-Harith b. Kalada, an Arab physician, said that when using food as a remedy, the physician should be careful to prescribe only foods which the patient is used to, for if he introduces new foods into his system, it could be detrimental to his health, because the stomach was the place where all illnesses arose.⁶⁵ However, eating should be kept to a minimum if the patient is seriously ill, for ibn Qayyim says that the process of digestion distracts the constitution from its primary focus of ridding the body of the disease, so eating too much could actually make the individual more sick.⁶⁶ If food is taken, then the patient should sleep after eating, because it was believed that sleep aided the process of digestion. Ibn Hindu says this is because: “the innate heat, during sleep, moves vigorously to the interior of the body, as to assist this process...the most beneficial way to sleep is upon one’s right side because

the food will be properly settled in the stomach in this way.’⁶⁷ The foods that physicians considered good to eat in small quantities were those which had simple textures and moderate temperatures, for they believed that those were the most effective in preserving strength. These included drinks containing apple, moist roses, and water lilies. Also beneficial was cold water mixed with a sweetening agent such as raisins, dates, or sugar.⁶⁸ However, one should avoid eating fruits, much like the Christian doctors had warned against, but for a different reason. While European physicians did not want patients to eat fruit, especially during the time of the plague because it could have absorbed some of the poisonous atmosphere, physicians in the Middle East prohibited it because they thought that it decomposed too quickly and the body was not strong enough to expel it once it had gone bad.⁶⁹ The belief in the importance of proper food was not unique to the physicians: even to laymen, diet was seen as an essential aspect of medicine. Ibn Battuta claimed that the people of Mecca were healthier than the surrounding populations and suffered from diseases far less frequently because of their dining habits: they only ate once a day, and if they were hungry between their meals, they ate dried dates.⁷⁰ If a medicinal effect was required, then he recommended people eat betel leaves with chalk and nuts, for it had a range of effects including aiding digestion and preventing jaundice.⁷¹ From the deep understanding of medicinal foods by the laymen such as Ibn Battuta, it would seem that for many diseases, diet was turned to more often than medicine.

Much like in Christian Europe, food was not the only part of one’s life that one could alter in order to avoid falling ill. Muslim doctors cautioned their

patients against excess exercise, saying that people would remain safe from many diseases if they participated in a moderate amount of exercise at the correct times.⁷² While ibn Qayyim writes that other physicians have recommended this, he does not explain why moderate exercise is beneficial. In a drastic difference from the Christian standard, he does say that frequent and moral sexual intercourse is one of the best ways of staying healthy. In fact, the longest section of his treatise on the Medicine of the Prophet is devoted to the Prophet's sex life and how following its examples can preserve health.⁷³

Physicians also had a choice of surgical procedures that they could use on a patient if the disease called for it. These mostly centered on altering the flow of blood, either through blood-letting or cupping. As discussed before, venesection, phlebotomy, and blood-letting are all the same, and involve the incision in a blood vessel to remove blood from the body. Cupping is done by placing a heated cup on the skin to create a vacuum, which was believed to draw blood closer to the surface of the body.⁷⁴ One method was generally preferable over the other, depending on the situation. Any disease that was hot in nature could be treated by either method, but if the patient lived in a hot country, then the physician should cup.⁷⁵ If not currently sick, the patient had to be very careful about his timing of cupping so that it was only done to prevent falling ill, but if he was already sick, then it could be done whenever necessary.⁷⁶ If venesection was to be performed, then it had to be done in the correct place: the basilic vein for the liver and spleen, cephalic vein for the head and neck, and medial arm vein for repletion or poisoning throughout the body.⁷⁷ The similarities between the practice of blood-

letting in Christian and Muslim communities is evident and seems to have undergone very few cultural changes, unlike the other types of medicine.

One common affliction which doctors were often forced to confront with surgical or medical procedures were pustules and abscesses. Ibn Qayyim differentiates between the two, saying: “Pustules are small abscesses that are caused by hot matter rejected by the constitution, so that it seeks a soft place on the body where they can come out”, while abscesses are formed when: “the inflammation [matter located in an organ formed from unnatural matter or superfluidities from the four humors and hot winds] collects together, it is called an abscess”⁷⁸ and can be found in all types of illnesses. Eventually, the abscess will become one of three states: dissolution, pus, or a hard mass. Dissolving is the best of the three, and happens when the body is strong and can overcome the corruption. If the body is not as strong, then the abscess becomes white pus, in which case ibn Qayyim says that a physician must help remove it, for if it remains in the body it can putrefy the organ.⁷⁹ Pustules and abscesses were not always bad, however, for ibn Hindu believed that the “excess secretions” could aid in removing the disease from the body, much in the same way that blood-letting was thought to cure disease.⁸⁰

If the intervention of a physician was required to treat a pustule or abscess, it was often incised. The Prophet himself advised that a man’s pustule be cut open because it contained pus.⁸¹ Cupping could be used in the place of incisions, especially if the pustule occurred on the thigh.⁸² If the patient did not want to undergo a surgical procedure, topical medications could be applied to the area.

