

CORONAVIRIDAE

- ***Genus Coronavirus***
 - Human coronaviruses include:
 - nCoV - 2019
 - SARS, Severe Acute Respiratory Syndrome (SARS-CoV)

Introduction

- **Coronaviruses are mostly respiratory pathogens.**
- **Respiratory coronaviruses are common in winter/early spring worldwide.**
- **Also important veterinary pathogen – causing variety of clinical illnesses in animals, e.g.**
 - **Bronchitis in chicken**
 - **Encephalitis in piglets**
 - **Enteritis in turkeys, dogs and calves**
 - **Zoonotic transmission likely; with genetic tweaking it can go from bats to civits to people**

SARS found in Common Palm Civet



Epidemiology

- **Contribution to upper respiratory infections might be as high as 35%, but median estimates ~ 15%**
- **In USA, HuCoV-OC43 and HuCoV-229E are periodically epidemic every 2-3 yrs interval**
 - **Rapid decline in antibody titers**
- **~ 50% infected will show symptoms for illness**
- **Asympomatic or subclinical people can spread the disease**

Clinical manifestations

- **Human respiratory coronaviruses cause colds**
- **Symptoms: sore throat, headache, malaise, cough, chills – rarely fatal**
- **More severe lower respiratory tract illness has been recognized – may be caused by certain strains**
 - **children and the elderly more susceptible**

Dress Rehearsal SARS

- During the winter of 2002-2003, a new coronavirus, Severe Acute Respiratory Syndrome was found to be a frequently fatal respiratory disease
- The outbreak originated in Guangdong Province of China probably following transmission from an animal in wild animal markets to humans
- **Chinese authorities kept it a secret, resulting in its spread.**
- It spread from there to Hong Kong and then to Southeast Asia, Europe, and North America

- Came to worldwide attention in Early March 2003, when large numbers of **severe, acute atypical pneumonia** were reported to WHO from Hong Kong, Hanoi and Singapore – **NOT CHINA.**
- SARS virus was isolated and sequenced. It was distantly related to previous coronaviruses.
- SARS outbreak triggered rapid and intense response from health authorities (coordinator WHO) and by the end of June 2003 transmission ceased in the world. (They also yelled at China.)

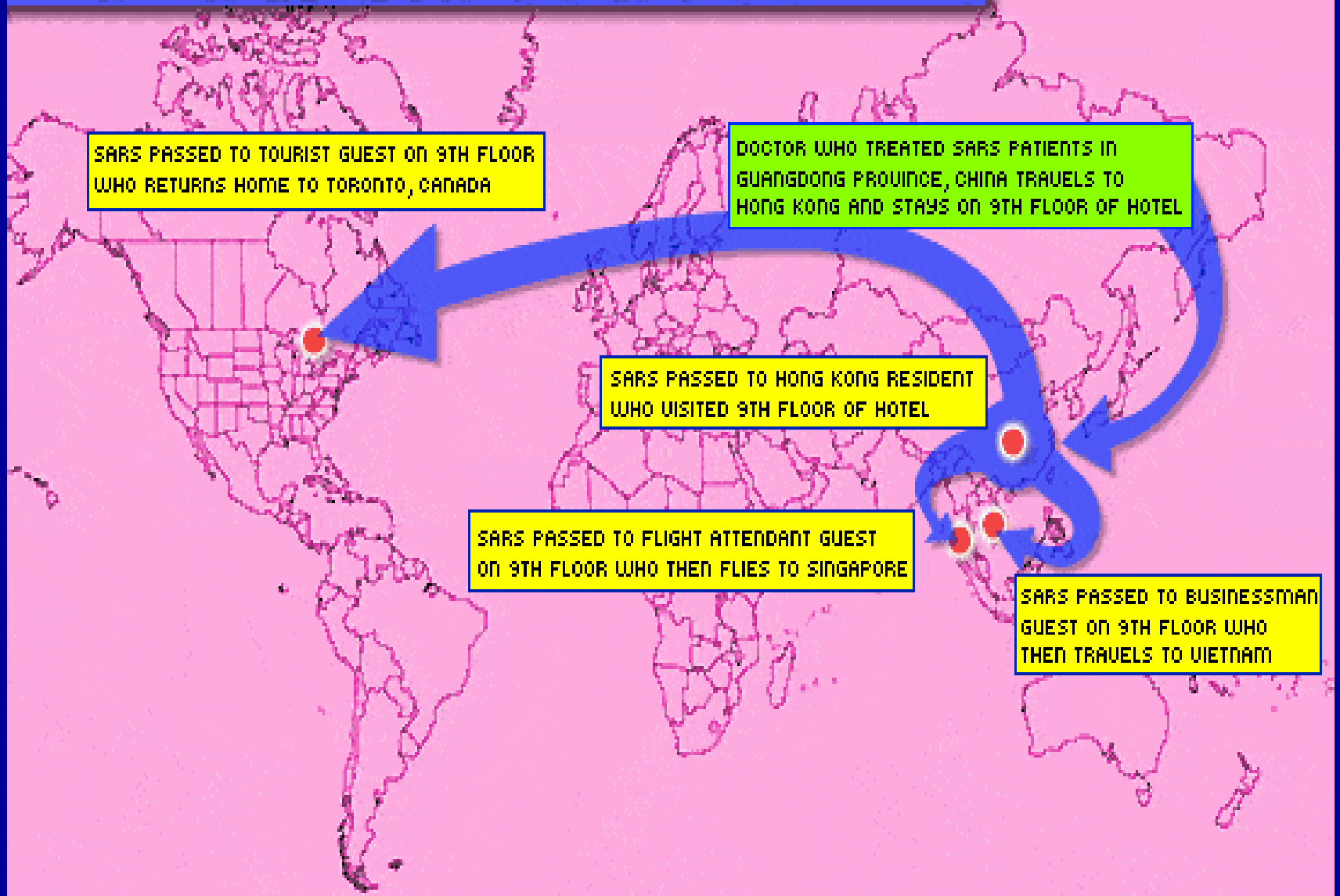
Pathogenesis

- SARS-CoV-2 infects lung epithelia interrupting cilia removal of mucous and debris. – bad cold – heavy cough.
- Immune response can lead to flooding in lungs – pneumonia
- Those with preexisting respiratory impairment most at risk
- Heavy exposure may be a factor.

