

Introduction to Presentation

Good morning friends and welcome to this presentation
Viral epidemics and American history course

I chose this topic because of my interest in history and my career in medicine.

Humans are infected by a wide variety of infectious organisms (germs)
Including bacteria, parasites, spirochetes, rickettsiae, fungal spores, mycobacteria, and also viruses

Viral infectious diseases have played a critical role in American history.

establishment of the European settlement in America
conquest of Mexico
the American Revolution
the Louisiana Purchase
building the Panama Canal.
end of World War I
the metamorphosis of FDR from fop to world leader

What is a virus

A virus is a one cell living organism

Peter Medawar a Nobel Laureate said

a virus is
"a bunch of genetic material
Surrounded by bad news" which are
the enzymes that attach to and
infect other cells taking over their metabolic & reproductive function

Viruses are very small and cannot be seen with naked eye
nor with regular light microscope
First seen with Electron microscope in 1931

Today we will begin to discuss 4 viral diseases

Smallpox, Yellow fever, Influenza and Polio

Introduction to Smallpox

Smallpox is disease caused by the virus variola major
Human to Human transmission only
No animal or insect vector,

No food or water transmission

BUT dried secretions on scabs and clothing and paper can be infectious

1. Typical Variola Major Infection

Mortality was about 30% in unvaccinated individuals.

Duration/disease around 30-32 days

Patients were *contagious* until the last skin scab fell off

Outcome was recovery or death

Survivors were immune for life from a second dose of the pox

Why was Smallpox so contagious and so Widespread

1. Patients who were incubating virus had no symptoms and could travel far and wide during 10 day incubation period and then spread disease to a new location
2. Contagious phase lasted about 20 days, plenty time to infect others
3. Contagion lasted Even after death
Corpses would be very infectious
4. Smallpox can be transmitted in any climate & in all parts of the world.
5. Contagious state could begin just before a rash appeared & would continue until the last scab had fallen from the skin

Brief world history of smallpox

Smallpox is a relatively old disease.. The disease is at least 3000 years old, with confirmed cases in China and India

Smallpox first appeared in Europe in the 6th century

There was no mention of smallpox in the Americas until the time of First Contact with Europeans 1492.

The native Americans had zero immunity to smallpox

They would be completely vulnerable to the smallpox introduced to them by the Europeans.

The introduction of smallpox to America quite rapidly depleted the native population, with a mortality rate over 90%%

At the time of First Contact with Europeans

There were an estimated 30 million people living in the Americas

After 100 years that number would decrease to 1 million
Most of the deaths were from smallpox.

The Spaniards were the first
but not the last Europeans to bring smallpox to the New World and the
effect upon the Native Americans was devastating

Columbus first landed on Hispaniola in 1492
Smallpox first came to Hispaniola in 1507

In 1518 250,000 Arawak Indians were living on Hispaniola
In 1531 there were only 600 left alive.
Smallpox probably caused the overwhelming majority of those deaths.

Conquest of Mexico

In 1519 Cortes attacked Tenochtitlan in Mexico and was beaten back
He retreated to the coast and was surprised to find that no Aztec forces
were following him.

A few months later, he sent spies into the capital where they reported
widespread smallpox among the people

Apparently one of Cortes' crew members, had acquired smallpox before
arrival in Mexico and was very infectious, He was captured by the Aztecs
and retained in the capital as a hostage.
He would be the only source of a smallpox outbreak that affected as many
as 2/3 of the Aztecs of Tenochtitlan in a matter of months

The Aztecs believed that the Spanish forces were employing supernatural
powers, (smallpox) and many of their military leaders decided to either join
the conquistadors, or flee, rather than fight them.

Cortes returned to Tenochtitlan and conquered the Aztecs in a matter of
weeks.

The Aztecs, possibly numbering in the millions, were thus subjugated to
Spain by Cortes and 300 conquistadors

The typical history of early settlement of N. America was one of Europeans
moving into an area, fighting aboriginals and over time, finding less and
less resistance. Smallpox was depleting the ranks of the natives
The Aztec, Huron, Iroquois, Mohican and other major nations with
populations in the millions were reduced to thousands or eliminated
altogether, mostly by smallpox.

The European settlement of North America had been made possible by the greatly weakened condition of the Indians from smallpox

The Indians reciprocated in kind

In exchange for smallpox, they infected the Europeans with the Great pox, syphilis, which was transported back to Europe on the genitalia of the returning conquistadors

New England had periodic smallpox epidemics in the 1600s and again in 1702. The survivors became immune to smallpox
Between epidemics smallpox would persist at much lower rates

By early May 1721, a new smallpox epidemic began in Boston
Within the first few days about 1000 people left town with the hope of avoiding the disease.

A Boston minister, Cotton Mather had a slave named Onesimus who had recently arrived from Africa. He informed Mather of the African practice of inoculation that prevented smallpox; and that he himself had received such an inoculation

Inoculation involved the extraction of material from the pustule of an infected person and, using a thorn, scratching it into the skin of the unaffected person.

