

A transmission electron micrograph (TEM) showing several spherical SARS-CoV-2 virus particles. The particles are roughly spherical with a distinct outer envelope and a darker, more granular interior. They are scattered across a light-colored, textured background. The overall color palette is warm, with shades of yellow, orange, and red.

SARS-CoV-2

James G. Dobbins, Ph.D.

02 March 2020



New Coronavirus Outbreak, Wuhan, China

Official Names to Remember

- The official name of the disease: **COVID-19** [COronaVirus Disease, 2019]
- The official name of the virus that causes COVID-19: **SARS-CoV-2**
- [Note that the disease SARS was caused by the SARS-CoV virus]
- WHO: *“We had to find a name that did not refer to a geographical location, an animal, an individual or group of people, and which is also pronounceable and related to the disease. We needed to avoid any stigma”.*

The Purpose of our Today's Discussion

- You already know the basic facts of this outbreak
- In addition, the situation is so fluid right now that it's pointless to present new facts that will be out of date by the time we leave the room
- Instead, my goal is to give you some perspective on the outbreak based on my experience in dealing with similar outbreaks

Some Much-Needed Perspective

The Beginning of the Outbreak - 1

- The outbreak began silently, unnoticed, in the south of the country
- Early deaths went unrecognized, occurring mostly in elderly patients or in persons with pre-existing, serious health problems

The Beginning of the Outbreak - 2

- Weeks later, however, a young child died unexpectedly at a research hospital
- Only then were the necessary tests conducted that allowed the authorities to identify an entirely new pathogen

The Beginning of the Outbreak - 3

- Working back through medical records and pathology specimens, scientists were able to identify most of the previously unnoticed cases and deaths
- The initial case, and the first death, had occurred in a woman who had extensive exposure to live animals

The Beginning of the Outbreak - 4

- After assembling the data from the first three weeks of the outbreak, epidemiologists were able to determine that over 80% of infected individuals had died
- There was immediate concern that a novel, infectious disease pathogen that could threaten a huge portion of the population was loose in the country

The Initial Response to the Outbreak - 1

- Once the first reports of the outbreak were reluctantly released to the public, there was, understandably, near panic, both among the citizens of the province and the country as well as among members of the government
- The first response was to block the movement of citizens in and out of the infected province

The Initial Response to the Outbreak - 2

- In addition, all citizens throughout the country were encouraged to wear surgical masks
- As the virus continued to spread throughout the province, the government decreed that there should be maximum social distancing
- Factories and stores were ordered to close, schools were closed, all public events were cancelled, and cinemas were shut down

The Initial Response to the Outbreak - 3

- As additional provinces became infected, the central government ordered a complete national ban on travel that included private vehicles, buses, trains, and aircraft
- As the virus continued to spread, entire cities were quarantined and the national economy was effectively shut down

The International Response to the Outbreak - 1

- Fear spread rapidly to neighboring countries, all of which imposed a travel ban on their own citizens
- First, their citizens were banned from visiting the infected provinces, and then from visiting the entire country
- Tourists coming from the infected provinces were no longer welcome to visit the neighboring countries

The International Response to the Outbreak - 2

- Tourists from these neighboring countries who had traveled to the infected country were, in many cases, not even allowed to return home
- International students who had been studying there were also not allowed to return home
- As the virus continued to spread within the country, it also began to spread to the neighboring countries as well as to distant countries throughout the world

The International Response to the Outbreak - 3

- Commerce with the infected areas came to a complete halt, but still the virus continued to spread
- Cruise ships that had visited the infected areas were checked for disease before they could dock at their destinations, and, if any infected passengers were identified, the ships were denied entry into these ports
- Both the virus and its accompanying panic continued to sweep around the globe

But Wait – This all Sound Vaguely Familiar...

- These last few slides refer NOT to the new coronavirus outbreak in China but instead to the 2009 pandemic of swine-origin influenza that began in southern Mexico
- Months later, when people finally stepped back to look at the data, the mortality rate was actually less than one-half of one percent, NOT 80%
- I remind you of these things because I want you to remember that we have been here before, only 11 years ago, with almost the exact same scenario

Why was There Panic Then and why is There Panic Now? - 1

- The first reason is simply fear of the unknown
- Fear that this outbreak, which was reportedly killing over 80% of its victims, could turn out to be like the 1918-1919 Spanish influenza pandemic that killed between 60 million and 100 million people world-wide

Why was There Panic Then and why is There Panic Now? - 2

- The second reason is that the world had only recently experienced the SARS outbreak in 2002-2003, also caused by a newly recognized coronavirus which had moved from animals to humans in China
- Had SARS not been contained, that outbreak could have easily caused a pandemic on the scale of the Spanish influenza

Why was There Panic Then and why is There Panic Now? - 3

- The third reason is that “experts” and the mass media are constantly warning the population that the Big One is just around the corner
- That the population of the world is basically screwed...that it’s only a question of when, not if, the Big One will hit us

Why was There Panic Then and why is There Panic Now? - 4

- The fourth reason, and perhaps the most important one, is that abysmal infectious disease surveillance and subsequent reporting of cases led to the stupidly erroneous estimate of 80% mortality for this coronavirus

Why Does Poor Surveillance Cause Problems?

- The first cases that are recognized in all outbreaks are usually found in the hospital and the morgue
- These are the easiest to find, even with poor surveillance
- Missing from the data, however, are all the moderate, mild, and inapparent infections
- So for almost every outbreak, estimates of its lethality are constantly being reduced as new, living infected persons are identified and added to the number of cases



Deaths
12,000 - 61,000*

Hospitalizations
140,000 - 810,000*

Illnesses
9,300,000 - 45,000,000*

Disease Pyramid, Seasonal Influenza



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12,000 - 61,000*

Hospitalizations
140,000 - 810,000*

Illnesses
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Case-Fatality Rate = 99.9%