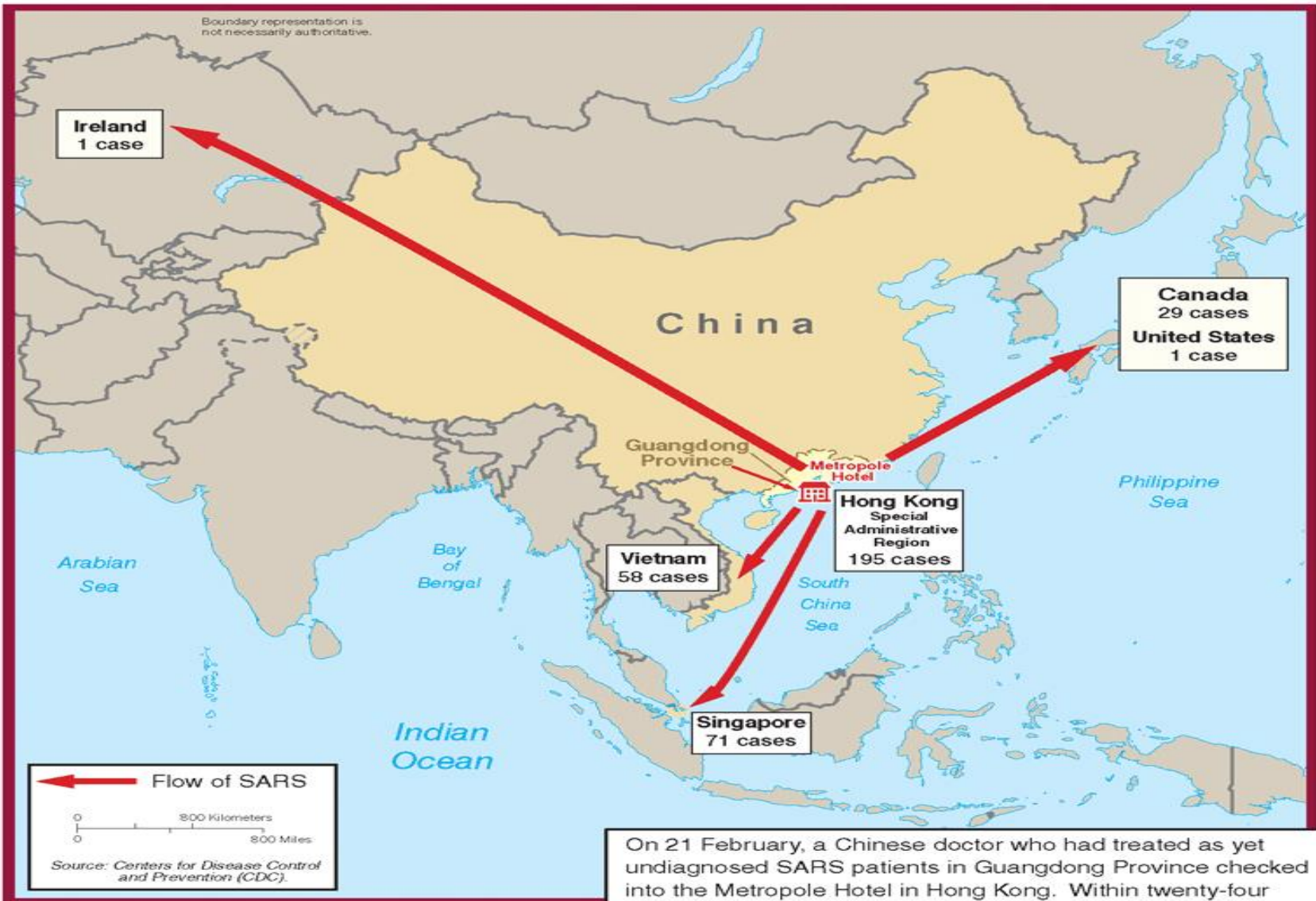
SARS epidemiology

- **The infection spread in hospitals to health care workers, visitors and patients**
- **Other settings include a Hong Kong hotel, an apartment complex and markets**