The deliberate introduction of smallpox would give the inoculated person immunity from smallpox. This inoculation was called variolation.

Mather sent a letter to Dr Zabdiel Boylston which convinced the doctor to start a campaign of inoculation.

Proving its efficacy would require a breakthrough in research methodology.

Mather and Boylston reported that 2% inoculated patients died, compared with 14.9% of patients infected in the natural way (14.9%).

As far as we know, this was the first use of numbers to evaluate a clinical trial. (statistical analysis)

Survival from the experimental, inoculated group was compared with a control group & it showed a clear advantage for the inoculated group.

BUT This treatment from Africa was too radical for Boston in 1721
Patients were infectious following inoculation, for several weeks

There was widespread opposition to the process in colonial America

In religious circles, it was deemed unnatural and perceived as subverting God's will.

1. . Most physicians opposed inoculation
2. The general public opposed inoculation
3. The opposition was vehement and occasionally violent
November 1721 a small bomb was tossed through the window of Mather's home

There were Questions about its efficacy and safety
The procedure had associated mortality and morbidity
Variolated person were contagious

Abigail Adams, had the new Sutton method of variolation

1. Shallow skin puncture and not deep wounds were used
2. Use of pus from other inoculees and not from primary patients
3. Inoculees were quarantined after inoculation
- 4 Less morbidity and probably as effective

Although infectious after her inoculation, Adams went to a public meeting

The debate over inoculation pitted rich vs. poor,
uneducated vs. educated.
elite vs. the great unwashed
doctors vs. ministers

This same cast of characters can be found in 2015 discussing measles vaccine and stem cell research and evolution

Lady Mary Wortley Montague gets the most credit for bringing variolation to Great Britain.

She was a writer, an early 'feminist', a socialite;

In December 1715 she contracted smallpox; which ruined her good looks;

In 1717 her husband was named British Ambassador to Ottoman empire

Mary and their child accompanied him to Constantinople;

While there, she witnessed and learned about variolation

In 1717 she had her son Edward inoculated against small-pox, after watching it be performed in Constantinople.

Variolation offered good protection but had its own intrinsic mortality and morbidity, about 2%

Mary had personal interest in smallpox, and upon her return to England she became an influential advocate for variolation.

She was literate, an aristocrat, and a friend of royal family, the poet Alexander Pope, and the politician Horace Walpole.

Since smallpox had killed Queen Anne's last living heir, the British Royal family would be very supportive of variolation as a means to protect the line of succession of the royal dynasty

It was also adopted by the British Army, the aristocracy and upper classes, the well educated, and others

The British Army had another association with smallpox Germ Warfare
Lord Jeffrey Amherst was commanding general of British forces in North America during the final battles of the French & Indian war (1754-1763). Amherst, Massachusetts, and Amherst College are named for him.

There is fair amount of evidence that Amherst approved of the distribution of blankets to the Indians that were smallpox infected.

Amherst wrote "..... try Every.....method that can serve to Extirpate this Execrable Race."

A unique property of smallpox

Since smallpox virus can survive for a number of years outside human hosts in a dried state, the disease can be transmitted through contaminated articles such as clothing or blankets and could be used as germ warfare

American Revolution

In 1751 George Washington accompanied his brother Lawrence on a trip to Barbados

His only trip out of the country during his lifetime

While there, the 19-year-old Washington contracted smallpox

He was gravely ill, but survived.

GW gained personal knowledge of the devastating effects of smallpox

1775 was the year that the American revolution began.

It was also the year that a very large epidemic of smallpox began in North America in 1775 that killed over 100,000 people over 7 years.

Why Epidemics are Worsened by Warfare

1. concentration of troops and civilians with intermingling of people from far and wide
2. crowded conditions in training camps, battlefields, prisons military hospitals and most significantly, the battle field
3. destruction of crops

BUT Smallpox continued to decimate the Continental Army

- New recruits became ill with smallpox
- Potential recruits stayed away for fear of smallpox
- The Army could not enter towns where smallpox was raging
- The Army was NOT allowed into healthy towns
- Military movement was severely limited

General Washington initially was opposed to variolation

BUT

Smallpox continue to fester through the summer

The Continental Army was entrenched around the Boston while

the British Army occupied the town and the British Navy was in the harbor

GW could **not** inoculate his army, while the British were so close

The sickened troops would be no match in combat with the Brits

His wife

1. The troops would eventually be inoculated, but not until they reached the relative safety of New Jersey later in 1776

To prevent smallpox from taking hold among their troops, the Americans set up a dedicated smallpox hospital at Fresh Pond near Cambridge.

On July 4th, 1775, Washington ordered:

"No Person is to be allowed to go to Fresh Pond on any other occasion as there may be a danger of introducing the small pox into the army."

But in November, 1775 the disease surged inside Boston.

