I. Summary of Innovation

Date(s)	Category	Innovation
1721	Healthcare	Dr. Boylston's application of an ancient African practice of inoculating children from smallpox incited fury but proved successful in protecting people from the vicious disease

Short description

The scourge of smallpox epidemics was a consequence of everyday life in large colonial towns. Roughly once a decade an epidemic would sweep through towns like Boston, decimating the population and throwing the populace into hysterics. In 1721, one such epidemic broke out in Boston. With testimony from one of his slaves, Onesimus, and knowledge of similar treatment in Turkey, Cotton Mather became a spokesman for inoculation. At Mather's insistence, an unlettered physician, Zabdiel Boylston, agreed to test the controversial process on his son, his slave, and his slave's son. The inoculation worked and soon 244 people were inoculated as a fury of controversy engulfed the port town. In the end, Boylston's inoculations were accepted and widely practiced, paving the way for more advanced forms of inoculation in the future and a greater acceptance of medical experimentation. Giving credence to a slave's home remedy was also a large stride in social relations, leading to recognition of Boylston by the Royal Society in London.

Proposed factors

Rank	Factor	Explanation
5	Local Leadership/ Entrepreneurs	Zabdiel Boylston staked professional and social credibility on an untried procedure of inoculating smallpox. Also, it was the influence of Cotton Mather that called Boylston's attention to variolation. Onesimus not only bolstered Mather's enthusiasm, he also described the process and led the way towards inoculation.
4	Mass Education	Trained as a physician and apothecary by his father, a doctor, Boylston never received formal university training. Though preparing to enter Harvard College, his father passed away at that time and Boylston finished his apprenticeship under Dr. Cutler of Boston.
4	Cluster Collaboration	Having faith in Onesimus' inoculation and attempting to test the procedure, Boylston took a large stride in social relations. Though it would appear that more credence would be given to tribal remedies, whites were still wary of those they believed to be inferior.
4	Inter-regional Collaboration	Through the tale of his slave, Onesimus, and

		knowledge of Turkish practices Cotton Mather became a vocal proponent for inoculations. His words became actions through the hands of Zabdiel Boylston, who performed the Boston version of the procedure.
4	Social and Scientific Interplay	Bringing together scientific understanding, experimentation, and public health, inoculating small pox came from a societal need.
2	The Masses had a Spirit of Changing Things	Taking a chance with life and livelihood, Mather and Boylston were determined to better the health of their community. Though their fellow citizens were not openly receptive, there is an undercurrent of change in the numbers that came to Boylston to be inoculated.
3	Immigration	It is important to note Onesimus' role. His testimony convinced Mather of the safety and need to inoculate. Though a forced immigrant, Onesimus' steadfast knowledge pushed racial tolerance.
2	Local Demand	Every ten years or so small pox would ravage the town. Great measure and expense was outlaid to prevent and harness any outbreaks. The inoculations would save money, ease anxiety, and save lives.
2	Transportation	Bringing in ideas, new immigrants, and slaves, Boston had a flow of new ideas and information that led to innovative social change.

II. Pertinent Background Info

Introduction to a Killer

> *How difficult a thing it is, to set Truth in a clear light in this case to the satisfaction of an unbelieving world.*
>
> *-Zabdiel Boylston*

Variola, from the Latin *varius*, meaning speckled, is one of history's greatest killers. Commonly known as smallpox, the disease is a gruesome ailment that leaves its victims vulgarly swollen, covering their skin with bubbling seething pus that reeks of the telltale scent of decomposing human flesh. The rotting skin becomes a writhing sheet enflamed in agony, their throats fill with sores so wretched that some victims are said to have died of thirst rather than suffer the intense misery of swallowing water. Those that survived were forever scarred; physically covered in grotesque disfigurement and often blind, and emotionally having come too close to seeing death's door. Transmitted through infected saliva, smallpox can spread quickly through a family, through a village, and through a burgeoning port town like Boston in the 18th century.