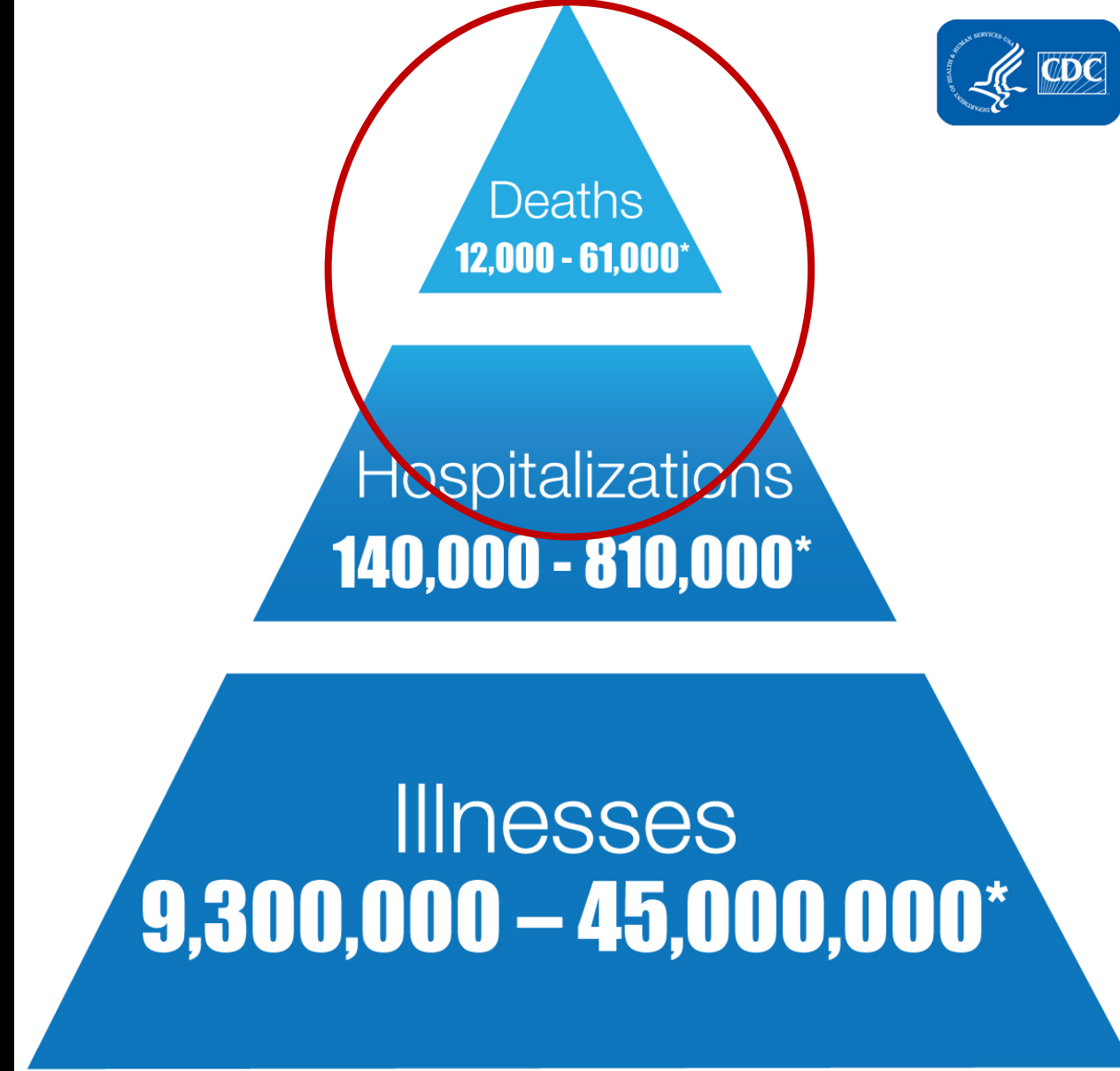


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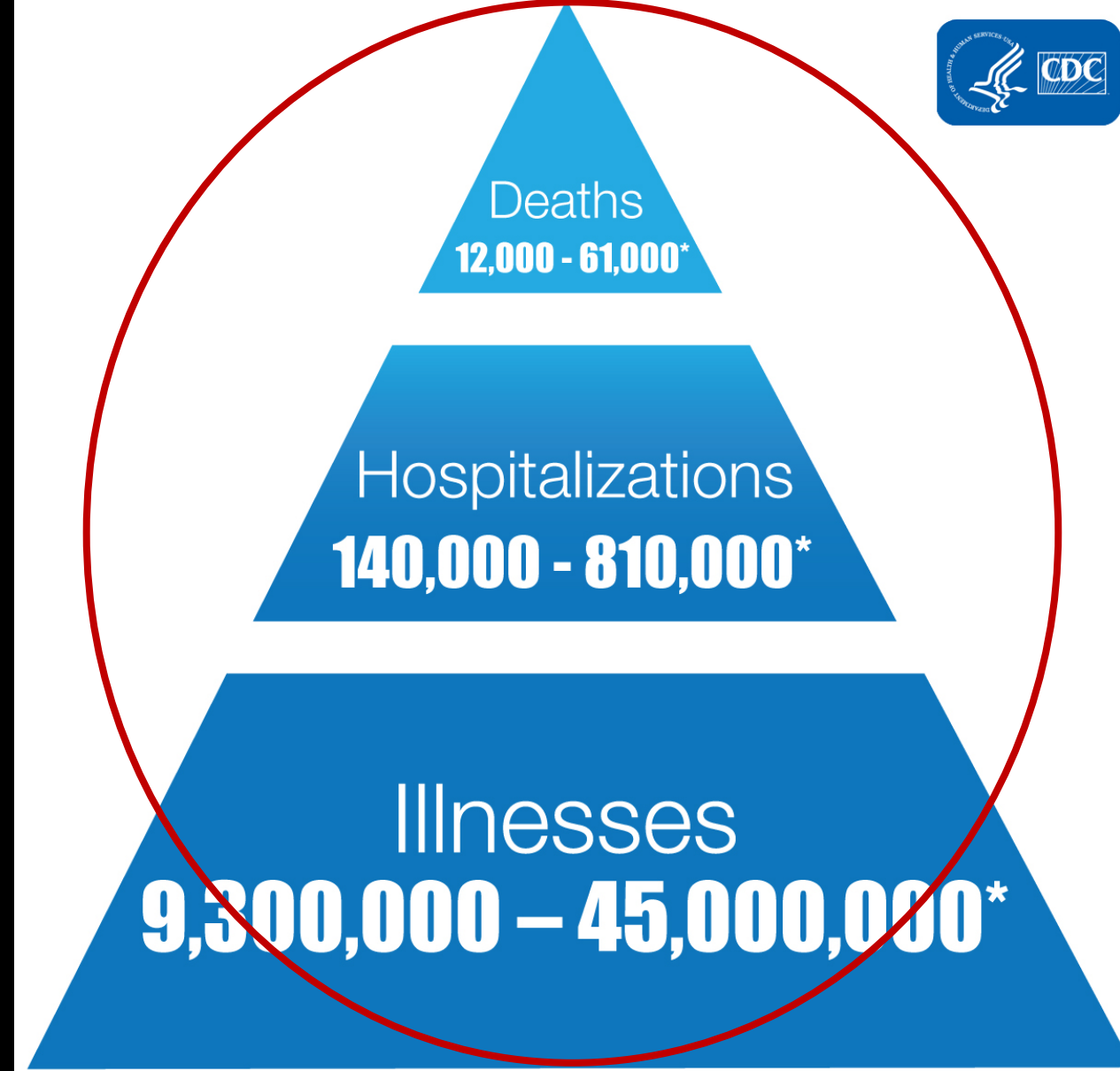
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Case-Fatality Rate = 80.0%



Case-Fatality Rate = 40.0%



Case-Fatality Rate = 0.1%

Lessons From Three Previous Outbreaks

1. Pandemic Influenza, Mexico, 2009





Lessons That Were Apparently not Learned – 1

- Highly-infectious respiratory viruses are very difficult to contain
- Containment depends entirely on early identification of an outbreak and rapid implementation of preventive measures

Lessons That Were Apparently not Learned – 2

- By the time the outbreak in Mexico was recognized, more than a month later, the battle was essentially over
- Almost all efforts at containment that were taken were a failure because by then the virus had already spread throughout the country

Lessons That Were Apparently not Learned – 3

- In the end, the virus reached almost every country in the world
- In other countries, however, preventive measures were at least successful in slowing the progress of the virus and in limiting the number of infected individuals
- Social distancing, isolation of infected individuals, and increased personal hygiene were probably the most important preventive measures

Lessons That Were Apparently not Learned – 4

- Finally, after six months, the virus, having run out of susceptible individuals, finally slowed down
- At last, the epidemic was over
- The virus, however, didn't disappear
- Instead, it became the dominant influenza A/H1N1 virus and is still with us today

Public Health Laboratories

The results of tests performed by public health laboratories nationwide are summarized below. Data from public health laboratories are used to monitor the proportion of circulating viruses that belong to each influenza subtype/lineage.

	Week 8	Data Cumulative since September 29, 2019 (week 40)
No. of specimens tested	1,783	62,234
No. of positive specimens	1,153	34,807
<i>Positive specimens by type/subtype</i>		
Influenza A	835 (72.4%)	18,421 (52.9%)
(H1N1)pdm09	697 (94.8%)	16,409 (91.6%)
H3N2	38 (5.2%)	1,511 (8.4%)
Subtyping not performed	100	501
Influenza B	318 (27.6%)	16,386 (47.1%)
Yamagata lineage	2 (0.7%)	205 (1.6%)
Victoria lineage	277 (99.3%)	12,657 (98.4%)
Lineage not performed	39	3,524

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But What About Masks?

- They were everywhere in Mexico and they are everywhere now
- Did they help slow the pandemic in 2009?
- Can they help to slow the novel coronavirus now?

Masks were everywhere in Mexico during the Pandemic



There was a severe shortage of masks then, just as there is now



And masks are everywhere now











© Supplied by Zhusi Tuorisen



The Definitive Answer About Masks – 1

- No, masks will probably NOT help to stop the spread of the virus
- The overwhelming majority of masks are surgical masks
- Surgical masks will not protect you from droplet spread
- But surgical masks will help to stop you from infecting others if you're already sick

The Definitive Answer About Masks – 2

- N-95 masks can help with both types of transmission
- In general, follow the advice of Julie Pryde, head of the C-U Public Health District
- She seems to be one of the few people in this country offering any common sense advice

