Emerging Pathogens: Have We Learned Any Lessons?

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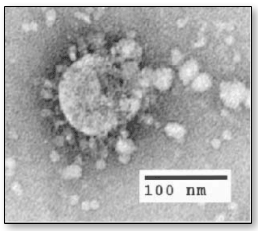

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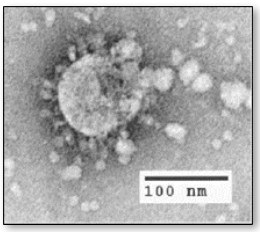

Hosted by Martin Kiernan
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May 27, 2021

Emerging Pathogens: Have We Learned Any Lessons?
Abstract

- Emerging and reemerging pathogens leading to a global pandemic is a complex issue driven by globalization and neglect for preparedness in health security. Obviously, we have reached a dangerous tipping point.

- The nature of this critical public health and healthcare problem has two primary components: 1) the emergence of diverse and novel pathogens, and 2) the alarming ability of these pathogens to be translocated and transmitted in a wide array of geographic and densely populated regions.

2

Objectives

1. Provide a BRIEF update on the current SARSCoV2 (COVID-19) pandemic.
2. Discuss the factors associated with the globalization of infectious diseases, including historical and current examples of how select pathogens can evade antimicrobial treatments, and how this confers an evolutionary advantage to that pathogen.
3. List and describe the effects of globalization in the spread of pathogens, particularly international travel and urbanization.
4. Describe how proper public policy, medical intervention strategies, and development of novel therapies can be used to curtail the emergence of pathogens.
5. Correlate the local and global issue of these pathogens through the lenses of globalization and public health.

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History and background

Virus spikes = "corona"

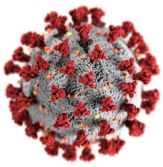

Image source: #23312 CDC/ Alissa Eckert, MSMI; Dan Higgins, MAMS

- On February 11, 2020 the World Health Organization announced an official name for the disease that is causing the 2019 novel coronavirus outbreak, first identified in Wuhan China. The new name of this virus is SARSCoV2 and the disease is coronavirus disease 2019, abbreviated as COVID-19. In COVID-19, 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease. Formerly, this disease was referred to as "2019 novel coronavirus" or "2019-nCoV".

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4

SARS-CoV-2 / COVID-19 Update

- Coronaviruses are everywhere. They are the second leading cause of the common cold (after rhinoviruses).
- Airborne transmission and are responsible for about 10-30 percent of colds worldwide.
- Seven human coronaviruses (HCoVs) have now been identified: HCoV-229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1, SARS-CoV (which causes severe acute respiratory syndrome), MERS-CoV (Middle East respiratory syndrome), and now SARS-CoV-2.

5

SARS-CoV-2 / COVID-19 Update

- Zoonotic infection meaning they can be transmitted between animals and people, but most infect only their specific animal host.
- Rarely, animal coronaviruses can evolve to infect and spread among people. This was the case with Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV).
- Coronaviruses are named for the crown-like spikes on their surface. There are four main sub-groupings of coronaviruses, known as alpha, beta, gamma, and delta.

6

DIN Image source: R. Rohde / https://onehealthplatform.com/content/james-steele-conference-diseases-nature-transmissible-man-din

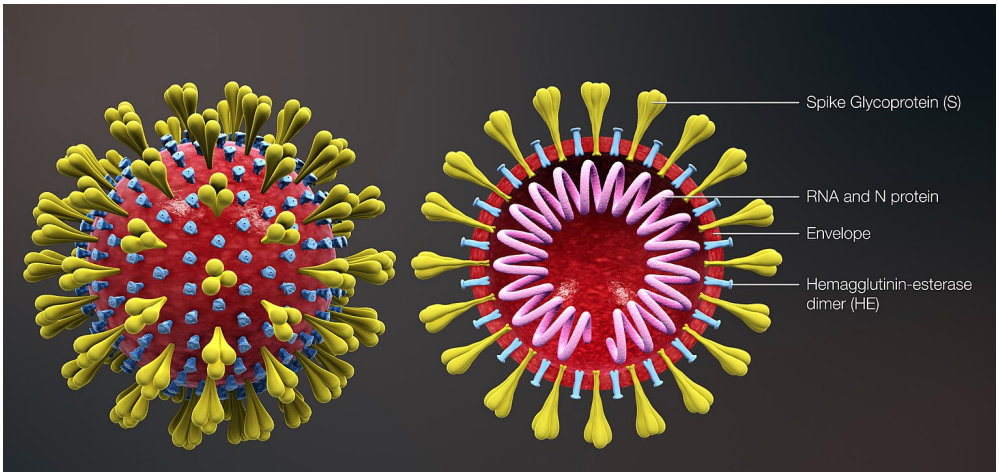
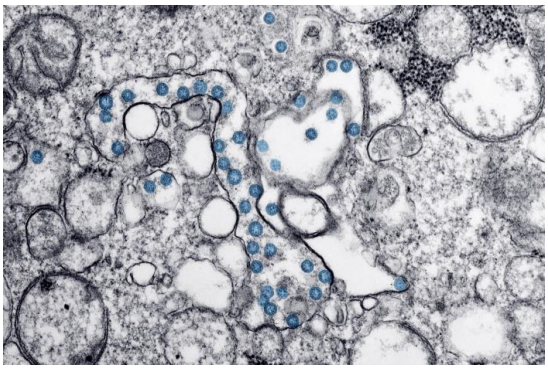


Diagram of coronavirus virion structure showing spikes that form a "crown" like the solar corona, hence the name.
Source: https://commons.wikimedia.org/wiki/File:3D_medical_animation_corona_virus.jpg

7

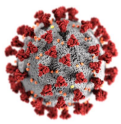
Transmission electron microscopic image of an isolate from the first U.S. case of COVID-19, formerly known as 2019-nCoV. The spherical viral particles, colorized blue, contain cross-sections through the viral genome, seen as black dots. Photo ID 23354



This image is in the public domain and thus free of any copyright restrictions. As a matter of courtesy we request that the content provider be credited and notified in any public or private usage of this image. CDC/ Hannah A Bullock; Azaibi Tamin

8

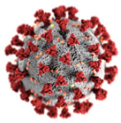
SARS-CoV-2 / COVID-19 Update



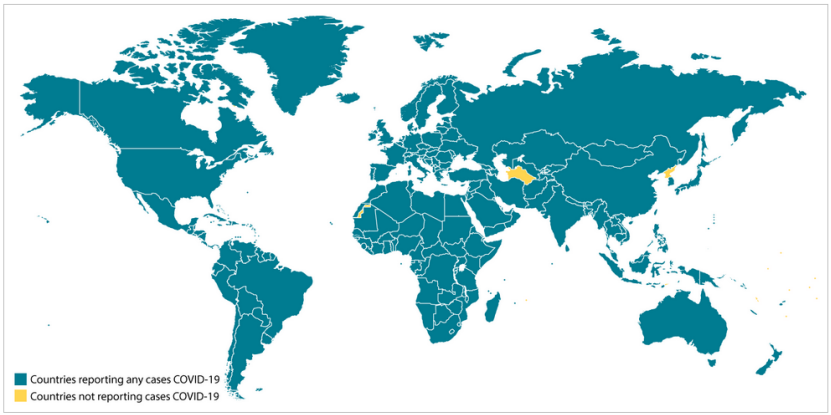
- SARS-CoV (the beta coronavirus that causes severe acute respiratory syndrome, or SARS)
  - SARS (2003) killed nearly 10% of the 8,096 people who fell ill in 29 countries (774 deaths).
- MERS-CoV (the beta coronavirus that causes Middle East Respiratory Syndrome, or MERS)
  - Since 2012, MERS has caused 2,494 confirmed cases in 27 countries and killed over 30% (858 deaths).
- SARS-CoV-2 (the novel coronavirus that causes coronavirus disease 2019, or COVID-19)
  - Provide current update for cases, mortality and geographic spread
  - Ongoing expansion