These included: the heart of the date palm, which would cause ulcers to seal up, the crushed dry leaves of sweet-smelling plants for healing ulcers containing a lot of moisture, olive leaves to relieve itching lesions, and clarified butter to soften hardened pustules.⁸³ Butter was also used by the Christians in their treatment of pustules and plague buboes,⁸⁴ suggesting that this is one of the most common treatments and did not undergo any changes during the shift in medicine in the fourteenth century.

Another condition which I mention here because of its prominence in cases of plague is fever. Ibn Hindu broke fever into two categories: contingent, which was often caused by sunstroke or high temperatures, not by a disease, and pathological. Pathological fever was further separated into three types: tertian quotidian fever, which lasts three days and attacks the vital spirit; putrid fever, which afflicts the humors and arises when high temperatures cause the humors to vaporize and rise to the heart; and hectic fever, which afflicts the primary organs.⁸⁵ If fever is present, it causes a heat to arise from the heart which affects all the parts of the body, making the person weak. Certain types of fever could even occur at the same time.⁸⁶ As for treatment, there appear to be two options available. When Ibn Battuta fell ill with a fever, he writes: "I had a stroke of fever...and gave orders to send for a doctor and to have prepared for my use in his own house everything that the doctor should prescribe in the way of medicine or diet...and God Most High healed me of what had befallen me."⁸⁷ This suggests that not only were fevers treatable, but the medicines used for this purpose were available to the general public (or at least the wealthy). Again, this may be related

to the devaluing of the medical profession, for the abundance of “medicines” available would seem to make the presence of a doctor less important. Others thought that fevers should not be medicated and should be left entirely untreated for both practical and religious reasons. The Prophet said that fever should not be treated because its presence removes sins, just like fire makes ore pure.⁸⁸ Ibn Qayyim, however, said that while the Prophet was correct in calling for fever not to be treated, it is actually because it can be beneficial to one who is sick. He argues: “Fever can be far more beneficial than taking medicaments, when it brings about the coction of those humors and corrupt matters which harm the body. When their coction has been effected, and these matters are ready for expulsion from the body, medicine completes the process and expels them. Thus, fever can be seen as a cause of healing.”⁸⁹ This implies that medicine was not held highly in Islamic society if some physicians considered fever to be a better treatment option than what others were prescribing. By extension, it also suggests that the physicians were useless if nature’s remedies were better than their own.

