

Infectious diseases 101 Infectious diseases have plagued humans since the Neolithic Agricultural Revolution. At that time communities became compactly settled, grew in size, and interacted closely with domestic animals and each other. Each of these factors continues to play a role in the presence and spread of communicable diseases. The terms “infectious,” “communicable,” and “contagious” signal the fact that certain human diseases are transmitted among humans. Many diseases, of course, are not. One does not “catch” obesity, diabetes, cancer, or arthritis by proximity to, or contact with, other people. One does, however, “catch” a cold, measles, plague, cholera, or influenza from contact with, or the proximity of, others whose bodies carry the appropriate pathogens – e.g. bacteria or viruses. Some infectious diseases require direct contact of two people; HIV/AIDS and syphilis are examples. Others are communicated through the air (influenza or primary pneumonic plague), water (cholera), or tainted surfaces (common cold) touched by two or more people. Still others require living vectors to move between the human carrier and the new victim. Mosquitos transmit malaria, body lice typhus, and certain fleas bubonic plague. A number of human disease outbreaks actually originate among animal populations and then spread to human communities. For example, plague’s rat fleas prefer living within rat fur, but when the diseased rodent dies its infected fleas seek a new home. Since rats, especially the black *rattus rattus*, enjoy human company, the closest new hosts are often people and domestic animals, and so the disease jumps species. As this piece is being written, 50,000,000 chickens in the American Midwest are reportedly being slaughtered out of fear of their having or spreading a form of “bird flu” virus that can be and has been transmitted to human populations (Revkin 2015). Almost any transmissible disease can kill people. Some, such as the pneumonic or septicemic forms of plague, act terribly quickly if untreated and act almost immediately on key human organs. Forms of some pathogens, such as the ebola virus, are naturally virulent (deadly) and resistant to treatment. Unattended, the symptoms of some diseases, such as high fever or diarrhea, can drain a body of its ability to continue functioning. Large volumes of a pathogen can literally overwhelm a body’s lymphatic system or blood stream defenses, leading to the poisoning of vital organs. People who are malnourished or otherwise suffering from debilitating conditions have weakened or compromised immune systems, making them more susceptible to a pathogen’s ravages. Some pathogens evolve within particular human populations whose members acquire biological defenses that allow their survival, and pathogens may respond by mutating into sometimes more, or sometimes less, virulent forms to accommodate their own survival. When members of a pathogen-carrying population come into contact with one that has never experienced the pathogen, sometimes called a “virgin” population, the results can be devastating. The near-extinction of indigenous American communities during the early phases of European contact is perhaps the paradigmatic case. So-called childhood European diseases, such as measles, became epidemic among native peoples and slaughtered perhaps millions over a very brief time. European adults who had survived relatively mild childhood measles obtained immunity but continued to carry the virus. In the New World, the disease spread within native communities first contacted.

Newly infected natives carried the pathogens to others, even at great distances, so that inland epidemics often preceded direct European contact by months. A similar but less catastrophic process occurred when African slaves were brought to the Americas. Because of long contact with Arabs and Europeans, Sub-Saharan Africans tended to be resistant to many of the diseases brought to the Americas, including otherwise deadly forms of malaria. But slave ships brought the insect-borne African disease known as yellow fever, to which native Africans had strong resistance, to American and Caribbean ports and plantations. European and mixed-race colonists suffered terribly in outbreaks that ranged as far north as Philadelphia (1793). Large numbers died of yellow fever, but survivors acquired immunity. This protection was vital for communal life on Caribbean islands such as Spanish Cuba, but southern US ports such as Charleston and New Orleans were periodically swept by epidemics that struck down the young and recent immigrants. Outbreaks, epidemics, pandemics Diseases, such as the common cold, that continually circulate within a population routinely infecting many but killing few, are known as endemic diseases. Societies generally adapt their behaviors to minimize the effects of these: the sick are isolated at home or in hospitals and victims are provided with remedies to treat symptoms. When a “new” disease appears in a population it may be considered potentially epidemic, as was Legionnaires’ disease and SARS decades back. If a small percentage of the population within a limited geographic area is in fact affected the event is usually labeled an outbreak. If they have identified and understand the disease, authorities may use historically effective measures to limit its spread. These may include isolation of victims, vaccinations of susceptible populations, or school closures. If the disease spreads significantly in geographic terms, in the numbers of identified cases (and percentage of those who die), and in its duration, then experts and the media will label the event an epidemic. While some epidemiology textbooks may suggest