Virtually Worthless Surgical Mask



Standard N-95 Mask



N-95 Mask with Exhalation Port







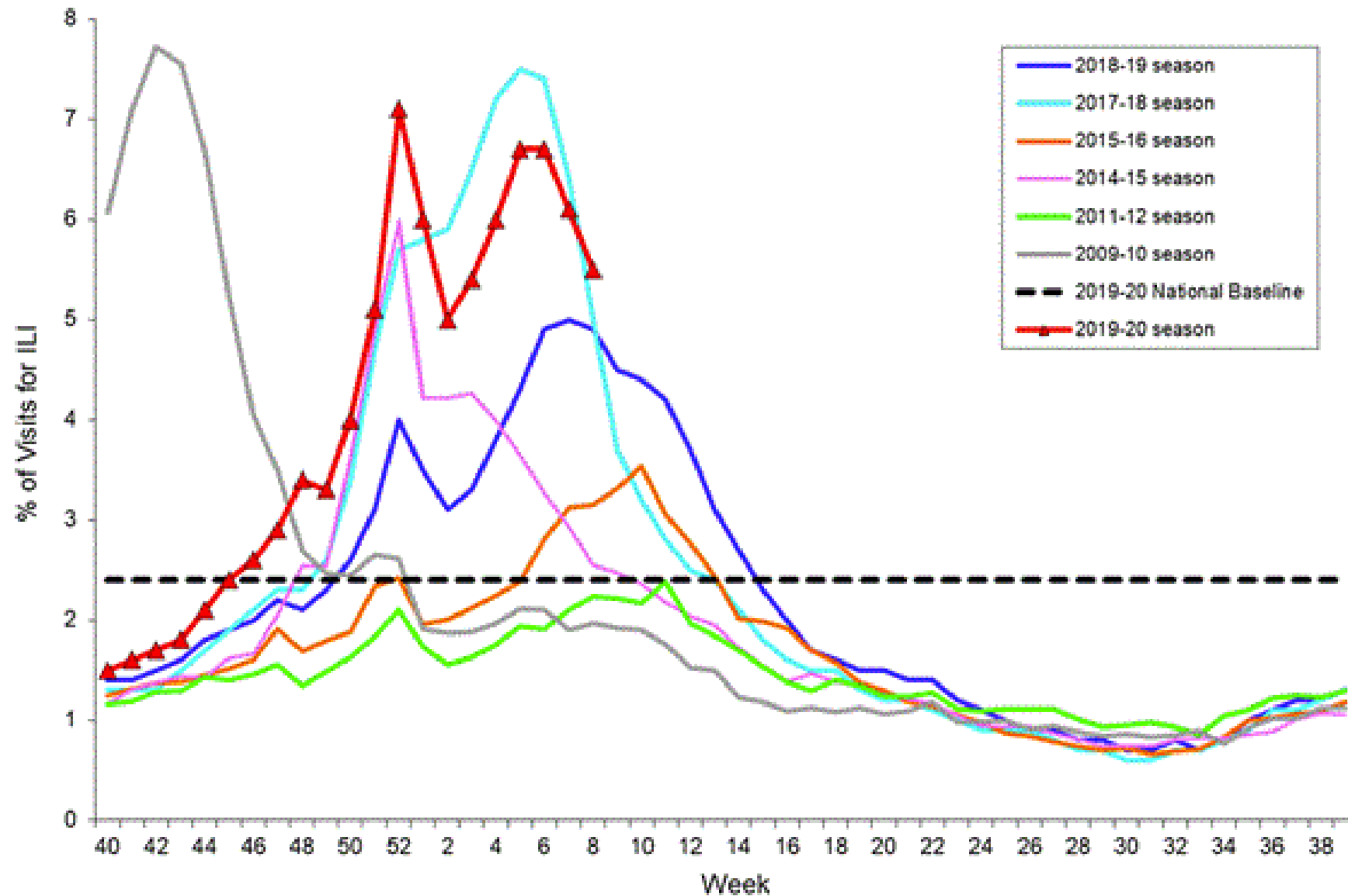


Guess what...Most of the Masks are Made in China



2. Seasonal Influenza, U.S., 2019 – 2020

Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2019-2020 and Selected Previous Seasons



Estimated Burden of Influenza, US, 2019 - 2020

	<u>Season to Date</u>	[<u>Total Season</u>]
• Number of cases:	26 million	[35 million]
• Number of hospitalizations:	250,000	[330,000]
• Number of deaths:	16,000	[21,300]

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The Magnitude of our Current Problem with COVID-19

- Think of the spread of seasonal influenza every year in the United States
- Now imagine trying to stop that spread of that virus
- *[Hint: There is currently no vaccine]*

3. First SARS Outbreak, China, 2002 – 2003

Why is SARS so Important?

- It could have easily caused a major pandemic with an unpredictable but huge number of deaths
- Our first real experience with a highly infectious respiratory disease in the age of routine jet travel
- Led to major changes in the way disease outbreaks are recognized and reported internationally: *IHR 2005*

The Beginning of the Outbreak

- Outbreak began on 16 November 2002 in Guangdong Province of China
- Index patient was a farmer who was treated in a local hospital and where he later died
- The outbreak spread rapidly in southern China with a large number of deaths
- No known cause for the illness and no treatment

Identification of the Outbreak

- Initial cases in China were not reported by the public health authorities
- After it spread to Beijing, a small portion of the cases were reported locally but not internationally
- Finally, one doctor contacted national and international mass media to try to publicize the illness



Spread of the Outbreak out of China

- On 21 February a Chinese doctor who treated cases in Guangdong traveled to Hong Kong for a wedding
- Stayed on the 9th floor of the Hotel Metropole
- He died of SARS on 4 March in a Hong Kong hospital
- Led to a large outbreak in Hong Kong
- 16 Other guests at the Hotel Metropole became infected and then flew out to other countries

Ninth floor layout of the Hotel Metropole in Hong Kong, showing where a super-spreading event of SARS occurred

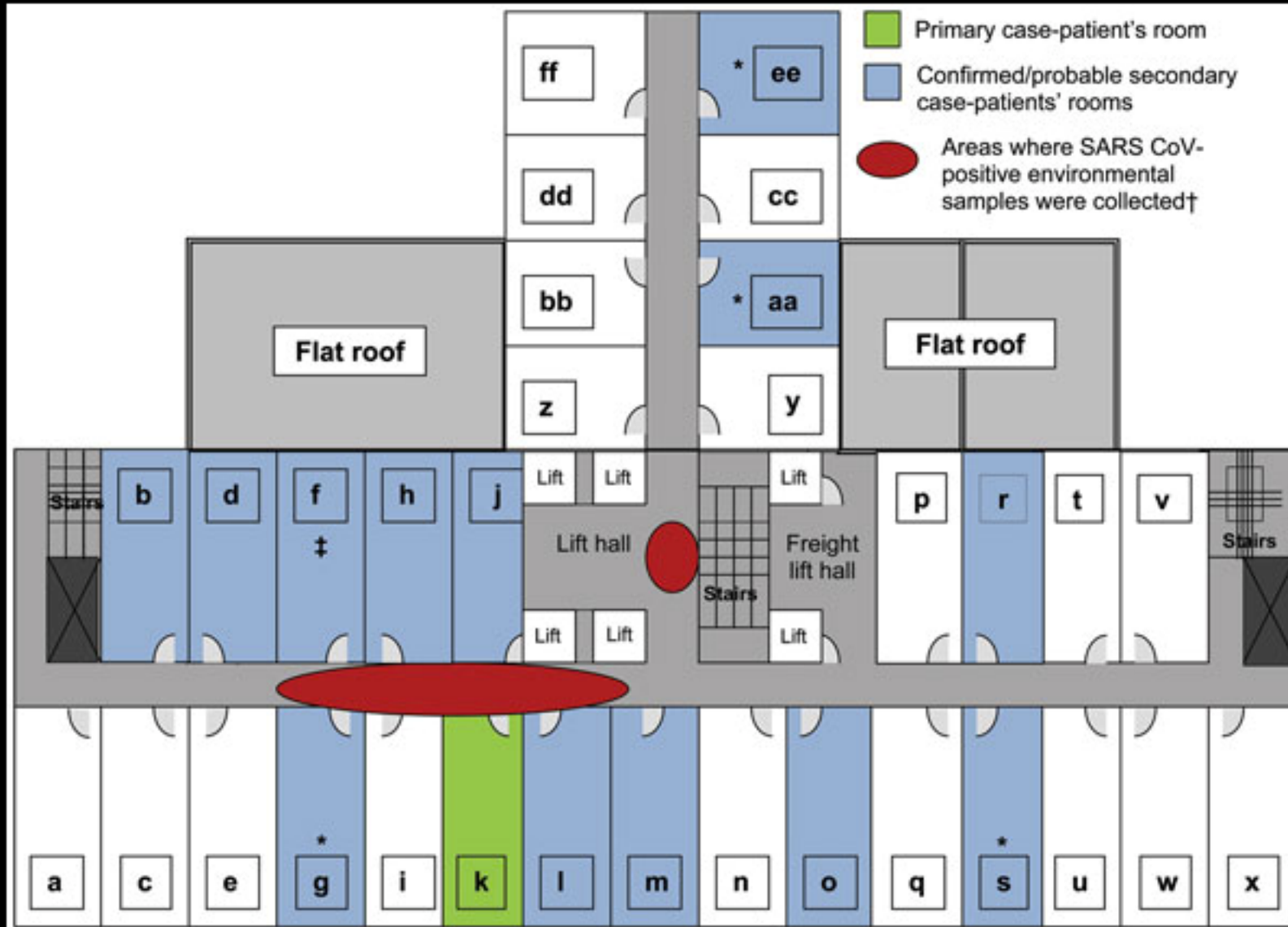
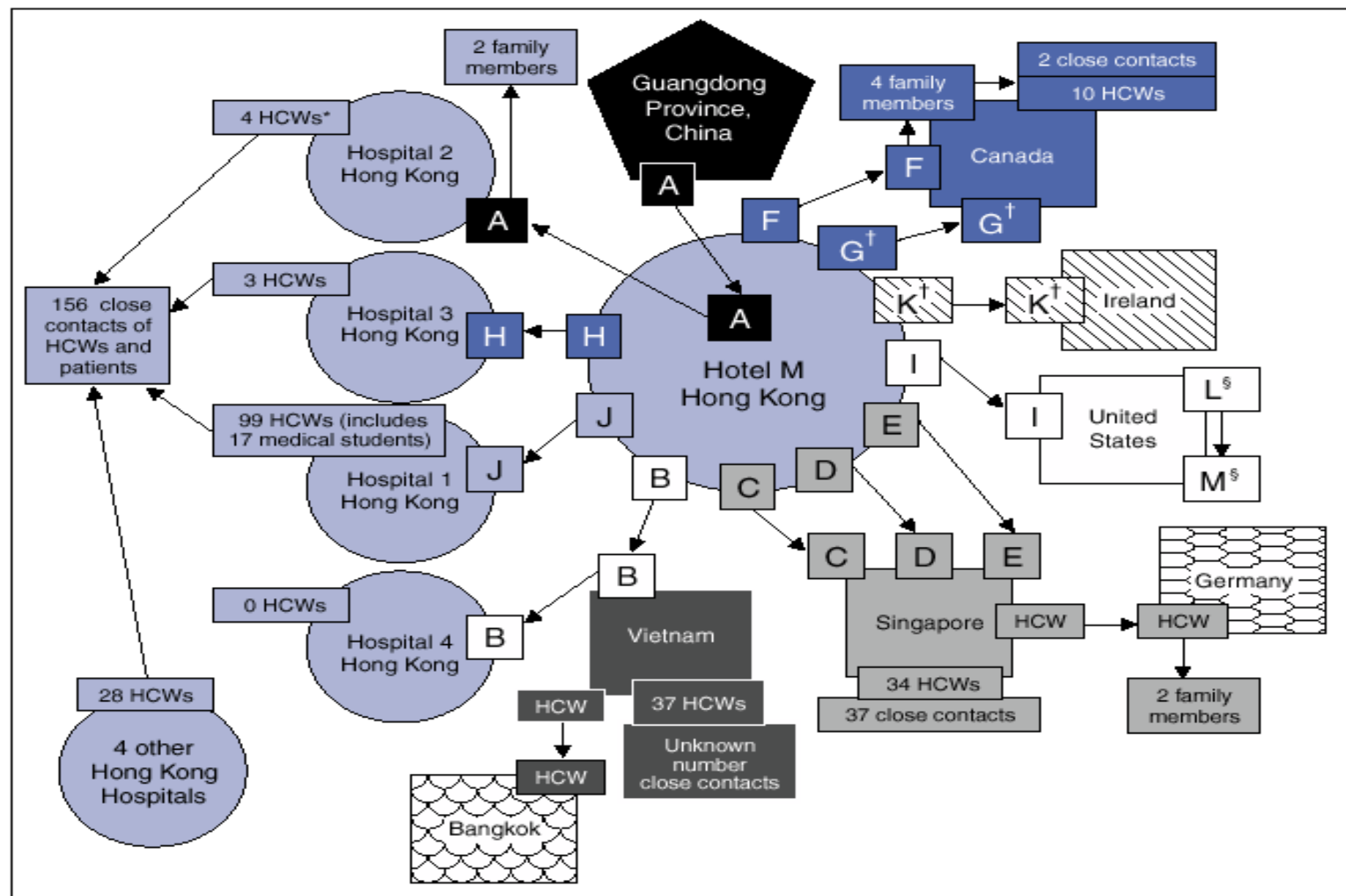