¹Johnstone. *Medicine of the Prophet*. 3

²Ibid, 4

³Ibid, 110

⁴Tibi. *The Key to Medicine*. 8

⁵Ibid, 63

⁶Ibid, 69-70

⁷Ibid, 85

⁸Ibid, 85-6

⁹Ibid, 21

¹⁰Conrad. *Contagion*. 173

¹¹Johnstone. *Medicine of the Prophet*. 77

¹²Ibid, 110

¹³Tibi. *The Key to Medicine*. 23

¹⁴Ibid, 23-7

¹⁵Ibid, 22

¹⁶Ibid, 60

¹⁷Johnstone. *Medicine of the Prophet*. 288

¹⁸Tibi. *The Key to Medicine*. 8

¹⁹Ibid, 36

- ²⁰Johnstone. *Medicine of the Prophet*. 74
- ²¹Ibid, 8
- ²²Ibid, 134
- ²³Ibid, 29
- ²⁴Gibb. *Ibn Battuta*. 144
- ²⁵Johnstone. *Medicine of the Prophet*. 17
- ²⁶Ibid. 114
- ²⁷Farhad Daftary. *Mediaeval Isma'ili History and Thought*. (Cambridge. Cambridge Press. 1996) 6
- ²⁸Nahyan Fancy. *Science and Religion in Mamluk Egypt: ibn al-Nafis, Pulmonary transit and bodily resurrection*. (Culture and civilization in the Middle East. Routledge, NY. 2013) 24
- ²⁹Tibi. *The Key to Medicine*. 7
- ³⁰Ibid
- ³¹Johnstone. *Medicine of the Prophet*. 11
- ³²Tibi. *The Key to Medicine*. 18
- ³³Ibid, 11
- ³⁴Johnstone. *Medicine of the Prophet*. 135
- ³⁵Ibid, 141
- ³⁶Ibid, 255
- ³⁷Gibb. *Ibn Battuta*. 257-58
- ³⁸Ibid, 258-59
- ³⁹Johnstone. *Medicine of the Prophet*. 27
- ⁴⁰Ibid, 12
- ⁴¹Aberth. *The Black Death*. 113
- ⁴²Johnstone. *Medicine of the Prophet*. 78, 111
- ⁴³Ibid, 7
- ⁴⁴Tibi. *The Key to Medicine*. 18
- ⁴⁵Ibid
- ⁴⁶Ibid, 36
- ⁴⁷Ibid, 37
- ⁴⁸Ibid, 16
- ⁴⁹Ibid, 11
- ⁵⁰Madhi Husain. *The Rehla of Ibn Battuta: India, Maldive Islands and Ceylon. Translation and Commentary*. (Oriental Institute. Baroda. 1976. 2nd edition) 77
- ⁵¹Tibi. *The Key to Medicine*. 13
- ⁵²Bernard Lewis. *Islam in History: Ideas, Men, and Events in the Middle East*. (London. Alcov Press. 1973) 226, and Johnstone. *Medicine of the Prophet*. 108
- ⁵³Johnstone. *Medicine of the Prophet*. 159
- ⁵⁴Gibb. *Ibn Battuta*. 87
- ⁵⁵Johnstone. *Medicine of the Prophet*. 7
- ⁵⁶Ibid
- ⁵⁷Ibid, 8
- ⁵⁸Ibid, 7
- ⁵⁹Ibid, 54
- ⁶⁰Tibi. *The Key to Medicine*. 85
- ⁶¹Gibb. *Ibn Battuta*. 93
- ⁶²Johnstone. *Medicine of the Prophet*. 241
- ⁶³Ibid, 7
- ⁶⁴Tibi. *The Key to Medicine*. 84
- ⁶⁵Johnstone. *Medicine of the Prophet*. 78
- ⁶⁶Ibid, 66
- ⁶⁷Ibid, 175
- ⁶⁸Ibid, 167
- ⁶⁹Ibid, 78
- ⁷⁰Gibb. *Ibn Battuta*. 218
- ⁷¹Ibid, 226
- ⁷²Johnstone. *Medicine of the Prophet*. 179

- ⁷³Ibid, 181
- ⁷⁴Lynne Elliot. *Medieval Medicine and the Plague*. (Crabtree Publishing Co. NY. 2006) 23
- ⁷⁵Johnstone. *Medicine of the Prophet*. 39
- ⁷⁶Ibid, 42
- ⁷⁷Ibid, 40
- ⁷⁸Ibid, 87
- ⁷⁹Ibid
- ⁸⁰Tibi. *The Key to Medicine*. 29
- ⁸¹Johnstone. *Medicine of the Prophet*. 86
- ⁸²Ibid, 41
- ⁸³Ibid, 214-32
- ⁸⁴Aberth. *The Black Death*. 65
- ⁸⁵Johnstone. *Medicine of the Prophet*. 19
- ⁸⁶Tibi. *The Key to Medicine*. 78
- ⁸⁷Gibb. *Ibn Battuta*. 150-51
- ⁸⁸Johnstone. *Medicine of the Prophet*. 21
- ⁸⁹Ibid, 19

Chapter 9: Treatment of the Plague in Muslim Societies

In his treatise Medicine of the Prophet, Ibn Qayyim describes plague in the following manner: “plague (ta’un) is a type of pestilence (waba’), says the author of the *sihah*. According to the medical people it is an evil inflammation, fatal in outcome, accompanied by a very fierce and painful burning that exceed the norm; most of the surrounding area of inflammation becomes black..., and the condition quickly turns to ulceration. Mostly this appears in three places; under the arm in the armpit, behind the ear and on the tip of the nose, and in the soft flesh.”¹ The abscesses, or tawa’in in Arabic, were caused by a poisonous substance within the body, although he declines to say what exactly it is. The wording of plague itself was vague: the word ta’un could be used to mean any poisoning of the heart resulting from an inflammation, although it was most generally used to mean those swellings which occurred in the glands.² Physicians also thought it was important to distinguish between plagues and epidemics in general. Al-Khalil wrote that every ta’un was a form of waba’, but not every waba’ was a ta’un.³ Ibn Hindu further differentiates between wafida (epidemics) and waba’iyya (fatal or pestilential epidemics). He says: “A pestilential disease is the worst sort of disease because it is general, acute and lethal. Because of its lethality, a pestilence is different from epidemic diseases that are harmless, and it is different from local diseases because of its foreignness, and different from particular diseases because of its generality.”⁴ In Medicine of the Prophet, Ibn Qayyim brings the symptoms of plague into its definition, along with its ability to kill vast numbers of people. He says that though it is important to note the

swellings and ulcers as symptoms, they are not the actual disease, a misdiagnosis which many doctors make. In order for a disease to be a plague, it must have the following: external symptoms such as buboes, the death of the patient, for plague was often considered to be a martyrdom for Muslims, and the original cause of the plague, although he does not bother to name that.⁵ This confusion as to what constitutes plague manifests itself several times throughout the discussion of plague medicine and prevention.