thresholds in terms of square miles, percentages, and numbers of weeks, in reality policymakers and medical experts shy from such cut and dried quantitative definitions. For decision makers, the point is not the nature of the current situation in an outbreak’s expansion but the stochastically forecasted trend of the event. Factors considered may include the characteristics of the affected population, the means of transmission, the incidence of deaths (deaths/cases), the nature of the public reaction to date and predicted for the future, the successes of attempts to curb the disease’s spread, the impacts (including costs and intrusiveness) of these attempts, and the public policy effects of declaring an epidemic (closing schools? closing airports? compulsive blood screening? erection of a cordon sanitaire?). Aside from being a potential public health trigger, the word “epidemic” has tremendous power among the general population and abroad. The technical difference between an “outbreak” of whooping cough and an “epidemic” of whooping cough may only be a few deaths or cases, but the perceived or rhetorical effects can be huge. When plague struck the western Russian Empire in the 1770s, the Moscow government famously dragged its feet for weeks after the point of epidemic conditions had very obviously been exceeded. Russians feared an official declaration of plague would result in international isolation and reductions in trade, which in fact foreign observers in Moscow had long been recommending to their own governments. As with finding the line between an outbreak and an epidemic, so determining when an epidemic becomes a pandemic is rather messy business. Cases need to be widespread, even in global terms today; percentages of cases and deaths within affected populations need to be high and growing; efforts to curb the effects are probably ineffective; and the forecast is for further spread within and beyond affected populations. Pandemics can span centuries, as with what scholars consider the first, second, and third plague

pandemics. Probably originating in Africa, the first was a series of eighteen waves of what is believed to have been *Y. pestis*, a bacillus-caused plague that swept the Mediterranean regions of Africa, Europe, and western Asia. It was first noted in 541 and seems to have run its course by 750. Quantitative records are impossible to come by, but contemporary accounts clearly describe social, economic, and cultural effects of severe and sudden population declines. Plague's next appearance occurred in the mid-1340s. As the infamous Black Death, it swept western Asia, North Africa, and all of Europe. Death tolls are usually estimated at about 40% of a given population until its final appearances in Russia in the early 1350s. This five-year massacre was clearly a pandemic. But the disease returned a decade later, and then locally or regionally with some regularity over the next centuries, especially in large cities. In England, its final, ferocious appearance was in 1665–1666; in southern France in the 1720s; and in Russia in the 1770s. Turkish-controlled areas of the Mediterranean continued to suffer epidemics into the mid-nineteenth century. The second plague pandemic thus stretched over half of a millennium, killing, conservatively, 60,000,000 people. The third began in China, probably in the later 1880s, and moved south and eastward. In British Hong Kong in 1894 the German-trained bacteriologist Shibasaburo Kitasato and French-trained Alexandre Yersin vied to uncover the secret of plague's cause. Yersin won, successfully isolating the bacillus later named *Yersinia pestis*. It took another two decades, however, for all of the pieces of the bacillus-fl ea-rat-human paradigm to be discovered and assembled. Though this pandemic swept parts of China, India, Madagascar, and Vietnam, and even appeared in Honolulu, San Francisco, and Seattle, developments in microbiology, pharmaceuticals (especially antibiotics), and public health meant that the third pandemic would be far less severe than the first two. Historians tend to mark the end of this pandemic with American involvement in the war in Vietnam, where plague had become endemic. Other historic pandemics include those of cholera in the nineteenth century and after, and of influenza – Spanish flu – at the end of World War I. A rod-shaped, self-propelling bacillus causes cholera. It thrives in human intestines, causing diarrhea and severe dehydration. Carriers pollute water and food with their diarrheic feces. New victims then ingest the bacillus, which, if it survives the stomach's acid, proceeds southward and begins the process again. The problem, obviously, is human waste disposal and personal hygiene. Closely related is maintenance of pure food and water supplies. In advanced societies today these are largely non-issues, though outbreaks of disease from waste-infected farm produce occur occasionally even in the United States. Cholera remains a threat to undeveloped countries with primitive water and sanitation infrastructures; regions suffering from civil war or refugee crises; bordering regions suddenly overburdened with refugees; or urban areas undergoing rapid and uncontrolled population growth. Epidemiologists consider that the world is still experiencing the seventh cholera pandemic, understood to have begun in 1961. The first began in 1817, and remained largely Asian in extent. Subsequent, sometimes worldwide, cholera pandemics were spurred by such technical innovations as the steamship and railroad, as well as horrific overcrowding and filthy living conditions in the world's great cities. Today most deaths can be avoided with rather simple antibiotics such as tetracycline and/or oral rehydration treatment (ORT) that flushes the dehydrated body with life-preserving fluids and electrolytes. Influenza is a highly contagious disease that remains in the news as its virus mutates almost annually, and public health officials and pharmaceutical companies strive to circulate appropriate vaccines. The name comes from Italian, simply meaning "influence," specifically referring to the supposed astrological effects of the stars on human health. During the worldwide pandemic of 1889–1890 scientists