THE WORLDWIDE SPREAD OF SARS

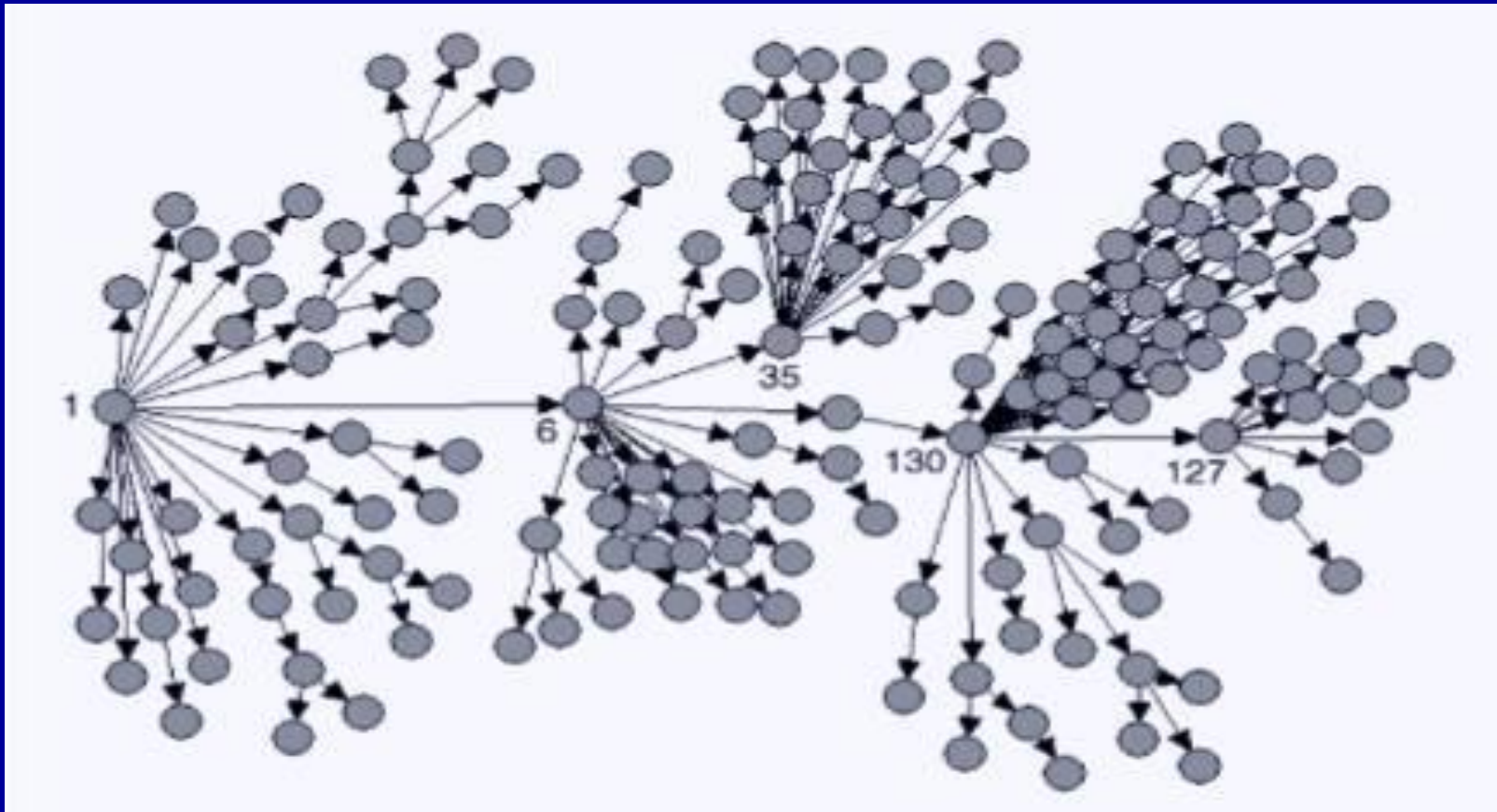


Boundary representation is not necessarily authoritative.



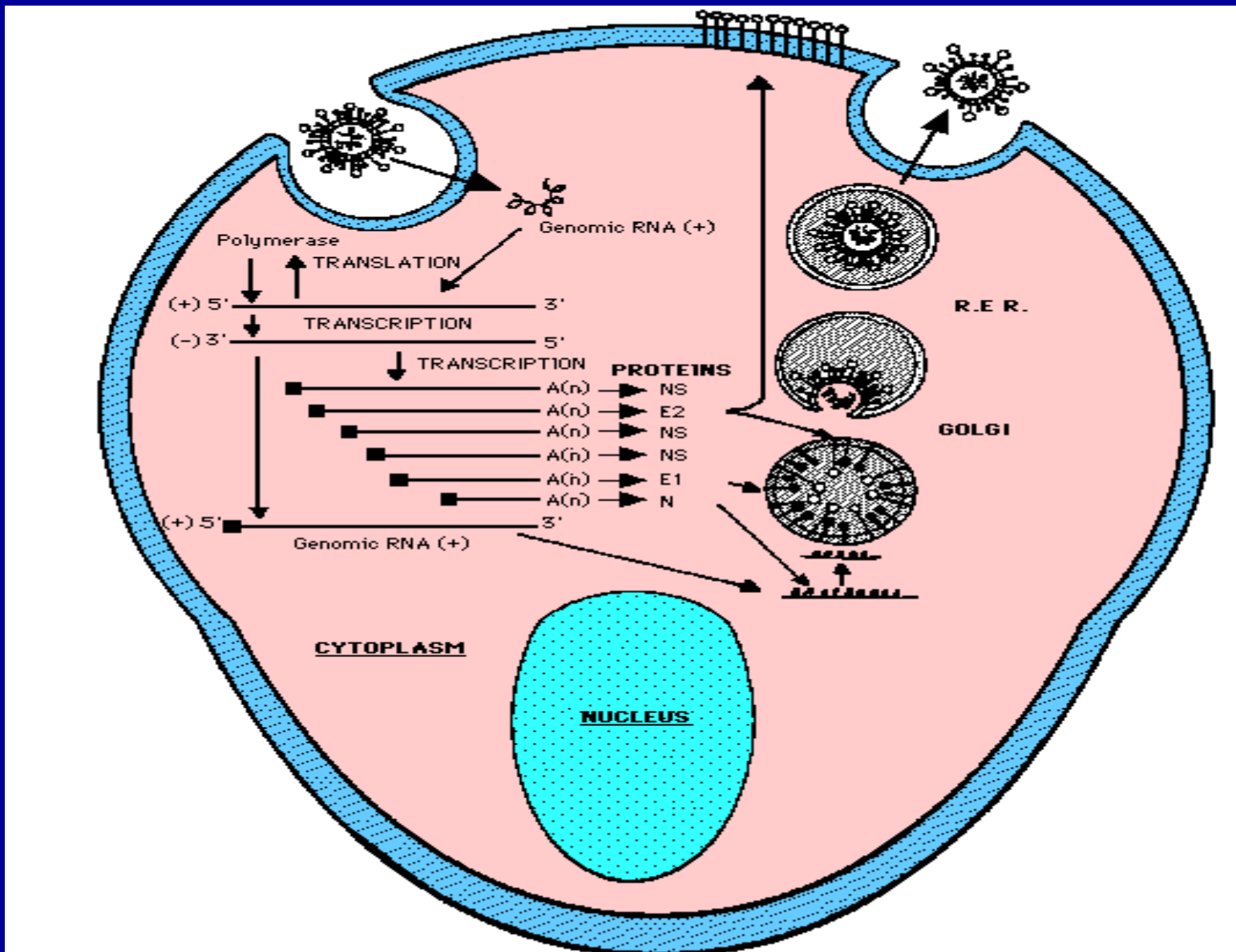
On 21 February, a Chinese doctor who had treated as yet undiagnosed SARS patients in Guangdong Province checked into the Metropole Hotel in Hong Kong. Within twenty-four hours, 12 people who stayed in the same hotel became infected with SARS and took the disease with them to Singapore, Hong Kong, Vietnam, Ireland, Canada, and the United States, infecting directly or indirectly more than 350 people. Eventually, the World Health Organization estimated that more than 4,000 cases worldwide could be traced to this "superspreader".