Previous scholarship has held that in Islamic societies, the theory of contagion was considered blasphemous for it went against the words of the Prophet, and was therefore not incorporated into Islamic medicine. Recently, however, scholars have begun to argue that this was not the case, and that contagion was more widely accepted than previously thought, for the words of the Prophet could be turned either to support or condemn contagion. In fact, the term translated as contagion, ‘adwa, has a greater meaning and was also used to denote infection, for there was no distinction between the two in medieval Islam.⁶ In fact, from my research, I suggest that the idea of contagion was very popular among the doctors and much of the learned classes. Prominent physicians such as ibn Khatib and ibn Qayyim write much more about the benefits of integrating contagion into medicine than their opponents do about its drawbacks. They often did this by utilizing the vagueness of the hadith to support the role of contagion in disease, as I shall demonstrate in the next section.

Similar to Christian physicians, those Muslim scholars and doctors who did believe that contagion was a real and powerful force thought that it acted

through the air. Ibn Qutayba broke contagion down into two types: the first was present in diseases such as leprosy, wherein the person who was ill would release a poison or odor into the air surrounding them, and anyone who spent too much time in their presence was liable to fall ill. In this case, it is important that people not interact with those who are sick, for the Prophet commanded that people not put themselves in danger by mixing health with disease. He is reported to have said: “flee from the leper as you would flee from a lion.”⁷ The other type of contagion that Ibn Qutayba speaks about is the ta’un, or plague, and was considered contagious for its ability to cause people to flee in great numbers from an area where an infection had occurred. Qutayba said that contagion could coexist with Islam, because it was Allah who said: “Do not water the sick with the healthy.”⁸ Ibn khatib did not need to find a fatwa or a quote from the Qur’an to support contagion. He wrote: “If it were asked, how do we submit to the theory of contagion, when already the divine law has refuted the notion of contagion, we will answer: the existence of contagion has been proved by experience, deduction, the sense, observation, and by unanimous reports, and these aforementioned categories are the demonstrations of proof.”⁹ For him, anything could carry disease, down to a fork from a house where someone had died. He also said that those who considered contagion to be heretical were just as bad as the plague, for their insistence of not recognizing the spread of disease was killing innocent Muslims as well. In that light, it was an offense to God to deny contagion, because it is destroying the lives of His people. He did recognize that many people wanted to follow the hadiths, and proclaimed that they were only

misinterpreted by anti-contagion proponents, and that they did in fact support contagion, for no hadith could ever go against what happened naturally. In the end, though, it really didn't matter to him what the fatwas regarding contagion said, because he thought that the role of religion in contagion was incidental to medical practice.¹⁰ Ibn Khatib and Ibn Qutayba were not alone in their views; Ibn Abi Shayba said that people were always wary of those who were ill and would go out of their way to avoid them as to not fall sick, and that: "In Cairo in 1262, a certificate signed by three Muslim physicians confirmed that a certain man suffered from leprosy, and so could not circulate among the Muslims 'because that condition is a transmissible and communicable disease (li-kawnihi mina l-amrad al-mu'diya al-muntaqila)."¹¹ It would therefore appear that contagion was widely accepted as at least playing a role, if not entirely controlling, the passage of disease from one individual to another.

Not everyone, however, believed the theory of contagion. In 1374, Ibn Khatib was lynched for these heretical beliefs by an angry mob after he continued to voice his support for contagion, despite the fatwas that were issued against it.¹² His outspokenness against the proclamations angered many, including al-Wardi, who refuted contagion and wrote a lengthy poem about the Black Death in which he insisted that God infected each person who was ill individually.¹³ According to him and the others who did thought contagious was blasphemous, their proof lay in the story of the Prophet and the Bedouin, which goes as follows: "The Prophet says, no contagion, and a Bedouin replies: "o apostle of God, what about my camels? They are like gazelle does on the sand; but let a mangy camel come and

mix with them, and soon they are all mangy.’ The Prophet counters: “and who caused the mange in the first one?” the answer is of course God.”¹⁴ Even the doctor ibn Khatima, who wrote much about plague, said that infection was an idea for unlearned Arabs for it contradicted the belief that Allah created all and had a divine will.¹⁵ It would seem that though he espoused this belief, he did not actually follow it, for many of his treatments attempt to prevent plague from spreading from one individual to another. Whether or not ibn Khatima believed what he wrote, the view was popular and derived from the belief that God was the cause of the plague, which influenced much of medicine in the Islamic cultures.

During the outbreaks of the plague, people turned to religion to save them from death. As with Christian societies, most religious measures involved mass prayers directed to Allah and the Prophet. They were similar to those practiced in Europe: in Damascus in 1348, a massive crowd gathered before the mihrab and recited scriptures many times over on the direction of a man who claimed to have seen the Prophet in a dream. When that did not work, the king of the amirs, Arghun-shah, ordered for the population to fast for three days while the amirs, qadis, doctors of the law, and other learned people met in the mosque and prayed all night. On the fourth day, a Friday, everyone processed to the mosque in bare feet to beg Allah to remove the plague. Ibn Battuta writes in his description of the city of Damascus that: “The entire population of the city joined in the exodus, male and female, small and large, the Jews went out with their book of the Law and Christians with their Gospel, their women and children with them, the whole concourse of them in tears and humble supplications, imploring the favor of God

