Learning from Wuhan, US and Europe COVID-19 data on public health interventions

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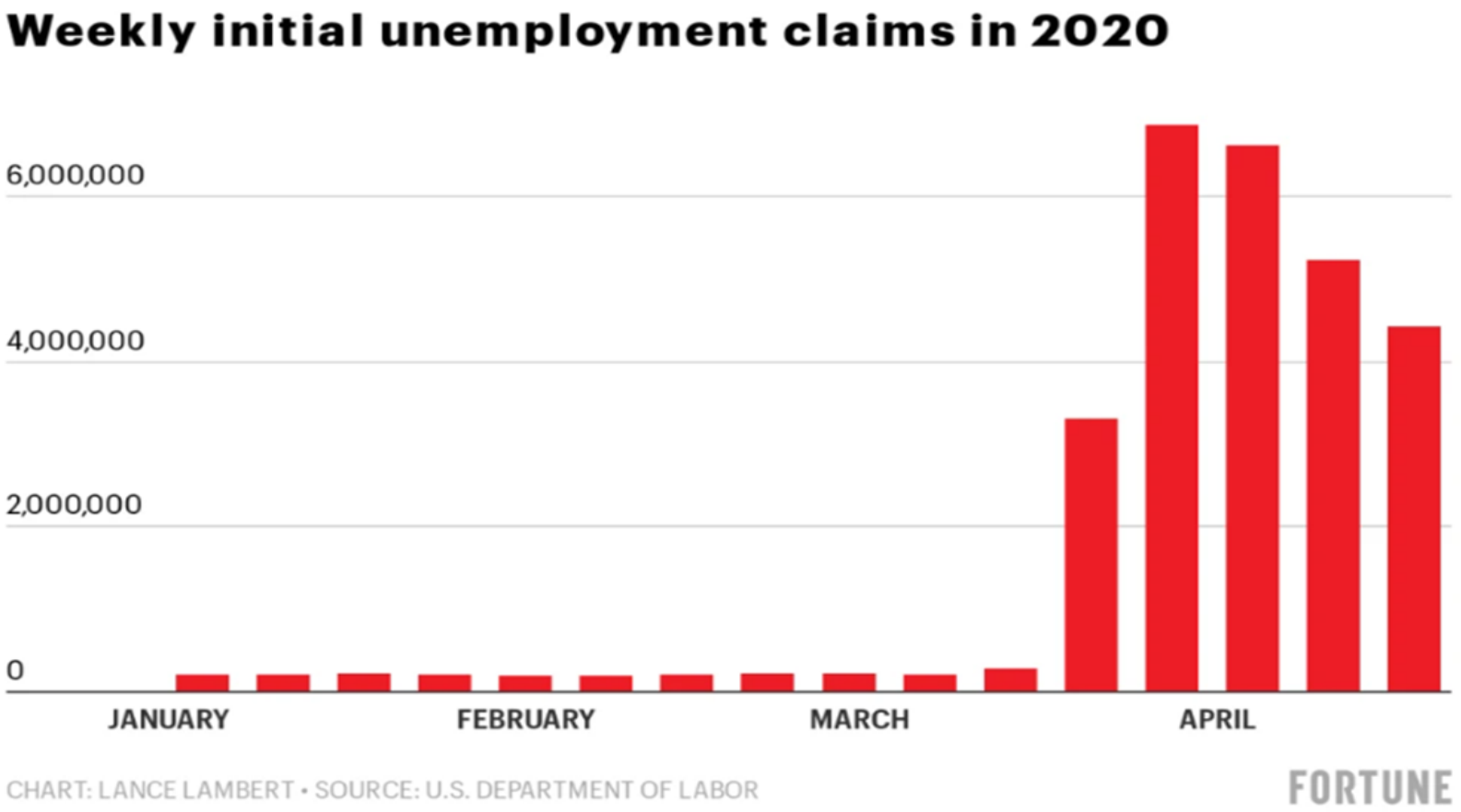
HEALTH

WHO declares the coronavirus outbreak a pandemic

March 11, 2020

By HELEN BRANSWELL @HelenBranswell *and* ANDREW JOSEPH @DrewQJoseph / MARCH 11, 2020