- **Spread in humans is thought to occur primarily through close contacts – droplet transmission, direct contact or fomite transmission (chairs, utensils, cloths)**
- **fecal-oral transmission may be possible**
- **In most instances, infected individual transmitted to very few others**
- **However, there are several well-documented instances where one person infected up to 100 or more persons, “superspreaders”**



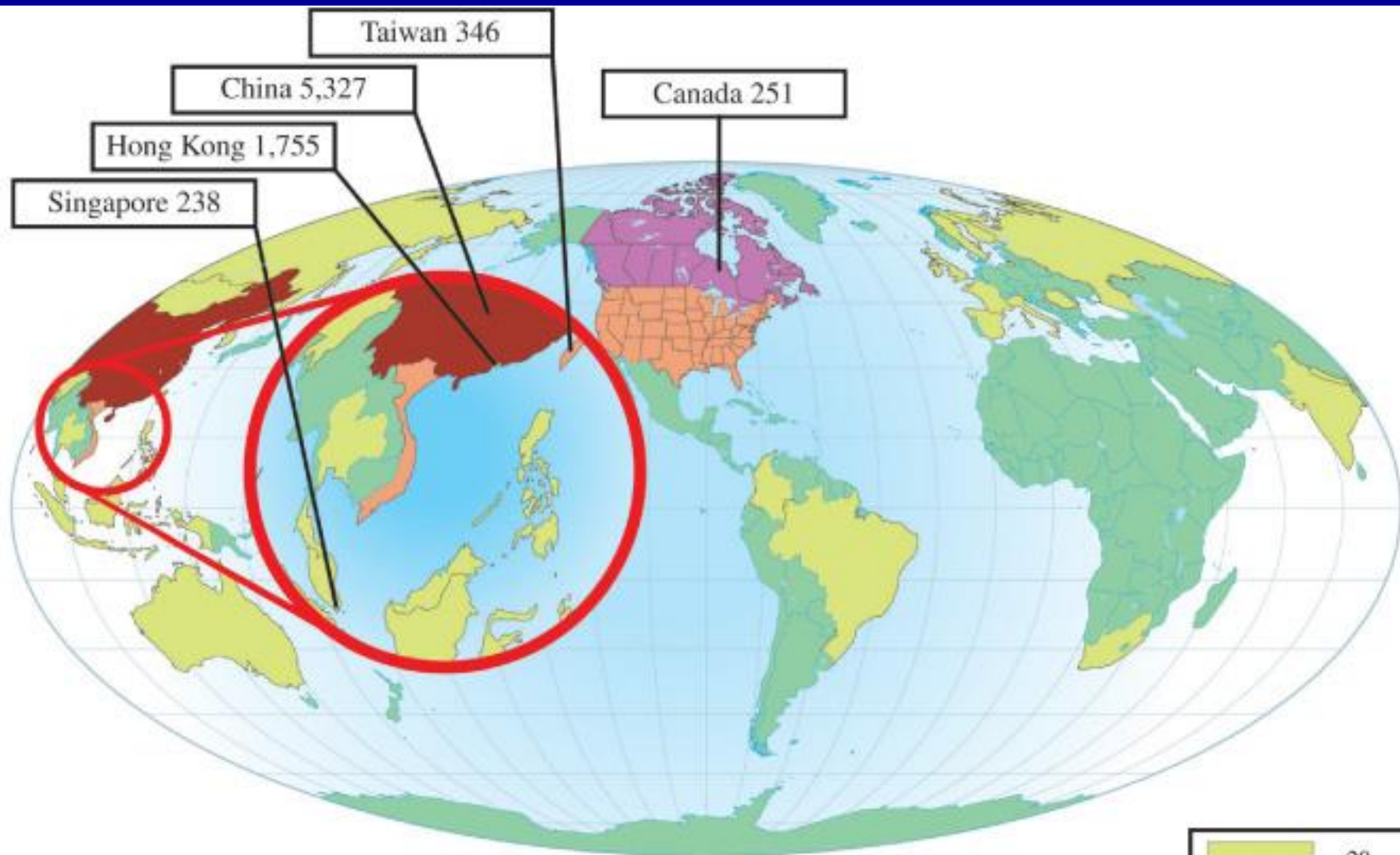
-The outbreak in Singapore was amplified by several so-called "superspreaders"

- 144 of Singapore's 206 probable cases have been linked to contact with only 5 individuals



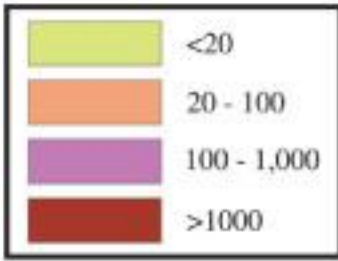
-Receptors human aminopeptidase N, 9-O-acetylated neuraminic acid,
 -HLA-I molecule

- **SARS Case Count**
- **During November 2002-July 2003, a total of 8,098 probable SARS cases were reported to the WHO from 29 countries with about 800 fatalities. 10% fatality rate.**
- **8 cases in the United States**
- **active global surveillance for SARS has been quiet since then**