9

SARS-CoV-2 / COVID-19 Update



As of 12:00 p.m. ET July 6, 2020



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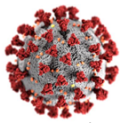
219 Countries and Territories around the world have reported a total of 142,329,811 confirmed cases of the coronavirus COVID-19 that originated from Wuhan, China, and a death toll of 3,036,631 deaths. April 19, 2021. https://www.worldometers.info/coronavirus/countries-where-coronavirus-has-spread/

10

SARS-CoV-2 / COVID-19 Update

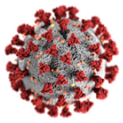


#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	142,329,811	+331,311	3,036,631	+3,740	120,981,352	18,311,828	107,538	18,260	389.6			
1	USA	32,407,610	+3,147	581,080	+19	24,961,311	6,865,219	9,804	97,452	1,747	429,244,053	1,290,773	332,547,930
2	India	15,238,620	+180,853	179,790	+997	13,052,017	2,006,813	8,944	10,957	129	267,894,549	192,620	1,390,790,274
3	Brazil	13,943,071		373,442		12,391,599	1,178,030	8,318	65,227	1,747	28,600,000	133,794	213,761,802
4	France	5,289,526		100,733		*4,115,944*	1,072,849	5,893	80,894	1,541	72,191,601	1,104,039	65,388,646
5	Russia	4,710,690	+8,589	105,928	+346	4,333,598	271,164	2,300	32,268	726	126,000,000	863,106	145,984,373
6	UK	4,390,783	+2,963	127,274	+4	4,156,135	107,374	332	64,409	1,867	140,944,028	2,067,538	68,169,978
7	Turkey	4,268,447		35,926		3,687,590	544,931	3,275	50,181	422	43,768,759	514,562	85,060,273
8	Italy	3,870,131		116,927		3,248,593	504,611	3,311	64,085	1,936	55,094,444	912,298	60,390,869
9	Spain	3,407,283		76,981		3,129,234	201,068	2,180	72,853	1,646	44,285,495	946,894	46,769,223
10	Germany	3,151,030		80,591		2,787,200	283,239	4,740	37,513	959	52,737,238	627,844	83,997,426
22	Canada	1,127,037	+5,539	23,656	+33	1,014,778	88,603	1,167	29,655	622	29,907,670	786,934	38,005,328

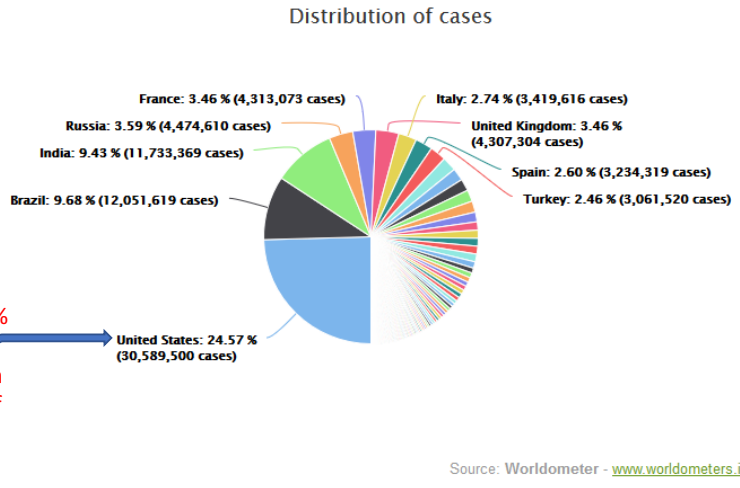
Top 10 Countries – April 19, 2021.
https://www.worldometers.info/coronavirus/#countries

11

SARS-CoV-2 / COVID-19 Update



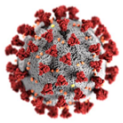
Countries cases distribution



U.S. has 5% of global population but 25% of cases!

12

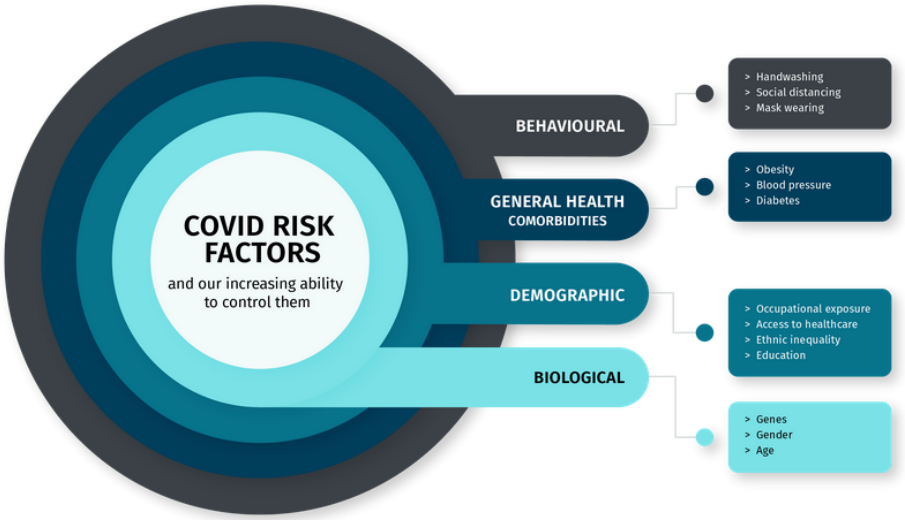
SARS-CoV-2 / COVID-19 Update



#	USA State	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	USA Total	32,407,610	+3,147	581,080	+19	24,961,311	6,865,219	97,907	1,756	429,244,053	1,296,799	
1	California	3,718,705		61,033		1,973,185	1,684,487	94,115	1,545	57,733,460	1,461,154	39,512,223
2	Texas	2,854,153		49,820		2,714,332	90,001	98,433	1,718	27,053,574	933,014	28,995,881
3	Florida	2,168,901		34,446		1,707,416	427,039	100,984	1,604	26,759,902	1,245,937	21,477,737
4	New York	2,045,065		51,856		1,373,678	619,531	105,125	2,666	48,960,229	2,516,775	19,453,561
5	Illinois	1,302,241		23,955		1,186,586	91,700	102,767	1,890	21,729,314	1,714,774	12,671,821
6	Pennsylvania	1,111,381		25,798		982,218	103,365	86,813	2,015	12,470,307	974,091	12,801,989
7	Georgia	1,084,272		19,758		846,308	218,206	102,122	1,861	8,616,406	811,535	10,617,423
8	Ohio	1,053,175		18,991		995,003	39,181	90,099	1,625	11,559,232	988,890	11,689,100
9	New Jersey	978,853		25,143		744,817	208,893	110,204	2,831	12,914,501	1,453,977	8,882,190
10	North Carolina	943,693		12,387		900,174	31,132	89,978	1,181	11,874,945	1,132,232	10,488,084

Top 10 U.S. States – April 19, 2021.
https://www.worldometers.info/coronavirus/country/us/