FIGURE 1. Chain of transmission among guests at Hotel M — Hong Kong, 2003



* Health-care workers.

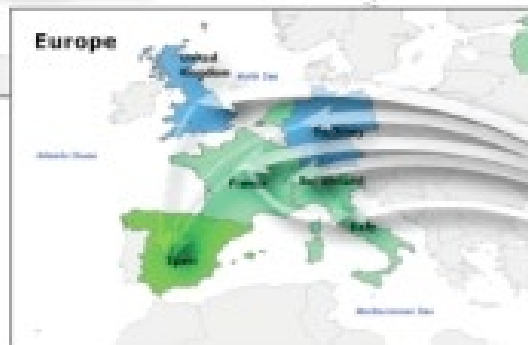
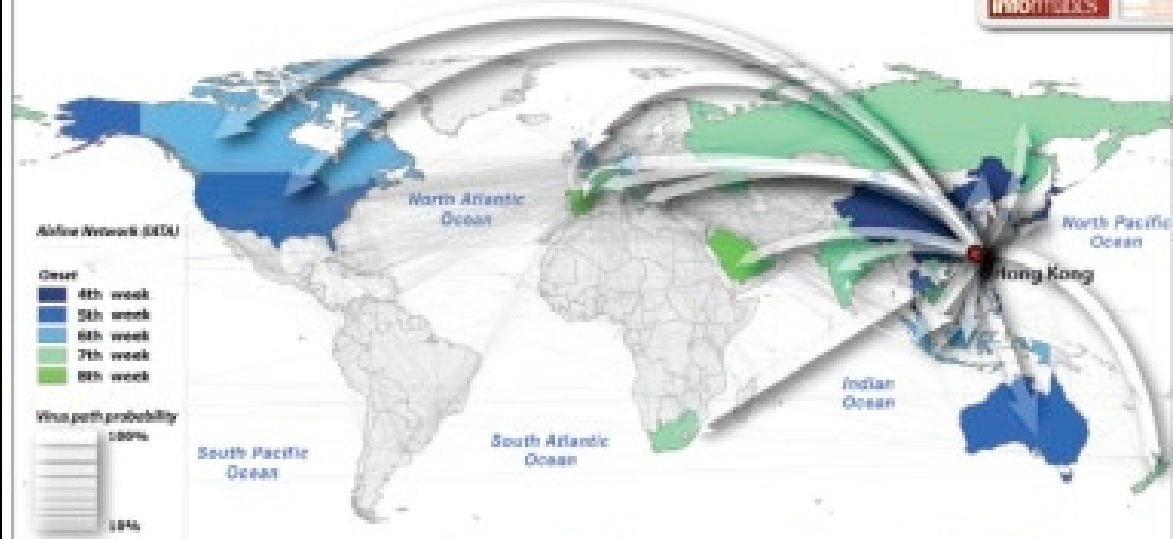
[†] All guests except G and K stayed on the 9th floor of the hotel. Guest G stayed on the 14th floor, and Guest K stayed on the 11th floor.

[§] Guests L and M (spouses) were not at Hotel M during the same time as index Guest A but were at the hotel during the same times as Guests G, H, and I, who were ill during this period.

SARS - Epidemic Pathways

Wawasan Cakrawala
Indonesian

Indormatics



SARS Spread in an Apartment Building in Hong Kong

- 321 people became infected in the Block E building of the Amoy Gardens Apartment Complex
- Person-to-person contact was ruled out
- Source was traced to a SARS patient from the mainland who visited his brother in the complex
- He had diarrhea and presumably infected the other through airborne droplets moving down the sewer pipes or through fecal contamination

Amoy Gardens Residences, Hong Kong



Control of the SARS Outbreak

- Controlled by rapidly identifying and isolating patients
- Finally ended by July 31st, 2003 after 9 months
- From this outbreak public health officials learned that new infections could spread overnight and that they were not ready to deal with that spread

The Final Toll of the Outbreak

- 8,273 cases
- 775 deaths

Response to the SARS Outbreak

- This outbreak led to fundamental changes in the way infectious diseases are reported
- There are to be no more hidden outbreaks
- Codified in International Health Regulations of 2005

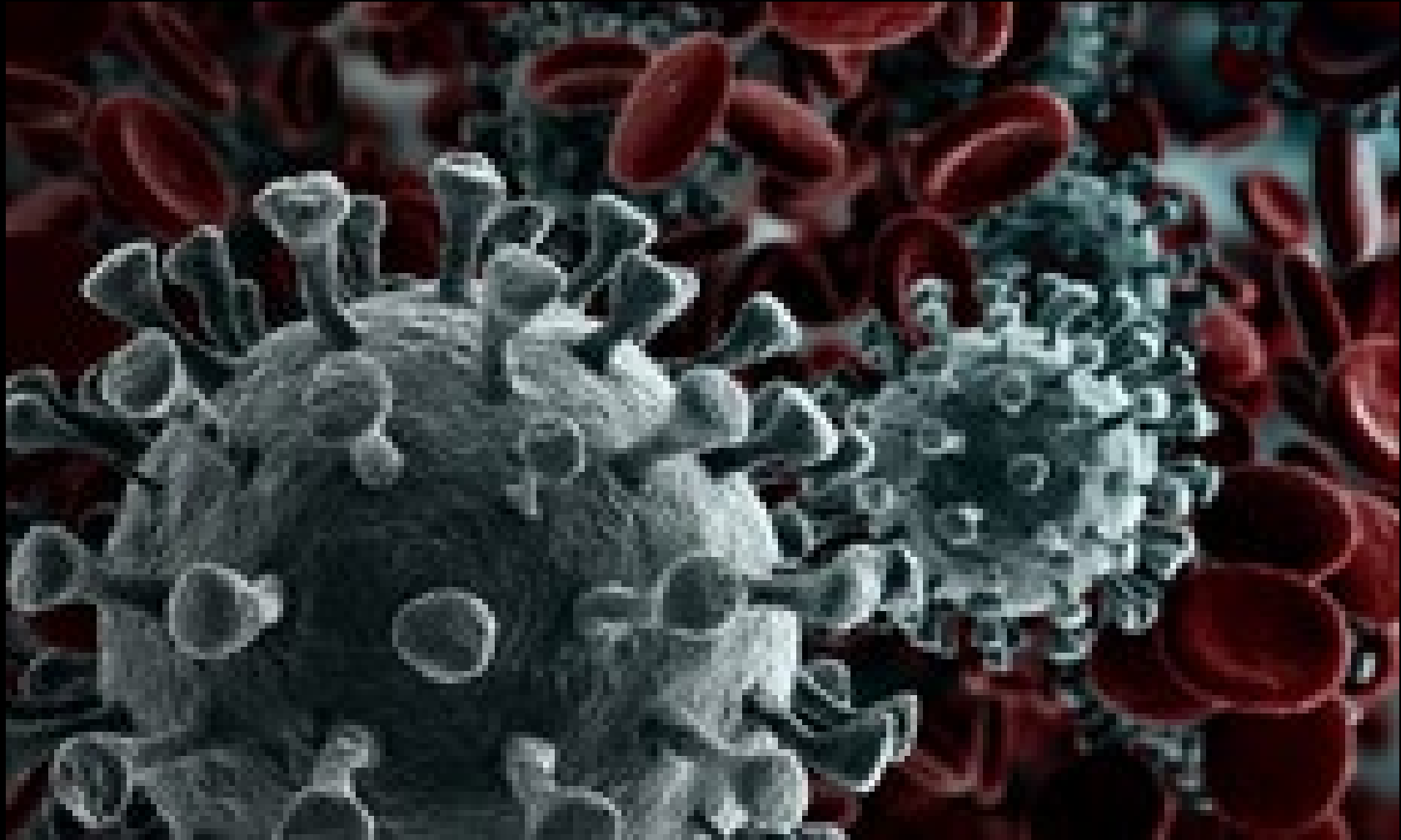
The International Health Regulations of 2005