Unemployment Rate in US



Scientific community

nature

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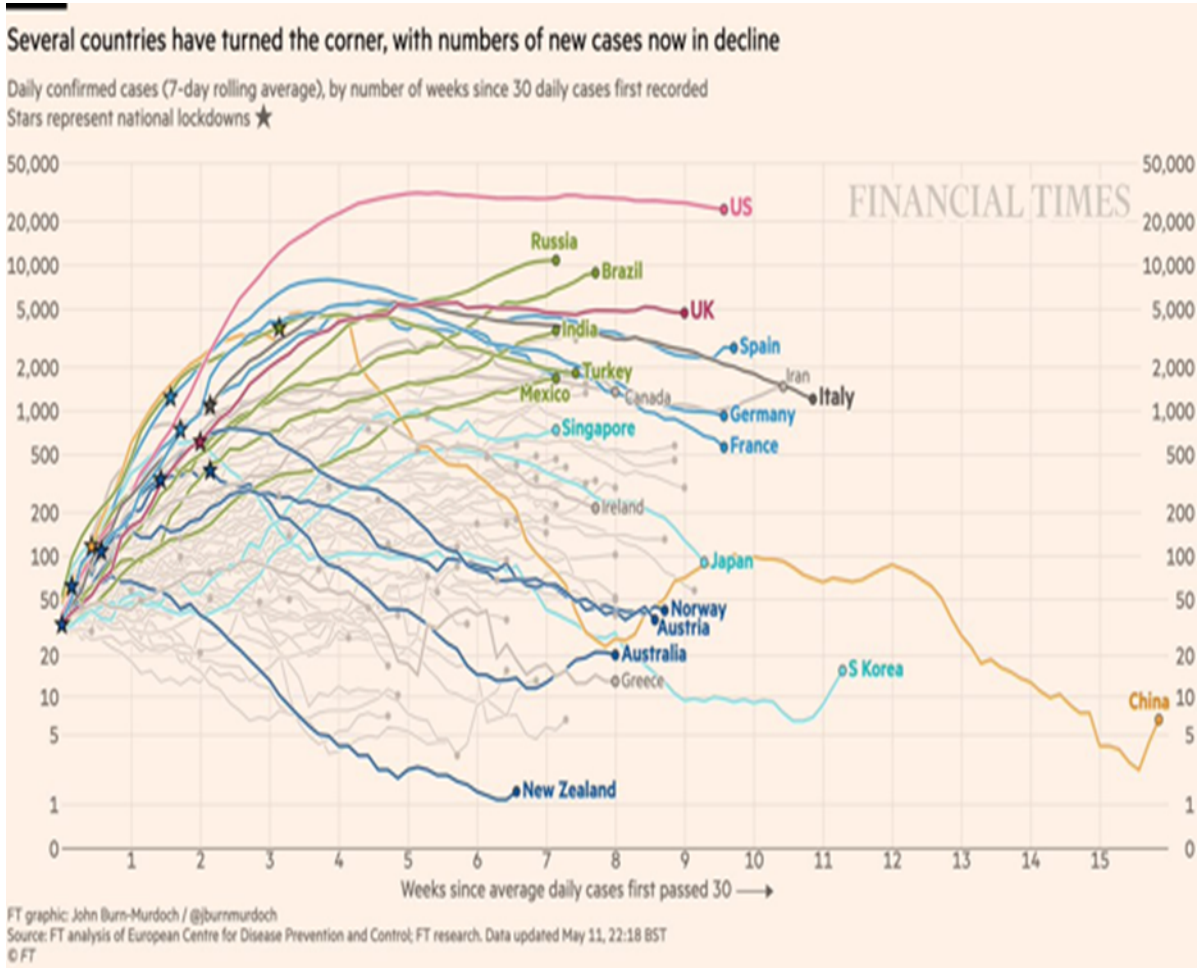
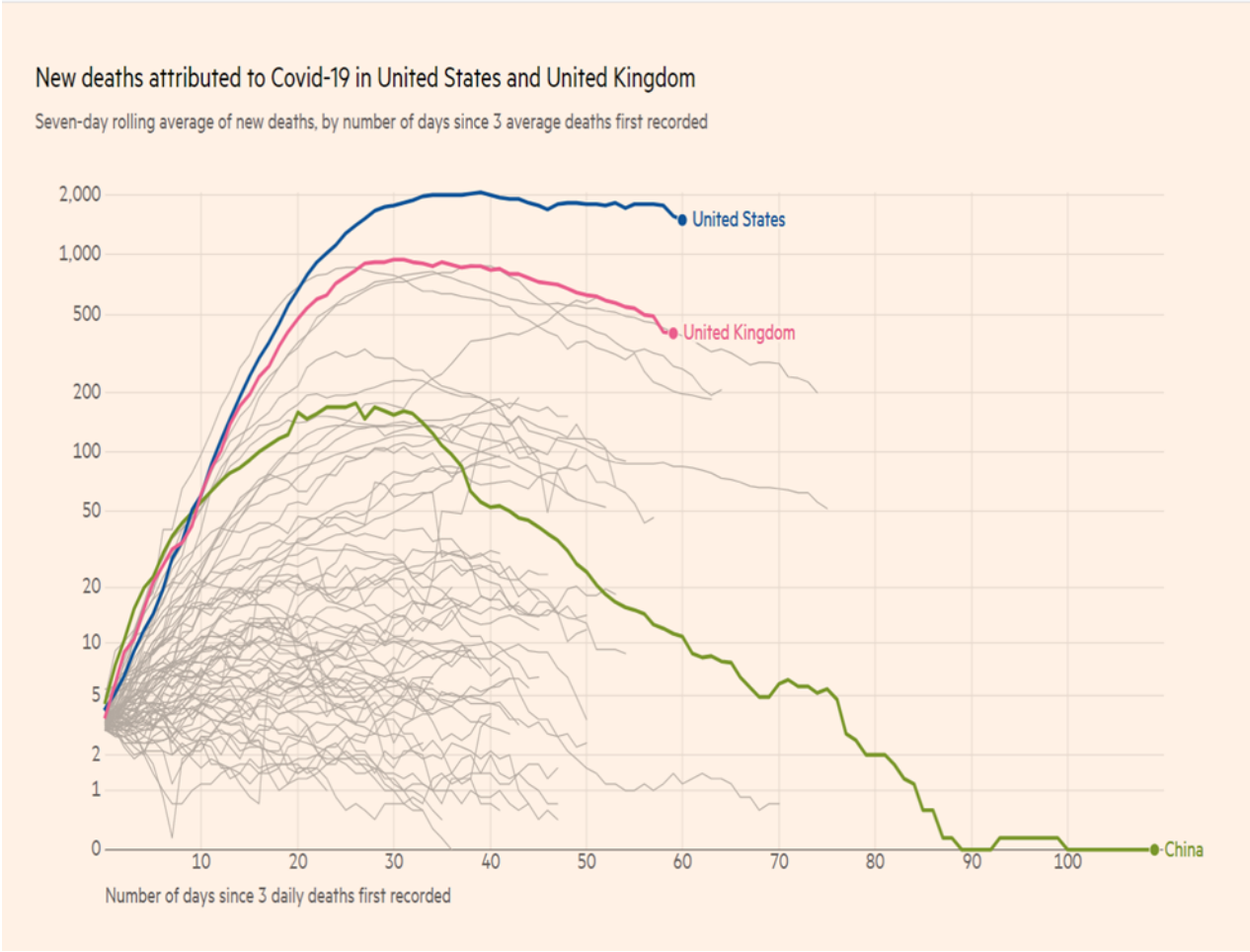
NEWS · 16 MARCH 2020

A year without conferences? How the coronavirus pandemic could change research

As scientific meetings are cancelled worldwide, researchers are rethinking how they network – a move that some say is long overdue.

4.2 Million COVID-19 Cases and 285K Deaths in the World (May 13, 2020)





Huge Multi-faceted Impact

Learning from COVID-19 Cases in Wuhan, US and Europe

A Pre-print of Analysis of 26,000 COVID-19 cases until Feb 18 in Wuhan was posted immediately in MedRxiv on March 6, 2020

medRxiv
THE PREPRINT SERVER FOR HEALTH SCIENCES

CSH Cold Spring Harbor Laboratory BMJ Yale

Comment on this p

Evolving Epidemiology and Impact of Non-pharmaceutical Interventions on the Outbreak of Coronavirus Disease 2019 in Wuhan, China

Chaolong Wang, Li Liu, Xingjie Hao, Huan Guo, Qi Wang, Jiao Huang, Na He, Hongjie Yu, Xihong Lin, An Pan, Sheng Wei, Tangchun Wu

doi: https://doi.org/10.1101/2020.03.03.20030593

This article is a preprint and has not been peer-reviewed [what does this mean?]. It reports new medical research that has yet to be evaluated and so should *not* be used to guide clinical practice.

Article usage: March 2020 to April 2020

Show by month	Abstract	Pdf
Total	114,652	43,794

See more details

- Picked up by **85** news outlets
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- Tweeted by **5420**
- On **1** Facebook pages
- Highlighted by **1** platforms

Abstract views=119K
Pdf downloads=46K

- A summary of the key findings is at my tweet @XihongLin

Acknowledgement

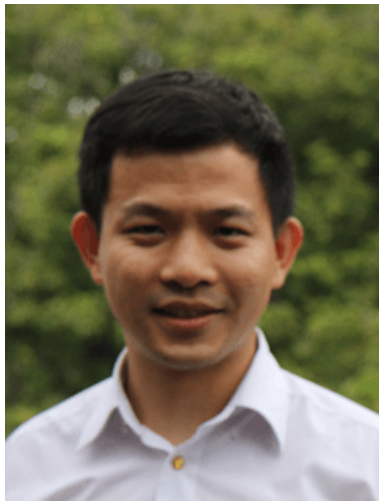
An Pan, Chaolong Wang, Li Liu, Xingjie Hao, Huan Guo, Qi Wang, Jiao Huang, Na He, Hongjie Yu, Sheng Wei, Tangchun Wu

Tongji School of Public Health

Huazhong Science and Technology University

Wuhan

(blue=HSPH alum)



Thank all of my Tongji SPH co-authors for their tireless work on finishing this manuscript in a short time. The gained knowledge benefits US and other countries at this critical time.