How GW controlled the smallpox epidemic that was raging in town,

- Washington and his men had to contend with an exodus of refugees from the stricken city. ‘
- GW banned these refugees from the American camp
- No one was allowed in or out of Boston
- He kept active cases isolated in the smallpox hospital in Cambridge
- The sick were kept in isolation and quarantine

GW had kept his army intact.

AND In a complex series of military maneuvers in early 1776,

Washington forced the Brits to evacuate Boston, along with hundreds of Loyalists families;

At the end of the day on March 17, 1776,

Boston and *New England* were freed from the British;

The loyalists and especially the Loyalist leadership had fled;

The smallpox epidemic among his troops was controlled; and

The Revolutionary Army was intact.

Do you think he was GREAT?

Washington brilliance was in knowing that he had two enemies the British and Smallpox; each of which could destroy his army and the Revolution.

He knew that smallpox was killing more soldiers than were the Brits and was the gravest immediate threat to the Army

He needed to deal with each of them.

His plan for the British

avoid large scale set battles

His plan for smallpox:

use quarantine and variolation in 1777

Meanwhile

Retreat from Quebec

- In Sept 1775 The Continental army had invaded Canada with two columns of troops
- One led by Richard Montgomery took off from Fort Ticonderoga
- The second was led by Benedict Arnold and left from Boston with soldiers who had taken part in the recent siege
- After initial success at Montreal, they were badly defeated at Quebec Dec 31 1775

This led to an historic death march back to New York state

- During the retreat from Quebec most of the Americans became ill with smallpox
- the British may have sent infected deserters, prisoners, and spies into the American camp with the purpose of infecting the Americans
- The retreat became a death march as there was no nursing care etc
- Walking on infected feet was extraordinarily painful
- About one third of American troops on the march died from smallpox

Any semblance of quarantine disappeared

1. Men in the full throes of smallpox struggled through the snow alongside men who had never had the disease,
2. Others, who were unaware they were incubating smallpox, mingled with healthy troops. “

General John Sullivan ordered the withdrawal back to New York state ‘
"or the Army will be lost, not by the enemy, but by sickness"

It took until September 1776 for the army to cleanse itself.

It is likely that smallpox killed about a thousand men during the Canadian campaign.

Furthermore, returning soldiers,, launched outbreaks in Connecticut and possibly Pennsylvania.

The defeat at Quebec had major consequences for the Revolution

- the ant-inoculation policy was re considered.
- Benedict Arnold gained fame and Washington's trust
- Canada remained British

In the winter of 1777 Washington began to inoculate all recruits in the Continental army and to quarantine them until they recovered.

.....the American forces went through inoculation at West Point, Morristown, Valley Forge, etc

.

This had to be done in great secrecy because the army would be quite vulnerable at that time, as inoculated soldiers were sick and contagious and unable to fight for several weeks.

In 1777 and 1778, the disease seemed to fade away.

While we applaud Washington, recall that his actions preceded all the great discoveries associated with Pasteur and Jenner et al

Before microbiology or epidemiology or virus were words .

No NIH, no science advisor, no Rockefeller Institute

How did he do it?

Washington now had a smallpox immune Continental Army, and could attack and maneuver without consequence of smallpox.

This was critically important in the Southern campaign in the final years of the war.

i.e. State militias, rarely inoculated, refused to march on Charleston, South Carolina, because smallpox was present there.

But an inoculated army was able to engage in battles anywhere---

And to be able to march from Newburgh New York to Yorktown in Virginia

And to withstand the British attempts at biological warfare that preceded the surrender at Yorktown.

The control of smallpox in the Continental army was one of several factors that now began to favor the Americans

Other Smallpox facts about Revolution

- Final victory at Yorktown was preceded by the abandonment of thousands of smallpox infected Loyalist black troops behind enemy lines. They had been left by the Brits to die unattended on the fields of Yorktown.
- Or perhaps the sick blacks were deliberately left there in an attempt to infect the Americans. Not likely to succeed since Washington's army was now smallpox immune

25,000 American soldiers died in Revolutionary Army ,

- About 7000-8000 in combat
- about half all deaths were from smallpox and
- about half of those while in prisons,
- many in prison ships in NY harbor

During the American Revolutionary War, the British arrested scores of soldiers, sailors, and private citizens on both land and sea

When the British ran out of jail space to house their POWs they began using decommissioned or damaged ships that were anchored in Wallabout Bay in NY harbor as floating prisons.

Disease was rampant, food and water were scarce or nonexistent, and the living conditions were overcrowded and wretched.

A great number of the captives died from disease and malnutrition.

Thousands of them died from smallpox

Their emaciated bodies were thrown overboard or buried in shallow graves in the sandy marshes of Wallabout Bay, waiting for the day when the Martyrs Monument would be built at Fort Greene Park, Brooklyn

The widow Betty Jackson was raising her three sons in Waxhaws in western south Carolina

In 1780, the British launched an invasion of South Carolina that leveled much of the Waxhaws, settlement killing more than one hundred Americans

Bette's older son Hugh joined a patriot regiment, and died at the Battle of Stono Ferry.

