The Chesapeake in the Seventeenth Century

Essays on Anglo-American Society

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Environment, Disease, and Mortality in Early Virginia

Carville V. Earle

Disease was one of the principal causes of death in early Virginia, and Jamestown was the locus of mortality. This association between disease and place has long been observed, but seldom understood. A geographic model of disease mortality, however, can account for the spatial, seasonal, and annual mortality variations in Jamestown and the James River estuary between 1607 and 1624. This model, derived from the first year in Jamestown, suggests the probable causes of disease-related deaths and offers a logical and consistent account of the pathogenic organisms; the sources of infection; the incidence of infection, morbidity, and mortality; and the recurrence of epidemics. This essay presents the derivation of the model, based on the first year at Jamestown; examines the application and testing of the model for the years 1608 to 1624; discusses the colonists' and the Virginia Company's inability to lower mortality rates; and, last, offers some speculation on the causes of declining death rates in Virginia after 1624.

The first year in Virginia portended the dreadful mortality that ravaged the colony until 1624. Initially things went well. The expedition of three vessels and 144 persons left England in December 1606, headed south and west to the West Indies, and then veered north to the Chesapeake Bay, entering it on April 26, 1607. Shortly thereafter, the colonists established Jamestown on the north side of the James River, nearly fifty miles from its mouth. The Virginia spring was beneficent, and when Captain Newport departed on June 22, he left 104 healthy colonists. But soon the colony took on a somber attitude. On July 6 George Percy's journal mentioned John Asbie's death by the "bloudie F l i x e . " Three days later George flewe died of the "swelling." In the space of a month 21 colonists died, causing Percy to lament that "our men were destroyed with cruel diseases, as Swellings, Flixes, Burning Fevers, and by warres, and some departed suddenly, but for the most part they died of meere famine." By the end of September, 46 were dead, and in January when the first supply ship arrived in Virginia, just 38 of 104 colonists were barely alive.²


3. Arber and Bradley, eds., Travels and Works of Captain John Smith, 1, lxxvi, 9, 96; Alexander Brown, The First Republic in America, An Account of the Origin of This Nation,
The abundance of demand explained an explanation. But Percy’s speculation that “meere famine” was the cause of death is unconvincing. In support of his thesis we can say that the colonists’ daily ration consisted of just half a pint of wheat and another of barley, mixed in a gruel that yielded roughly half the caloric intake required for an active man of the colonists’ stature.4 But we should not hastily accept Percy’s “meere famine,” if only because of the political disputes and intrigues rending the first colony. Percy may have had an axe to grind. The selection of Jamestown over the Archer’s Hope site displeased him, and conceivably he chose to support the faction that accused President Edward Maria Wingfield of hoarding the colony’s food and drink for presidential favorites. Whatever Percy’s motives, his emphasis on famine spotlighted President Wingfield. The president, of course, denied such allegations.5 His rebuttal drew indirect support from one of his enemies, Captain John Smith. Smith made little of the shortage of provisions, stating matter-of-factly on several occasions that the colony still had many weeks of supplies remaining. He knew that the annual sturgeon run would provide a supplementary source of food. Thousands of these fish entered the James estuary in April and May, and their run to freshwater spawning grounds continued through the summer, when the big fish came in. “From the later end of May till the end of June,” wrote Smith, “are taken few, but young Sturgeons of 2 foot or a yard long. From thence till the midst of September, them of 2 or three yards long and fewe others. And in 4 or 5 hours with one nette were ordinarily taken 7 or 8: often more.”6 A few years later John Rolfe related that two men in a few hours had axed forty sizable sturgeon.7 Since the Atlantic sturgeon averages over one hundred pounds, the output of two axe-wielding men would have totaled four thousand pounds, or nearly forty pounds per colonist per day.8 A daily intake of two pounds of sturgeon, some crabs, and the wheat-barley gruel was more than adequate for the colonists’ metabolic needs. Furthermore, two pounds of fish daily would have provided 90 percent of the daily thiamine requirement, and would thus have thwarted the outbreak of beriberi that has been postulated by the medical historian Wyndham Blanton.9

The food supply during Jamestown’s first summer, though unappealing, provided sufficient nourishment to ward off starvation and vitamin deficiency diseases. Starvation was not the principal cause of death at Jamestown, but the possibility was constantly feared by the colonists. By mid-September they perceived that starvation was imminent. Newport had left them supplies for thirteen or fourteen weeks, and even though the death of 50 colonists had reduced the drain on the supplies, by September they had only enough for four to eight weeks and did not expect additional supplies until October at the earliest. Moreover, the sturgeon run fell off.

