Briefing to

Texas A&M University

"Learning, Relearning, and Not Learning the Lessons of COVID-19"

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RAND CORPORATION

Some Interesting Comparisons

Total U.S. Combat deaths

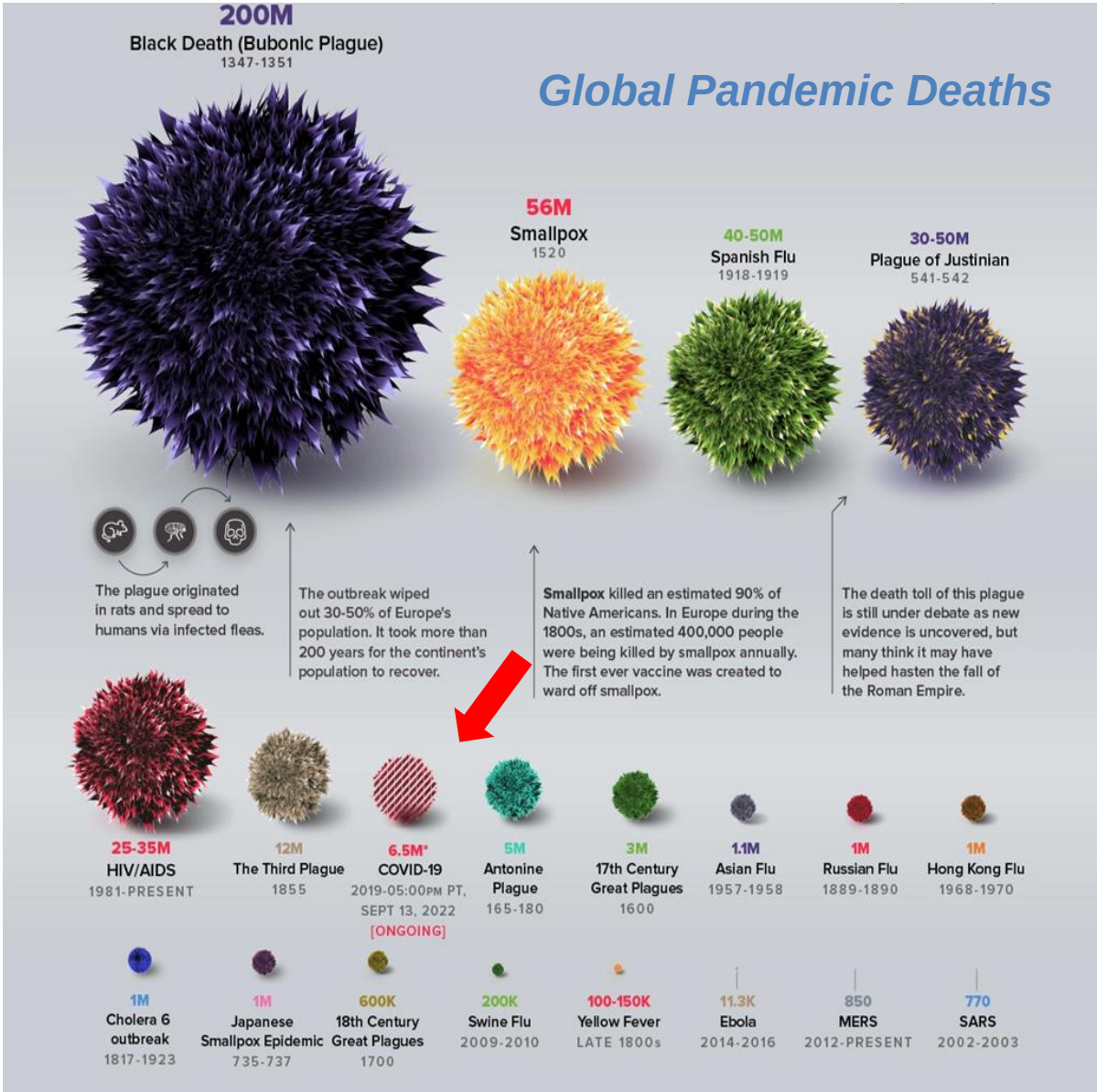
World War I: 116,516
World War II: 405,399
Korean War: 36,574
Vietnam War: 58,209