Part I of the Updated MedRxiv Preprint was Published in JAMA, April 10: Analysis of 32,000 cases Until March 8, 2020

New Online | Views 113,680 | Citations 0 | Altmetric 1391 | Comments 2

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Original Investigation

ONLINE FIRST FREE

April 10, 2020

Association of Public Health Interventions With the Epidemiology of the COVID-19 Outbreak in Wuhan, China

An Pan, PhD[1]; Li Liu, MD, PhD[1]; Chaolong Wang, PhD[1]; et al

Top 0.01% among 15 millions of articles

Testified in the Evidence Session of the Science and Technology Committee of the UK Parliament on April 17

Weekly update

17 April 2020

This week (the week commencing 13 April)

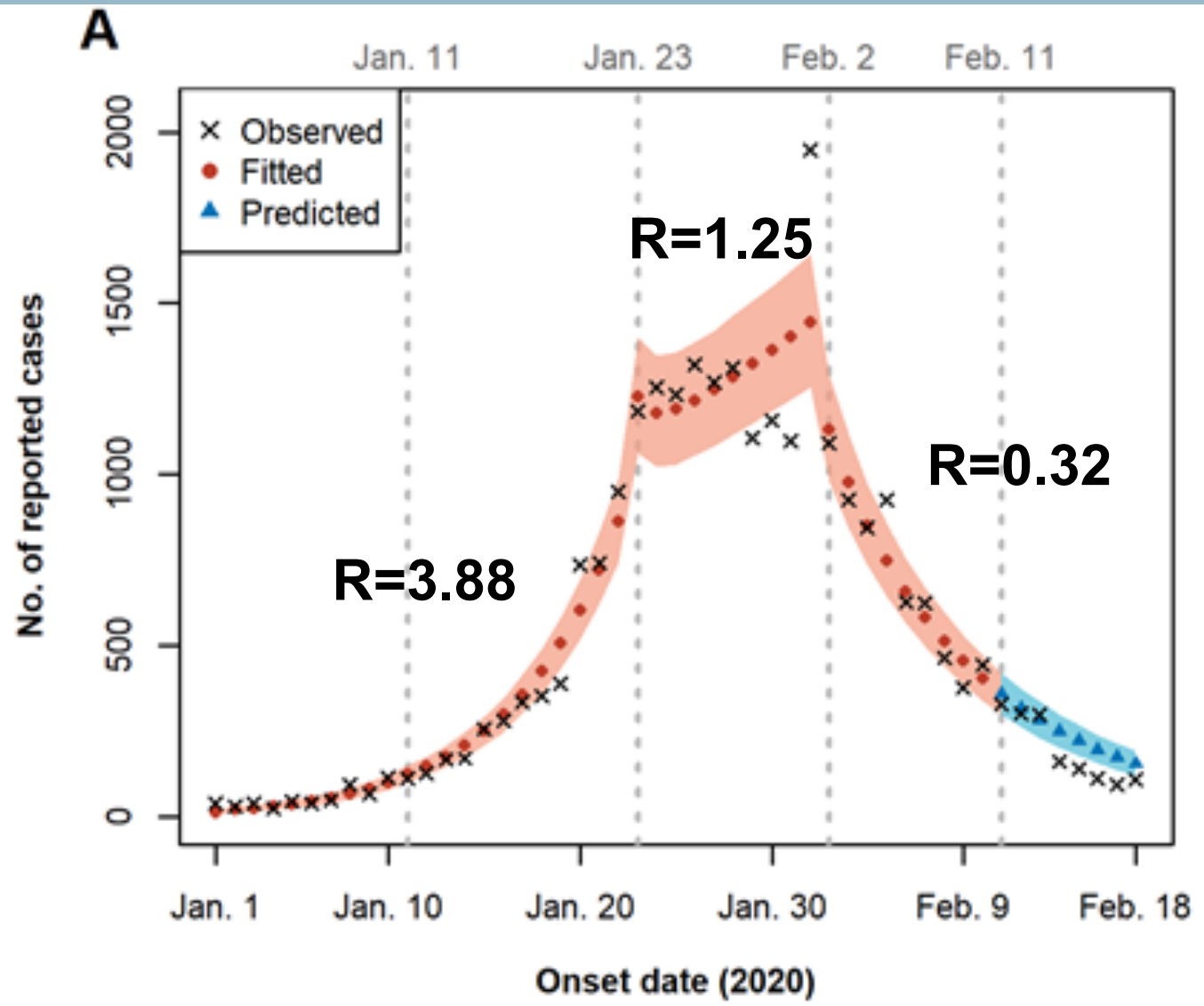
As part of our inquiry into UK science, research and technology capability and influence in global disease outbreaks, we held our third public evidence session. We focussed on the effectiveness and longevity of social distancing measures in the UK, the wider implications of these measures for the population, and international strategies for relaxing social distancing measures.

This week, we took evidence from:

- Dr James Rubin, Reader in the Psychology of Emerging Health Risks, King's College London
- Professor Graham Medley, Professor of infectious disease modelling, London School of Hygiene and Tropical Medicine
- Professor Xihong Lin, Professor of biostatistics, Harvard T.H. Chan School of Public Health

Media Coverage and Interview

Key Point: Wuhan Experience shows the COVID-19 Outbreak Can Be Controlled: Social Distancing + Centralized Isolation and Quarantine