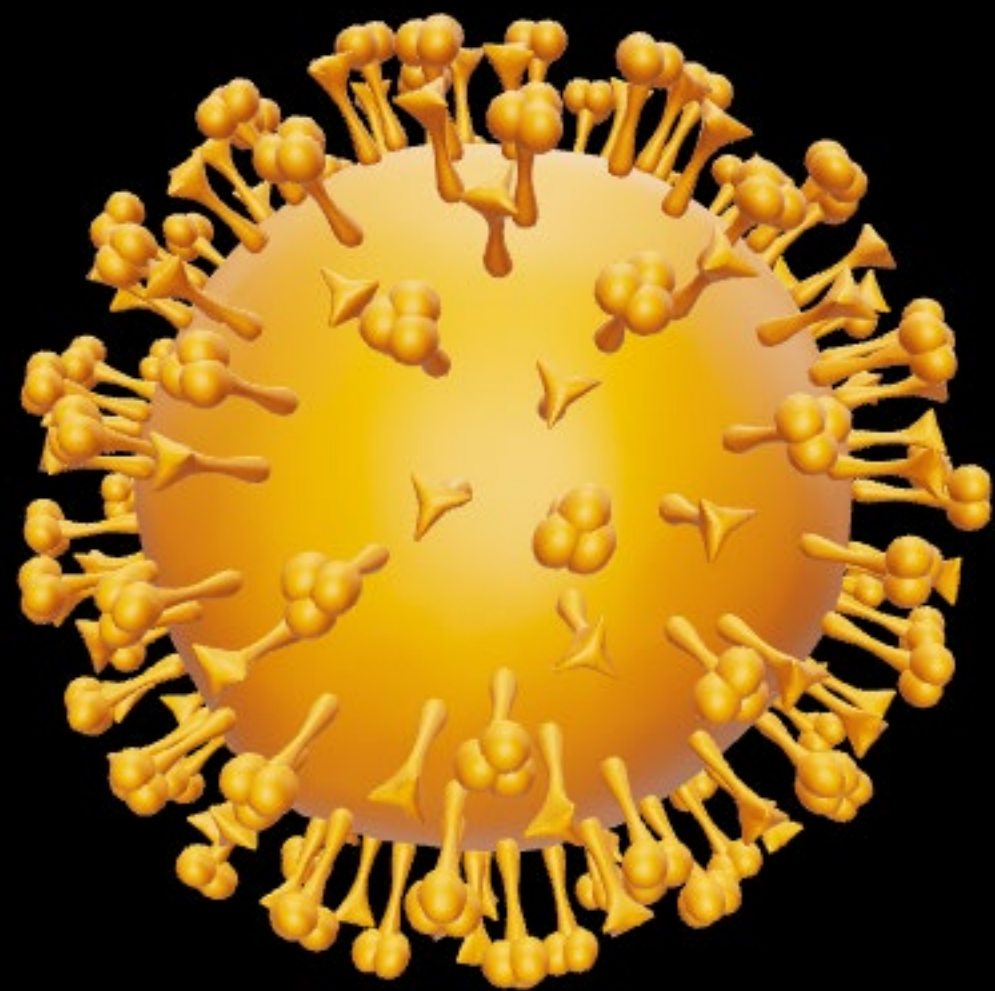
- One specific person in each country is in charge of all contact with the WHO regional office
- Anyone else can also make a report, including someone in a neighboring country
- Every country had to agree to abide by these regulations, including and especially, China

SARS-2 Outbreak, China, 2019 – 2020

The Virus

- A coronavirus, SARS-CoV-2
- Distantly related to the SARS-CoV-1
- Also similar to the MERS-CoV
- Other, less lethal coronaviruses cause about 15% of the common colds in the U.S.





The Cause of the Outbreak

- A novel coronavirus that moved from animals to humans
- Bats are thought to be the natural host of this virus as well as for those for SARS-1 and MERS
- The specific virus causing COVID-19 in humans is thought to have first passed through an intermediary host, pangolins

Intermediate Horseshoe Bat, *Rhinolophus affinis*



Pangolin, *Manis pentadactyla*



The Origins of the Outbreak – 1

- The origins of this outbreak are hidden by a lack of information, official secrecy, and a mantle of misinformation
- The official story is that the outbreak began in the Huanan Seafood Wholesale Market on 08 December 2019
- Interestingly, it wasn't until 30 December that China officially notified WHO about the outbreak

The Origins of the Outbreak – 2

- However, a recently published analysis of genetic sequences of the viruses found in SARS-2 patients shows that it began earlier and was imported into the Huanan Market from elsewhere

Elsewhere?

- “In the first two months, most infected people were linked to Wuhan, but some infected patients outside China may be linked to Guangdong Province or other places”*

*Yu Wen-Bin, Tang Guang-da, Zhang Li, Corlett R. (2020). Decoding evolution and transmissions of novel pneumonia coronavirus (SARS-CoV-2) using the whole genomic data.

<https://www.researchgate.net/publication/339351990>.

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Location of Hubei, Shanghai Guangdong Provinces, China



Additional Aspects of the Origin of SARS-CoV-2

- “Phyloepidemiologic analyses suggest that the SARS-CoV-2 source at the Huanan market was imported from elsewhere. The crowded market then boosted SARS-CoV-2 circulation and spread it to the whole city in early December 2019.”*

*Yu Wen-Bin, Tang Guang-da, Zhang Li, Corlett R. (2020). Decoding evolution and transmissions of novel pneumonia coronavirus (SARS-CoV-2) using the whole genomic data.

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The Inevitable Internet Conspiracy Theory

- In the absence of real, hard information, conspiracy theories will always emerge
- This one comes from the Op-Ed page of the New York Post
- *“The virus escaped from one of the countries bioresearch labs”*

The Evidence for This Theory?

- The “evidence”?
 - Xi Jinping suggested that the country needed to strengthen its biosecurity in labs that handle viruses like the new coronavirus
 - There is only one high-containment BSL-4 lab in China – in Wuhan
 - The top expert on biological warfare, Maj. Gen. Chen Wei, was sent to Wuhan to help with containing the virus
- You heard it here first!