1918 Pandemic deaths

Worldwide: 50 million
U.S.: 675,000

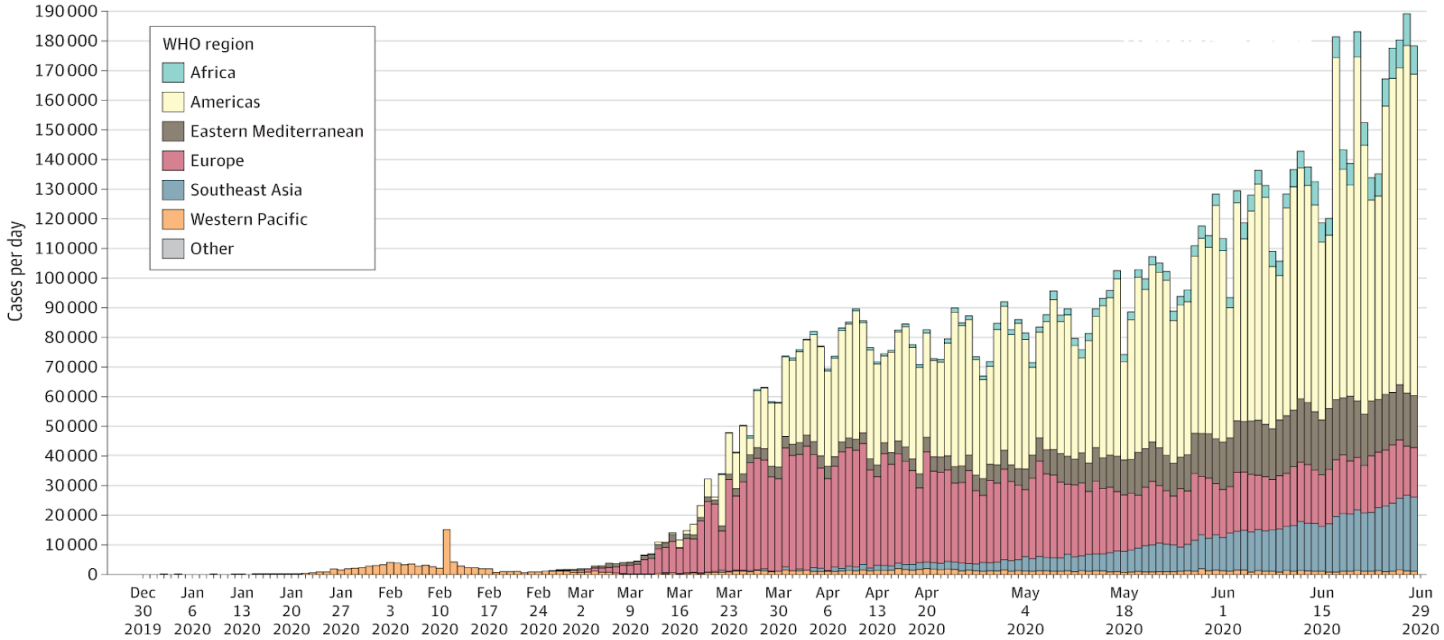
Worldwide Deaths from Smallpox*

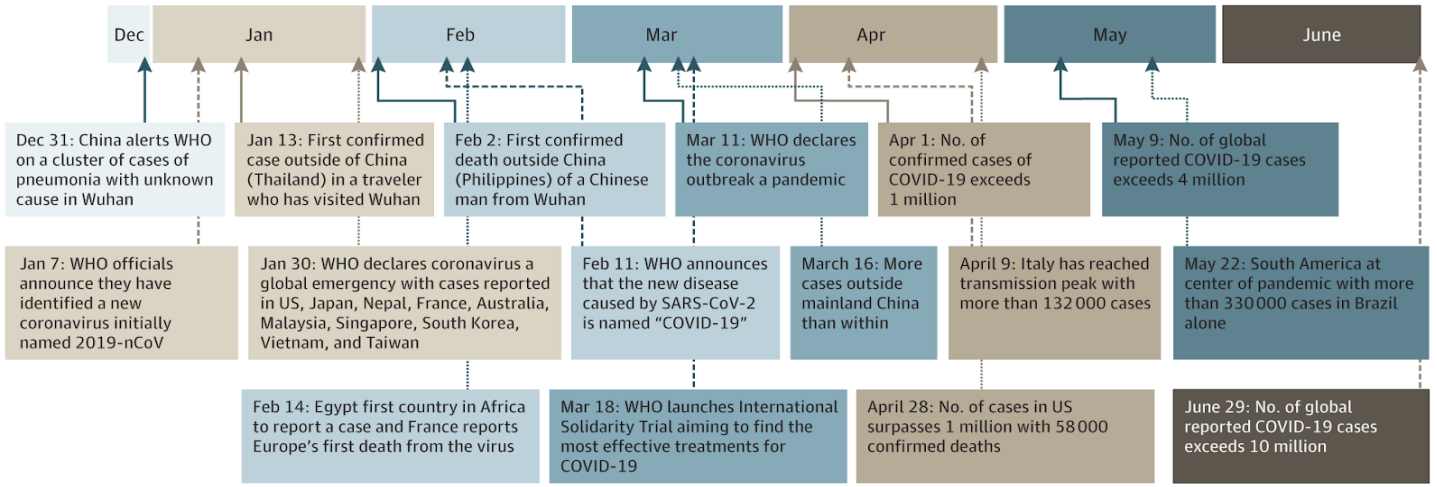
Over 3,000 years: 400 million
20th Century: 300 million



* https://publichealth.jhu.edu/2020/40-years-in-a-post-smallpox-world#:~:text=By%20no%20means%20novel%2C%20smallpox,in%20the%2020th%20century%20alone.

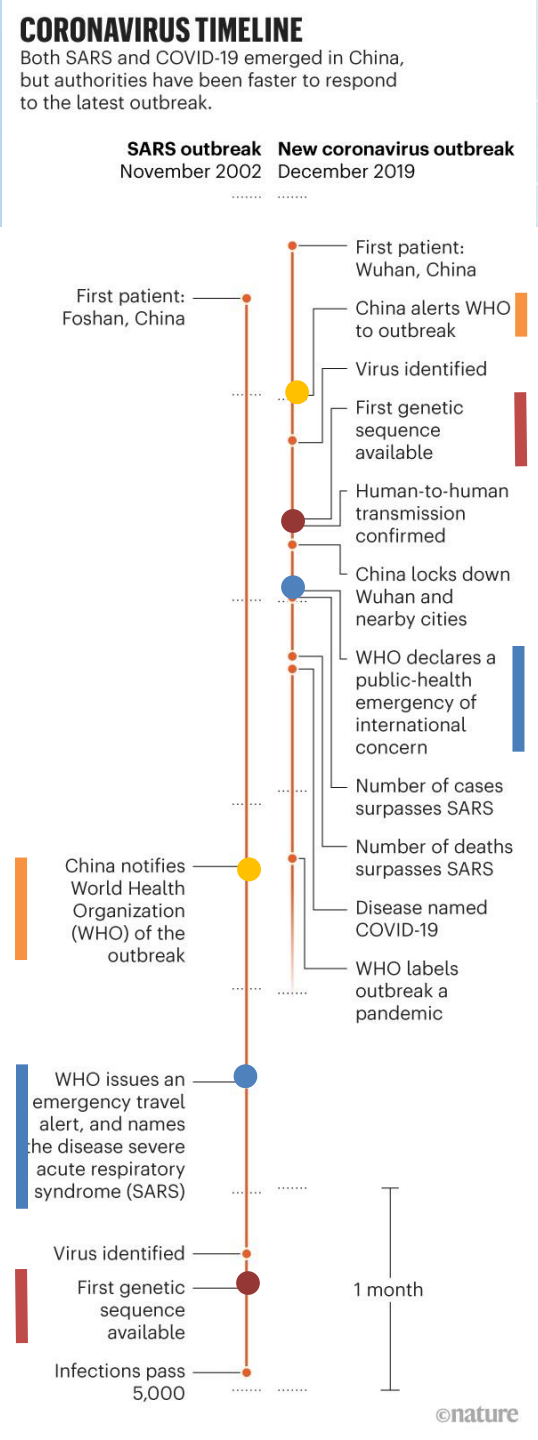
COVID-19 Timeline
We didn't know what we didn't know