Effective Reproductive Number R_t

=

Average # of people infected by a case

Analysis of 26,000 cases

SEIR model

Wuhan, China

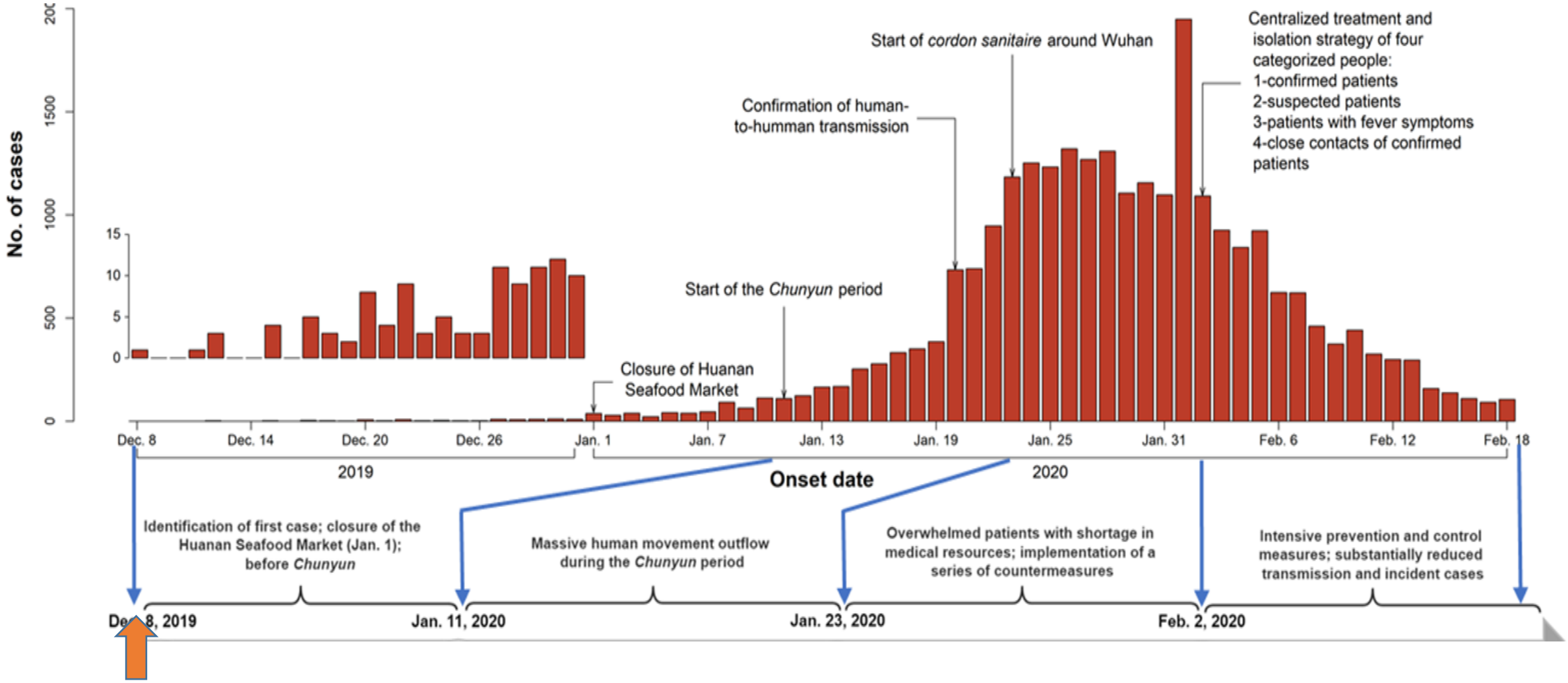
Population Size: 11M

Wuhan, China

Changjiang river in the background

East Lake, Cherry Blossom

Wuhan CDC (n=25,961): December 8 – February 18



Dec 8, 2019: First case: close to the Huanan Seafood Market

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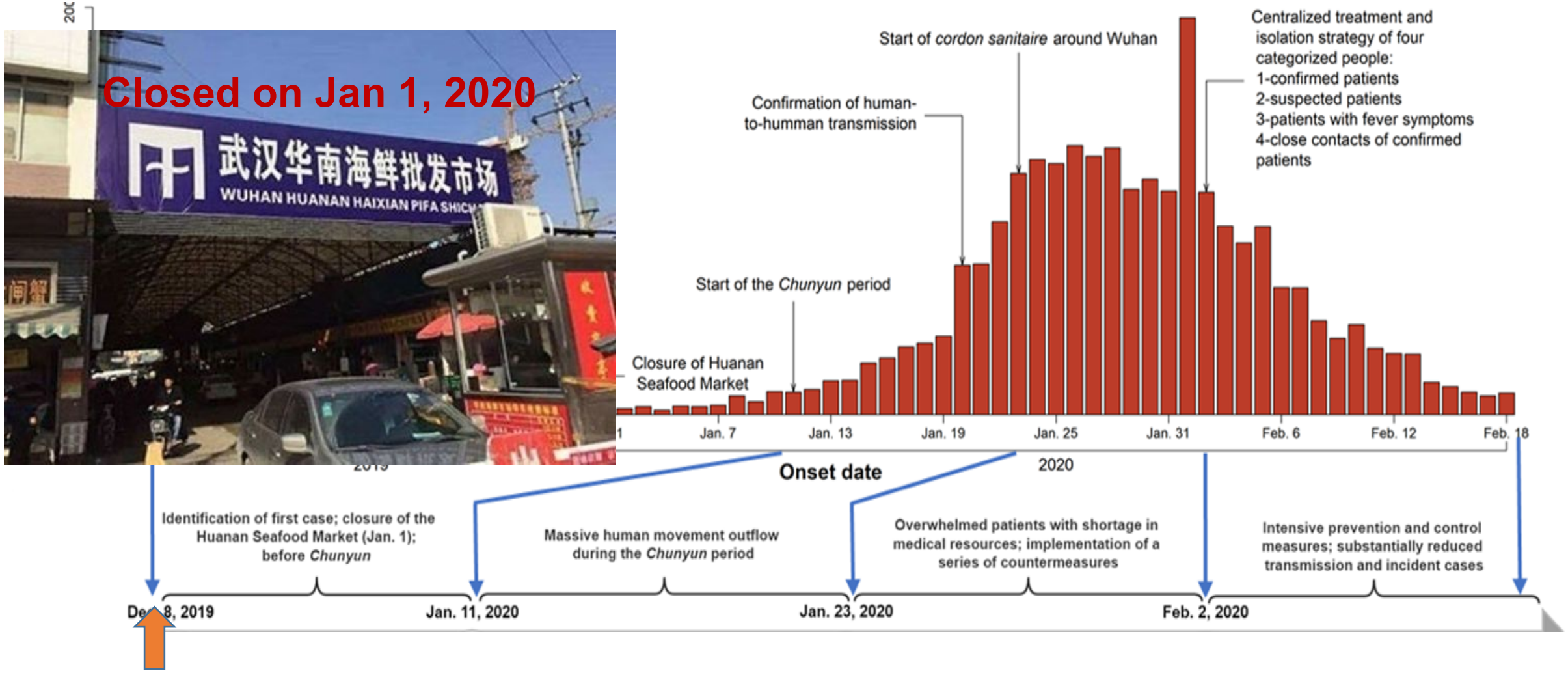