Comparison of the SARS-1 and SARS-2 Viruses

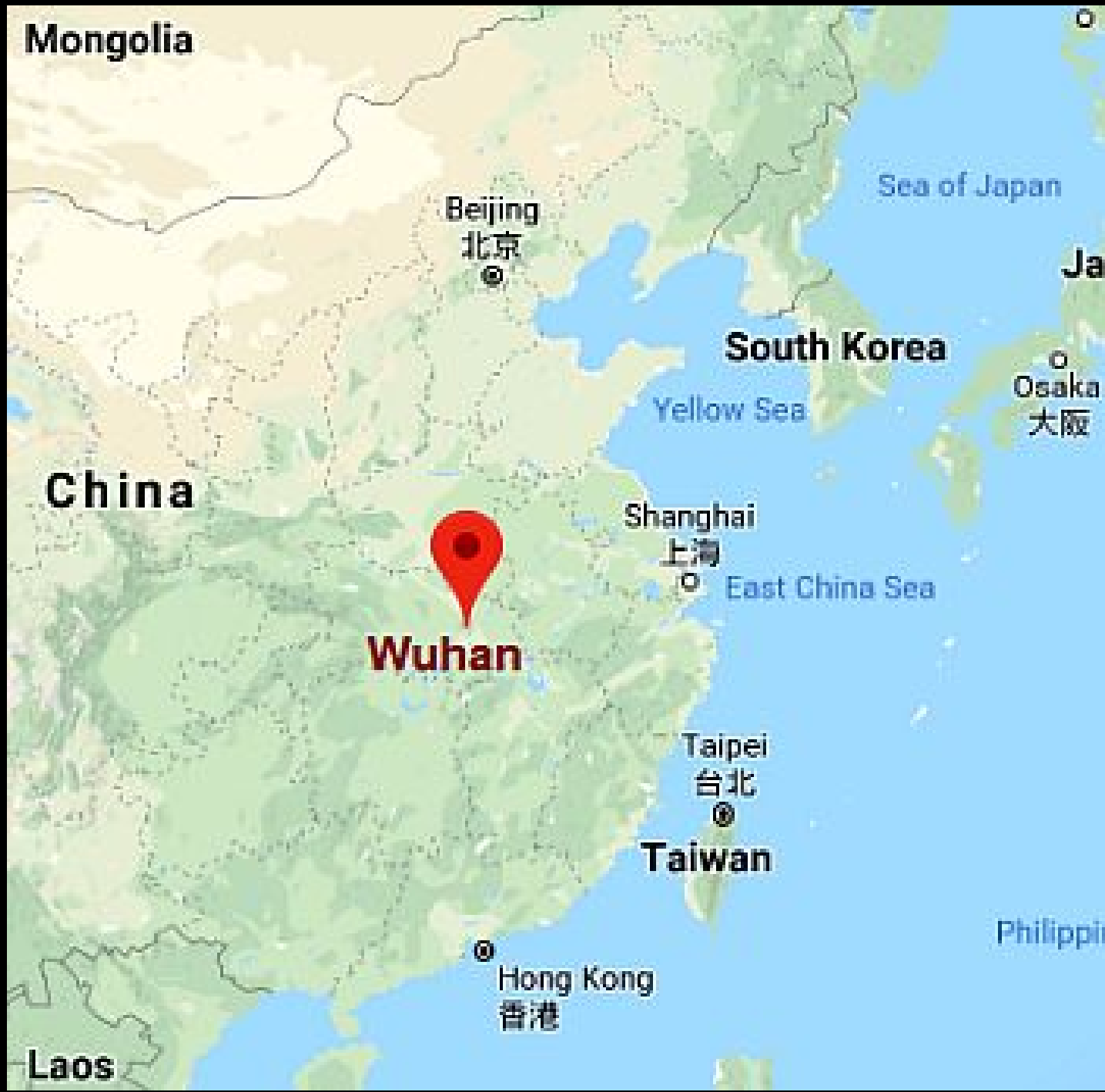
	<u>SARS-1</u>	<u>SARS-2</u>
Incubation	7 days	1 – 14 days
Infected cells	Lung tissue	Lung tissue
Transmissability	Lower, usually after Sx	Higher, plus before Sx
Transmission	Droplets, surfaces	Droplets, surfaces
Superspreaders	Yes	Yes?
Infectious locations	Yes	Yes?
Mortality rate	≈10%	≈1%

The Main Victims of Both Viruses

- The elderly, because of weakened immune systems
- People with pre-existing conditions, especially conditions involving the lungs or heart
- Medical personal who have such close contact with patients that their initial infections are probably located further down the respiratory tract

The Location of the Outbreak

- First cases were observed in Wuhan, China
- Subsequently, cases were found in other cities in Hubei Province
- We now know that earlier cases were also found in Guangdong Province



Mongolia

Beijing
北京

Sea of Japan

Ja

South Korea

Osaka
大阪

Yellow Sea

China

Shanghai
上海

East China Sea

Wuhan

Taipei
台北

Taiwan

Philippi

Hong Kong
香港

Laos

Comparison of Populations of Chinese and U.S. Cities

- | | |
|---------------------|-------------|
| • Shanghai, China | 34 million |
| • Guangzhou, China | 25 million |
| • Beijing, China | 25 million |
| • Shenzhen, China | 23 million |
| • Wuhan, China | 19 million |
| • New York, U.S. | 8.4 million |
| • Los Angeles, U.S. | 4.0 million |
| • Chicago, U.S. | 2.7 million |
| • Houston, U.S. | 2.3 million |
| • Phoenix, U.S. | 1.7 million |

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 - Phoenix, U.S. 1.7 million
- } = 19.1 million





Chinese Wet Markets

- Wet markets like Huanan are common in China. They're called wet markets because vendors often slaughter animals in front of customers.
- "That means there's a lot of skinning of dead animals in front of shoppers and, as a result, aerosolizing of all sorts of things,"*

*Emily Landon, an infectious disease specialist at the University of Chicago.

The Sale of Wildlife in Wet Markets

- The sale of live wildlife at wet markets is prohibited in China
- The Huanan Market was closed in late December when it was identified as the source of infection for most of the cases
- Reports indicate that before the Huanan Market closed, vendors there sold seafood, meat, and live animals, including chickens, donkeys, sheep, pigs, foxes, badgers, bamboo rats, hedgehogs, pangolins, and snakes









武汉华南海鲜批发市场

WUHAN HUANAN HAIXIAN PIFA SHICHANG

永红特菜商行

杨智辉大闸蟹 孙氏泥鳅鱼 金祥龙虾蟹 孙氏水产



商行

川野山珍

力天大闸

西区十二街

进步

守礼,崇尚





东区二街

为人先, 追求卓越

营造良好的社会

车行

白...
电话: 13811000011

The Spread of the Virus within China



CoV-2 Spread in an Apartment Building in Hong Kong

- On 11 February two residents in an apartment building were diagnosed with COVID-19
- That had never met but one lived directly above the other
- Transmission is suspected through fecal matter traveling down the sewer pipe connecting one apartment to the other
- The building was evacuated and there were no more cases

Hong Mei House Residences, Hong Kong





Coronavirus cases

Confirmed cases 84,119

Deaths 2,871

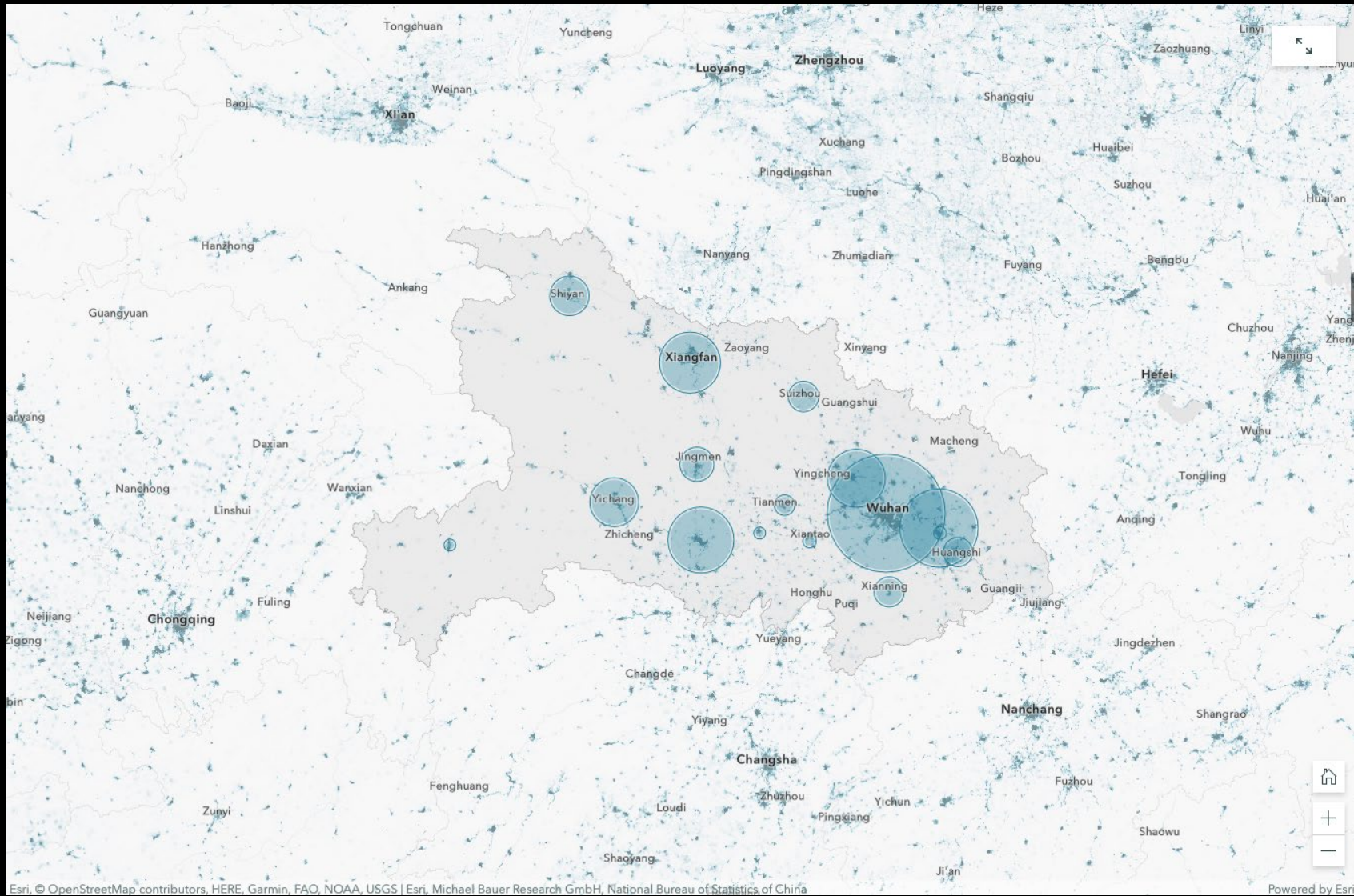
Source: USA Today, 28 Feb 20

As of 28 February 2020

Control of the Outbreak – 1

- On 23 January, authorities placed Wuhan under quarantine
- All flights, trains, and long-haul buses in and out of the city were suspended
- By the end of January, another 15 cities in Hubei Province were included in the travel restrictions
- A total of 57 million people lived in these quarantined cities

Location of 15 Quarantined Cities in Hubei Province







Control of the Outbreak – 2

- Strict travel restrictions were also imposed within the cities themselves
- Factories and shops were closed and all mass gatherings were prohibited
- Citizens were prohibited from leaving their residences except for specific times
- All of these restrictions took place during the Lunar New Year Holiday, normally the busiest travel season of the year







Control of the Outbreak – 3

- But by the end of January, the virus had a 2-month head start on the public health authorities
- It had already spread to every province in the country
- Travel restrictions were then imposed on cities in most of these infected areas

A Tale of Three Locations in China

	<u>Hubei Province</u>	<u>Shanghai</u>	<u>Beijing</u>
Population	58 million	34 million	25 million
COVID-19 cases	66,907	337	411
COVID-19 deaths	2,761	3	8

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Response to the Outbreak

- One of the main problems at the beginning of the outbreak was that the healthcare system was overwhelmed
- In response to this, the city of Wuhan built new hospitals and clinics just to care for the victims of COVID-19
- One of these, the Huoshenshan Temporary Field Hospital, was completed, from start to end, in just 10 days



发热患者定点
诊疗区

无灯目院

宝善门诊区 ↑

通知











Amazing! Huoshenshan Hospital's 1st building completed in 16 hours!