https://curriculum.covidstudentresponse.org/module-1-from-bench-to-bedside/basic-virology-and-immunology

SARS versus COVID Timelines



- **The 2003 SARS outbreak went on for three months before being identified as a distinct disease**
  - **Then, for nearly two more months, it was a disease in search of a pathogen: the identification and genomic sequencing of the virus itself largely came from researchers outside China.**
- **By contrast, three weeks after the first known case of the disease now known as COVID-19, China had notified the WHO of a spike in cases of a pneumonia-like disease**
  - **Two weeks after that, the coronavirus had been isolated, genetically sequenced, and a diagnostic test developed, giving China the tools it needed to launch one of the greatest infectious-disease containment efforts the world has ever seen**
- **Comparison**
  - **The COVID-19 virus, although not as lethal as SARS, has proved much more pervasive**
  - **Took less than two months from the discovery of the first infection for the number of confirmed cases to pass the total that SARS reached over several months**
  - **In three months, COVID-19 has killed more than five times as many people as SARS**

Nature 579, 482-483 (2020). doi: https://doi.org/10.1038/d41586-020-00758-2

Where did COVID-19 come from?

AREAS OF BROAD AGREEMENT

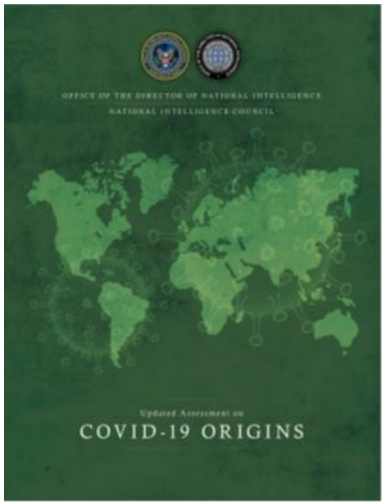
- First known cluster of COVID-19 cases emerged in Wuhan, China in December 2019
- Virus not developed as a biological weapon
- Virus not genetically engineered
- China's officials unaware of virus before pandemic emerged

TWO PLAUSIBLE HYPOTHESES ON INITIAL HUMAN EXPOSURE

- Natural transmission from animal to human
- Laboratory-associated incident
- Evidence not strongly diagnostic of either hypothesis

CHINA'S COOPERATION KEY TO UNDERSTANDING ORIGINS

- Beijing's lack of cooperation on origins not diagnostic of either hypothesis
- Numerous information gaps, particularly related to technical data

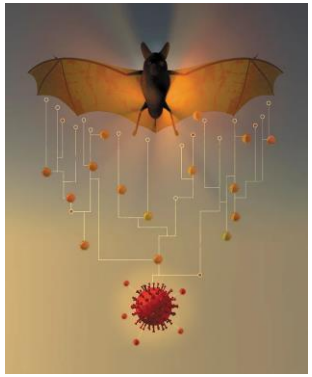


https://www.dni.gov/files/ODNI/documents/assessments/Declassified-Assessment-on-COVID-19-Origins.pdf

Understanding the Spread of COVID

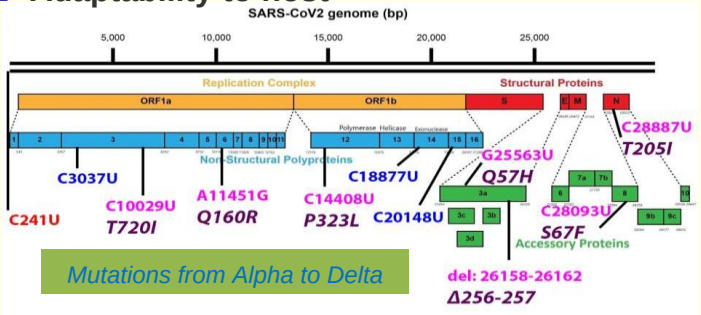
The Virus and Countermeasures

Origins



1 Virus Properties (VP) (e.g.)

- ❑ Virulence
- ❑ Transmissibility (e.g., Asymptomatic)
- ❑ Mechanisms of action
- ❑ Replication & Mutations
- ❑ Adaptability to host



- noncoding nucleotide mutations (noncoding) (red)
- synonymous mutations (minor) (blue)
- nonsynonymous mutations (change the gene that is expressed) (pink)
- corresponding amino acid mutations (purple)

2 Non-pharmaceutical interventions (NPI) (e.g.)

- ❑ Social distancing
- ❑ Wearing masks
- ❑ Infection control
- ❑ Testing
- ❑ Contact tracing
- ❑ Biosurveillance
- ❑ Telework (incl schools)
- ❑ Quarantine