The disease did not exist in the New World until Europeans came. With no exposure over the centuries to build any form of immunity, many Indian populations were quickly decimated and weakened with the arrival of Europeans. Posing the greatest risk to urbanized populations living in close contact, the growth of colonial towns coincided with the increased risk of epidemic. Though of greatest consequence to these multiplying cities of Europe and the New World, the early battles against this vile disease were not the result of Western science. Rather the first inroads were made ages before in the homes of those that Europeans considered ignorant and backwards, Middle Eastern and African people. Those that they slighted were those that provided solace from the storm of epidemic.

A Doctor, a Preacher, and a Slave

It took Zabdiel Boylston, a highly competent yet unlettered country physician and apothecary from Muddy River, Massachusetts (now Brookline) to perform in the colonial world what had been performed for ages elsewhere. Never attending a university for his medical training gave Boylston an organic quality that trusted instinct and intuition, that listened to all voices of advice, and understood the variety of places that cures can come from. Though not a new method, when the idea of inoculating patients for smallpox came to Boylston's attention it was considered too barbaric, sinful, and murderous to perform in good faith. It took nerve, confidence, and a willingness to risk everything for Boylston to experiment with inoculation.

Inoculation, also known as variolation, is the method of taking a small amount of the pus from an infected patient and rubbing the live disease into a small cut of the uninfected. This method had been practiced for centuries in the homes of Africa, the Caucuses, and the Middle East. The newly infected patient would run a short course of the disease, breaking into fever and suffering a slight case of blistering pockmarks that would scar the area of incision, but would not have the danger of the full course. Of course if the physician applied too much of the pus, the patient would suffer the full, and often lethal, run of the disease. After, the inoculated patient would have enough antibodies in their blood to fight any further exposure to the disease.

This method came to the attention of the popular minister, Cotton Mather, in 1706 through a story told to him by a recently purchased slave, Onesimus. Onesimus, meaning helpful and profitable, told the story of his youth in Africa, of how he was inoculated along with all the children, and then he showed Mather the scar on his arm as testament. Mather had suffered the near loss of three children from smallpox, and was anxious to convince physicians to perform the procedure so other fathers would not have to suffer the same agony. Though Mather was a prominent preacher in the Boston area, his name had been tainted through his son's late night activities that dwindled his family's fortune away and tainted the family's name. In this position, Mather was still able to rally the support of the religious community behind his actions.

Boston, and other port towns in colonial America took many precautions to curb the epidemics. In Boston all incoming ships were first checked for sick sailors with the telltale signs of smallpox: reddened, seething, blisters covering the skin. Those infected

were sent to Spectacle Island in Boston Harbor. There they were made to stay until the symptoms passed- or they died- before they could come to port. Though they took many precautions, the disease still made its way to land about decennially.

Boston Faces-down Speckled Death

1721 was one of those years. The fleet led by the British warship *Seahorse* sailed into Boston Harbor in April of that year. Sailing from Salt Tortuga in the Caribbean, the sailors carried the smallpox that was ravaging London and Barbados at the same time. With some of the men escaping the *Seahorse* by night, the earliest infections were noted at the Paxton household. Captain Paxton wrote to the town's selectmen, and soon the town did its best to quarantine the sick. It was too late and soon smallpox was spreading through the houses and streets of Boston. At this time Cotton Mather continued to preach the benefits of inoculation, needing a brave doctor to perform the procedure, and again his words fell on pessimistic ears. It seems that one physician, Boylston, was not ignorant to Mather's pleas, and after a devastating May and June, Boylston decided to attempt the experiment on June 26, 1721.

Boylston's trial was one closest to home; his favored son Tommy would become the first patient, soon followed by his slave, Jack, and Jack's son, Jackey. Boylston had taken a vile of pus from one of his infected patients legs, he scored his son's arm by the elbow, took a quill and drew a minute bit of the white pus from the vile and applied it to the cut. He then repeated the procedure on Jack, on his neck, and Jackey, on his leg, and they all waited. By nightfall it appears that talk of the procedure had made its way through the entire town. There was a popular outcry, calls for Boylston to be tried as a murder if his patients died, and the selectmen barred him from repeating the experiment. The three patients went through mild symptoms, including fever, sweats, and mild sores but nothing like the full course of smallpox. With the recoveries, the newspaper *The New England Courant* subsided its attacks on inoculation and the uproarious populace quieted down.