After another small engagement near Waxhaw, the other two Jackson brothers, were captured by British troops

The younger son was wounded in the head and hand by the British commander's sword

The British took the two Jackson boys and twenty other prisoners to Camden, nearly forty miles away. There, the British placed all of them into a small prisoner camp with 250 other men, with no medicine, no beds, and only a small amount of bread for food.

Both boys became infected with smallpox.

Fortunately, their mother, Betty, helped to arrange a prisoner transfer—that included her two sons.

The younger son walked the forty miles(while he had smallpox) back home, while his mother and his dying older brother rode beside him.

Robert died two days after returning home, and it was several weeks before the youngest boy recovered.

Betty then left to tend to other soldiers in prison ships in Charleston harbor. She became ill with typhus—and passed away at the house of a relative.

The 14 y.o. boy was now an orphan, having lost his entire family to the war, He was combat veteran, had been a POW, had been wounded, and had survived smallpox.

Military families pay a high price for our liberty.

Andrew Jackson would be the only American President to have been a prisoner of war, & was the last President to have soldiered in the Revolutionary War .

One cannot talk about smallpox with mentioning Edward Jenner.
a British physician who introduced cowpox vaccine to the world in 1796
He had observed that milk maids who developed
cowpox from the infected udders of cows, never got smallpox

So he took fluid from the pustules on their hands and scratched it into the hands
of non immune subjects.

Weeks later, the subjects were challenged
with variola virus but they did not get smallpox

Since the material was from a cow, the disease was called vaccinia and
The inoculation was called Vaccination.

Vaccination was adopted world wide with dramatic decrease in smallpox
in the western world

Thomas Jefferson was instrumental in the adoption of vaccination in the
US, and in fact vaccinated many people himself

Lincoln at Gettysburg

Nov 19, 1863

The Gettysburg address is one of the world's best known speeches.

Its brevity may be due to the fact that Lincoln wrote and delivered the address.. while
suffering from first stages of smallpox

Lincoln returned to Washington, and had progressive weakness

He soon developed fever and a red rash that developed into scattered blisters

He would be diagnosed as having smallpox
Not able to get out of bed and walk until Dec 7
& not able to return to work until Dec 15

Lincoln's valet William H Johnson, then developed smallpox and died from it on January 12 1864

Approximately 1 out of 3 cases of smallpox don't survive.
The President and his son survived, his valet William Johnson didn't.
A close call for the Union

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YELLOW FEVER

Yellow fever is an acute, infectious, hemorrhagic viral disease that causes liver failure and death

The virus is transmitted to humans through the bite of the aedes mosquito
The life cycle of the virus is spent only between mosquito and humans

The manifest destiny of the US to be a continental nation from Atlantic to the Pacific was not pre ordained Instead it was an accident of history, aided in part by an epidemic of yellow fever in Haiti

After the European conquest of America,
a new labor force was required to exploit the New World

American Indians were not going to do much of this work

- Many, if not most Native Americans had died from smallpox
- Many native Americans resisted slavery by escaping to the wilderness
- It was frequently difficult to organize the Indians
- The Catholic church was ambivalent re: forced labor of Indians

Indentured servants and bonded laborers from Europe

- 1. did not do well in the tropics.
- 2. they suffered in the heat
- 3. Yellow fever, malaria and small pox would take their toll

Africans

- Many African slaves had an advantage as laborers in the tropics already with some immunity from smallpox, malaria, & yellow fever

- Many Africans had acquired these diseases in childhood and the survivors had immunity
- They were already well acclimated to the tropical heat

The slave trade from Africa became an international enterprise involving England France Holland Portugal and Spain

And thus was established the infamous triangular trade of slaves, rum and molasses.....

The slavers had a long ocean voyage and they needed the slaves to arrive alive and in relatively good shape

There would be plenty of stored water aboard ship and
Therein lies a tale

The mosquito vector of YF prefers to live and breed in man-made containers of water. This mosquito, *aedes egyptii*, has a life span of about 1-2 months, considerably longer than the duration of the ocean voyage,
The mosquitos traveled on slave ships in the water containers on board, survived the Middle Passage-and came to America ,

Along with millions of slaves
came billions of aedes egypti mosquitoes and
trillions of YF viruses

The mosquitos came ashore and found new sources of their favorite food, human blood, most of it was non African
Upon dining, they infected those humans with YF virus
And YF blossomed forth all along the slave route and coastal cities
The slave trade and YF went hand in hand

Immunity to Yellow fever

Africans	Many had YF as children, survived & now had immunity, not lifelong and not complete
Afro Americans Their offspring	Less immunity than Africans, but still some Still had some genetic immunity Also protected by some degree of herd immunity
Europeans	No immunity and no resistance
Native Americans	No immunity and no resistance

But Indians had very little exposure, to YF
They were not in the slave trade, and
They did not congregate in the coastal cities

Viral epidemiology had favored the institution of enslavement of Africans and Afro Americans, because they could survive the awful ocean passage and work in the tropics

Unlike smallpox it will be the Europeans who bore the brunt of the introduction of a new viral disease to the Americas

YF would be concentrated in port cities and in the tropics and on the slave ships among the Europeans

Haiti was a French colony and was the source of 2/3 of the *commercial wealth of France, namely sugar plantations*

In 1779, more than 500 Haitian volunteers, gens de couleur - free men of color, had fought with the French alongside American colonial troops against the British in the Siege of Savannah

The French Revolution of 1789 had abolished slavery, but some of the folks in Haiti thought otherwise.....