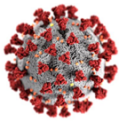
13

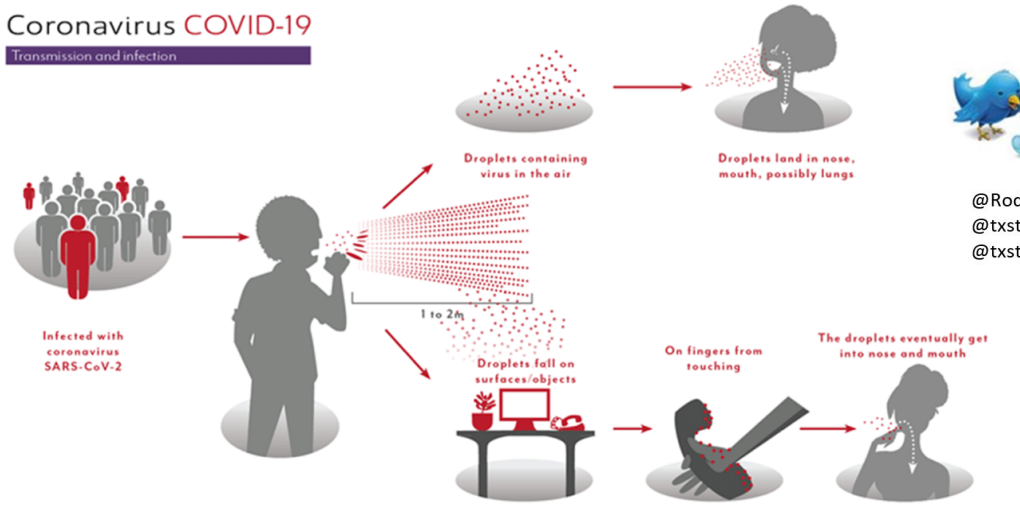


Risk factors impacting your susceptibility to COVID-19 & your ability to control them. Credit: Molly Patton

14

SARS-CoV-2 / COVID-19 Update





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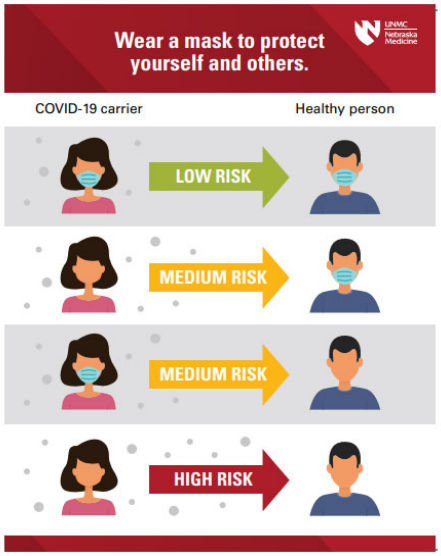
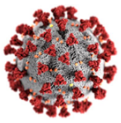
15

SARS-CoV-2 / COVID-19 Update

Masks – research and evidence show they work!





- N95 Masks
- Surgical (procedural masks)
- Cloth Masks
- Face shields

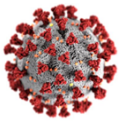
Image source: https://www.nebraskamed.com/COVID/coronavirus-is-not-canceled-wear-your-mask

https://www.youtube.com/channel/UCtWrOlPkjfLm2_i1G3ZVWBg

16

SARS-CoV-2 / COVID-19 Update

Masks – research and evidence show they work!



#TXSTrespect

https://www.youtube.com/channel/UCtWrOlPkjfLm2_i1G3ZVWBg

17

Your risk of COVID19

Those Who Need Extra Precautions

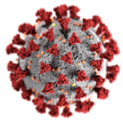
- Racial & Ethnic Minority Groups
- People with Disabilities
- People with Developmental & Behavioral Disorders
- Pregnant People
- People Experiencing Homelessness

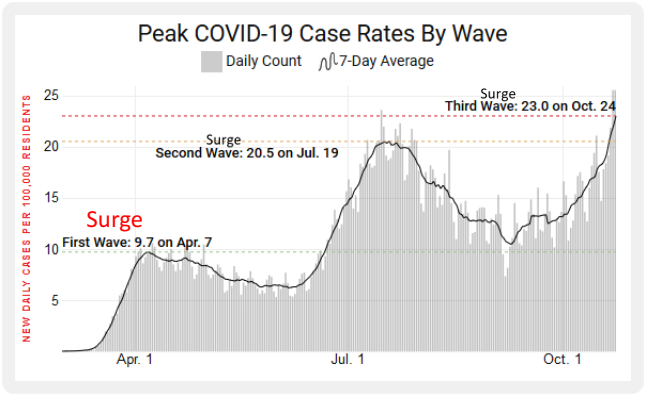
- Take home message – IMMUNOCOMPROMISED (generally at more risk)
- #Superspreader events are REAL!
  - Church/choir, bars, large gatherings (rallies, etc.) where precautions are not used

18

https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/other-at-risk-populations.html

SARS-CoV-2 / COVID-19 Update





https://time.com/5903673/record-daily-coronavirus-cases/

Just days before a momentous and unpredictable Presidential election, the United States has reached a new record high in the number of daily COVID-19 infections, surpassing the peak in mid-July during the second surge of the coronavirus pandemic's domestic toll.

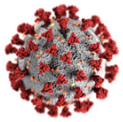
As of Oct. 24, there was a weekly average of 23.0 infections per 100,000 residents, up from 20.5 on July 19 and ticking rapidly upward.

The country also set a new single-day record on Oct. 23 with 83,757 new cases.

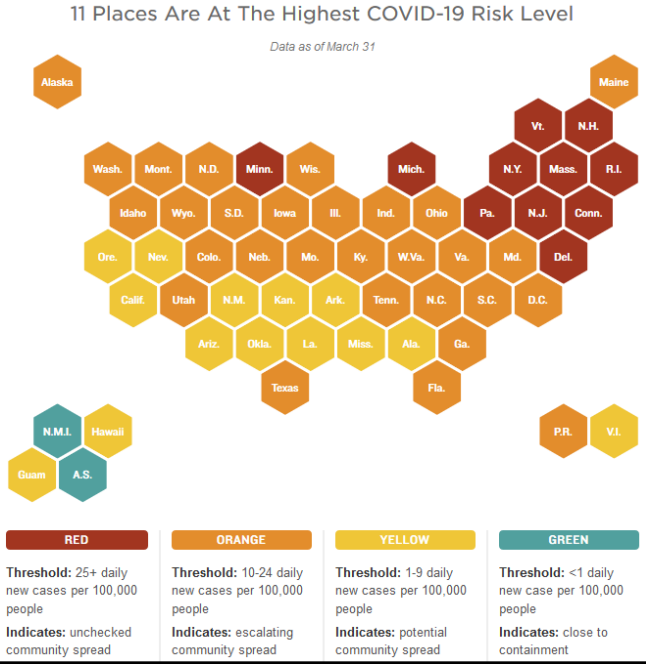
Thursday, Feb 4 2021: **US records more than 5,000 Covid deaths in single day after data audit** [5,077 deaths]

19

SARS-CoV-2 / COVID-19 Update

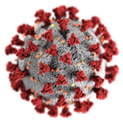


Source: https://www.npr.org/sections/health-shots/2020/09/01/816707182/map-tracking-the-spread-of-the-coronavirus-in-the-u-s



20

SARS-CoV-2 / COVID-19 Update



THE HIGHEST-RISK PLACES INCLUDE:

STATE	RISK LEVEL	AVG. THIS WEEK	PER 100K	2 WEEK TREND
Michigan	RED	5,686 new cases/day	57 per 100K	+125%
New Jersey	RED	4,411 new cases/day	50 per 100K	+19%
New York	RED	8,089 new cases/day	42 per 100K	+16%
Connecticut	RED	1,229 new cases/day	34 per 100K	+52%
Rhode Island	RED	360 new cases/day	34 per 100K	-3%

Source: https://www.npr.org/sections/health-shots/2020/09/01/816707182/map-tracking-the-spread-of-the-coronavirus-in-the-u-s

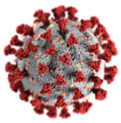
Note: Daily cases are a 7-day average to smooth out day-to-day variations in the data. Risk levels are based on a scale developed by the Harvard Global Health Institute and a collaboration of top scientists at institutions around the country.