Although Percy blamed famine, his list of clinical symptoms brings us closer to the actual causes of death—typhoid, dysentery, and perhaps salt poisoning. Medical historians generally agree that Percy’s “flicks” or “bloudie Flickes” describe dysentery, and “Burning Fevers” are symptomatic of typhoid fever.10 The “Swellings,” though perhaps associated with dysentery, could also result from salt intoxication from the salty river water.11 These three diseases are also indicated by the incidence and rapidity of death, as chronicled by Percy. Typhoid fever progresses rapidly after infection by the bacterium Salmonella per colonist per day.8 A daily intake of two pounds of sturgeon, some crabs, and the wheat-barley gruel was more than adequate for the colonists’ metabolic needs. Furthermore, two pounds of fish daily would have provided 90 percent of the daily thiamine requirement, and would thus have thwarted the outbreak of beriberi that has been postulated by the medical historian Wyndham Blanton.9

Written from the Records Then (1624) Conceived by the Council, Rather than from the Histories Then Licensed by the Crown (Boston and New York, 1898), 55.
6. Ibid., 8–9, 51.

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typhosa. The first week may be symptomless, as the organisms spread through the bowel wall and into the lymphatic glands. In the second week the organism enters the bloodstream, causing a rapid rise in body temperature, recognized by colonists as the “Burning Fever.” The illness peaks in the third week, and death may result. Before the use of antibiotics, it is estimated that 15 to 20 percent of infected persons died. Dysentery, caused by amoebic parasites, produced the “bloody Flice.” While several types of amoebic parasites reside in the human intestinal tract, most are harmless commensals or organisms that may cause diarrhea or mild dysentery. More dangerous is Entamoeba histolytica; it may invade the bowel wall, causing ulceration and the bloody stools that gave the disease its seventeenth-century name. More serious complications result when these parasites bore into a large blood vessel, causing massive hemorrhage, or when the amoeba gets into the bloodstream and travels to other organs. Dysentery is often fatal, especially when populations are weakened by other illnesses or undernourishment. Pre-antibiotic mortality rates of 12 to 25 percent have been recorded. Like typhoid, dysentery can act quickly, though the rates of incubation vary with the individual. Controlled experiments with human volunteers have shown “that the prepatent period, i.e., from exposure until the amoebas appeared in the stools, averaged nine days, varying from one to 44 days in the 17 of 20 exposed individuals who became infected.” Clinical symptoms usually appear within one to four weeks, but the range may be from a few days to several months.

12. The fever lasts 21 days usually and occasionally up to as many. Frederick P. Gay. Typhoid Fever Considered as a Problem of Scientific Medicine (New York, 1918), 13–24; William Budd. Typhoid Fever: Its Nature, Mode of Spreading, and Prevention (New York, 1931); Jacques Meyer. May, The Ecology of Human Disease (New York, 1958), 171–188. Gay shows 15 to 27 percent mortality for the London Fever Hospital, 1848 to 1870. In general I agree with Jones that typhoid killed numerous Virginians in 1867. I disagree with him on the following points: (1) that typhoid, aided by beriberi, was the principal killer; (2) that typhoid was probably introduced by Reverend Robert Hunt; and (3) that the Jamestown environment was essentially passive in the typhoid epidemic. Gordon W. Jones, “The First Epidemic in English America,” Virginia Magazine of History and Biography, LXXI (1963), 3–10.


18. Gay. Typhoid Fever, 43.
impossible to detect in the absence of laboratory diagnoses. The Jamestown carriers passed millions of disease organisms in their feces and also their urine in the case of typhoid. The diseases were then transmitted, in all probability, through a contaminated water supply.