3 Pharmaceutical interventions (PI) (e.g.)

- ❑ Supportive care
- ❑ Antivirals
- ❑ Vaccines
- ❑ Monoclonal antibody treatment

These 3 areas are related

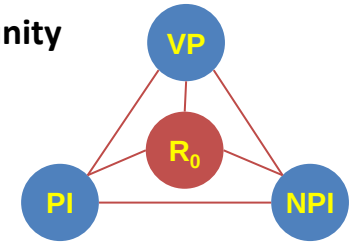
Effect on R naught (R_0)

R_0 is basic reproduction number, or how many other people an infected individual will infect

<1=not sustained transmission
>1=sustained transmission
Higher the R_0, the greater the spread

COVID-19 R_0

- Originally thought to be 2-3
- Did not know about asymptomatic transmission
- Delta variant could be 6-9
- Breakthroughs for vaccinated and ability to transmit is problematic
- Unvaccinated population increases spread
- More opportunities for mutations—effect on herd immunity

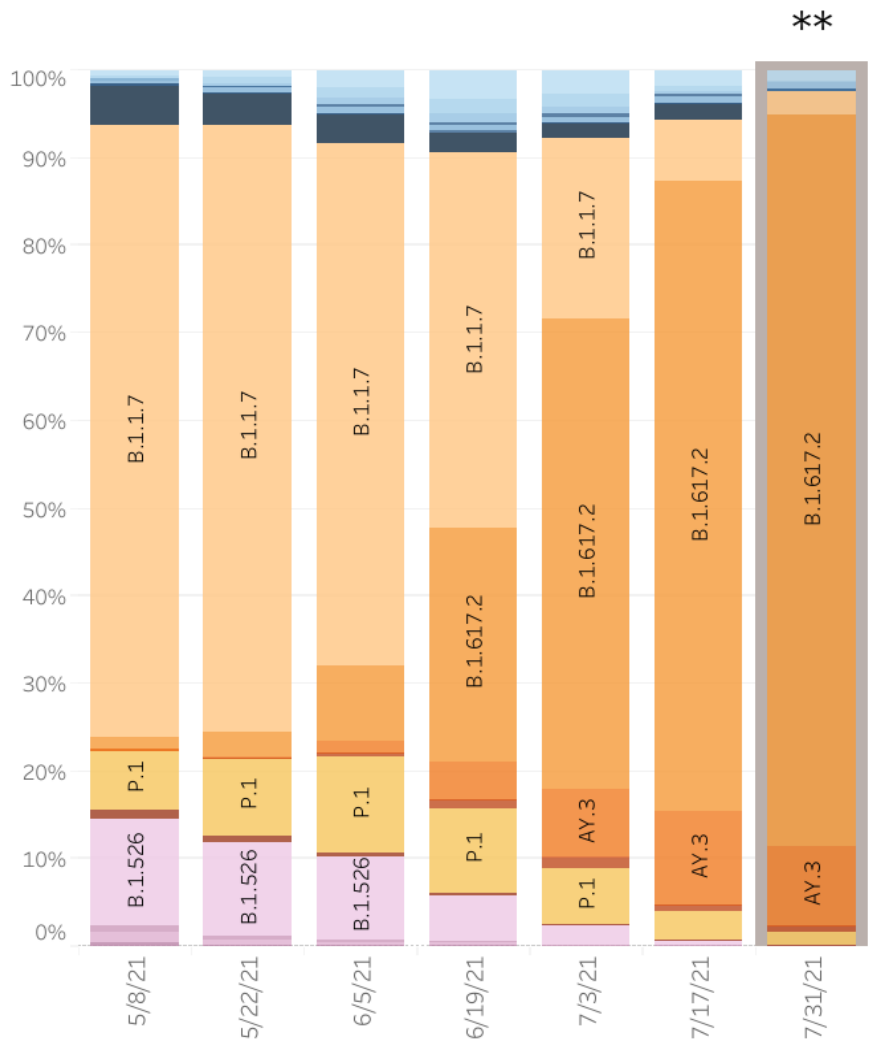


https://www.harvardmagazine.com/2020/05/r-nought
https://www.ecdc.europa.eu/en/publications-data/covid-19-guidelines-non-pharmaceutical-interventions
https://www.scientificamerican.com/article/how-chinas-bat-woman-hunted-down-viruses-from-sars-to-the-new-coronavirus1/

Variant Tracking

United States: 4/25/2021 – 7/31/2021

Earn MileagePlus Frequent Flyer Miles | United Airlines
https://www.united.com/web/en-US/content/mileageplus/Default.aspx



USA

WHO label	Lineage #	Type	%Total	95%PI
Alpha	B.1.1.7	VOC	2.9%	1.2-4.7%
Beta	B.1.351	VOC	0.0%	0.0-0.2%
Gamma	P.1	VOC	1.3%	0.2-2.5%
Delta	B.1.617.2	VOC	83.4%	79.6-87.0%
	AY.3	VOC	9.1%	6.2-12.0%
	AY.2	VOC	0.8%	0.0-1.7%
	AY.1	VOC	0.1%	0.0-0.5%
Epsilon	B.1.427	VOI	0.0%	0.0-0.2%
	B.1.429	VOI	0.0%	0.0-0.2%
Eta	B.1.525	VOI	0.0%	0.0-0.2%
Iota	B.1.526	VOI	0.2%	0.0-0.7%
	B.1.621		1.1%	0.2-2.2%
	B.1.621.1		0.6%	0.0-1.5%
	B.1.628		0.3%	0.0-1.0%
	B.1		0.1%	0.0-0.5%
	A.2.5		0.0%	0.0-0.2%
	Other*		0.0%	0.0-0.2%
	B.1.617.3	VOI	0.0%	0.0-0.2%
	B.1.626		0.0%	0.0-0.2%