Soon people were defying the ban, requesting the doctor to perform the inoculation on their families. By the end of the epidemic Boylston had inoculated about 244 people, with six dying. Compared to the non-inoculated population of 5980 that contracted the disease, of which 844 died, the former had a less than three-percent mortality rate compared to the latter's fourteen-percent. Of note, the patients were still contagious while they were suffering through the lapses into the disease. It took Jenner's cowpox vaccination to make a inoculated person non-contagious.

With time, variolation became widespread around the colonies, accounting for a boom in population following. In Europe, the Royal Society in London published Boylston's accounts of his experiments. Eventually, in conjunction with other successful physicians administering inoculations, the British royal family, other European royalty, and many others were inoculated.

Boylston's success influenced many to experiment and better the techniques of inoculation. In 1796 the Englishman Edward Jenner developed the first vaccine using

cowpox pus to perform a similar procedure. Up until this point smallpox outbreaks continued to ravage Europe and the Americas. Though smallpox was not fully conquered until the 1970s, it was Boylston's willingness to face the lynch gang, to attempt radical procedures, and to push popular sentiment that paved the way for the corralling and eventual eradication of a lethal disease. His use of variolation not only had the affect of immunizing patients against smallpox but also engendering a new sense of possibility and optimism of medicine's preventative possibilities.

III. List of Variables

5: Local Leadership/ Entrepreneurship
There is more than one form of leadership entrenched in this case. Without Cotton Mather's insistence, belief, and resolve to have inoculations performed it is unknown how long it would have been before variolation was practiced in the New World and Europe. Mather's leadership was one of gleaning the story of African family inoculation from his slave, Onesimus; corroborating it with other slaves' testimony; and comparing those to what he had heard from English doctors practicing in the Middle East and Mediterranean.

From Mather's certainty and insistence Zabdiel Boylston was convinced of the credibility of the procedure. Using his own 'flesh and blood,' his son, and his own slaves (his 'investments') Boylston showed readiness to attempt new procedures in the face of adversity. At the same time the general public was assailing him as a murderer, Boylston remained even-keeled and confident in his decision.

Together they formed the vanguard of preventative action against infectious disease. Though both were insulted and under fire for their preaching and action, it was truly Boylston that led the way and showed the greatest leadership.

Without the knowledge and steadfastness of Onesimus, the remedy would not have come to Mather's attention. Though he had been thinking of it for years, the direct assuredness of Onesimus bolstered his belief in the procedure.

4: Mass Education
Shadowing his father from an early age and apprenticing under him for a number of years gave the young Boylston a confidence and demeanor that cannot be taught in the university. When his father passed away Boylston was not able to attend Harvard College as planned. Rather, he became a physician's apprentice under Dr. John Cutler of Boston. A colleague of the late Dr. Boylston, Cutler versed Boylston in anatomy, surgery, apothecary, and bloodletting. He was trained as a physician, a surgeon, and a pharmacist, all without walking through the hallowed gates of Harvard. It was from the words of Cutler and his father that Boylston had gained the keen sense of taking knowledge from where you find it.

4: Cluster Collaboration

Mather, Onesimus, and Boylston all worked together directly and indirectly to produce a life saving procedure. Though the methods were hundreds of years old, it was their new application within Boston that revolutionized the medical world and made the world as a whole a more livable- literally- place.

4: Inter-regional Collaboration

Through the tale of his slave, Onesimus, and knowledge of Turkish practices Cotton Mather became a vocal proponent for inoculations. Information had traveled across the Atlantic through the slave trade and through other channels. This transfer was often indirect, but the flow brought new ideas and methods from across the seas.