through his books and his prophets. They made their way to the mosque of the footprints and remained there in supplication and invocation until near midday, then returned to the city and held the Friday service.”¹⁶ Though this story may seem incredible, Ibn Battuta was not the only one to write about it. Ibn Kathir tells the same story.¹⁷ It is interesting to note that all three monotheistic faiths participated in this procession. In Europe, I have been able to find no accounts of Jews and Christians praying together, although they often lived quite close to each other. I do not know exactly why Christians and Jews were allowed in this procession when Jews and Muslims were not welcome in the Christian ceremonies, although I have several ideas. First, it could be a matter of population size, as there were likely more Jews and Christians in Damascus than there were Jews and Muslims in say, Northern France. It also could have been because unlike the Christians of Western Europe, there were no cases of Muslims accusing Christians or Jews of poisoning wells and causing the plague themselves. The epidemics were always a manifestation of the will of Allah, never of human origin.

The broad similarities between Muslim and Christian treatment of plague continue in medicine. Though both groups certainly used religion as a way of bolstering the people’s spirits, and probably believed that it did some good, it was more for use as insurance, in case the medicine did not work and someone died and had to face God. There were also similarities in what physicians prescribed and thought would be useful, probably due to the fact that both systems of medicine were based on classical learning. On the whole, however, I argue that

medieval Muslim physicians were not as adept at treating bubonic plague as Christian doctors, for I have found that they had far less treatments and wrote fewer treatises on plague. This may be due to a number of reasons, from the Islamitization of medicine¹⁸ to the fact that even among doctors, the role that contagion played in disease was still hotly debated¹⁹ and was not nearly as embraced in medicine as it was in the Christian universities.

When it came to treating and preventing infection, a person's daily regimen played just as much a role in their health in the Middle East as it did in Europe. In one treatise, Ibn Khatima describes all of the important things that one should be doing to preserve one's health. When it came to drinking, the wine so praised by Christian physicians was of course prohibited, as told by ibn Qayyim²⁰, but one could drink water from the source of a stream where it was running and had not collected poisons, for it was not stagnant.²¹ Both men agreed that patients could "dry" their constitutions as well by getting rid of excess moisture, relieving constipation, and eating very little.²² Much like John of Burgundy, he also advised that people not bathe during times of plague and to avoid exercise. It was important not to exercise, he said, because if the internal temperature of the body is raised, then it needs to take in more air, and then they would have a greater chance of consuming the corrupted air. Instead, a person should lie down and rest. Not only does this obviate the need to breathe deeply, for the body is not at work, but it also prevents the humors from moving too quickly throughout the body and potentially spreading poison and disease.²³ If the pestilence has already come to the area where you live, ibn Khatima says that it is especially important to follow

his instructions, because you will not be able to leave without exercising, and therefore have a better chance of survival remaining still in one place than running to a new place. This argument against fleeing can be traced back to the understanding of contagion, for the Prophet had once said that “if it is in the land in which you are, do not leave it. He also said: if it is in a land, do not enter it.”²⁴ For Ibn Khatima and many others, this declaration formed the basis of their understanding of how to prevent plague. It could be used to support contagion, for Ibn Qayyim writes in his Medicine of the Prophet that it prevents healthy individuals from coming into close proximity with those who are sick, so they cannot inhale the poisonous air they have released.²⁵ It could also be used to disprove contagion, for it could be reasoned that Allah did not want you to die at that time, so he had not placed you in an area to which he had sent plague, and it would be against his will to go there and put yourself at risk.

Muslim physicians believed that protection from the plague on a larger scale could come from burning fires and smelling sweet or pleasant plants. However, one had to be careful what one burned, for the wrong items could cause adverse effects. Ibn Khatima said: “Also, burn sandal wood...avoid anything which could produce heat, such as rice bran or bran of millet. Also, beware of warm winds, stoves, and everything which produces heat.”²⁶ Sandalwood was popular among Christians too, probably for its pleasant smell. As for scents, Khatima writes: “one should always take care to have fresh air by living in houses facing north, by filling them with cold fragrances and aroma of flowers...by sprinkling the houses with rose water mixed with vinegar.”²⁷ This is because they

were thought to “nourish the spirit”, which would then improve the body’s faculties. Citron was spread during epidemics, because it was thought to rid the air of pestilence and purify the air, which was considered: “one of the six essential elements through which the preservation of the health of the body is achieved.”²⁸ It would appear, however, that the importance of clearing the air came not from a fear of a corrupt substance within the air which could then enter through the pores or into the lungs when breathing, as in Europe, but because there was some malignant spirit in the air which could be driven away. Ibn Qayyim said that it was important to wear perfume, because: “Perfume has this special characteristic that the angels like it, but the demons flee from it; for what the demons like best is an unpleasant, putrid smell.”²⁹ It is unclear whether ibn Qayyim actually believed this, for in other sections of his treatise he hints that it is the air that is poisonous,³⁰ but there must have been a fairly large population who believed in the disease-causing power of demons for him to have written this.