This began a bloody rebellion in Haiti that was fought along complicated racial lines. Many of the Haitians who had served in gens de couleur would go on to form the nucleus of the officer corps of the rebel armies

In the summer of 1793 refugees from the rebellion in Haiti came to the US by boat, many coming to Philadelphia. which was the biggest city in the United States with a population of 40,000 and also the nation's capital

These refugees were French colonials, other Europeans and some American traders. Along with the refugees came their fellow travelers, billions of mosquitos and trillions of viruses

Shortly after their arrival, an epidemic of YF began
About half the population would leave Philadelphia including Washington, Hamilton, Jefferson and most of the US government.
Was this the first US govt. shutdown?

Of the remaining 20,000 population about 5,000-10,000 would die of YF

Jefferson was Secretary of State and was in Philadelphia during this time
He witnessed and appreciated first hand the terror and devastation of YF

This insight would serve him well during his Presidency

Alexander Hamilton developed YF but survived.

The blacks volunteered to do much of the dirty work;

- working as cart drivers;
- handling bodies
- digging graves
- caring and nursing for the sick and dying

Despite the erroneous belief that blacks could not contract YF, 240 of them died from it. As a group, they only had partial immunity. Then false accusations began against the black citizens who had worked so hard to save the sick and dying. That would be their reward.

The weather cooled, mosquitos died, the disease subsided, and the deaths stopped.

The people of Philadelphia believed that YF was due to poor sanitation and fouled water supply from privies, fouled market trash, manufacturing sites. The association of YF with mosquitos was not yet known. The Yellow Fever epidemic of 1793 forever changed Philadelphia. and great adaptations were made.

1. Hospitals and orphanages were organized
2. The city fathers of Philadelphia would do the right things for the wrong reasons
3. The city's sanitary condition were improved
4. Homeowners were now held responsible for cleaning up their property
5. But the biggest change would be the great improvement made in Philadelphia's water supply

In 1799, Benjamin Latrobe, was hired to design and construct Philadelphia's first waterworks and the first public water system in the US.

Using steam engine pumps

Latrobe's waterworks removed water from the Schuylkill River and lifted the water into huge wood reservoirs which

- Used gravity to carry the water to houses around the city
 - Water from the central pump house surged to wash streets and docks.
6. As you might predict YF would continue in Philadelphia, but there would be less water borne disease such as cholera and typhoid.

The 1793 YF epidemic also sped up the planned transfer of US government to Wash DC

Latrobe later went on to design the capital of the United States, Washington D.C. Ironically, he died of Yellow Fever in 1820 while constructing the waterworks of New Orleans .

Louisiana Purchase

Louisiana had initially been French	1699 to 1763
then sold to Spain which ruled	1762 to 1803
and then back to France....	Nov 1803.
Transferred to US	Dec 1803

The treaty of Paris in 1783 had given the US most of the land east of the Mississippi that is modern day USA, with notable exception of Florida and the present day Gulf Coast

The vital concern of the US had always been free navigation of the Mississippi River, which had been guaranteed in the treaty of Paris

The US had signed a treaty with Spain in 1793 guaranteeing the US use of the port of New Orleans

BUT

The Spanish authorities began to interfere with transfer of US goods in New Orleans

After Louisiana had been transferred to the French the Jefferson administration sought to buy New Orleans from them but the French offered all of Louisiana including New Orleans

By a treaty signed on Apr. 30, 1803, the United States purchased from France ,, not only New Orleans but the entire Louisiana Territory, more than 800,000 sq miles of land extending from the Mississippi River to the Rocky Mountains. The price was about \$15 million

The US took possession of New Orleans and Louisiana about one month after the Spanish had transferred it to France

Why would France and Napoleon want to sell Louisiana to the US?

The French plan had been for Louisiana to become the breadbasket for Haiti, whose land was used for sugar and not for food.

BUT The Rebellion in Haiti became very costly to France

In 1803 France sent over 30 000 troops to Haiti, almost of whom died from YF, including their commander LeClerc, who was Napoleon's brother in law

There was not much reason for the French to keep Louisiana, since YF and rebellion made it impossible for them to exploit Haiti, and there would be NO need for a breadbasket.

After that huge loss of French soldiers Napoleon was ready

- to cut his losses,
- grant independence to Haiti

Anyway, Napoleon was more interested in European adventure
So he sold Louisiana to the US for much needed hard cash.