Source: Center for Systems Science and Engineering at Johns Hopkins University, Census Bureau 2019 population estimates, 2010 Census (U.S. territories)

The map above shows the risk of infection in each state based on new daily cases per capita. The consortium of researchers and public health experts who developed these risk levels advises states in the red category to issue stay-home orders. They advise orange states to consider stay-home orders, along with increased testing and contact tracing. Yellow states need to keep up social distancing and mask usage, and all states should continue testing and contact tracing.

21

SARS-CoV-2 / COVID-19 Update



- The best way to prevent illness is to avoid being exposed to this virus (avoid high case areas).
  - Hand hygiene / avoid high touch surfaces
  - Physically distance (at least 6 feet / avoid enclosed areas)
  - Use a mask [don't let the perfect be the enemy of the good]
  - Ventilation matters
  - Clean and disinfect (EPA N list)
  - Monitor your health and those around you

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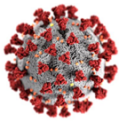
22

SARS-CoV-2 / COVID-19 Update



- Treatment / therapy options
  - Remdesivir (antiviral)
  - Convalescent plasma
  - Monoclonal antibodies [REGN-COV2 (2 MABs) cocktail & Eli Lilly]; others in development
  - Steroids [dexamethasone]
  - Patient position [on tummy if severe illness]

23

Virus mutation

- Coronaviruses do not have segmented genomes [like flu] and cannot reassort. Instead, the coronavirus genome is made of a single, very long piece of RNA. However, when two coronaviruses infect the same cell, they can recombine, which is different than reassortment.
- In recombination, a new single RNA genome is stitched together from pieces of the two "parental" coronaviruses genomes. It's not as efficient as reassortment, but scientists believe that coronaviruses have recombined in nature.
- When this happens, scientists identify the resulting virus as a "novel coronavirus." The generation of a novel coronavirus, although occurring by a different mechanism than antigenic shift in influenza viruses, can have a similar consequence, with pandemic spread.

24

SARS-CoV-2 Variant Classifications and Definitions

- Genetic variants of SARS-CoV-2 have been emerging and circulating around the world throughout the COVID-19 pandemic.
- Viral mutations and variants in the United States are routinely monitored through sequence-based surveillance, laboratory studies, and epidemiological investigations.
- A US government interagency group developed a Variant Classification scheme that defines three classes of SARS-CoV-2 variants:
  - Variant of Interest – low level
  - Variant of Concern – moderate level
  - Variant of High Consequence – high level
- The B.1.1.7, B.1.351, P.1, B.1.427, and B.1.429 variants circulating in the United States are classified as variants of concern

25

SARS-CoV-2 Variant of Concern

- A variant for which there is evidence of an increase in transmissibility, more severe disease (increased hospitalizations or deaths), significant reduction in neutralization by antibodies generated during previous infection or vaccination, reduced effectiveness of treatments or vaccines, or diagnostic detection failures.
- Possible attributes of a variant of concern (in addition to the possible attributes of a VOI):
  - Evidence of impact on diagnostics, treatments, and vaccines
  - Widespread interference with diagnostic test targets
  - Evidence of substantially increased resistance to one or more class of therapies
  - Evidence of significant decreased neutralization by antibodies generated during previous infection or vaccination
  - Evidence of reduced vaccine-induced protection from severe disease
  - Evidence of increased transmissibility
  - Evidence of increased disease severity

26

Name (Pango lineage)	Spike Protein Substitutions	Name (Nextstrain[a])	First Detected	BEI Reference Isolate[b]	Known Attributes
B.1.1.7	Δ69/70 Δ144Y (E484K*) (S494P*) N501Y A570D D614G P681H	20I/501Y.V1	United Kingdom	NR-54000	• ~50% increased transmission [5] • Likely increased severity based on hospitalizations and case fatality rates [6] • Minimal impact on neutralization by EUA monoclonal antibody therapeutics [7, 14] • Minimal impact on neutralization by convalescent and post-vaccination sera [8,9,10,11,12,13,19]
P.1	K417N/T E484K N501Y D614G	20J/501Y.V3	Japan/ Brazil	NR-54982	• Moderate impact on neutralization by EUA monoclonal antibody therapeutics [7,14] • Reduced neutralization by convalescent and post-vaccination sera [15]
B.1.351	K417N E484K N501Y D614G	20H/501.V2	South Africa	NR-54009	• ~50% increased transmission[16] • Moderate impact on neutralization by EUA monoclonal antibody therapeutics [7,14] • Moderate reduction on neutralization by convalescent and post-vaccination sera

27

B.1.427	L452R D614G	20C/S:452R	US-California		• ~20% increased transmissibility [21] • Significant impact on neutralization by some, but not all, EUA therapeutics • Moderate reduction in neutralization using convalescent and post-vaccination sera [21]
B.1.429	S13I W152C L452R D614G	20C/S:452R	US-California		• ~20% increased transmissibility [21] • Significant impact on neutralization by some, but not all, EUA therapeutics • Moderate reduction in neutralization using convalescent and post-vaccination sera [21]

(*)=detected in some sequences but not all
a – Nextstrain
b – The Biodefense and Emerging Infections Research Resources (BEI Resources) is a NIAID-funded repository to provide reagents, tools, and information to the research community. The reference viruses proposed here facilitate the harmonization of information among all stakeholders in the COVID-19 pandemic research community. Please note that the reference viruses provided in the tables below are based on what is currently available through the BEI resources.

These variants share one specific mutation called D614G. This mutation was one of the first documented in the US in the initial stages of the pandemic, after having initially circulated in Europe[13]. There is evidence that variants with this mutation spread more quickly than viruses without this mutation[1,2].

28

SARS-CoV-2 Variant of High Consequence

- **A variant of high consequence has clear evidence that prevention measures or medical countermeasures (MCMs) have significantly reduced effectiveness relative to previously circulating variants.**
- **Possible attributes of a variant of high consequence** (i*n addition to the possible attributes of a VOC):*
- Impact on Medical Countermeasures (MCM)
  - Demonstrated failure of diagnostics
  - Evidence to suggest a significant reduction in vaccine effectiveness, a disproportionately high number of vaccine breakthrough cases, or very low vaccine-induced protection against severe disease
  - Significantly reduced susceptibility to multiple Emergency Use Authorization (EUA) or approved therapeutics
  - More severe clinical disease and increased hospitalizations

29

SARS-CoV-2 Variant of High Consequence

- A variant of high consequence would require public health officials declare a **PHEIC (if not already declared), reporting to CDC, an announcement of strategies to prevent or contain transmission, and recommendations to update treatments and vaccines.
- Currently there are no SARS-CoV-2 variants that rise to the level of high consequence.