referred to “pestilential miasmas,” or waves of poisoned air, that were believed to cause many epidemics. As with Yersin and the plague bacillus, discovery of the flu virus was long in coming, being possible only with the electron microscope in the 1930s. In 1918, as World War I was coming to a close, refugees were streaming across borders, soldiers were scattering from Europe’s battlefields, and trade was beginning to recover, an unusual strain of influenza swept the world for some forty-six months. America lost 675,000 (Barry, 397) over a few months. Though its most terrible effects were felt in India – a recent estimate suggests at least 14,000,000 dead there alone (Chandra et al.) – the pandemic was truly global. Considering that four years of dreadful warfare in Europe took some 10,000,000 lives, the so-called Spanish influenza’s effects were horrific. Disease and society, then and now There is a qualitative difference between a soldier’s death in the trenches (or steppes or jungle or desert) and death by a disease, whether medically understood or not. Soldiers and others who either choose or are forced to step into harm’s way understand that, whether they accept it or not, bodily harm or even death may result from their activities. Cultures throughout history have disciplined young males to embrace the risks of combat and see glory in the outcome – even if that is one’s own death. Members of other occupations also tacitly accept death as a possible outcome of their efforts: missionaries, firemen, race car drivers, and doctors in epidemic situations, for example. Humans accept that certain lingering health conditions are effectively death sentences, as cancer used to be, and with old age comes inevitable death. Death from disease on a small scale may send out small ripples, and often the particular circumstances of the victims seem to provide a soothing rationale: She smoked, what did she expect? He was a practicing homosexual and shot up heroin, what should one expect? But when it appears that the entire society is suddenly and unprecedentedly at risk from a lurking act of nature – or nature’s God – whether correctly understood or only wildly guessed at, the cultural reaction is significantly different. There is also a quantitative difference between historical epidemics and modern ones. Before the emerging discovery of germs and their effects on the human body in the later nineteenth century, the origins of disease remained mysterious. Medieval physicians wrote about God’s anger with immoral human behavior, and artists symbolized plague as arrows that missed some, wounded others, and killed those whom the divinity chose. Renaissance physicians were taught astrology, so that regimens of treatment, such as viper-flesh-based theriac, could be timed appropriately with the phases of the zodiac. Even after the scientific revolution scientists credited poisoned air with causing plague fatalities, leading to the use of bonfires and gunfire to purify the atmosphere. Some habits die hard: to a few religiously oriented social commentators in the later twentieth century, HIV/AIDS deaths were God’s punishment for drug use and homosexual behavior. But even these critics understood that it was not arrows but pathogens that caused the deadly condition. And scientists knew that pathogens could be understood and, in time, their effects combated effectively. The real quantitative difference, then, is in the number of fatalities. For most recognized diseases today the issue is not whether professionals are able to treat them effectively, but whether conditions on the ground will allow for the provision of treatment. Epidemics occur today largely because personnel, money, drugs, transportation, and facilities are locally in short supply, and because politics, warfare, and even culture interfere with effective medical treatment. Yet just as modernity is marked by more accurate understanding of diseases and more effective disease treatment, it is also true that modern transportation can spread potentially deadly disease pathogens across the globe in mere hours. During the second plague pandemic it seems that *Y. pestis* could travel no faster than a sailing vessel, horseman, or rat-infested cart. Nineteenth-

century *Vibrio cholera* bacteria found new homes at much longer distances and more quickly thanks to railroads and steamships. During the 2014 ebola outbreak in Africa, North American media were preoccupied with the success of medical efforts in Africa because of the handful of cases that inadvertently or purposely arrived in the United States. Hours in the air replaced days or weeks at sea, and efficient personal and public transportation on the ground meant that even identified cases could virtually disappear into the American landscape. Nonetheless, the media flap over ebola remained just that, as the ebola outbreak never matured into a proper epidemic. In part, at least, because of the interconnectedness of global regions, aid from the developed world poured in, leaving large, well-stocked temporary wards and other facilities unused. At the very least the response may be seen as a dry run for future catastrophes