Jefferson was well positioned to take advantage of the situation
Jefferson understood first hand

- the terror and deaths of YF from his Philadelphia days and why the French might want to get rid of Haiti, with the continuing threat of YF
- Jefferson had been Minister to France and Secretary of State and thought he knew how to deal with the French

And so the US came to purchase Louisiana Territory,
extending the US from the Atlantic seaboard to the Rocky Mountains.

And Haiti became the second independent nation in the Americas

The impact of YF upon American history so far had been immense

- Promotion of black African slavery
- Shutdown US government in 1793, mini Renaissance in Philadelphia
- US purchase of Louisiana in 1803

BUT There are still two more major events

1. The 1878 Memphis epidemic...almost total destruction of an American city...the prototype for the apocalypse
85% of people in the city got YF
70% whites died vs 10% of blacks

2. Panama Canal

Fast forward to the end of the 19th century

Ferdinand deLesseps, the man who built the Suez Canal for France was unable to build a canal in Panama & in 1889 his company went bankrupt

Several factors were in play

Most Important

Death from disease with 20,000 workers dying, mainly of YF,

including the chief engineer and his family

Yet in 1914 the US would open its recently built Panama Canal
That tied the east and west coast of US closer together
and helped make San Diego the great port city that it now is
and the US the super power that it is
How did the US succeed where the French had failed.

By the end of the 19th Century the germ theory of infectious disease had
been established. This was highlighted by the work of

Louis Pasteur and Robert Koch who

- conclusively showed that micro organisms caused disease and
- that specific micro organisms caused specific disease.

It had been shown that infectious disease could be transmitted in one of
several routes

- drinking impure water;
- eating contaminated food,
- animal bites,
- inhalation of infected respiratory droplets,
- direct contact...skin to skin

But none of these explained the transmission of YF

In 1879 the Cuban physician Carlos Finlay theorized that yellow fever was
transmitted to man by bite of the mosquito, but he could not prove that

In 1897 Ronald Ross showed the presence of the malaria parasite in the
stomach of the anopholes mosquito.

Here was the mosquito/ malaria connection

In 1898 the US went to war with Spain and acquired Cuba where
YF was endemic

In 1901 Dr Walter Reed demonstrated that YF was transmitted by the bite
of the aedes aegypti mosquito

He based his work upon Dr Finlay's theories

Right away Dr William Gorgas put that information to work in Havana
By covering up water cisterns and kicking over any collection of water,
YF disappeared from Havana

In 1904 Gorgas became the chief sanitation officer for the US Panama Canal Zone where YF was rampant

He began a mosquito control campaign

- Covering water cisterns, draining swamps covering standing water outdoors with layer of oil
- Spraying living quarters with fumigants
- Using screens for living quarters and hospitals
- Quarantine of YF patients

YF disappeared completely and malaria was greatly reduced
Mosquito control effected both aedes and anopholes species and prevented both YF and malaria.

The US then had healthy workers who went ahead & built Panama Canal

I think that a direct link can be made starting with
Dr Carlos Finlay and mosquito/YF hypothesis
to Dr Walter Reed and his experiments
to Dr Gorgas destroying mosquitos in Panama,
to healthy workers being able to build Panama Canal
to the US becoming a super power

In 1937, Max Theiler, working at the Rockefeller Foundation , developed a safe and highly efficacious vaccine for yellow fever that gave a ten-year immunity from the virus.

This vaccine is still in use

Effects of Yellow Fever in American history

- Promotion of black slavery
- Shutdown US government in 1793
- Accelerated move of US capital to Washington DC
- US purchase of Louisiana
- Near extinction Memphis in 1878
- US built the Panama Canal and became the world power

Influenza

Respiratory tract ailment

Human to human transmission by inhalation of large respiratory droplets
this implies a close contact

Incubation period 1-4 days

Duration symptoms about 3 to 7 days

Most healthy adults may be able to infect others beginning 1 day before symptoms develop and up to 5 to 7 days after becoming sick..

Uncomplicated influenza illness typically resolves after 3—7 days,

Epidemics had occurred episodically over the centuries, followed by relative calm before the next storm

Lets set the scene for the 1918-1919 Pandemic

- WWI began in August 1914
- Germany resumed unrestricted submarine warfare in 1917
- US declared war on Germany April 1917

The US Army began training recruits in the fall of 1917 at 32 large camps, each home to 25,000 to 55,000 troops.

Our concern is for three groups of patients

1. American civilians
2. American soldiers in training camps in the US
3. The AEF, American Expeditionary Force, in France and en route

The Pandemic would come in 3 waves

1. First wave of the pandemic;

Began in military training camps in US and spread to civilians living near the camps

Fourteen of the largest training camps had reported influenza outbreaks in March, April, & May. This wave killed far fewer victims than the second

Americans stricken with the flu that spring wondered at the intensity of its symptoms and its incredible contagion, but also low mortality
America's public health system ignored it, as it was not reportable disease

The infected troops carried the virus with them as

1. they moved from camp to camp; &
2. aboard ships across the Atlantic.
3. finally to the battlefields in France

By May 1918, hundreds of thousands of soldiers were crossing the Atlantic each month to build a combat force of two million by November.