* Enumerated lineages are VOI/VOC or are circulating >1% in at least one HHS region during at least one two week period; remaining lineages are aggregated as "Other".
** These data include Nowcast estimates, which are modeled projections that may differ from weighted estimates generated at later dates
# Sublineages of P.1 and B.1.351 (P.1.1, P.1.2, B.1.351.2, B.1.351.3) are aggregated with the parent lineage and included in parent lineage's proportion. AY.1, AY.2, and AY.3 are no longer aggregated with B.1.617.2.

https://covid.cdc.gov/covid-data-tracker/#variant-proportions

US Laws Governing Public Health (Select)

From https://constitution.findlaw.com/amendment14/annotation07.html and https://www.cdc.gov/quarantine/specificlawsregulations.html

- **The Constitution gives states "police power" to protect public health and safety**
  - **However, the 14th Amendment prevents states from infringing on "the privileges or immunities of citizens of the United States" without due process of law**
- **What does the Constitution say about public safety?**
  - **Under their reserved powers, states can create laws to promote public safety - known as "police powers," subject to Fourteenth Amendment limits which require they do not infringe on a person's constitutional rights without due process**
- **What does the Constitution say about public health?**
  - **The Tenth Amendment gives states all powers not specifically given to the federal government, including the power to make laws relating to public health. But, the Fourteenth Amendment places a limit on that power to protect people's civil liberties**
- **Does public health override the Constitution?**
  - **No. Public health regulations cannot violate a person's constitutional rights. Governors can order quarantines during a public health emergency or direct people to stay in their homes, as long as there are exceptions for food and other necessities. They can also impose curfews in the name of public health. There is even Supreme Court precedent for vaccine mandates**
- **Specific Laws and Regulations Governing the Control of Communicable Diseases**
  - **The Secretary of the Department of Health and Human Services has statutory responsibility for preventing the introduction, transmission, and spread of communicable diseases in the U.S.**
- **Legal Authorities for Isolation and Quarantine**
  - **The federal government derives its authority for isolation and quarantine from the Commerce Clause of the U.S. Constitution (See more at Legal Authorities for Isolation and Quarantine)**

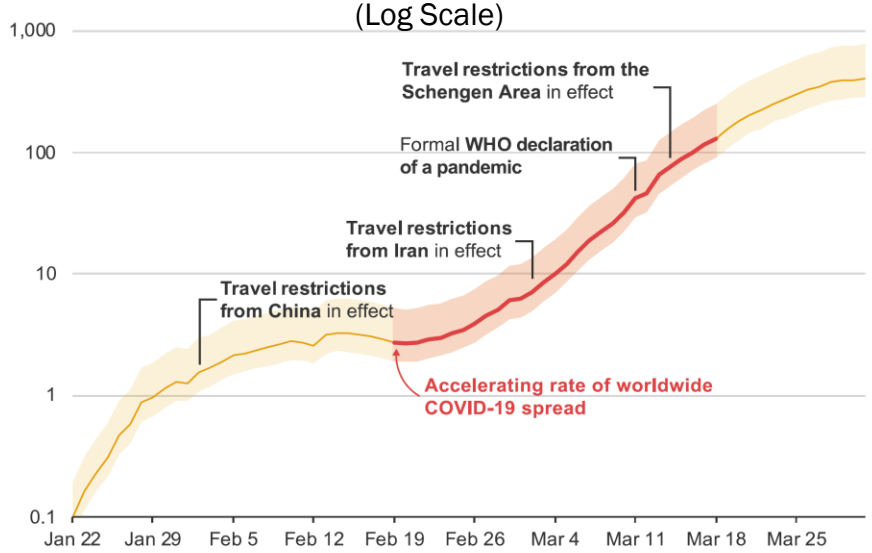
Lessons Learned--Timing

- Early during COVID-19, the U.S. was 2-4 weeks late on most key decisions which came at a significant economic and health risk cost
- Early downplaying the virus
  - Meant we had to go containment which meant social distancing and shuttering the economy
  - Uncertainty and misinformation … science versus politics
  - Confusion with American people
  - Volatility in markets
- Failures
  - Pandemic planning (did not use the Obama administration plan)
  - Testing failures (CDC test)
  - Upending two centuries of emergency management doctrine
  - Strategic communications shortfalls
- Nations that were most successful took early actions
  - Failure to learn from other nations

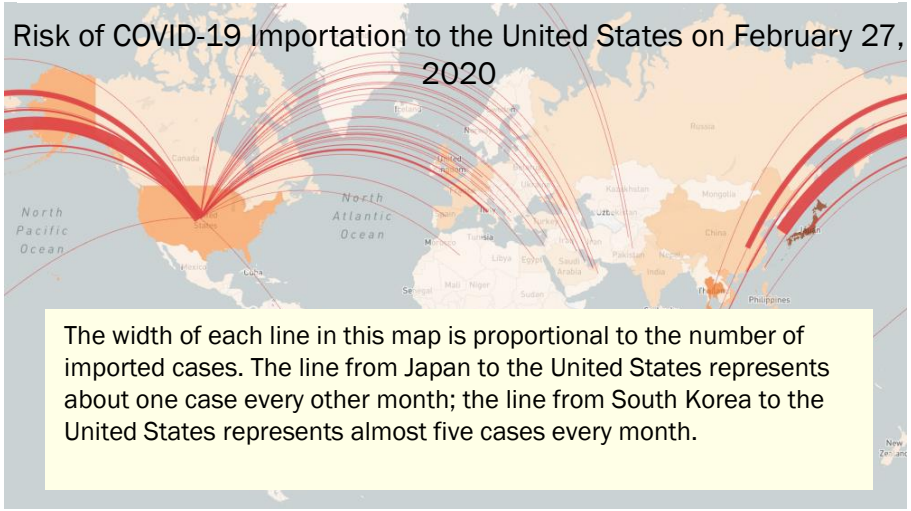
Lessons Learned--Airline Travel

- **Indications are that by the time that travel bans began to be implemented, the virus was already rapidly spreading around the world**
  - **Return of U.S. citizens turned into a "super spreader" event—Chicago as an example**
  - **Failed to realize initially that the virus was coming from both Asia and Europe**
- **Difficulty in understanding the early spread of the virus**
- **Lack of international collaboration**