The physicians in Islamic communities only understood the external symptoms of the plague, and were able to treat those with a limited amount of success. Ibn Hindu writes that: “The physicians have nothing whereby to repel these illnesses and their causes, any more than they have anything to explain them.”³¹ Being unable to explain where the plague came from in the body did not stop them from attempting to treat it. Ibn Khatima says that there is no cure for the spitting up of blood,³² but that the buboes can be rectified. He says that when the buboes have fully matured and all of the blood turned into pus, then the physician can cut them out or drain them, but it is incredibly dangerous to work

on them before they have matured. If they are not mature and still full of blood, then the blood can flow out and cause the patient to exsanguinate, for he believed that they were connected to the heart³³ (similar to the theory of emunctories, although drainage as a function is not mentioned). Ibn Battuta wrote that: “Those who fell victim to the disease were advised to have their blood drawn, apply egg yolk to the plague buboes, wear magical amulets, or have their sick bed strewn with flowers. Above all, God’s creatures were urged to spend their nights in the mosque and beg divine mercy.”³⁴ Though he is not a doctor and cannot be expected to understand all the different types of medicine, it would appear that compound medicines were not as prevalent, or at least not as utilized in cases of plague as they were in the West.

A more popular approach than treating the symptoms, despite their “better” understanding of them, was the standard surgical fallback: blood-letting. Ibn Khatima said: “It [bleeding] is the best way to maintain one’s health during this calamity... therefore, we found no easier and more successful treatment than bleeding, especially if it is performed immediately when there are signs of the disease, and before the fever takes hold and gruesome symptoms appear.”³⁵ Blood-letting was to be done as soon as possible to maximize the patient’s chances of survival, but unlike the Christians, they believed that blood should be drawn not in small amounts, but until the patient felt faint. In fact, even if the patient were to faint, doctors were instructed to continue bleeding.³⁶ Ibn Khatima boasts of a success story in which he bled 40 oz. of blood from a man, who went on to completely heal from the plague.³⁷ (For reference, the human body contains

160 oz. of blood, and a standard blood drive from the Red Cross will take 16 oz. in intervals no less than 8 weeks apart.) Later in his text, however, ibn Khatima says that patients should not be bled until they faint, suggesting that the amount of bleeding undergone probably depended on the case and the ability of the patient. When it came to actually performing the phlebotomy, Khatima orders that it be done on the opposite side of the body if the pain is in the armpit, but on the same side if it is in the neck or the groin.³⁸ This is different from the Christians, who warned that blood should not be taken from the opposite side of the body, because it will cause the corrupt humors to cross over the heart and infect other healthy areas. This disparity may arise from the different understandings of how plague occurred. Ibn Khatima said himself that he knows bleeding doesn't make sense as a treatment, but it seems to work, so he will continue to advocate for its use.³⁹

These are the treatments that I have found documented for cases of plague in Islamic societies. For perhaps one, or even several of the theories postulated above, the medicines do not appear to have been as sophisticated or as widely disseminated as they were in Christian societies. This does not mean, however, that all Muslim physicians were unable or unwilling to treat plague patients with the medicines available, or that they were not experimenting with new treatments.

¹Johnstone. *Medicine of the Prophet*. 27

²Ibid, 28

³Ibid

⁴Tibi. *The Key to Medicine*. 76-7

⁵Johnstone. *Medicine of the Prophet*. 28

⁶Conrad. *Contagion*. 163-64

⁷Ibid, 166

⁸Ibid, 170

⁹Aberth. *The Black Death*. 115

¹⁰Ibid, 116

¹¹Conrad. *Contagion*. 176-77

¹²Aberth. *The Black Death*. 115

¹³Conrad. *Contagion*. 177

- ¹⁴Ibid, 168
¹⁵Aberth. *The Black Death*. 56
¹⁶Gibb. *Ibn Battuta*. 144-
¹⁷Aberth. *The Black Death*. 111
¹⁸Fancy. *Science and Religion in Mamluk Egypt*. 24
¹⁹Conrad. *Contagion*. 169
²⁰Johnstone. *Medicine of the Prophet*. 117
²¹Aberth. *The Black Death*. 57-62
²²Aberth. *The Black Death*. 58. Johnstone. *Medicine of the Prophet*. 31
²³Aberth. *The Black Death*. 57
²⁴Conrad. *Contagion*. 172-73
²⁵Johnstone. *Medicine of the Prophet*. 31-2
²⁶Aberth. *The Black Death*. 57
²⁷Ibid
²⁸Johnstone. *Medicine of the Prophet*. 245
²⁹Ibid, 199
³⁰Ibid, 31-2
³¹Ibid, 28
³²Aberth. *The Black Death*. 62
³³Ibid, 62
³⁴Dunn. *Adventures of Ibn Battuta*. 273
³⁵Aberth. *The Black Death*. 59
³⁶Ibid
³⁷Ibid, 62
³⁸Ibid, 61
³⁹Ibid, 60