In the late spring and summer, influenza visited all of the armies of Europe, including the AEF, but few patients became critically ill,

2. **Second Wave of Influenza**

The late summer saw the emergence of a new, lethal influenza as "epidemics of unprecedented virulence" *exploded* in the same week upon three port cities thousands of miles apart

- Freetown, Sierra Leone, transfer port for Indian troops
 - Brest, France, and major landing port for US troops
 - Boston, Massachusetts. major training base (Devens)
major embarkation port
- *This deadly wave would effect the whole world, military and civilian*
 - It lasted about four weeks in any one individual place and
 - Ran its course throughout the Army in about 8 weeks, roughly from September 15 to November 15, 1918.

Influenza reached all Army training camps,

- arriving first September 8 at Camp Devens,
- with last arrival October 9 at Camp Lewis, Washington.

Within 10 days, the base hospitals and regimental infirmaries were overwhelmed with thousands of sick trainees

In Europe, influenza attacked Allied and German armies alike, filling field hospitals and transport trains with weak, feverish men all along the Western Front.

The high-water mark for deaths

- in the United States the week of October 4
- and in the AEF, the week of October 11.

At the height of the American military involvement in the war, September through November 1918, influenza and pneumonia sickened about 26% of U.S. Army & Navy personnel, (in France & US). That would be about 1 million men

In Europe and the United States, medical officers found themselves on the front lines of an epidemic worse than any of them had ever seen.

The epidemic struck during the climax of the American military effort, limiting the AEF's performance in its largest campaign of the war, the Meuse-Argonne Offensive.

Influenza clogged transportation lines along the battlefield, choked hospitals, killed thousands of soldiers, and rendered many more too sick for combat.

Hundreds of thousands of troops were released from combat to transport and care for the ill.

World War I and influenza collaborated:

The war fostered disease by creating conditions in the crowded trenches of France that some epidemiologists believe enabled the influenza virus to evolve into a killer of global proportions.

As soldiers in the trenches became sick, the military evacuated them from the front lines and replaced them with healthy men.

This process continuously brought the virus into contact with new hosts—young, healthy soldiers in which the influenza virus could adapt, reproduce, and become extremely virulent without danger of burning out.

In turn, the disease shaped the war effort by rendering much of the Army and Navy non-effective and diverting resources from combat

The exigencies of war also thwarted many of the civilian efforts to control the epidemic. such as crowd mitigation and quarantines

Recommendations from the military and academic doctors were

1. Halt transfers in or out of Camp Devens until the epidemic passed. .
2. Suspend all troop movements overseas be suspended for present
3. the commander of Camp Upton, debarkation point for France, put the 30,000 inhabitants under *quarantine*, barring travel in & out of camp.
- 4, Stop sending troops from infected US camps to France until the epidemic was over in their region.
5. Cancel all draft calls for registrants destined for infected camps6.
6. Minimize transfers between camps.
7. Establish one-week quarantine of all troops prior to embarkation and
8. Reduce the capacity of troopships by one-half.

Most of these were ignored or modified to be useless

Surgeon General Gorgas .(of YF and Panama Canal fame)....."we can control pneumonia absolutely if we could avoid crowding the men,"

But if it was difficult to control crowding in the training camps, it was impossible in the battlefields. Quarantines were also impossible to maintain

.....in late September new recruits were still entering training camps.

Only the Provost Marshall's cancellation of the October draft finally eased pressure on the camps.”

General Marsh, Army Chief of Staff told President Wilson that troop shipments should not be halted for any reason, *and the President deferred to his judgment.*

March & Wilson had no intention of retarding U.S. participation in the war.

Were Americans distracted from influenza?

- great interest in American efforts in the war overshadowed influenza
- women's suffrage-movement
- the conviction and sentencing of Eugene Debs
- victory of the Boston Red Sox in the 1918 World Series.

Reasons for exacerbation of influenza Pandemic

- The United States did not have a sufficient nor a coordinated network of federal, state, and local public health departments.
- Generally, public health departments did not receive reports of influenza.
- Usual Bacteriological tests were of no use in a viral illness
- Wartime censorship restricted information about influenza
- Absent political leadership
- The shortage of nurses and the uneven distribution of nurses created an even more desperate situation

When the second wave of influenza broke out in Boston, it spread with remarkable speed.

Doctors urged

- quarantine the sick
- restrict attendance at large public gatherings
- stop the troop shipments and
- stop the draft registration

What was the response to that

- Patriotic war fervor continued and the doctors were ignored
- Large public gatherings in support of the war, brought masses of people together to breathe on each other & spread the flu, i.e. Bond Rallies
- The public ignored closing orders for schools, churches, theaters, and other places of public meetings.