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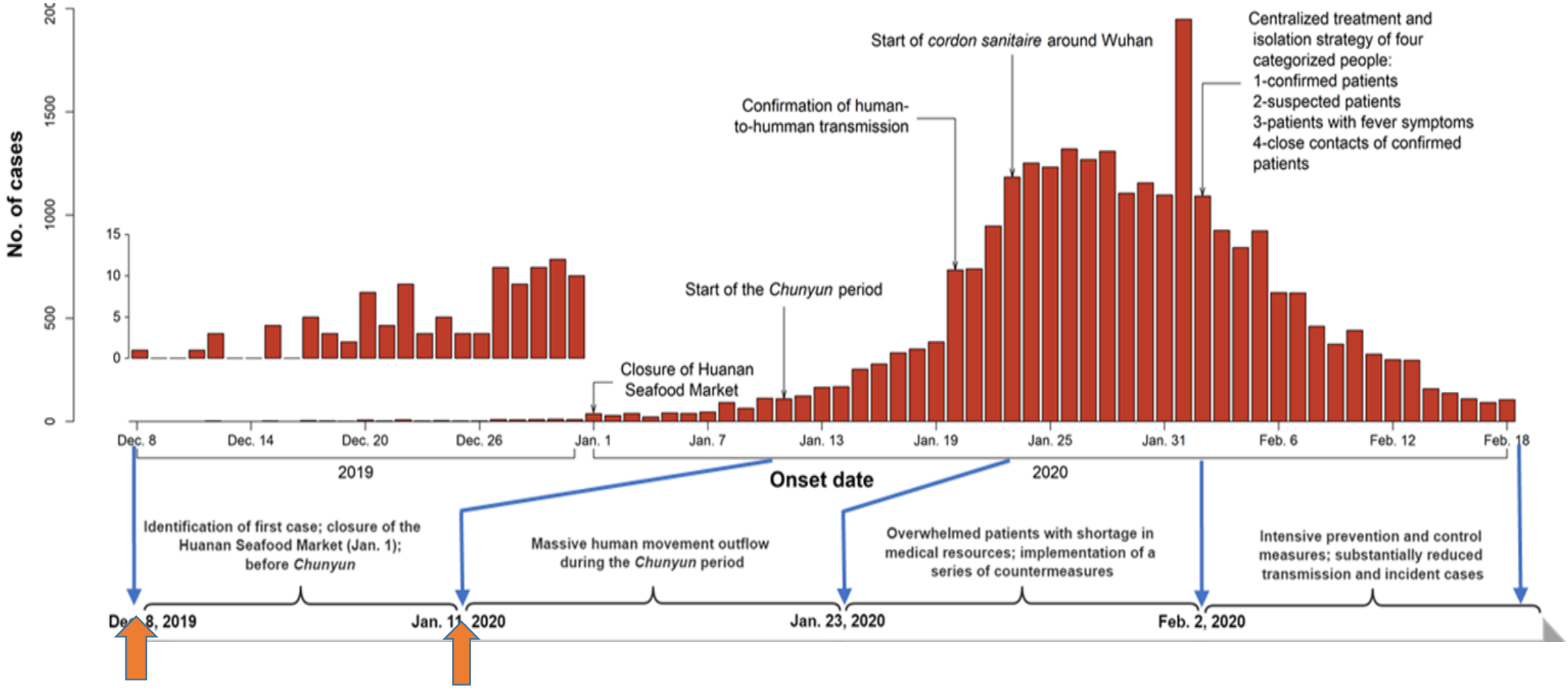

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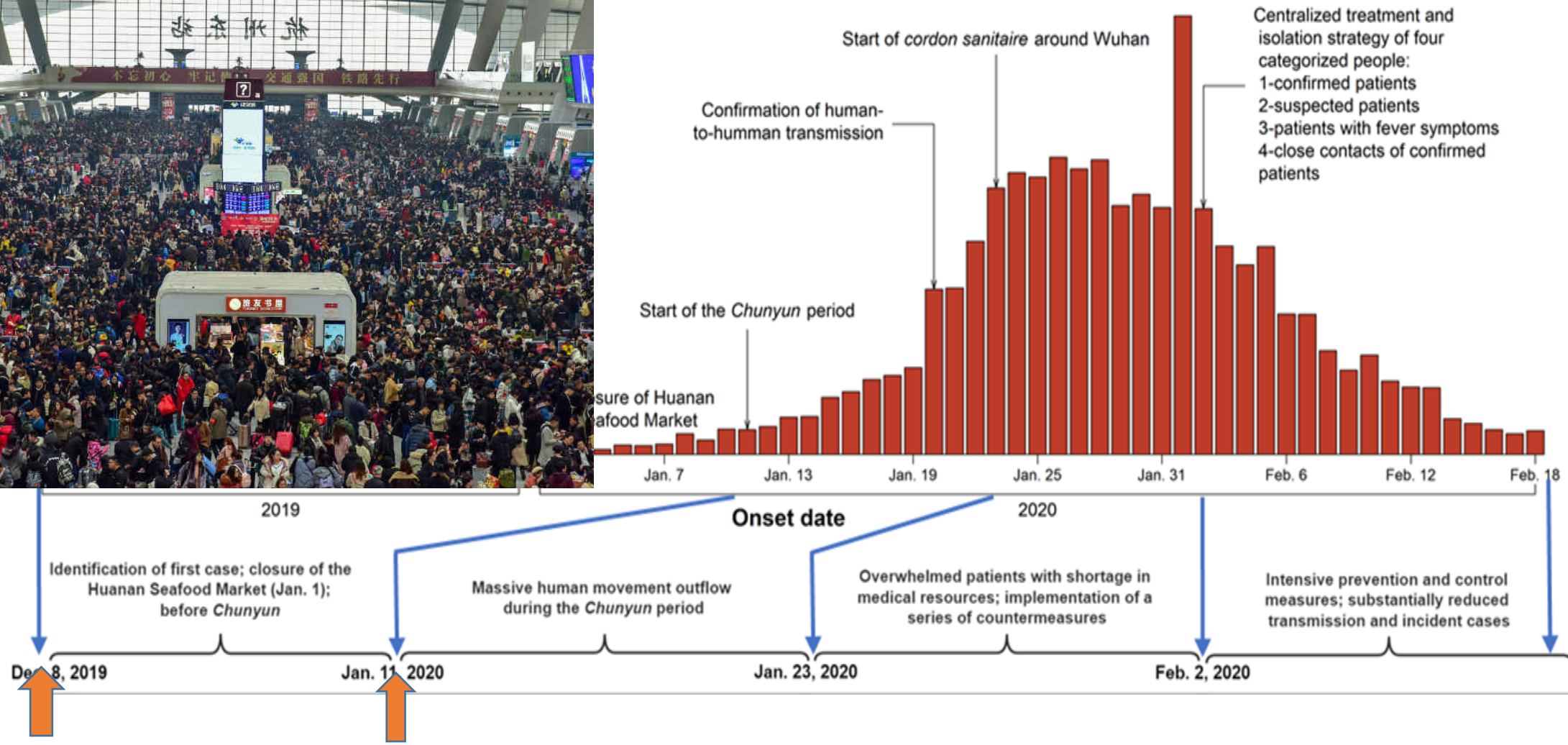