By Danfe TV - January 27, 2020

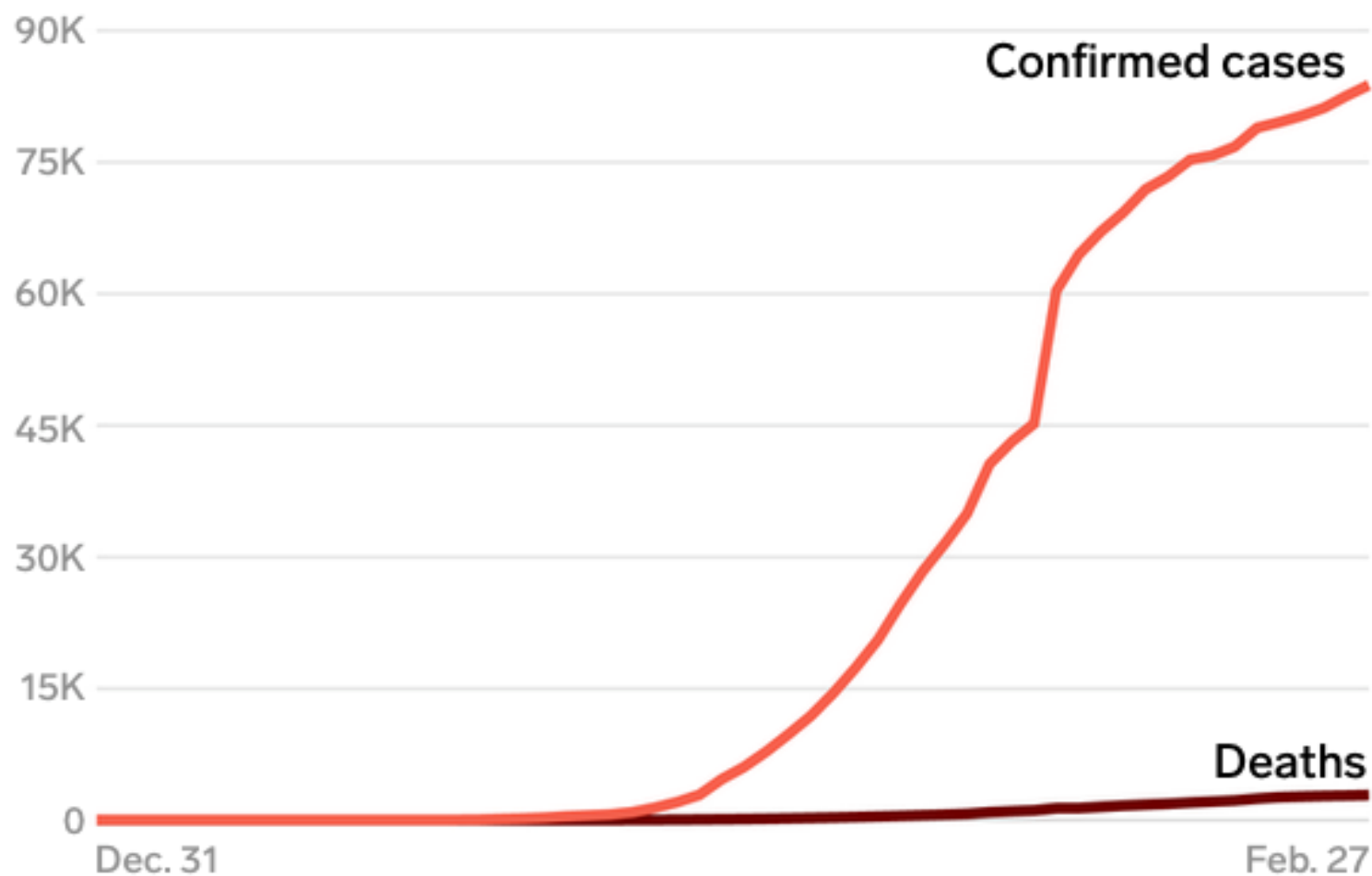
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1st building of Wuhan's special novel Coronavirus hospital, Huoshenshan Hospital, completed construction on Monday, in 16 hours. It is expected to be transferred to the military for management on February 2. Another Leishenshan Hospital is also under construction.



The dramatic spike in the COVID-19 reported cases



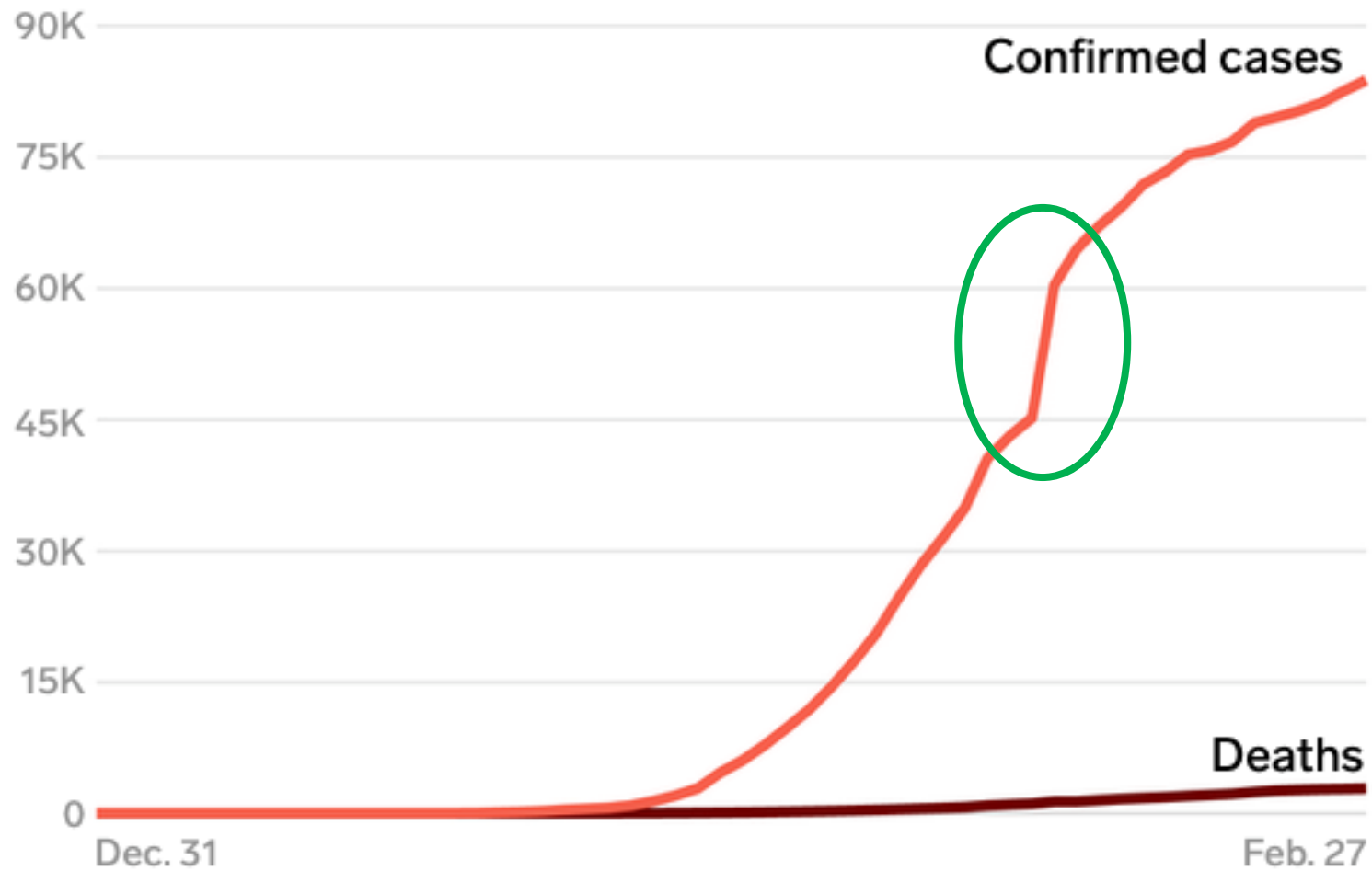
Note: Hubei health officials revised the way they count cases on February 13 (GMT) to include clinical diagnoses made via CT scans in addition to lab tests.