Total Cases 8,096
 Total Deaths 774
 Figures as of December 31, 2003

Source:WHO



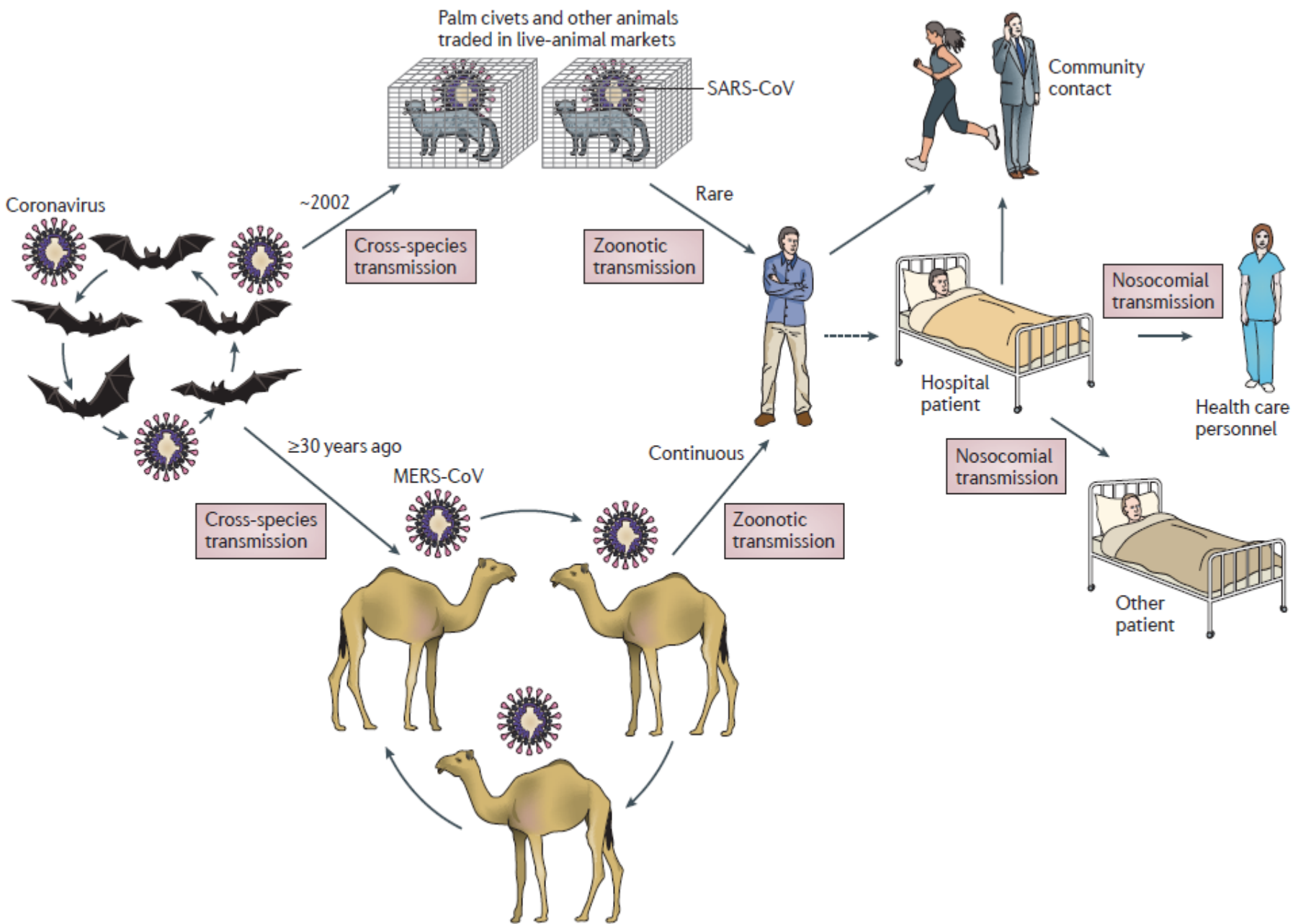
SARS

- **First sign in most cases is fever with headache, malaise and myalgia**
- **Is followed by a cough within a few days but can be up to a week – this stage can transmit the virus**
- **25% have diarrhea**
- **~25% develop severe pulmonary disease**
- **Patients with underlying health conditions or older age (>65) are more prone to develop severe pulmonary complications (50% mortality rate)**
- **Overall mortality is estimated to ~ 10%**

MERS

- Middle East Respiratory Syndrome
- Coronavirus with bat and camel reservoir. They give it to civets and people.
- Thus far, the cases reported have come from Qatar, Saudi Arabia and Jordan.

- MERS can cause a severe, acute respiratory infection presenting as pneumonia. Acute organ failure has also occurred.
- In 2017 there were 1791 cases with a 35% mortality rate.
- There are no vaccines or treatments.



nCoV - 2019

- Outbreak started in a wild animal food market in Wuhan, China in Dec 2019
- Officials harassed medical personnel and suppressed data until after the political congress was over.
- Jan 13 – 1st case outside China - Thailand
- Jan 19 – Chinese scientists shared the genome of the virus on the web to speed up research.

- Jan 18 Beijing dispatched an expert to Wuhan
- Jan 20 – Dr Zhong said on state television
Coronavirus can spread by human contact
- Jan 23 Wuhan locked down – too late
- Millions had already fled the city to China and
Asia
- Feb 2 - Philippines – 1st fatality outside China
- Feb 5 – 24,544 cases and 491 deaths
- Many countries closing borders with China
- SARS had 8098 case and 800 deaths

Feb 23, 2020

- 76936 cases; 2442 deaths – 3%
- Still centered in Wuhan
- Spreading in Italy and South Korea
- Italy shutting down “hot spots”
- Russia fanning fear on internet
- Corona Diamond Princess – case study of what not to do.

Corona Diamond Princess



Diamond Princess

- 2666 passengers; 1045 crew
- Buffet and other activities continued for a day after they knew Corona on board
- Sick crew shared cabins with healthy crew who still worked the ship – undermining 14 day quarantine.
- Even medical personnel did not wear all safety gear. Many got sick.