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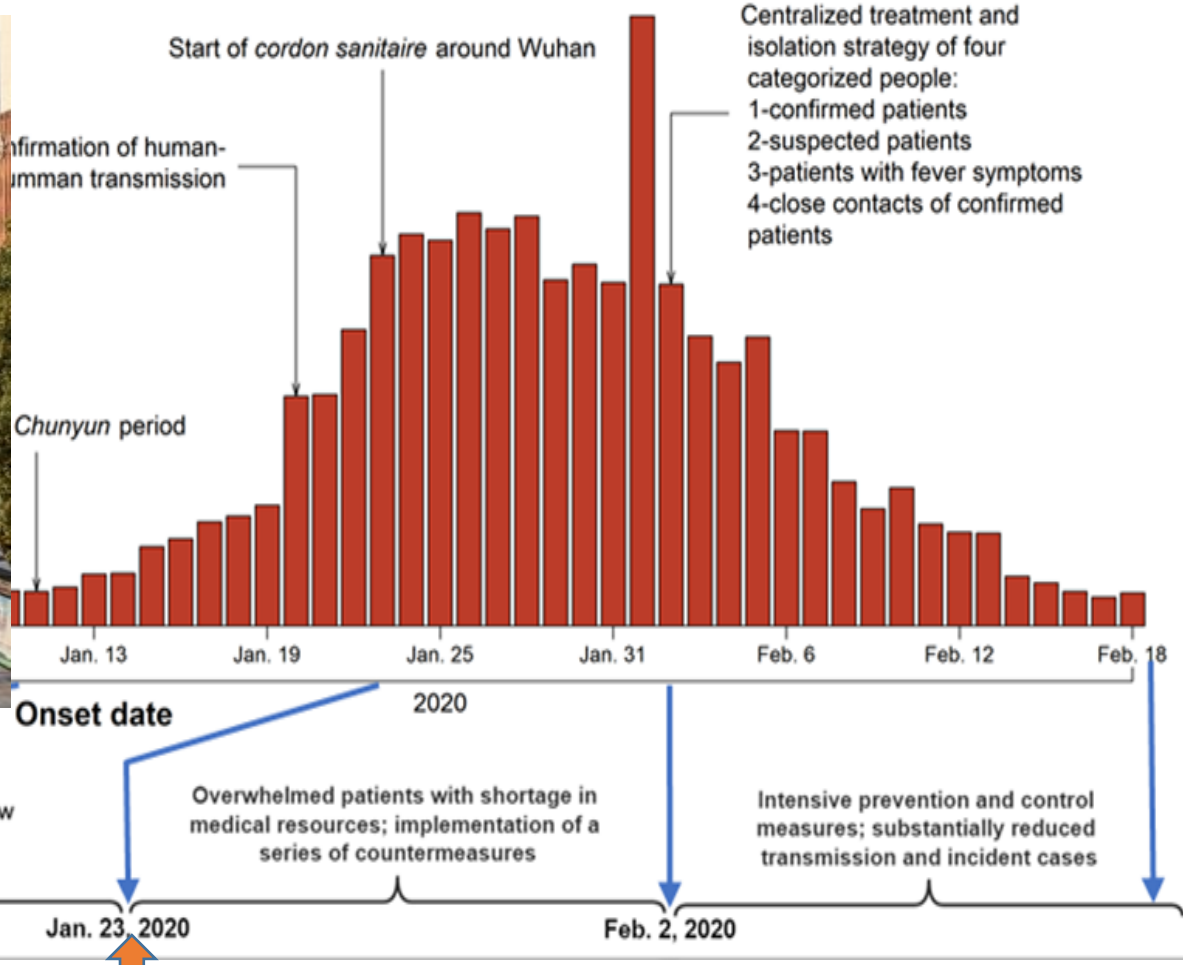

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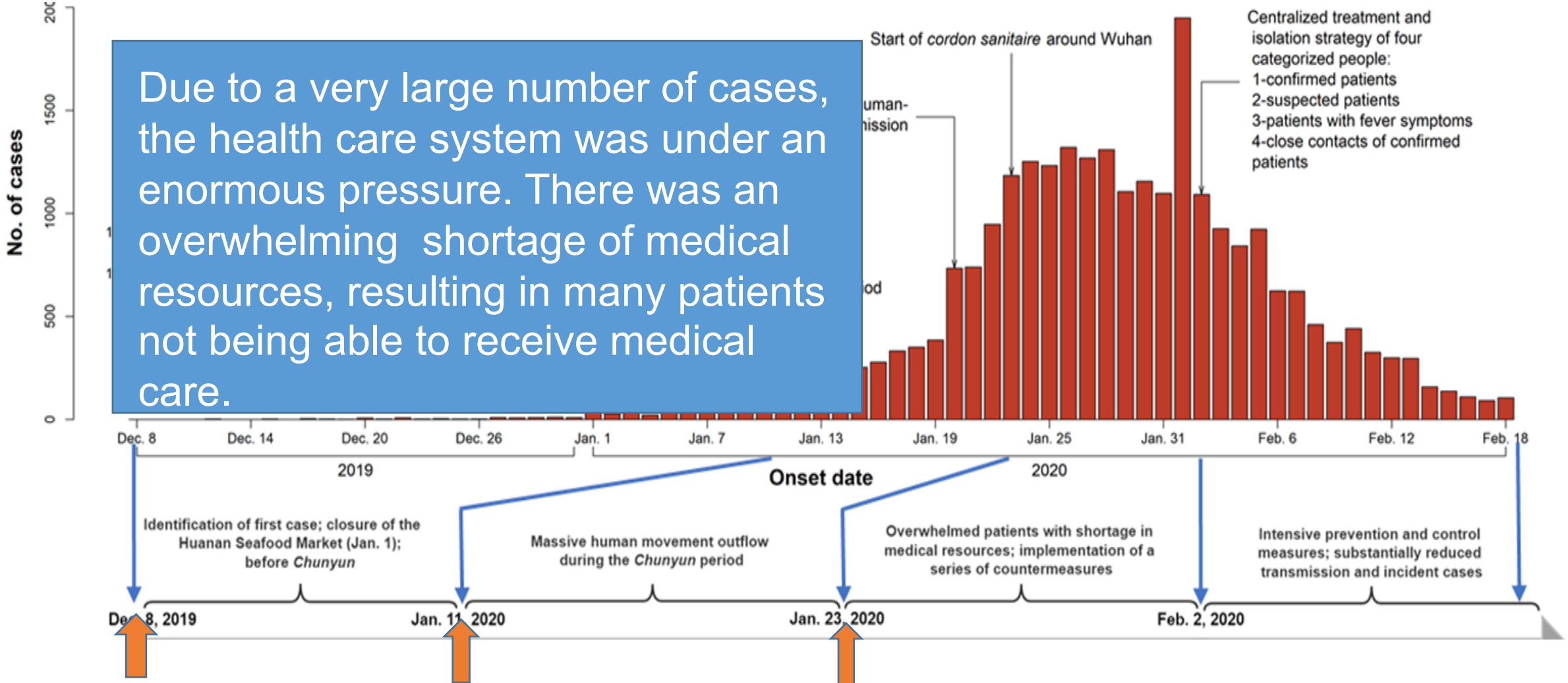
Jan 23, 2020 Start of *Cordon Sanitaire*

Wuhan CDC (n=25,961): December 8 – February 18



Due to a very large number of cases, the health care system was under an enormous pressure. There was an overwhelming shortage of medical resources, resulting in many patients not being able to receive medical care.