that might fill these same facilities. Whereas early modern pastors informed their flocks of local manifestations of God's wrath on a Sunday morning, and early twentieth-century tabloid headlines screamed days-old accounts of influenza, telecommunications today are instantaneous and largely unfiltered. Newspaper photographs from Antietam battlefield brought the horrors of the American Civil War into northern parlors, as television introduced American families to the tragedy that was the Vietnam War. In both cases such knowledge shook American opinion and support. Today everyone with a cell phone is a Mathew Brady or "Charlie Mopic" (combat cameraman), while images and commentary can cover the earth in a matter of minutes, unfettered and unaffected by an editor or producer. Even with the tightest security, a single smartphone can, in a matter of seconds, expose the world to the effects of a new plague or other medical disaster. Media experts argue the potential effects of such disclosure: some predict mass hysteria, others better informed social awareness and debate leading to faster action, while others believe traditional media will continue to write the script. How people learn about a medical disaster, from whom, and how information is presented will shape how they will react to the fate of others and to the possibilities of their own (Byrne, 2008). No human willingly courts death by disease. Historically, individuals have reacted to the threat or presence of disease within a community by flight or by remaining but taking culturally prescribed prophylactic measures. According to Hadith, during the first plague pandemic the Prophet Muhammad warned against either fleeing from or entering an area stricken with the disease (Pormann and Savage-Smith, 59). This was quite a reasonable public health measure, especially given modern understanding of contagion. Arab medicine, however, had no conception of contagion and Islamic teaching insisted that sinful victims deserved their suffering, and the righteous victims would be welcomed in Heaven. Nevertheless, Muhammad's warning against leaving an affected area was clearly in conflict with the self-preservation instinct. After prayer, flight was the universal prescription of second pandemic-era Christian physicians as well as clergy: flee quickly, go far away, and do not hurry back. In the proem to Boccaccio's *Decameron* (1353) the brigata of ten young men and women, who have done all they could for those dying of plague in Florence, exit the hecatomb of a city for a pleasant villa in the contado. Here they would tacitly follow doctor's orders and maintain their equanimity – and health – with good food, music, and entertaining stories. A generation later plague or rumors of plague sent urban elites to country estates, relatives' residences, or rented quarters in towns at some distance. A key question arose: do we go where plague has or has not yet appeared? By the seventeenth century London's wealthy streamed from the city when plague was declared. Though contagion made little medical sense at the time, farmers and innkeepers knew that somehow those who fled often brought the disease with them. They literally barred their doors against even the wealthiest, some of whom succumbed along the

roadside. Flight was no guarantee of safety. Personal prophylactics ranged from smoking tobacco to adjust the supposedly tainted air, to wearing amulets that supposedly focused occult healing powers. Behavioral changes included avoiding all sick persons and large gatherings, as in church or the market, where sick people might be present. Cardinal Borromeo of Milan told his clergy to shorten the hems of their cassocks so they didn't stir up plague-tainted dust in the streets. Priests heard last confessions through bedroom windows while standing in the street. Rooms in which victims had died were scrubbed down with vinegar and whitewashed to remove or at least cover the taint of plague. For the living, doctors prescribed diets whose components supposedly strengthened the body by maintaining the balance of its humors. Pharmacists had plenty of pills and potions to keep the plague at bay, and others, especially some with opiates, helped ease the suffering of victims. Because the second pandemic plague recurred in the same regions over centuries, societal responses to it varied but followed certain clear patterns. Many of these were also utilized during outbreaks or epidemics of other diseases, as Western nations began to develop regimens of public health. Though formal medicine blamed poisoned air (miasma) for plague, isolating individuals who displayed symptoms was one of the most common responses. One effect, at least, was to remove the victims from the sight of other, healthy people. Hospitals, makeshift huts, monasteries, tent cities, and even large purpose-built plague houses collected the suffering from their families, and from these the dead were consigned to mass graves. During outbreaks of smallpox, cholera, or yellow fever similar structures went up to accommodate the stricken. Some of these were relics of plague times, and a few of these still dot the European countryside and cities. One English response was to seal up not only the symptomatic victim but his or her entire family in their home. The community provided food and water until forty days had passed and all still alive remained well, or all had died. The inhumanity of such a harsh policy was not lost on the humane and humanistic: both Erasmus and Daniel Defoe decried the practice. Another type of isolation was that of those suspected of having the disease. Properly, this was quarantine, from the Italian quaranta, forty, the number of days after