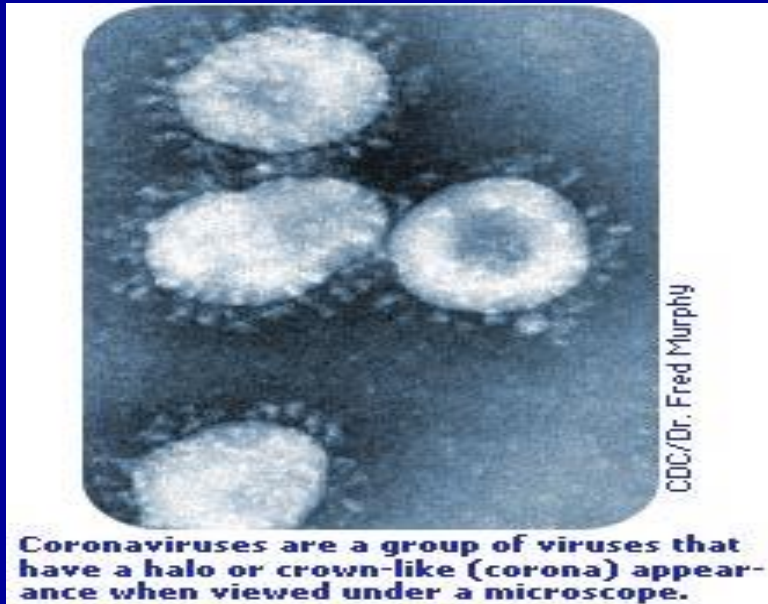
Cruise ships are Petrie dishes

- Sheer number of people overwhelmed Japanese authorities
- Quarantine mistakes – 14 days may not be enough- may have made things worse
- Sick people trapped in cabins for 14 days
- Some people released to US later seroconverted – incubation period unclear
- 634 cases. 2 deaths.

COVID 19 named SARS-CoV-2

- March 6 – 101,000 cases;
- 3500 deaths - 3.5% fatality rate
- Northern Italy shut down
- Draconian containment working in China, unless they are lying
- 380 cases/19 deaths in US in 25 states
- 1 Westchester Lawyer infected 23 people

VIROLOGY



- Virions are round, enveloped and 100-150 nm in diameter
- Envelope contains glycoprotein spikes composed of protein trimer – vaccine target



Mortality

- Fatality rate 2% - 10%- depending on country and population under study
- At least 10X more lethal than flu
- 3X more contagious
- Elderly and frail most vulnerable
- Average fatality age - 80 years
- Most people will just have a bad cold.
- 16% will have severe resp illness.

Incubation period

- Average 5.1 days
- 97.5% will show S & S within 11 days
- 14-day quarantine 99% effective but
- 10,000 in quarantine, 101 will develop S&S later.
- Children largely asymptomatic – big factor in spread.

Transmission

- Chiefly aerosol via speaking
- Viable about 3 hours in air
- Sneezing, coughing too but by then person often isolated
- The most dangerous thing is to be in a confined space with someone in excess of 5 minutes

Transmission (NIH, CDC)

- Masks effective
- Social distancing not so much.
- Very small droplets stay in the air and drift around as much as 20 feet
- Fomites not a major spreader
- Each infected person infects 3 - 4 others

Comparison of Corona to flu

a sick person breathes, talks, coughs or sneezes. These droplets fall to the

makes the virus harder to get than pathogens like measles, chickenpox and tuberculosis, which can travel a hundred feet

through the air. But it is easier to catch than H.I.V. or hepatitis, which spread only through direct contact with the bodily fluids of an infected person.

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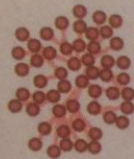
If 5 people with the new coronavirus each infected 2.6 others, here are the number of people who could be sick after each of five cycles.



5



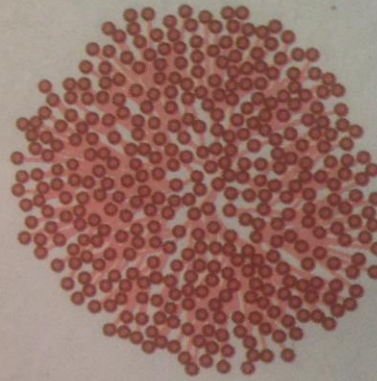
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52



140



368

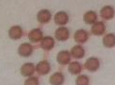
If 5 people with seasonal flu each infected 1.3 others, here are the number of people who could be sick after each of five cycles.



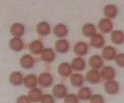
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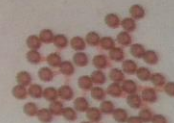
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45

How deadly is the virus?