But what was the water supply, and why was it contaminated in July and August and not earlier or later? The colonists drank river water. In spring the water was safe. With river discharge at a maximum—owing to high precipitation, low evaporation, and high runoff—the fresh running water swirled around Jamestown Island and flushed disease organisms downstream. But the water supply became contaminated as summer set in. River discharge fell, water levels receded some ten to fifteen feet, and Jamestown Island became a peninsula attached to the mainland. Pools of standing water and stagnant marshes rimming the mainland side of the island created a wateland environment ideal for the retention of Salmonella typhosa and Endamoeba histolytica. Even more deadly was the summer contamination of the river water with salt, sediment, and fecal material. As freshwater discharge fell, saltwater invaded some thirty miles up the James estuary from Hog Point in the spring to Jamestown by mid-summer. And along the landward-moving freshwater-saltwater boundary, sediments and organic wastes were trapped by the salt plug—particularly on the north side of the James, owing to the rightward deflection of the marine incursion by the earth's rotation. Percy put it succinctly: “Our drink [was] cold water taken out of the River, which was at a flood verie salt, at low tide full of slime and filth, which was the destruction of many of our men.”

At flood tide the colonists drank water containing salinity concentrations of over five parts per thousand—far above the recommended standard for constant daily usage of one part per thousand. The colonists suffered from salt poisoning, with its characteristic symptoms of “swellings” (edema), lassitude, and irritability. The idle, lazy, and factious behavior of early Virginians was, in part, the result of a steady summer diet of salty water. The ebb tide, though less saline, was very turbid, organically polluted, and deadly. The trapped pathogens of typhoid and dysentery, thus floated back and forth past Jamestown with the summer tide. The danger from contaminated water faded in September. River discharge increased, pushing the salt incursion and its deadly associates downstream toward Hog Point.

The 1607 epidemic of typhoid and dysentery was the first of many summer epidemics in early Virginia. Fevers, fluxes, sickness, and death visited the colony recurrently between 1607 and 1624. One decisive factor underlying these repeated epidemics is the limited immunity conferred by the diseases themselves. Dysentery survivors acquire no immunity to subsequent attacks. Severe dysentery attacks do evoke a limited antibody response for two weeks after the infection, but thereafter the survivor is again susceptible to infection. Typhoid attacks confer slightly more immunity. Typhoid recurrence is usually put at .75 to 4.2 percent; however, the recurrence rate rises to 8 to 15 percent in especially virulent and massive infections, like those in Jamestown. Thus, the survivors of dysentery and of typhoid epidemics at Jamestown were only slightly less susceptible to these diseases than newly arrived immigrants. Survivors of a Virginia sum-

19. The normal regime of Chesapeake estuaries is described here. Discharge, however, will depart from the norm of spring high and summer low under atypical meteorological conditions, e.g., prolonged drought or excessive rainfall, variable evapotranspiration, variable snow-melt water. Virginia, Virginia Conservation Commission, Division of Water Resources, Surface Water Supply of Virginia: James River Basin, nos. 5, 13, 17, 25 (Charlottesville and Richmond, Va., 1944–1961). As the James rose in spring and receded in summer, Jamestown occupied alternately an island and a peninsula attached to the mainland. C. A. Browne, “Reverend Dr. John Clayton and His Early Map of Jamestown, Virginia,” William and Mary Quarterly, 2d Ser., XIX (1939), 5–6. The recession in river depth is estimated from depths of the main channel at Jamestown. Percy gives 6 fathoms (36 feet) in spring; an English pilot, interrogated by the Spanish in 1611, put the depth at 3½ fathoms (21 feet) at the least. The river’s annual range is 15 feet. “Observations by Master George Percy,” in Tyler, ed., Narratives of the Movement in England, 1605–1616, Which Resulted in the Plantation of North America by Englishmen, . . . Set Forth Through a Series of Historical Manuscripts . . . (Boston and New York, 1890), 519; Samuel H. Yonge, The Site of Old “James Towne,” 1609–1698 . . . (Richmond, Va., 1904).


22. Drinking water preferably should contain not more than 0.5 parts per thousand salt content; however, some contemporary municipal water supplies use two parts per thousand without public complaint. Thomas R. Camp and Robert J. Meserve, Water and Its Impurities, 2d ed. (Stroudsburg, Pa., 1974), 2; Kellel, Pathophysiology and Treatment of Body Fluid Disturbances, 162–164, 209–210; Bland, “Clinical Physiology and Four Avenues of Loss and Gain,” in Bland, ed., Clinical Metabolism, 133–164. A composite of early Virginians’ behavior would include irritability, lassitude, short tempers, factiousness, and hyperbolic perceptions. The extremity of their situation accounts for some of these behaviors; salt poisoning accounts for them all. On idleness in early Virginia, see Edmund S. Morgan, “The Labor Problem at Jamestown, 1607–1618,” American Historical Review, LXXVI (1971), 595–611.

23. Faust, Anabasis, 30–32.