Estimated Daily Global Exports of COVID-19 via Air Travel (Log Scale)



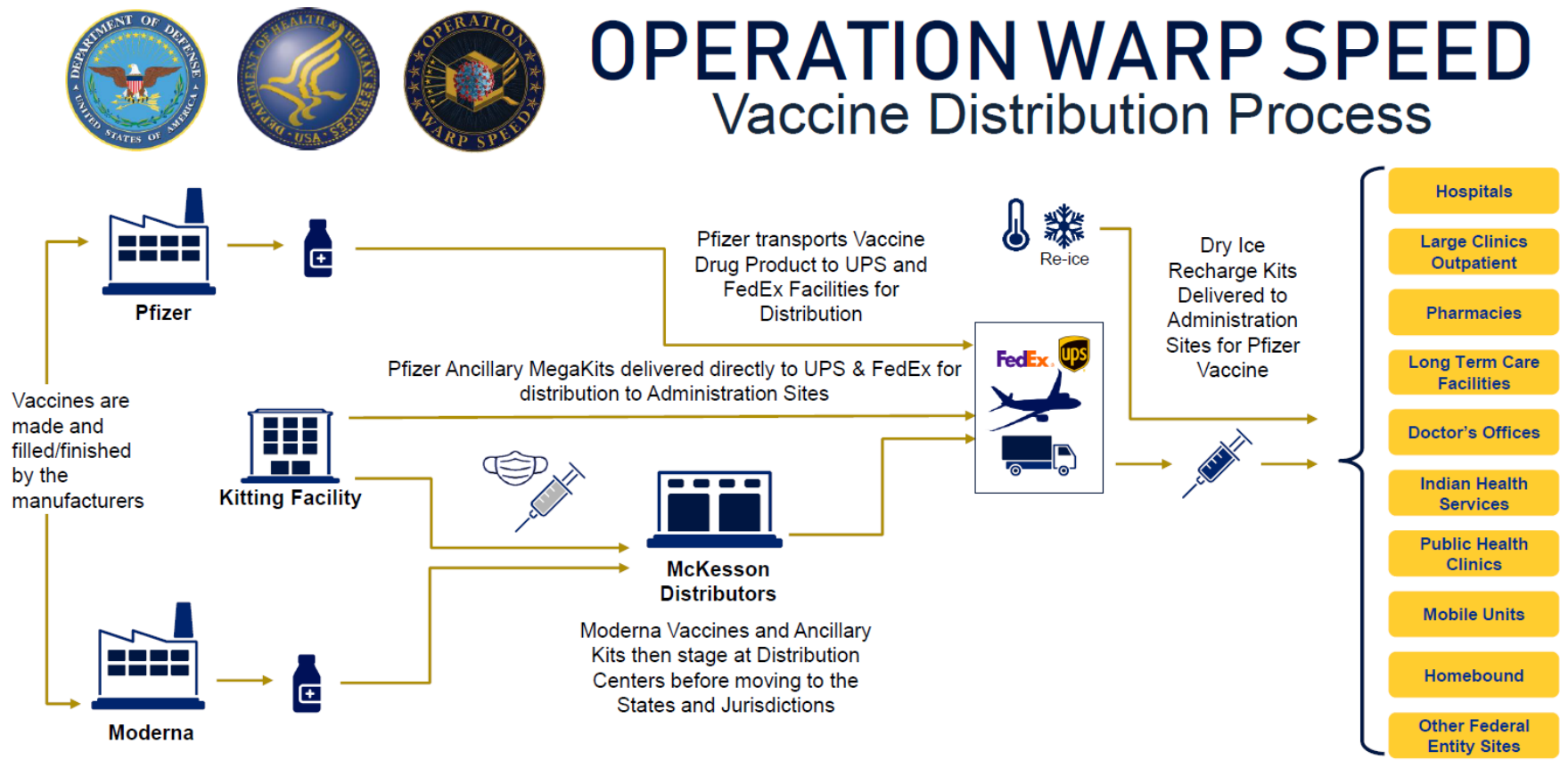
Risk of COVID-19 Importation to the United States on February 27, 2020



The width of each line in this map is proportional to the number of imported cases. The line from Japan to the United States represents about one case every other month; the line from South Korea to the United States represents almost five cases every month.