30 **Public Health Emergency of International Concern

SARS-CoV-2 Variant Epidemiology

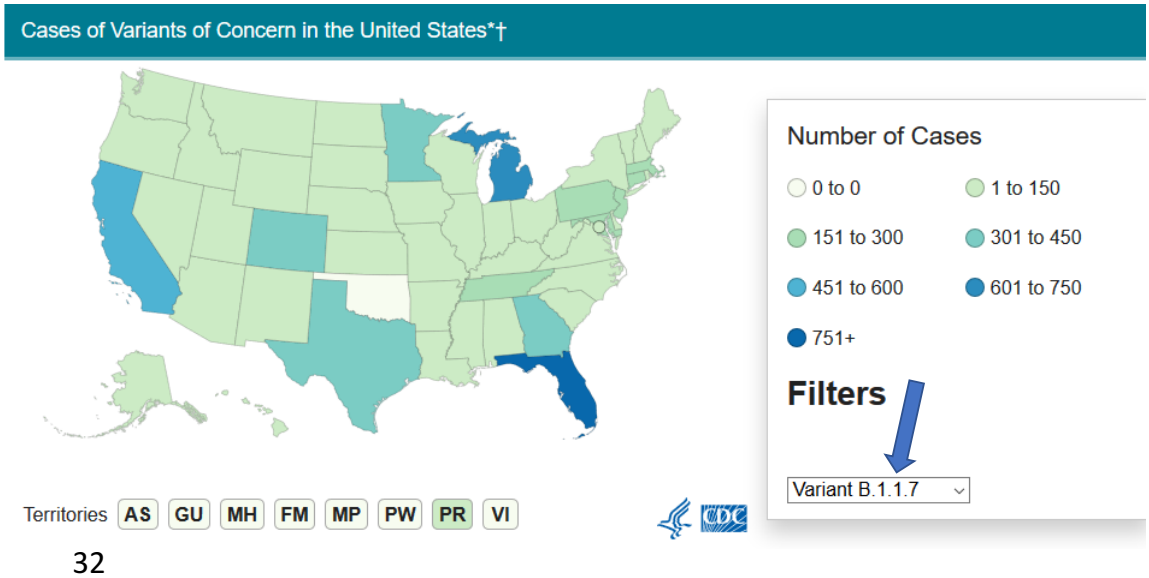
US COVID-19 Cases Caused by Variants

Updated Mar. 21, 2021 Languages Print

Variant	Reported Cases in US	Number of Jurisdictions Reporting
B.1.1.7	6390	51
B.1.351	194	27
P.1	54	18

31

SARS-CoV-2 Variant Epidemiology



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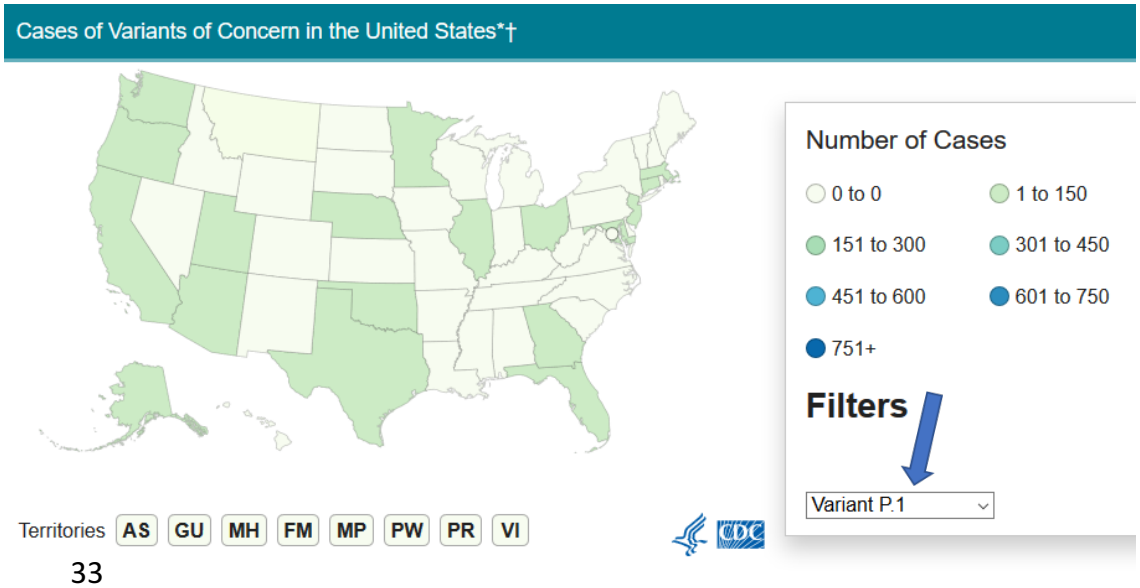
SARS-CoV-2 Variant Epidemiology



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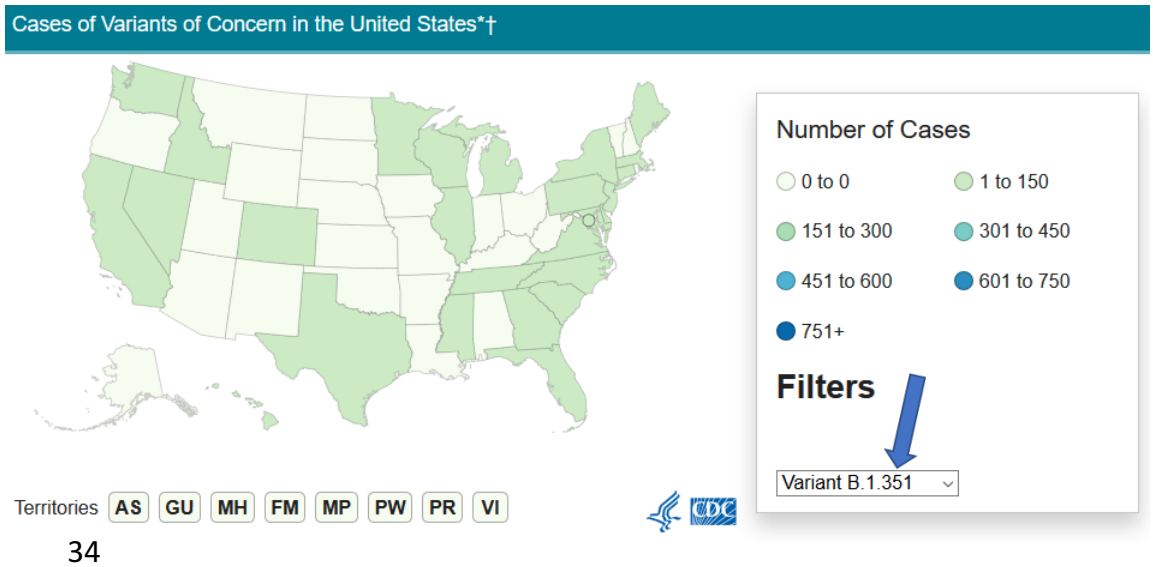
SARS-CoV-2 Variant Epidemiology