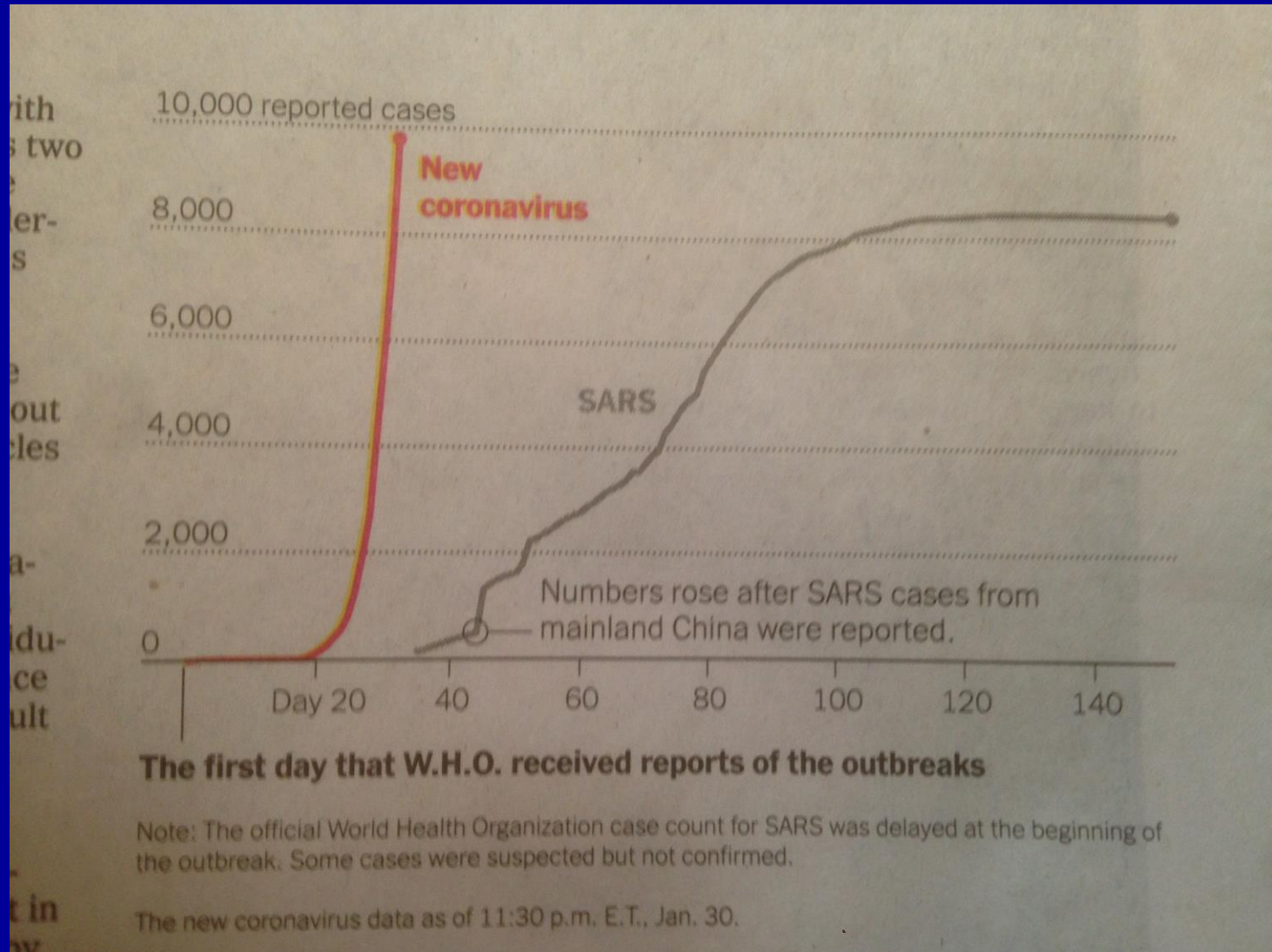
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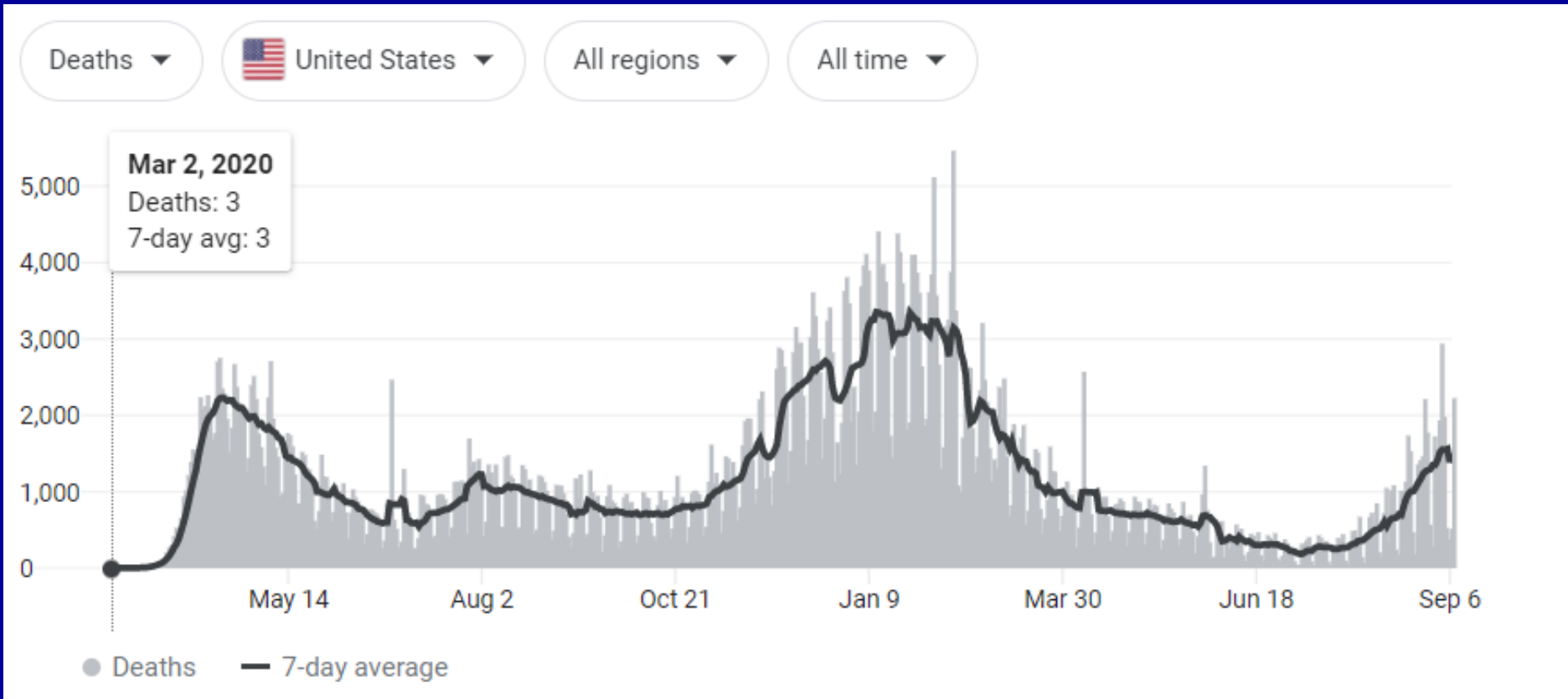
Fatalit