which the disease-free would be released. The crews, passengers, and cargoes from known plague ports, and even cross-border merchants with goods from suspect places, would be held up until proven disease free. Some theories on why Europe became plague free from about 1650 focus on the success of cordons sanitaires, well-guarded borders that turned away or quarantined any suspect outsiders. Nonetheless, such interference with commerce often met with resistance and debate, as in plague-stricken Moscow in the 1770s and in 1832 when cholera raged in Europe. American newspapers, physicians, and officials opposed the measure, claiming it would simply "flatter vulgar prejudices [. . . and] embarrass with unnecessary restrictions, the commerce and industry of the nation" (Rosenberg, 79). Many said essentially the same thing in 2014 when others suggested curtailing airline flights to ebola-affected countries (e.g. Luntz). Breakfast at Tiffany's . . . death in the afternoon One of the truly disquieting aspects of plague was that a person could appear asymptomatic one day and be dead of the disease the next. Fourteenth-century world traveler Abu Abdullah ibn Battuta wrote of visiting a recently plague-swept village. After having dined with and slept near his perfectly healthy host, he awoke next morning to find the man dead of plague (Byrne, 2012). The prayers, the prophylactics, the flight, the remedies, the isolation: all were meant to prevent or limit death by disease. In the pre-modern world – before vaccines, immunizations, oral rehydration therapy, or antibiotics – epidemic or pestilence meant death and suffering. Only the sexually active seemed to contract syphilis, but anyone could fall prey to plague or influenza, or

later smallpox, or later still tuberculosis. The suffering of young Ryan White was a trumpet blast to the world that HIV/AIDS was not just a disease of intravenous drug users and homosexuals. Renaissance-era historian Lauro Martines wrote “after 1348 plague was to be the great nemesis always, with its characteristic removal, swift and ‘pitiless,’ of multitudes of people, especially in the cities” (41). The same might have been written about AIDS and the gay communities across America, let alone those who have suffered in Africa. The frightening characteristic of it is that death indeed comes “swift and pitiless,” often for anyone and therefore potentially everyone. Even wealth was often no prophylactic: American President Franklin Roosevelt, scion of one of America’s great families, suffered from adult onset of crippling polio, one of the most feared diseases of the twentieth century. But epidemics and pandemics by definition result in the deaths of large numbers of people within a short period of time. Medieval plague is marked by the iconic tumbrel filled with corpses, whose driver calls out, “Bring out your dead!” Tumbrels were used because they could be tipped back on their single axle and their contents slid into the deep trenches that served as mass graves. One of the earliest commentators on the second plague pandemic noted that the dead were piled atop each other like layers in a lasagna (Marchione di Coppo Stefani). But if burial was anonymous, death came to each person individually. Records from epidemics contain gut-wrenching descriptions of fathers burying their several children one at a time; of women who tend their familial sick back to health but themselves die of the disease they helped defeat; of entire families found dead and huddled together, like the victims of ancient Pompeii or the Lisbon earthquake of 1755. Collectively, the immediate impact of epidemic deaths could be aesthetically and psychologically devastating: The corpses had backed up at undertakers’, filling every area of these establishments and pressing up into living quarters; in hospital morgues overflowing into corridors; in the city morgue overflowing into the street. And they had backed up in homes. They lay on porches, in closets, in corners of the floor, on beds. Children would sneak away from adults to stare at them, to touch them; a wife would lie next to a dead husband, unwilling to move him or leave him. The corpses, reminders of death and bringers of terror or grief, lay under ice at Indian-summer temperatures. Their presence was constant, a horror demoralizing the city; a horror that could not be escaped. (Barry, 326) While this could easily be a description of Boccaccio’s Florence in 1348, it is of Philadelphia a century ago, at the height of the American influenza experience of 1918. “Don’t get scared!” the newspapers pleaded. On October 10 the reaper claimed 759 Philadelphians; during the next week 4,597 more (Barry, 329, 332). The sick numbered in the hundreds of thousands in Philadelphia alone, and all at one time. What would bloggers say; what would the smartphone pictures look like? It is the stuff of horror films and dystopic novels or video games. And yet it is also history, and real, and possible again. Infectious diseases are not alone in causing death on a massive scale. Among natural agents, earthquakes, tidal waves, and hurricanes can kill catastrophically, and war, especially nuclear events, can slaughter untold numbers. Plague destroyed perhaps half the population of Europe and the Middle East in less than five years; HIV/AIDS has killed an estimated million people a year, on average, worldwide since 1981; and the flu swept away perhaps a million and a half people a month across the globe the year my uncle was born. Indeed, disease, with its unexpected patterns of death, its unpredictable onsets and indeterminable duration, and potential for recurrence, has carved a place of its own in the human history of death.