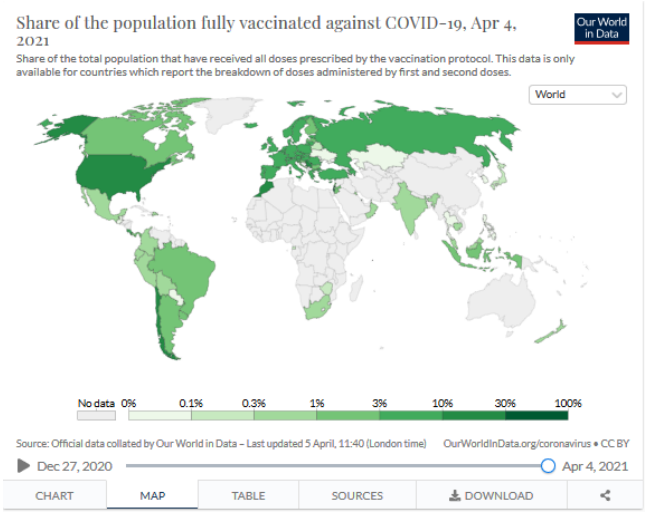
34

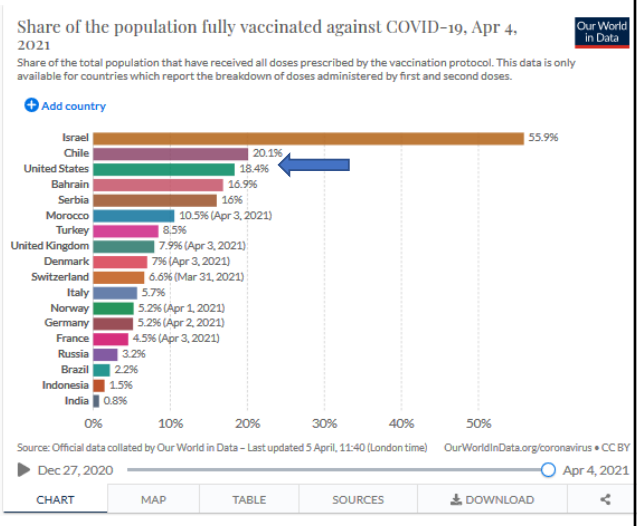
Vaccines

Key features of the COVID-19 vaccine frontrunners

	Pfizer/ BioNTech BNT162b2	Moderna mRNA-1273	AstraZeneca/ Oxford ChAdOx1-S/ AZD1222	Janssen (Johnson & Johnson) Ad26COVS1
Type of vaccine	mRNA in lipid nanoparticles	mRNA in lipid nanoparticles	Non-replicating adenovirus vector	Non-replicating adenovirus vector
Dosage	2 doses 21 days apart	2 doses 28 days apart	2 doses 28 days apart	1 dose or 2 doses 56 days apart
Antibody detection	7 days after booster	14 days after booster	14 days after booster	14 days after booster
Efficacy	95%	95%	70%	N.A. ~80%
Planned production volume	50M (2020) 1.3B (2021)	20M (2020) 0.5-1B (2021)	3B (2021)	1B (2021)
Storage requirement	-70°C±10°C	-20°C	2-8 °C	2-8 °C
Shelf life once thawed	5 days	30 days	180 days	180 days
Phase III trial enrollment	43,000 (age 16-85)	30,000 (age 18+)	11,500 (age 18+)	Single dose 60,000 Two dose 30,000 (age 18 +)

35





36

https://ourworldindata.org/covid-vaccinations

Emerging Pathogens: Have We Learned Any Lessons?
Globalization & Infectious Diseases

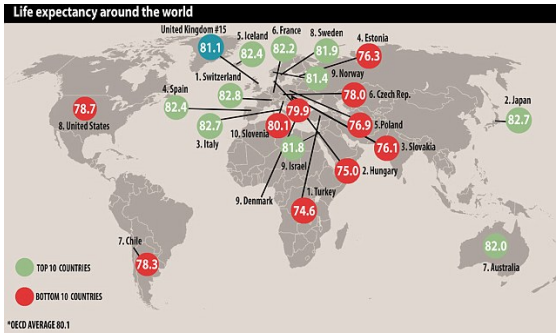
- Several human activities that characterize the Anthropocene account for the increases in NTDs.
- See figure to facilitate the emergence of two of the most devastating NTDs in 2014 and 2015—Ebola and Zika virus infections, respectively.
- AND, the return of vaccine-preventable diseases – measles, polio, pertussis, etc.

Figure: The major forces arising out of the Anthropocene now promoting the emergence of catastrophic neglected tropical diseases (NTDs). doi:10.1371/journal.pntd.0004648.g002 (Hotez, 2016)

37

Globalization & Infectious Diseases

- **Global Health Revolution**
  - **Global life expectancy**
    - **1948 – 46 years**
    - **1999 – 65 years**
    - **2015 – 71 years**



- **Global health revolution**
  - Health care and prevention, communications, agricultural productivity, trade
  - While life expectancy around the world has risen by an average of 10 years in rich nations, the *US is lagging behin*d. It is among the bottom 10 countries….

38

Science and the "Conquest" of Infectious Disease

- Scientific triumphs: Antibiotics, Vaccines, Sanitation
- Led scientists 60 years ago to proclaim that "we" would conquer infectious disease by turn of 21st century (1977: Smallpox Zero)
- Other "conquests" in public health or medicine?

39

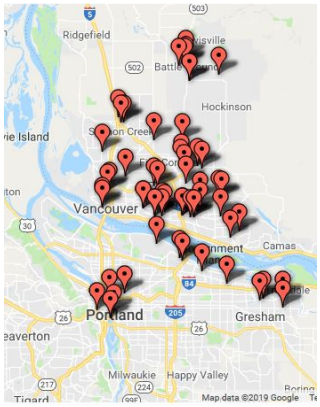
But….hold up!

- Optimism based on false assumptions:
  - Diseases could be geographically isolated / "systematically controlled"
  - Microbes didn't change / "We're smarter"

40

Microbes don't read the books or play by the rules!

- Since 1973:
- ~31 Emerging Infectious Diseases (EIDs)
  - HIV/AIDS, Hepatitis C; Lyme Disease, Ebola, Hantavirus, SARS, Zika, etc.
- ~20 Reemerging Diseases
  - MEASLES, TB, diphtheria, malaria, cholera, yellow fever, etc.



Clark County Public Health has confirmed 64 measles cases in its ongoing outbreak investigation.

41

Interdependence: The Shrinking World

- 1 billion people cross international borders each year or 25/second
  - unprecedented vulnerability
  - Threats spread faster, further, and non-linear
- Increased threats of global pandemics
  - Significant risk in resource-poor countries with under funded public and animal health systems

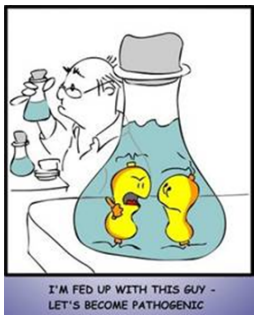
Source: Professor William Powderly, J. William Campbell Professor of Medicine, Director, Institute for Public Health, *Health Challenges : The Need for Transdisciplinary Science*

42

Factors Leading to Emergence and Reemergence of Infectious Disease

I. Microbial Adaptation

- Genetic mutation and evolution
- Resistance to antibiotics
- Resistance to pesticides / disinfectants (e.g. malaria, HAIs)



43

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

C. Global Commerce and Travel

- Air Travel since the 1970s (^ transmission)
- Movement of People (tourists, migrants, military personnel) spread pathogens to new populations
  - Sometimes naïve populations (low immunity)
- Commerce spreads contaminants across borders via food, plants
- Hitchhiking insects (e.g. Foot and Mouth Disease)

44

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

D. Globalization of Food Supplies

- Free trade and comparative advantage
- Limited regulation of food production, preparation, handling and outdated laws
- Cheap animal feed (Mad Cow Disease and new variant -- Creutzfeldt-Jakob)
  - (e.g. human food lobby, animal industry & McDonalds)

45

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

E. Economic Development & Environmental Degradation

- Changes in land use > reforestation; encroachment on tropical forests; conversion of grasslands to farms; clearance of rainforests
- Zoonotic diseases (animal > human)
  - e.g. Flu, SARS

46

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

E. Economic Development & Environmental Degradation

- Changes in water management (dam building) spreads water-breeding vectors (mosquitoes, snails)
  - malaria in Nile valley

Undermines local livelihoods forcing migration

47

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

F. Climate Change

- Climate change / global warming favors mosquitoes, rodents, other insects > spread of malaria in highland areas; spread of subtropical diseases into US
- Ocean algae blooms
- Weather patterns (impact of floods, droughts)

48

Factors Leading to Emergence and Reemergence of Infectious Disease

II. Human Activity

G. Breakdown of Public Health & Medical Laboratory

- Complacency > faith in antibiotics and vaccines undermined spending
- Failure to keep up with new technologies
- National disasters and economic collapses (impact of structural adjustment programs)
- Hidden professions / recognition / understanding

49

Do we know what's coming next? Emerging Pathogens

- On 24-25 January 2017, the WHO held an informal consultation in Geneva, Switzerland, to review the list of priority diseases for the WHO R&D Blueprint.
- The R&D Blueprint focuses on severe emerging diseases with potential to generate a public health emergency, and for which insufficient or no preventive and curative solutions exist.
- The original list of diseases that most readily meet these criteria and for which additional research and development is urgently required was agreed at an international consultation held in November 2015

50

Do we know what's coming next?