https://www.rand.org/pubs/research_reports/RRA248-6.html

Lessons Learned--Vaccine Development Versus Vaccine Delivery

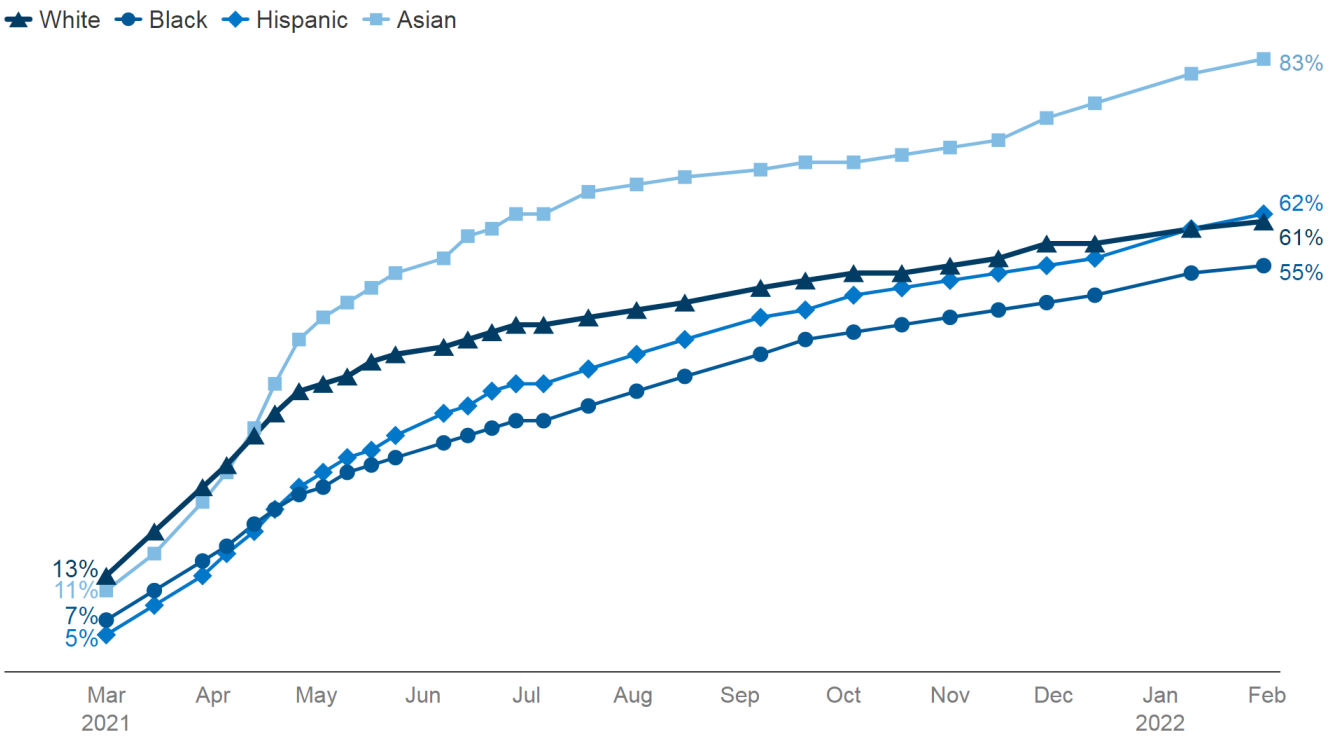


Lessons Learned – Have to Meet People Where They Are

Percent of total population vaccinated by race/ethnicity

Figure 3

Percent of Total Population that Has Received at Least One COVID-19 Vaccine Dose by Race/Ethnicity, March 1 to January 31, 2022