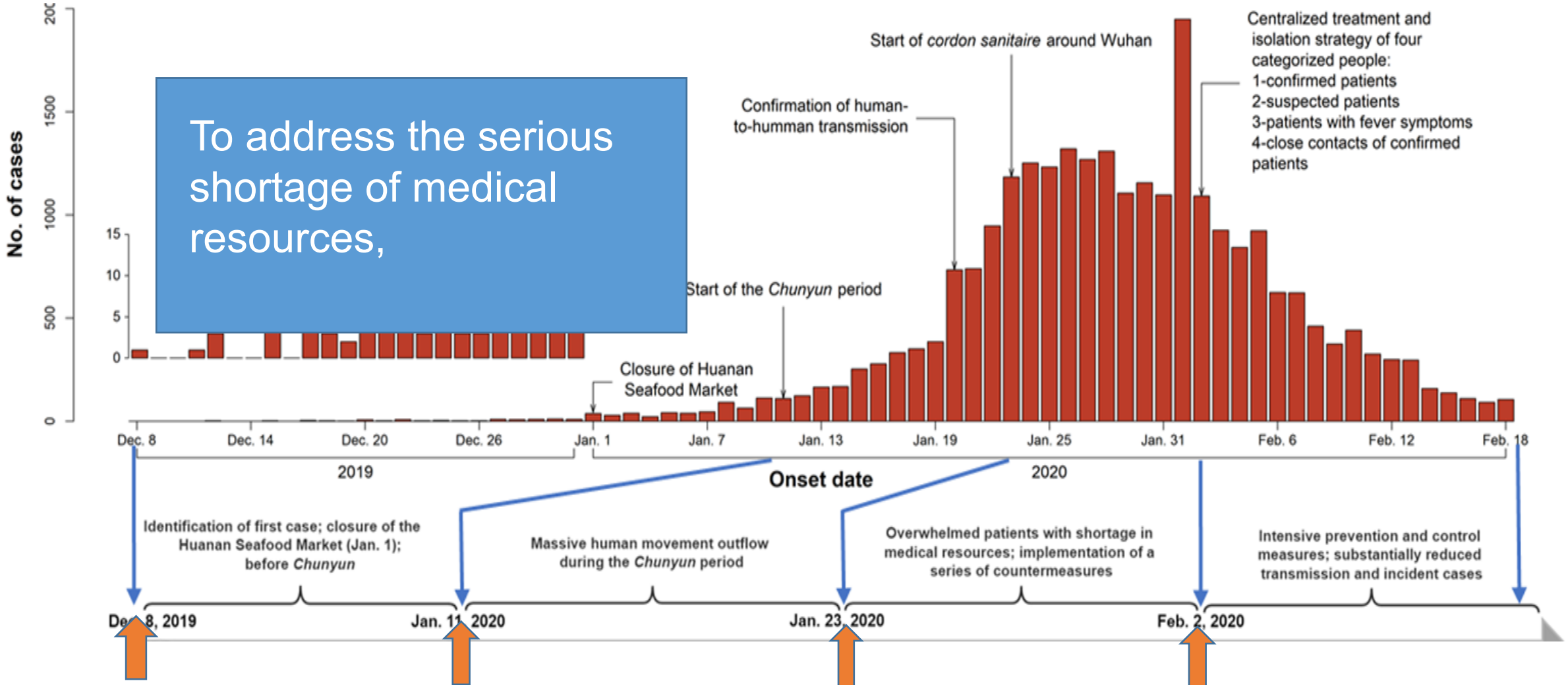
Dec 8, 2019: First case: close to the Huanan Seafood Market

Jan 11, 2020: Start of Spring Festival Travel

Jan 23, 2020 Start of *Cordon Sanitaire*

Wuhan CDC (n=25,961): December 8 – February 18

To address the serious shortage of medical resources,



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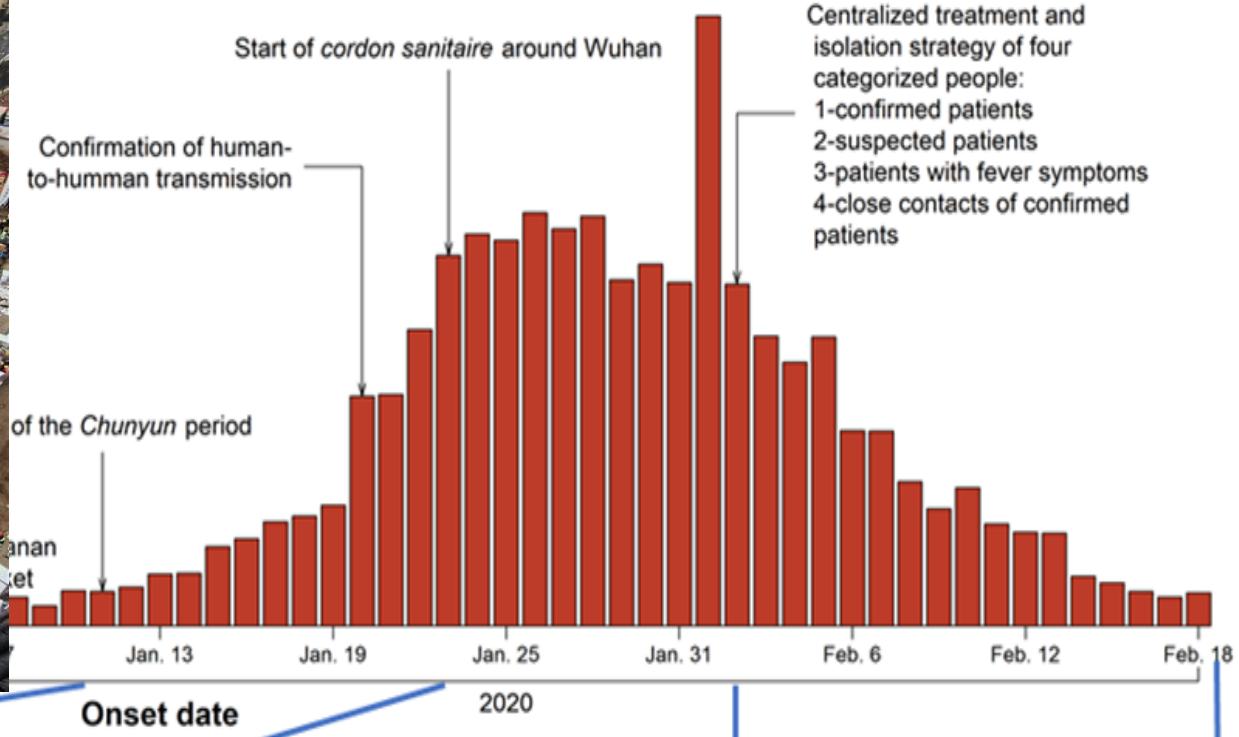
Jan 11, 2020: Start of Spring Festival Travel