- The 2017 annual review determined there was an urgent need for research and development for:
  - Arenaviral hemorrhagic fevers (including Lassa Fever)
  - Crimean Congo Haemorrhagic Fever (CCHF)
  - Filoviral diseases (including Ebola and Marburg)
  - Middle East Respiratory Syndrome Coronavirus (MERS-CoV)
  - Other highly pathogenic coronaviral diseases (such as Severe Acute Respiratory Syndrome, SARS)
  - Nipah and related henipaviral diseases
  - Rift Valley Fever (RVF)
  - Severe Fever with Thrombocytopenia Syndrome (SFTS)
  - Zika

  **Chikungunya was designated as 'serious', requiring action by WHO to promote R&D as soon as possible

51

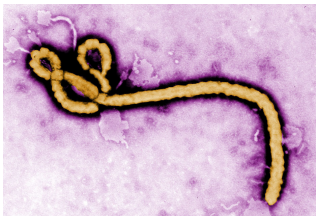
Do we know what's coming next?

- Other diseases with epidemic potential?
- For example, HIV/AIDS, Tuberculosis, Malaria, Avian influenza and Dengue
  - Not included because there are major disease control and research networks for these infections, and an existing pipeline for improved interventions.

52

Do we know what's coming next? Ebola virus disease (EVD)

- Ebola virus disease (EVD) is a deadly disease with occasional outbreaks that occur primarily on the African continent.
- It is caused by an infection with a group of viruses within the genus Ebolavirus:
  - Ebola virus (species Zaire ebolavirus)
  - Sudan virus (species Sudan ebolavirus)
  - Taï Forest virus (species Taï Forest ebolavirus, formerly Côte d'Ivoire ebolavirus)
  - Bundibugyo virus (species Bundibugyo ebolavirus)
  - Reston virus (species Reston ebolavirus)
  - Bombali virus (species Bombali ebolavirus)



http://www.cdc.gov/ncidod/dvrd/spb/mnpages/dispages/ebola/qa.htm CDC - Nat. Center for Infectious Diseases; Special Pathogens Branch
Information extracted from IPTC Photo Metadata.

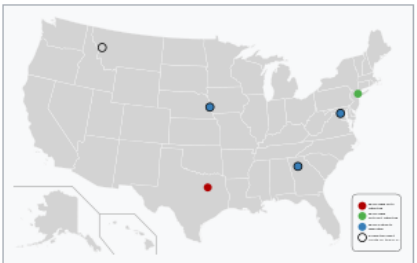
53

Ebola virus disease (EVD)

Who died of Ebola in the US?

Two died – a Liberian visiting the United States and a doctor who had treated Ebola patients in Sierra Leone. Two American nurses contracted the disease while treating the Liberian patient, but both recovered. In other words, only two people have ever been infected with Ebola while on American soil and neither died.

Ebola virus disease in the U.S.



Map of Ebola cases and infrastructure throughout the U.S.

Cases contracted in the U.S.	2
Cases first diagnosed in U.S.	4[note 1]
Cases evacuated to U.S. from other countries	7[1]
Total cases	11[note 2]
Deaths	2[2]
Recoveries from Ebola	9[note 2]
Active cases	0

54

Do we know what's coming next? Concerns closer to home …

National Institute of Allergy and Infectious Diseases (NIAID's) pathogen priority list is periodically reviewed and is subject to revision

Category A pathogens are those organisms/biological agents that pose the highest risk to national security and public health because they

- Can be easily disseminated or transmitted from person to person
- Result in high mortality rates and have the potential for major public health impact
- Might cause public panic and social disruption
- Require special action for public health preparedness

55

Do we know what's coming next? Concerns closer to home …

Continued…

- **Category B pathogens** are the second highest priority organisms/biological agents. They
- Are moderately easy to disseminate
- Result in moderate morbidity rates and low mortality rates
- Require specific enhancements for diagnostic capacity and enhanced disease surveillance

56

Do we know what's coming next? Concerns closer to home …

Continued…

- Category C pathogens are the third highest priority and include emerging pathogens that could be engineered for mass dissemination in the future because of
- Availability
- Ease of production and dissemination
- Potential for high morbidity and mortality rates and major health impact

57

Do we know what's coming next? Concerns closer to home …

- **Category A pathogens**
  - Examples – anthrax, botulism, plague, smallpox, tularemia, Arenaviruses (Lassa fever, etc.), Bunyaviruses (hantaviruses, etc.), Flaviviruses (dengue), and Filoviruses (Ebola and Marburg)
- **Category B pathogens**
  - Examples – *Burkholderia pseudomallei* (melioidosis), *Coxiella burnetii* (Q fever), *Brucella* species (brucellosis), *Burkholderia mallei* (glanders), *Chlamydia psittaci* (Psittacosis), Typhus fever (*Rickettsia prowazekii*), Food- and waterborne pathogens (e.g. *Listeria monocytogenes, Campylobacter jejuni;* Mosquito-borne viruses (Zika, EEE, WEE, VEE, WNV, JE, etc.).
- **Category C pathogens**
  - Examples – Antimicrobial resistance, excluding research on sexually transmitted organisms, unless the resistance is newly emerging*, Nipah and Hendra viruses, Tick-borne hemorrhagic fever viruses, Tickborne encephalitis flaviviruses (e.g. Powassan/Deer Tick virus), Tb, influenza, rabies

58

Do we know what's coming next?

ALWAYS a concern!

https://www.bbc.com/news/health-53218704

Health

Flu virus with 'pandemic potential' found in China

By Michelle Roberts
Health editor, BBC News online

30 June 2020 Share

Coronavirus pandemic

The new flu strain is similar to the swine flu that spread globally in 2009

A new strain of flu that has the potential to become a pandemic has been identified in China by scientists.

It emerged recently and is carried by pigs, but can infect humans, they say.

59

Do we know what's coming next?