Sources: World Health organization, Wuhan Muncipal Health Committees, NetEase

Updated as of Feburary 28, 2020.

BUSINESS INSIDER

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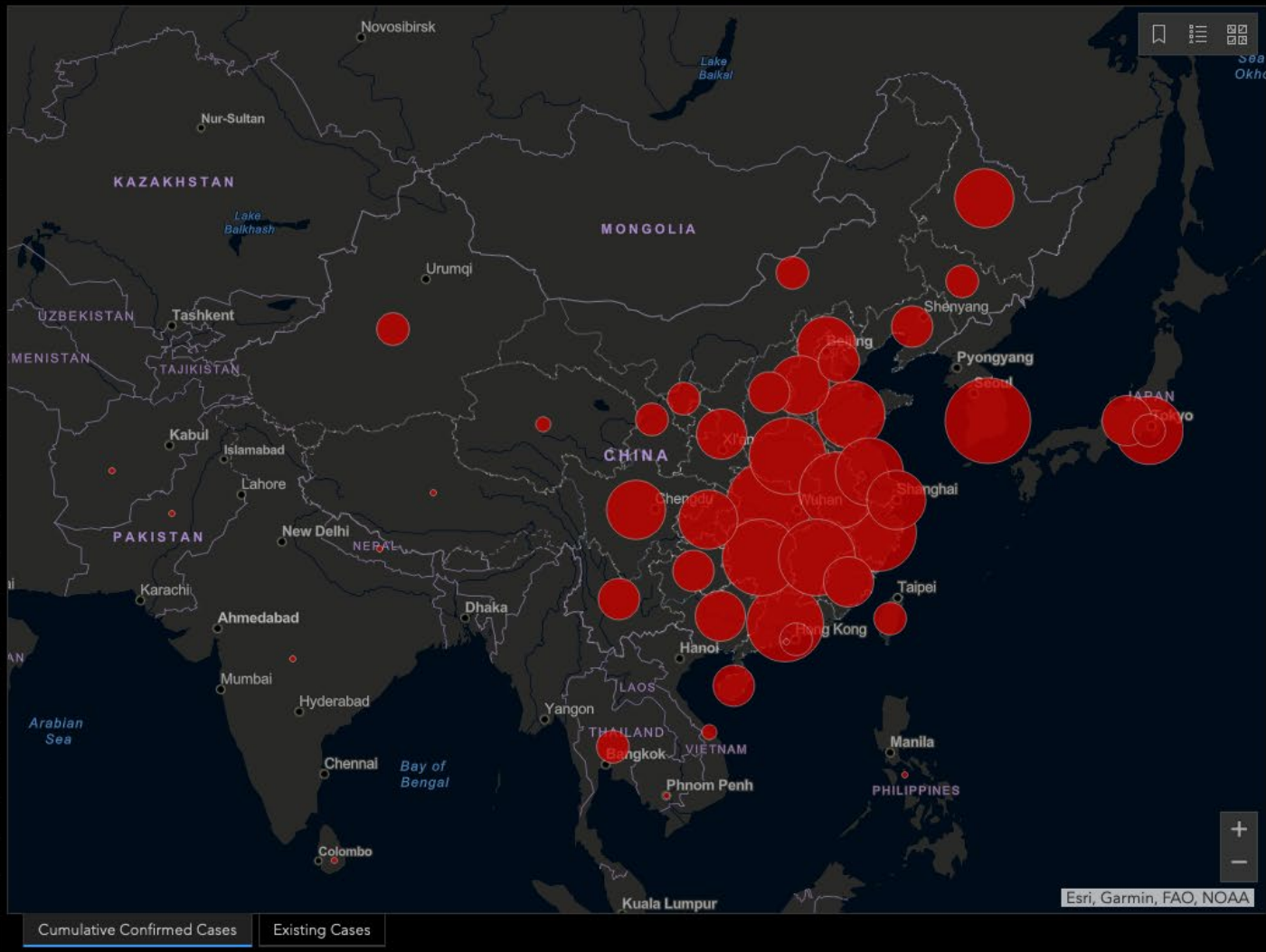
Total Confirmed
89,253

Confirmed Cases by Country/Region

80,026	Mainland China
4,335	South Korea
1,694	Italy
978	Iran
705	Others
256	Japan
150	Germany
130	France
120	Spain
106	Singapore
98	Hong Kong
86	US
47	Bahrain
45	Kuwait
43	Thailand
41	Taiwan
36	UK
29	Australia

Country/Region: City, St/Prov:

Last Updated at (M/D/YYYY)
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Lancet Article: [Here](#). Mobile Version: [Here](#). Visualization: [JHU CSSE](#). Automation Support: [Esri Living Atlas team](#) and [JHU APL](#).
 Data sources: [WHO](#), [CDC](#), [ECDC](#), [NHC](#) and [DXY](#). Read more in this [blog](#). [Contact US](#).
 Downloadable database: [GitHub](#): [Here](#). Feature layer: [Here](#).
 Point level: City level - US, Canada and Australia; Province level - China; Country level - other countries.
 Existing cases = total confirmed - total recovered - total deaths.

Total Deaths

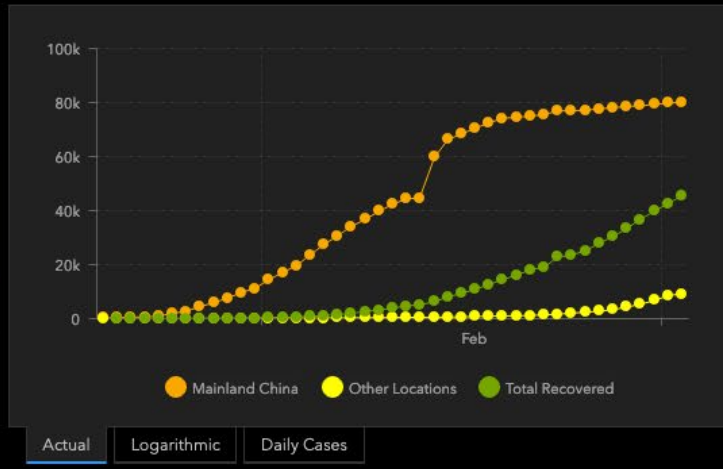
3,048

2,803 deaths	Hubei Mainland China
54 deaths	Iran
34 deaths	Italy
26 deaths	South Korea
22 deaths	Henan Mainland China
13 deaths	Heilongjiang Mainland China
8 deaths	Beijing Mainland China
7 deaths	Guangdong Mainland China
6 deaths	Japan

Total Recovered

45,394

33,934 recovered	Hubei Mainland China
1,205 recovered	Henan Mainland China
1,069 recovered	Zhejiang Mainland China
1,059 recovered	Guangdong Mainland China
917 recovered	Anhui Mainland China
887 recovered	Hunan Mainland China
850 recovered	Jiangxi Mainland China
543 recovered	Jiangsu Mainland China
460 recovered	Shandong Mainland China



Can COVID-19 Patients be Re-infected?

- Reports of COVID-19 patients being hospitalized after they were declared disease-free
- Their outcomes are reportedly worse than for other patients
- They probably had never recovered but instead were discharged because nasopharyngeal swabs were negative
- But if the virus was present in their lungs it might not be detected this way
- With virus is in their lungs, they could go on to develop pneumonia with higher mortality

Can We Stop SARS-CoV-2 in the U.S.?

- Yes, possibly, but are we willing to pay the price that the Chinese have paid in order to do so?
- I think that we may be able to contain it, to limit its spread and speed, but certainly not to stop it
- For instructions on how to do this, we only need to look at different approaches that cities took in 1918-1919 during the Spanish Flu pandemic
- Social distancing clearly worked then and would clearly work now

Can We Contain SARS-CoV-2 in the U.S.?

- Our hope is that the virus will smolder and then go out
- We do NOT want the virus burning through the population
- Currently the virus is smoldering in China and Japan
- The virus is burning through parts of South Korea, Iran, and Italy

Reasons for Growth of Five Clusters of Disease

Hubei Province, China	Government secrecy & lies gave the virus 2 month head start; only now beginning to catch up
Daegu, South Korea	Secretive religious cult hid cases & refused to cooperate with public health authorities
Northern Italy	Slow start when SARS CoV-19 not suspected because initial case had no travel history
Diamond Princess	Slow start even after 1st case detected; air and water systems are all connected on ships
Iran	Total secrecy, denial, lies, incompetence; now extremely difficult to catch up

Educated Guesses About the Future Course of the Outbreak

- The virus will continue to spread to almost all countries of the world [*It is now already in at least 60 countries*]
- Some countries will contain their outbreaks within two or three cycles of disease after each introduction
- In most of the other countries, however, health authorities will be unable to catch up to the spread of the virus; it will only end when there are no more susceptible individuals
- The virus itself could eventually disappear, possibly by the summer

Every Good Story Has a Hero



Thank You!

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