4: Social and Scientific Interplay

Bringing together scientific understanding, experimentation, and public health, inoculating small pox came from a societal need. In Africa and Turkey the methods were seen to have worked and were not scientifically understood. That was unnecessary when the result were so conclusive. In Boston these results were brought into the scientific lexicon of the day and eventually mainstreamed. Though the procedure remained dangerous it opened the door for Jenner and others to better the techniques.

3: Immigration

It is important to note Onesimus' role. His testimony convinced Mather of the safety and need to inoculate. This driver is under immigration because forced or voluntary it is the inclusion of new blood and ideas into the community that adds new dimensions.

2: The Masses had a Spirit of Changing Things

Taking a chance with life and livelihood, Mather and Boylston were determined to better the health of their community. Though their fellow citizens were not openly receptive, there is an undercurrent of change in the numbers that came to Boylston to be inoculated.

2: Local Demand

Every ten years or so small pox would ravage the town. Great measure and expense was outlaid to prevent and harness any outbreaks. The inoculations would save money, ease anxiety, and save lives.

2: Transportation

Bringing in ideas, new immigrants, and slaves, Boston had a flow of new ideas and information that led to innovative social change. Though the 'hub of transportation' can be a sticky term in the case of the slave trade, triangle trade, and other nefarious enterprises, they were the realities of colonial Boston.

IV. Economic or Social Impact

The preservation of life always impacts a society socially and economically. While before populations remained stagnate in large part or had a slow growth rate, with the advent of inoculating and modern science population blossomed. This can be viewed as a good or a bad circumstance. The positive, more people live, more hands to do work, and more productivity means that innovation is fast-forwarded out of demand and need. The negative is that there are greater urban problems, overpopulation with time, and the necessities to feed, house, and clothe all these people.

The smallpox inoculation did not have this impact immediately; over generations and centuries, built off of expanding protection from disease, population grew and changed.

V. Timeline

Circa 1000:	Inoculations were first performed in China and India. Powder made from dried smallpox pus with inhaled or added to scratches on the skin.
Circa 1400:	Powdered smallpox 'crusts' were rubbed on pinhole skin punctures in the Middle East.
1706:	Cotton Mather purchases the slave Onesimus and learns of the African practice of inoculation. Mather begins to preach the value of such procedures.
1717:	Lady Lady Mary Mortley Montagu, the wife of the British ambassador to Turkey had her son inoculated after seeing the practice performed in Turkey. This may have been the first European variolation.
June 26, 1721:	in Boston, Massachusetts, Zabdiel Boylston administers small amounts of smallpox pus to his son, Tom, his slave, Jack, and his slave's son, Jackey. These actions incited uproar, but all three saw their way through and survived with only minor symptoms of the disease.
Fall of 1721:	Though banned by the selectmen of Boston, Boylston had inoculated many citizens. As the last cases cleared 244 people had been inoculated, of this number 6 died.
1722:	Boylston travels to London to tell his tale at the Royal Society of London.
1726:	Boylston is elected to the Royal Society and continues to pine for variolation.
1796:	Edward Jenner discovers that English milkmaids that contract cowpox do not get smallpox. He then uses the cowpox to vaccinate people against smallpox.

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VII. Next Questions to be Followed Up – when revisited

Occidental bias? If there was use of inoculation in Africa, Turkey, the Middle East, China, India, and the Caucuses, that means that Europe was surrounded by those that understood what Europeans couldn't. This case demonstrates the leadership in the West of a practice that was under plundering European noses for centuries.

How long did it take, what percentage of the population, and who (social/class) was inoculated?

Why did smallpox still ravage when the technology was there to immunize?

1) 'Demand' might not accurately explain the *demand* (i.e.: constant threat of epidemic causing the populace to wish for a cure)
2) Not certain if Boylston's apprenticeship and lack of formal university training makes him a candidate for Mass (double entendre?) Education.
3) Is there an appropriate way of listing the barriers to innovation? For example, in this case Boylston was assailed by the common man, prohibited to perform more inoculations by the selectmen, and cut against the cultural grain of God's revenge/ wrath/ judgment through disease, etc.