Troubling chart



- Covid statistics – USA
- 42 million infected (maybe many more)
- 700,000 deaths, more than all the wars of the 20th century combined.
- 150,000 new cases a day
- 2,000 deaths a day
- Unvaccinated people make up 98% of new cases
- Vaccines are holding up well against Delta
- Booster shots not recommended except for the medically frail

Covid fatalities



Vaccine stats

- 350,000,000 doses of vaccines
- 51% fully; 10% 1 shot
- 1 million shots a day going out.
- 6968 reports of death (0.0019%)
- However, that is death by any cause. If a 90-year-old nursing home resident died for any reason days, weeks or months after being vaccinated it would still be reported to VAERS. (VAERS designed for childhood vaccines)

Vaccine safety

- There are no confirmed deaths associated with Pfizer and Moderna.
- J and J has been linked to blood clots and Guillaume Barre syndrome in rare cases, including a few deaths.
- The numbers are so small it is impossible to know if it was an immune response to the vaccine or an independent infection.

Vaccine safety

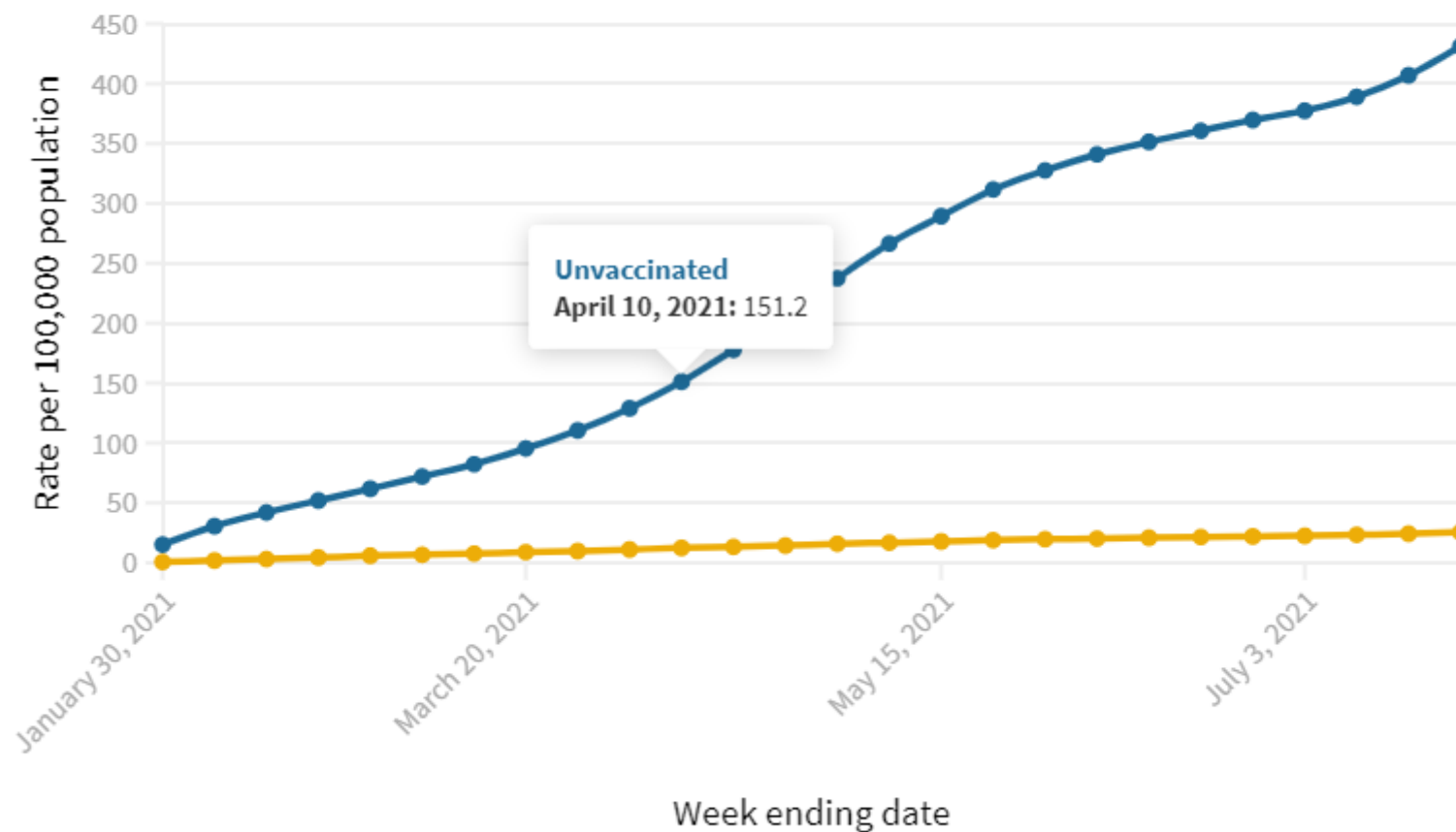
- You are about 3 X more likely to be struck by lightning than you are to have a serious reaction to J and J.
- With 350,000,000 vaccinations, if there was a big problem we would know about it.
- Unvaccinated people are going to get covid and spread it to others, including children.

Break through infections

- Most vaccinated people are immune.
- Some will get infected subclinically for a few hours. They can spread the infection during that time to the unvaccinated.
- Some people will get mildly sick.
- Elderly, frail, or patients with compromised immune systems can get very sick and even die.

Cumulative rates of U.S. COVID-19 hospitalizations of adults by vaccination status, January–July 2021

■ Unvaccinated ■ Fully vaccinated



Source: E.P. Havers et al./medRxiv.org

Covid special tricks

- Because it attaches to the cells that make ACE (blood pressure), anyone with diabetes, obesity or any kind of blood pressure issues is extremely vulnerable
- Separate problems include:
 - Cytokine storm
 - Blood clots
 - Severe anemia

Covid special tricks

- Pneumonia still the biggest killer.
- Children can get multisystem inflammatory Syndrome
- Mu, eta, iota, and lambda variants
- Herd immunity about 5 months away
- Worldwide, at least a year, probably more.