Conclusions

The study of plague has come far, both in terms of history and biology, since Alexandre Yersin first identified *Y. pestis* as the causative agent in 1894. In the 43 years since Geoffrey Marks published his survey of the Black Death of 1347-1351, the study of the history of science and medicine has come to the forefront of this field. In this time, theories about medicine and how it was used and valued by its contemporaries have been formed and reformed. Traditionally, these theories have been focused on the use of medicine in Western Europe, for this was often seen as the ancestor of modern scientific enquiry. Until recently, little attention has been paid to the medicine practiced in the Middle East and other realms in Islamdom. In the past 20 years, this field has become more popular, though is still far under-researched. Early in its history, historians such as Hull argued that there was a great deal of conflict between those who practiced medicine and those who were legal or religious scholars in the fourteenth century¹. More recent research, however, has shown that the situation was not as clear as first thought, and that while jurists certainly attempted to undermine medicine, they did so to preserve the piety of the people and to protect them from the charlatans whom they believed to have taken over the practice of medicine². It would therefore appear that they were not attempting to block the discipline of medicine, but that they wished to allow only those of good moral standing whose practices aligned with their faith to be physicians. My sources have provided overwhelming evidence to suggest that these jurists continued to block medicine, especially in times of pandemics often associated with apocalyptic imagery. Ibn

Lubb (d. 1381), for example, said that people should not leave their sick relatives during the plague, because he could see no evidence that it was contagious.³ Another jurist, al-Subki (d. 1369), argued that physicians should be listened to during the plague, but Stearns says that he was in the minority for giving such authority to physicians.⁴ In contrast, if a person presented with a disease that was not part of an epidemic, such as leprosy, then the jurists seemed more than willing to follow the advice of the physician,⁵ suggesting that the issues the jurists held were not necessarily with medicine, but with the role it could play in a disease which was thought to have arisen from divine will.

In this paper, I have attempted to make my own slight contribution to the fields of both history of medicine and history of Islamic medicine by arguing that during the Black Death, though there were differences between the treatments and prayers utilized by physicians, the overwhelming majority of medicines were similar in both Islamic and Christian communities. Even religion, which at first glance would appear to create a distinction between the two medical practices, actually played a similar role in both. When used as a form of treatment, religion in the form of prayer was generally practiced on a large scale to rid disease from an entire area, such as the processions in Damascus and England. Though prayer was occasionally used on an individual, it was often discarded in favor of medicines and surgeries, including theriacs and phlebotomies. Though this is not a comprehensive study in plague medicine, I hope to have shown that there appears to be a general pattern in treatments used by both Christian and Islamic physicians. Perhaps more importantly, I wish to impress upon the reader that

overall, medicine was not the religious quackery practiced by a group of God-fearing, ignorant imbeciles that it is so often suggested to have been. In fact, it was a well-regulated practice, generally held in high esteem by its contemporaries, and most importantly, seems to have been of some aid to those who were suffering from the plague.

¹Asad Ahmed, Behnam Sadeghi, and Michael Bonner. *The Islamic Scholarly Tradition. Studies in History, Law, and Thought in Honor of Professor Michael Allan Cook*. (Leiden/Boston. Brill. 2011) 276-79

²Ibid, 280-81

³Ibid, 282

⁴Ibid

⁵Ibid

Literature Cited:

- Aberth, John. *The Black Death: the great mortality of 1348-1350: a brief history with documents*. Boston. Bedford/St. Martin's. 2005
- Abbot, Rachel C. and Tonie E. Rocke. *Plague*. Virginia. National Wildlife Health Center. US Geological Survey. 2012
- Ahmed, Asad, Behnam Sadeghi, and Michael Bonner. *The Islamic Scholarly Tradition. Studies in History, Law, and Thought in Honor of Professor Michael Allan Cook*. Leiden/Boston. Brill. 2011
- Allen, Meagan. *Bede and the Resurgence of the Justinianic Plague in Anglo-Saxon England*. Unpublished. 2013
- Atchman, Mark, Kerstin Zurth, Giovanna Morelli, Gabriela Torrea, Annie Guiyoule, and Elizabeth Carniel. *Yersinia pestis, the Cause of Plague, is a Recently Emerged Clone of Yersinia pseudotuberculosis*. Proceedings of the National Academy of Sciences of the United States of America. 1999
- Bishop, Morris. *Letters from Petrarch*. Bloomington. Indiana University Press. 1966.
- Black, Jacquelyn G. *Microbiology: Principles and Explorations*. John Wiley & Sons. 2008
- Chain, P.S.G. et al. *Insights into the evolution of Yersinia pestis through whole genome comparison with Yersinia pseudotuberculosis*. Proceedings of the National Academy of Sciences of the United States of America. 2004
- Conrad, Lawrence I. and Dominik Wujastyk. *Contagion: perspectives from pre-modern societies*. Burlington. Ashgate Publishing Company. 2000
- Daftary, Farhad. *Mediaeval Isma'ili History and Thought*. Cambridge. Cambridge Press. 1996
- Dunn, Ross E. *The Adventures of Ibn Battuta: A Muslim Traveler of the 14th Century*. Los Angeles. University of California Press. 1986
- Elliot, Lynne. *Medieval Medicine and the Plague*. New York. Crabtree Publishing Co. 2006
- Fancy, Nahyan A.G. *Science and Religion in Mamluk Egypt: ibn al-Nafis, pulmonary transit and bodily resurrection*. London. Routledge. 2013