- On a single day , September 12, 1918
13 million men crammed into federal buildings across the nation to register for the draft (and cough and sneeze on each other).

Other Factors worsening epidemic

- Hospitals overflowed with patients
- with almost 30% of American physicians in military service, “there were sections of the country that were absolutely stripped of physicians.”
- Congress never appropriated any funds specifically for influenza care
- Many people thought of the flu as just another aspect OF THE WAR, & the dead from Influenza were thought of as other casualties of war

Coincidentally

The war ended in November 1918 at the same time that the second wave of the Pandemic was ending

What was the bigger threat/danger to the US; Influenza or the Kaiser?
How can one justify sending sick troops overseas?

Could the American Army have been wiped out by Influenza?
10 weeks in 1918 1.6% of the Army died from Influenza

Non performance of Congress & the President in controlling influenza

- No Notices to the public
- No Mobilization of doctors and nurses
- No quarantine
- No crowd control I.e. bond rallies
- No. coordinated effort any where

Why did the US army continue to register and recruit in the fall of 1918, even after the Germans sued for peace and the epidemic was raging?

What blocked Wilson from understanding the negative impact his policies had upon the epidemic, and upon the army and navy
How could he ignore all his medical advisors

How could the Princeton professor fail to grasp what Washington understood 143 years earlier?
That the epidemic was destroying the army and needed to

be contained as the first war policy.

Wilson had done absolutely nothing to address the influenza epidemic that killed 675,000 Americans.

and for this he has to be considered ***the greatest failure as President***

3. There would also be a milder **third wave of influenza** in the first months of 1919 but by then the war was over

To summarize

POPULATION 1918-1919

World	1.86 billion
US	106 million

Total Deaths from WWI

World wide	40,000,000
US Deaths WWI	116, 000

Deaths / Influenza

World	50,000,000
US	675,000 (greater than all US combat deaths 20th century)

Philadelphia Oct 1918

Population	1.8 million
Influenza Deaths	11,000
Philadelphia at Peak of epidemic	1,800 day

Why was Philadelphia hit so hard

Philly received a quadruple dose of influenza risk

- presence of training station with sick naval recruits,
- embarkation port with sick troops going overseas
- presence of naval shipyard intermingling sick sailors & dockworkers
- large immigrant population that could not read or understand enough English to notices or communicate with health care workers.

FDR and Polio

Poliomyelitis, is a paralyzing disease caused by the polio virus.

Transmission is Human to Human: via fecal oral contamination

FDR's mother had kept him away from other children and he never got infected with some of the childhood disease, including polio.

When he did get polio it was as an adult. He had not been exposed as a child, & had failed to acquire any immunity to the polio virus

For every 100 patients with polio, about 95 have a moderate febrile illness with NO paralysis

About 5% patients become paralyzed, but most of them recover, leaving 1% of all patients with permanent paralysis.

That would be the fate of FDR.

Most scholars believe that FDR contracted polio at the Boy Scout Jamboree that he attended just prior to going to Campobello in 1921. One August morning at age 39, he awoke paralyzed and would remain paralyzed from the waist down for the rest of his life.

Even though FDR had been the VP candidate of the Democrats in 1920, it may be said that he was a patrician dilettante with many friends and affectations, not a great leader, and not a great innovator.

That would all change with his struggle with polio.

His struggles included

- Sudden onset of polio and paralysis at age 39
- Years of painful therapy that had led to no improvement
- He was immobile, confined to a wheelchair
- Unsuccessful attempts to learn to walk
- the struggle to keep alive his political career

How he changed from his struggles

- Understood suffering
- Became innovative
- Believed in unlimited hope
- The concept of possible Recovery was paramount

He had found his way to Warm Springs Georgia, where he became rejuvenated.

Physical therapists taught him how to ambulate by using canes and holding onto others. He loved to swim and to play games with other patients.

Eventually he purchased Warm Springs where other residents called him Dr. Roosevelt.

The amazing transformation of his persona occurred at Warm Springs and along the back roads of Georgia.

Driving his custom made Ford and expanding his horizons, meeting the poor and rural-folk he had never met before.

He would particularly sympathize with them.

Some believe that FDR's struggle with polio was the furnace in which he was forged and created the great man who became President. It was polio and the resulting paralysis that changed FDR into the dynamic world leader that he was

Prior to polio no one would have predicted greatness for FDR
But polio changed him forever

FDR and his law partner Basil O'Connor founded the March of Dimes that supported the development of the Salk vaccine

Many of his public speeches had medical references
Most remarkable was the quarantine speech of 1937 that opposed military aggression as though it was an infectious disease that needed to be quarantined

On the negative side

Learning to disguise his paralysis also made FDR an expert in duplicity and was part of the reason the general public did not seem to take notice nor care that FDR could not walk unassisted,

Suggested reading

Pox Americana	by Elizabeth Fenn
The Great Influenza	by John Barry
Deadly Companions	by Dorothy Crawford