African swine fever

'Million pigs killed' as African swine fever worsens in Nigeria

Outbreaks of disease becoming increasingly common, with latest 'worst ever' for continent

'This downturn is serious': China growth rate lowest in 26 years

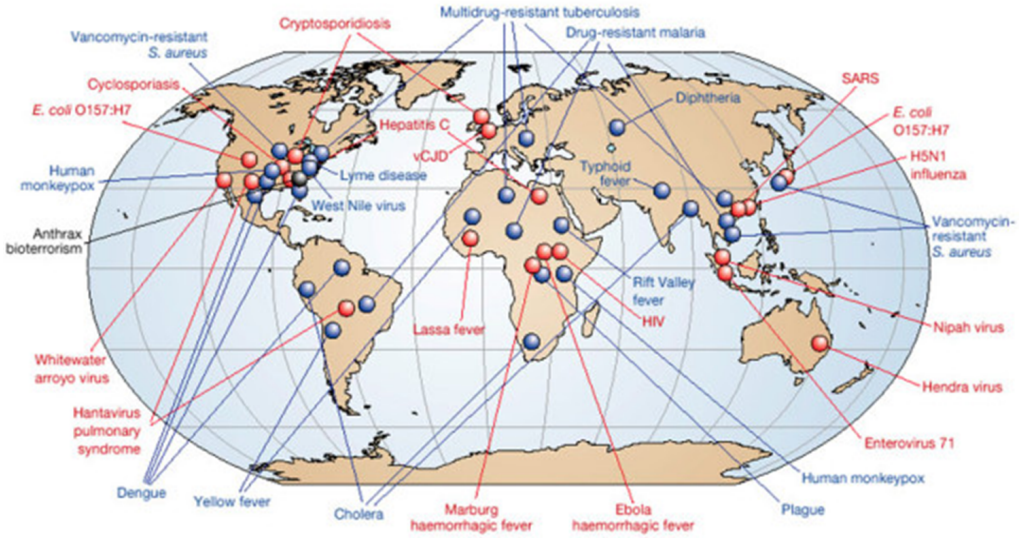
ASIA
South Korea braces to stop swine fever after outbreak in North Korea

ASIA
China's unprecedented pig crisis to impact entire world, expert warns

https://www.independent.co.uk/topic/african-swine-fever

60

Globalization of infectious diseases



Source: https://publichealthwatch.wordpress.com/2014/11/24/study-global-outbreaks-emerging-infectious-diseases-on-the-rise/

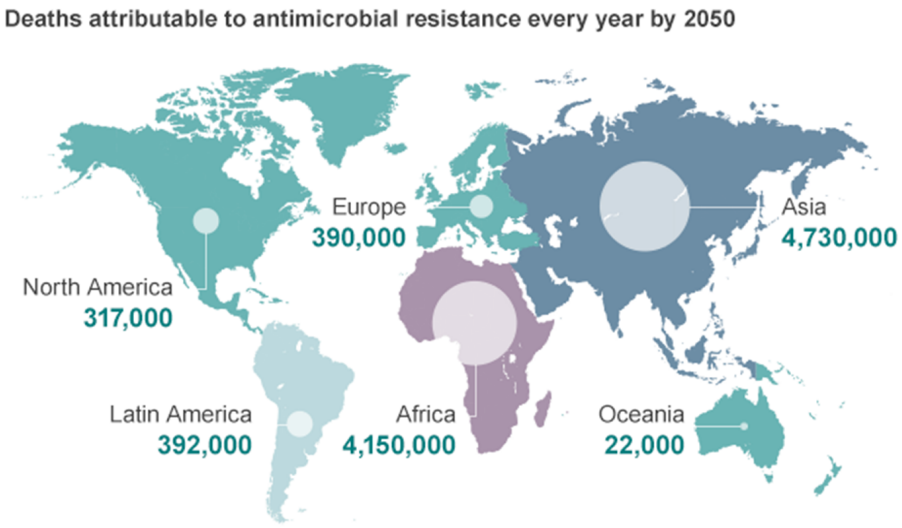
61

Globalization & One Health

And….yet, there is still an elephant in the room that I believe is a "*hidden pandemic*" and maybe our biggest worry globally….

62

Antimicrobial resistance / HAIs



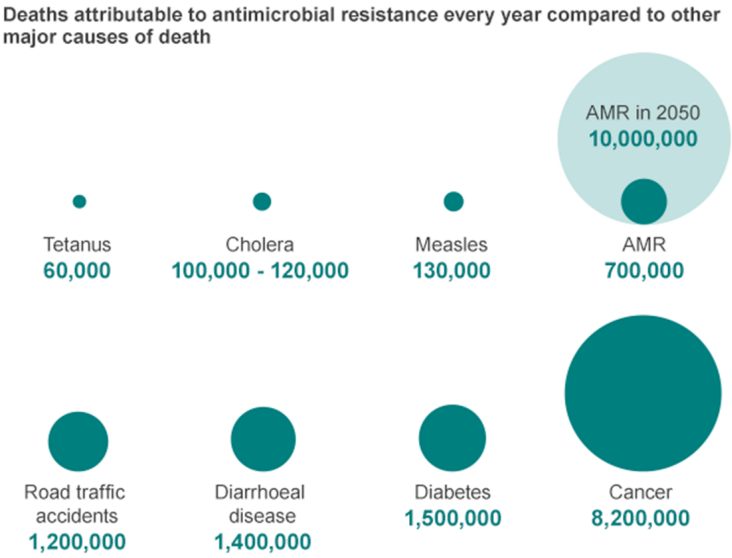
63

Source: Review on Antimicrobial Resistance 2014

Antimicrobial resistance / HAIs

WHO (by 2050)
- $100 trillion
- 10 million
- 1 new AMR / 3 sec

Healthcare Associated Infections (HAIs)
- 1 in 25



64

Source: Review on Antimicrobial Resistance 2014

Global Challenges

- Challenges are *interdependent*: an improvement in one makes it easier to address others; deterioration in one makes it harder to address others.

- Challenges are *transnational* in nature and *trans-institutional* in solution.
  - Cannot be addressed by any government or institution acting alone.
  - Need collaborative action among governments, international organizations, corporations, universities, NGOs, and creative individuals.

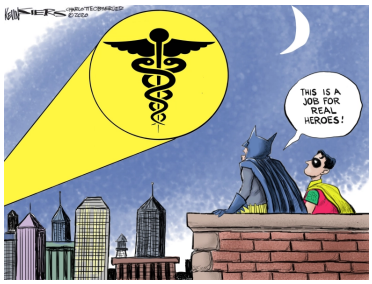
65

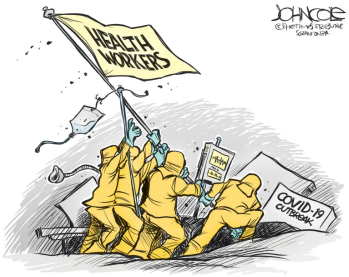
Have we Learned any Lessons?

Let's talk…

- National / Global strategy for prevention / preparation?
  - Policy
  - Funding
  - Operationalization – boots on the ground!
- National / Global strategy for TESTING?
- Treatment [for COVID19 but also the NEXT agent]
  - Therapeutics
  - Vaccines
  - Other?
- Experts
  - Medical Laboratory
  - Public Health
  - Healthcare
  - Science / Research

@RodneyRohde
@TXST_CLS
@txst_THR





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68

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Thanks / Questions

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#Lab4Life

#WeSaveLivesEveryday -> #TellYourStory / #TellOurStory about the #MedicalLaboratory!

69

www.webbertraining.com/schedulep1.php	
June 8, 2021	*(European Teleclass)* **ASSESSING PERSONAL PROTECTION EQUIPMENT** Speaker: **Linda Kilsdonk-Bode**, Amphea Hospital, The Netherlands
June 16, 2021	*(FREE South Pacific Teleclass)* **FROM POLICY TO PRACTICE – IMPLEMENTING GOVERNMENT DIRECTED POLICY & IMPLICATIONS FOR INFECTION CONTROL PRACTICE** Speaker: **Sally Havers**, Queensland University of Technology, Australia
June 24, 2021	**CONTINUOUS ACTIVE ANTI-VIRAL COATINGS** Speaker: **Prof. Charles Gerba**, University of Arizona
July 15, 2021	**PANDEMIC IMPACT ON HEALTHCARE LAUNDRY IN ACUTE CARE AND LONG TERM CARE FACILITIES** Speaker: **Dr. Lynne Sehulster**, American Reusable Textile Association
July 27, 2021	*(FREE European Teleclass)* **THE CHANGING PERCEPTIONS OF INFECTION PREVENTION AND CONTROL**

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