French, Roger. *Medicine from the Black Death to the French disease*. Brookfield, VT. Ashgate Publishing. 1998

Friedlander, Arthur M. et.al. *Relationship between virulence and immunity as revealed in recent studies of the F1 capsule of Yersinia pestis*. Clinical Infectious Diseases. 1995

Garcia-Ballester, Luis. *Practical Medicine from Salerno to the Black Death*. Cambridge. Cambridge University Press. 1994

Gibb, H.A.R. *Ibn Battuta's Travels in Asia and Africa: 1325-1354*. London. George Routledge & Sons, LTD. 1929

Harbeck, Michaela, Lisa Seifert, Stephanie Hansch, David M. Wagner, Dawn Birdsell, Katy L. Parise, Ingrid Wiechmann, Gisela Grupe, Astrid Thomas, Paul Keim, Lothar Zoller, Barbara Bramanti, Julia M. Riehm, Holger C. Scholz. *Yersinia pestis DNA from Skeletal Remains from the 6th Century AD Reveals Insights into Justinianic Plague*. 2013

Horrox, Rosemary. *The Black Death*. Manchester. Manchester University Press. 1994.

Husain, Madhi. *The Rehla of Ibn Battuta: India, Maldiv Islands and Ceylon. Translation and Commentary*. (Oriental Institute. Baroda. 1976. 2nd edition)

Jansen, Katherine L, Joanna Drell, and Frances Andrews. *Medieval Italy: texts in translation*. Philadelphia. University of Pennsylvania Press. 2009

Johnstone, Penelope. *Medicine of the Prophet by ibn Qayyim al-Jawziyya*. Cambridge. Islamic Texts Society. 1998

Kelly, John. *The Great Mortality: An intimate history of the black death, the most devastating plague of all time*. New York. Harper Perennial. 2005

Kohn, George Childs. *Encyclopedia of plague and pestilence: from ancient times to the present, 3rd edition*. New York. Facts on File, Inc. 2008

Little, Lester K. *Plague and the end of Antiquity: the pandemic of 541-750*. Cambridge. Cambridge University Press in association with the American Academy in Rome. 2007

Lorange, Ellen A, Brent L. Race, Florent Sebbane and B. Josph Hinnebusch. *Poor Vector competence of Fleas and the Evolution of Hypervirulence in Yersinia pestis*. The Journal of Infectious Diseases. 2005.

Marks, Geoffrey. *The Medieval Plague: The Black Death in the Middle Ages*. Doubleday. 1971

Martin, G.H. *Knighton's Chronicle: 1337-1396*. Oxford. Clarendon Press. 1995

McVaugh, Michael and Lola Ferre. *The tabula antidotarii of Armengaud Blaise and its Hebrew translation*. Philadelphia. American Philosophical Society. 2000

Nicaise, E. and Leonard D Rosenman. *The major surgery of Gui de Chauliac: surgeon and master in medicine of the University of Montpellier*. Philadelphia. Xlibris Corporation. 2007

Orth, Kim, Zhaohui Xu, Mary Beth Mudgett, Zhao Qin Bao, Lance E. Palmer, James B. Bliska, Walter F. Mangel, Brian Staskawicz and Jack E. Dixon. *Disruption of signaling by Yersinia effector YopJ, a ubiquitin-like protein protease*. Science. 2000

Priest, David and James G. Clark. *The Chronica Maiora of Thomas Walsingham: 1376-1422*. Woodbridge. Boydell & Brewer Ltd. 2005

Taavitsainen, Irma and Paivi Pahta. *Medical and Scientific Writing in late Medieval English*. Cambridge. Cambridge University Press. 2004

Tibi, Aida. *The key to medicine and a guide for students (miftah al-tibb wa-minhaj al-tullab) by Abu al-Faraj 'Ali ibn al-Husayn ibn Hindu*. Reading. Garnet Publishing Limited. 2010

Throop, Priscilla. *Hildegard von Bingen's Physica: the complete English translation of her classic work on health and healing*. Rochester. Healing Arts Press. 1998

Totaro, Rebecca. *The plague in print: essential Elizabethan sources, 1558-1603*. Pittsburgh. Duquesne University Press. 2010