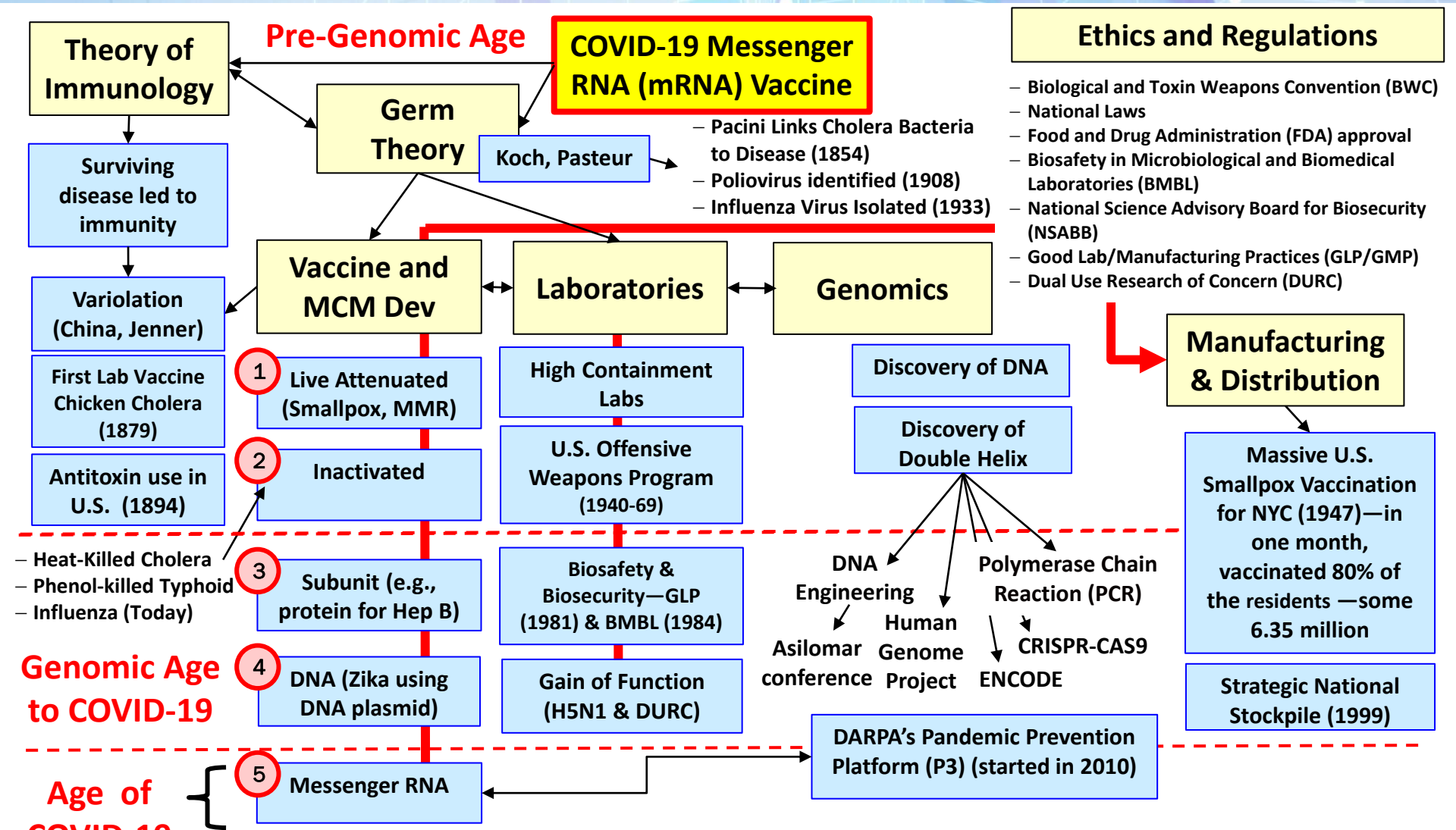


SOURCE: Vaccination data based on KFF analysis of publicly available data on state websites; total population data used to calculate rates based on KFF analysis of 2019 American Community Survey data. Number of states included in analysis varies based on available data at time of data collection. • PNG

KFF

https://www.kff.org/coronavirus-covid-19/issue-brief/latest-data-on-covid-19-vaccinations-by-race-ethnicity/

Lessons Relearned—Public-Private Partnerships & COVID-19 mRNA Vaccine

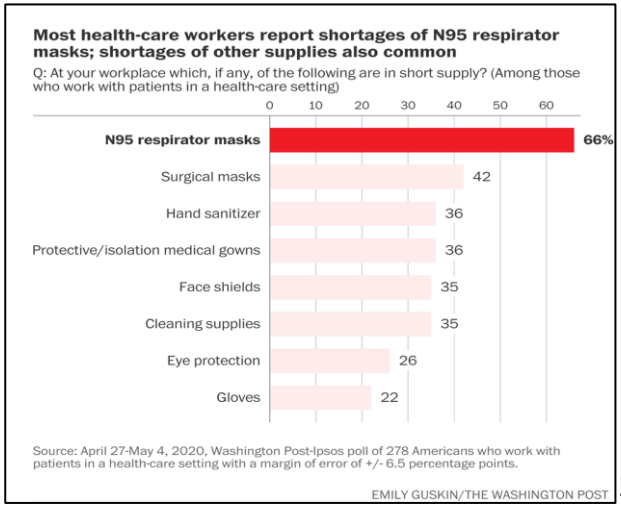


BioNTech began development of a COVID-19 vaccine on 10 January 2020, when the SARS-CoV-2 genetic sequences were released by the Chinese CDC …

https://www.historyofvaccines.org/timeline#EVT_100531

Lessons Learned--Miscellaneous

- **Delay in lockdowns led to at least 36,000 more American deaths:**
  - **"If the United States had begun imposing social-distancing measures one week earlier in March, about 36,000 fewer people would have died in the pandemic, according to new estimates from Columbia University disease modelers," the New York Times's James Glanz and Campbell Robertson report**
- **PPE shortages never went away:**
  - **"Front-line health-care workers still experienced shortages of critical equipment needed for protection from the coronavirus into early May — including nearly two-thirds who cited insufficient supplies of the face masks that filter out most airborne particles, according to a Washington Post-Ipsos poll," Lenny Bernstein and Alauna Safarpour report**
- **Failure to use what we had learned from previous disasters and through exercises and planning resulted in at exacerbating the disaster:**
  - **200+ years of Emergency Management doctrine gets a makeover**
  - **Not using the pandemic playbook developed in the Obama administration after Ebola crisis**
  - **Our supply chains are very vulnerable**
  - **A failed strategic national stockpile (SNS)**
  - **Unhealthy competition between states for resources**
  - **Lack of international collaboration and vaccine nationalism**
  - **Failures in strategic communications that continue today**
  - **Institutions no longer "fit for purpose"**



Some Concluding Thoughts-- Early in the pandemic I was asked about the long-term impacts of COVID-19 …

Winners	Too Soon to Tell	Losers
Gained momentum during this pandemic	Some are a bit counterintuitive, but … Likely restructuring	Long recovery, if at all
Communications Tele-anything (work, medicine, education) Social media and smart phones Broadband communications AR/VR **Science** Research and development Biotechnology (and novel agriculture) Artificial intelligence (AI) and robotics **Enhanced Services** Public health (& related considerations) Supply chains that stretch to our front doors	**Large-scale gatherings** Education, especially higher education Sports, concerts, etc. **Institutions** Government (FSLTT) Global collaboration on transnational issues **Spending** Defense budget Traditional agriculture Cybersecurity Economic self-sufficiency spending **Health and Medicine** Healthcare (and delivery services) Immigration (vaccination passports?)	**Tourism and travel** Transportation systems Cruise line industry and airlines **Services industries requiring close contact** Brick & mortar establishments Restaurants Lower wage/skill workers

Some Concluding Thoughts From COVID-19

Conclusions	Examples
The technology of today was the basic research of yesterday	• Human Genome Project • Messenger RNA • Coronavirus mRNA vaccine
We are using 18th century legal frameworks with 19th and 20th century processes to develop 21st century technology	• Emergency management doctrine • FDA processes and timelines for medical countermeasure (MCM) approval • Animal models vice AI, modeling & simulation (for cellular, host, community effects)
We remain challenged to identify, assess, communicate and mitigate risks	• Understanding supply chain risks • Hinders decisionmaking process • Communicating risk
Policy without science is fantasy, but science without policy is also problematic	• Hydrochloroquine and bleach (Trump administration) • CDC and mask guidance (Biden administration) • Mixed guidance on non-pharmaceutical and pharmaceutical interventions
Innovation during all phases of the pandemic remained imperative	• Accelerated move to virtual society • Operation Warp Speed for vaccine development • Last tactical mile for vaccine distribution in Biden Administration

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Questions?

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