Jan 23, 2020 Start of *Cordon Sanitaire*

Feb 2, 2020 2 New and 16 Field Hospitals Launched

Wuhan CDC (n=25,961): December 8 – February 18

2 new simple hospitals built in <2 weeks



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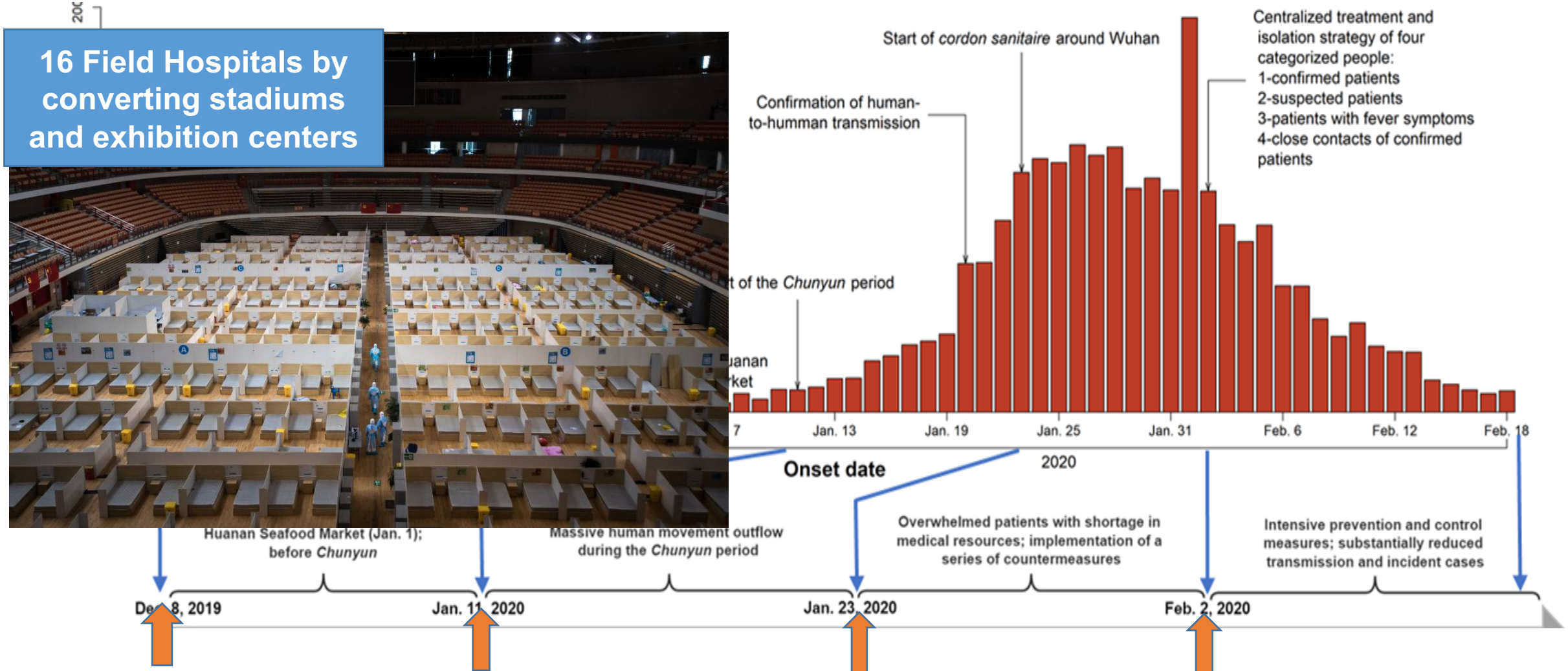
Wuhan CDC (n=25,961): December 8 – February 18

16 Field Hospitals by converting stadiums and exhibition centers



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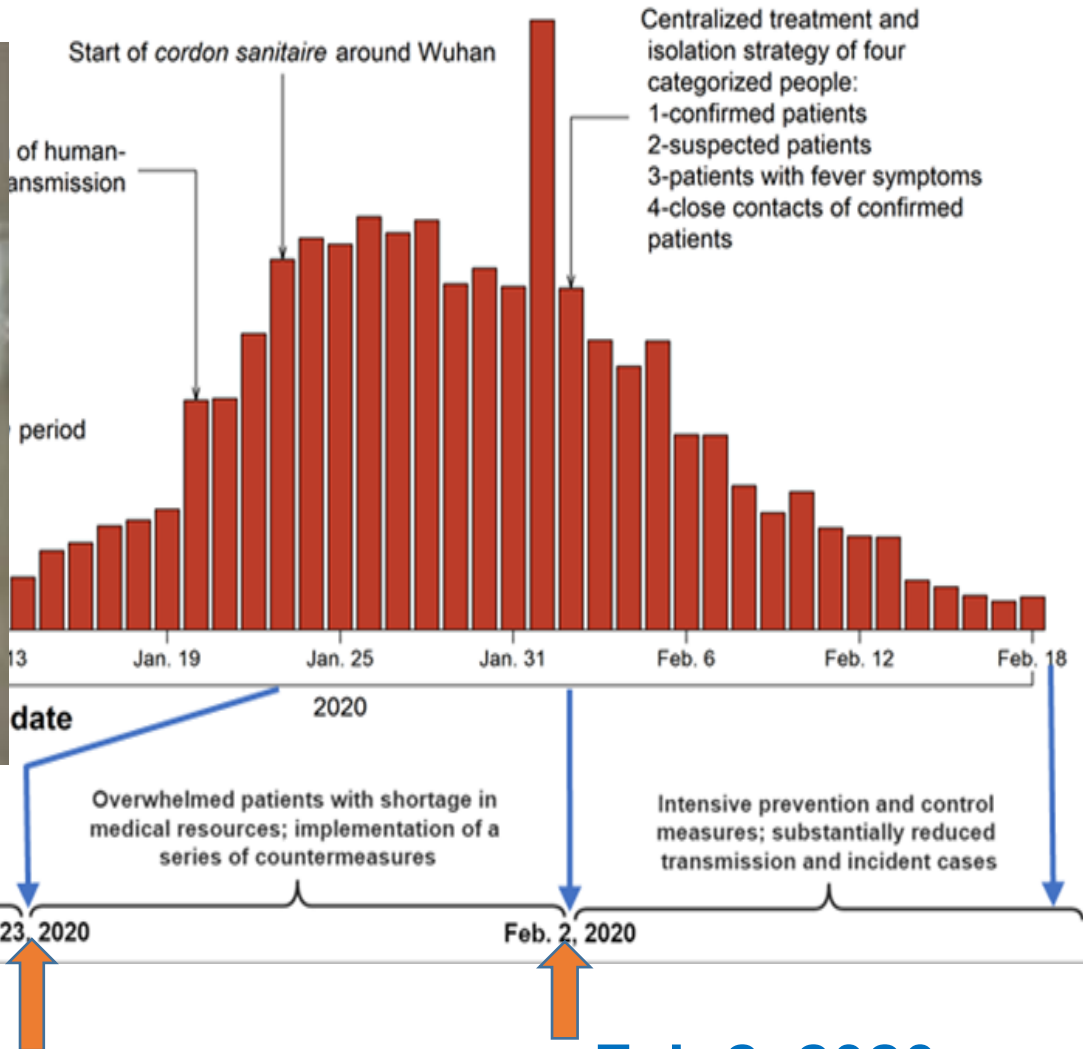
Jan 23, 2020 Start of *Cordon Sanitaire*

Feb 2, 2020 2 new and 16 field hospitals launched

Wuhan CDC (n=25,961): December 8 – February 18

Designated hotels and university dorms were used for additional beds for presumptive cases and close contacts



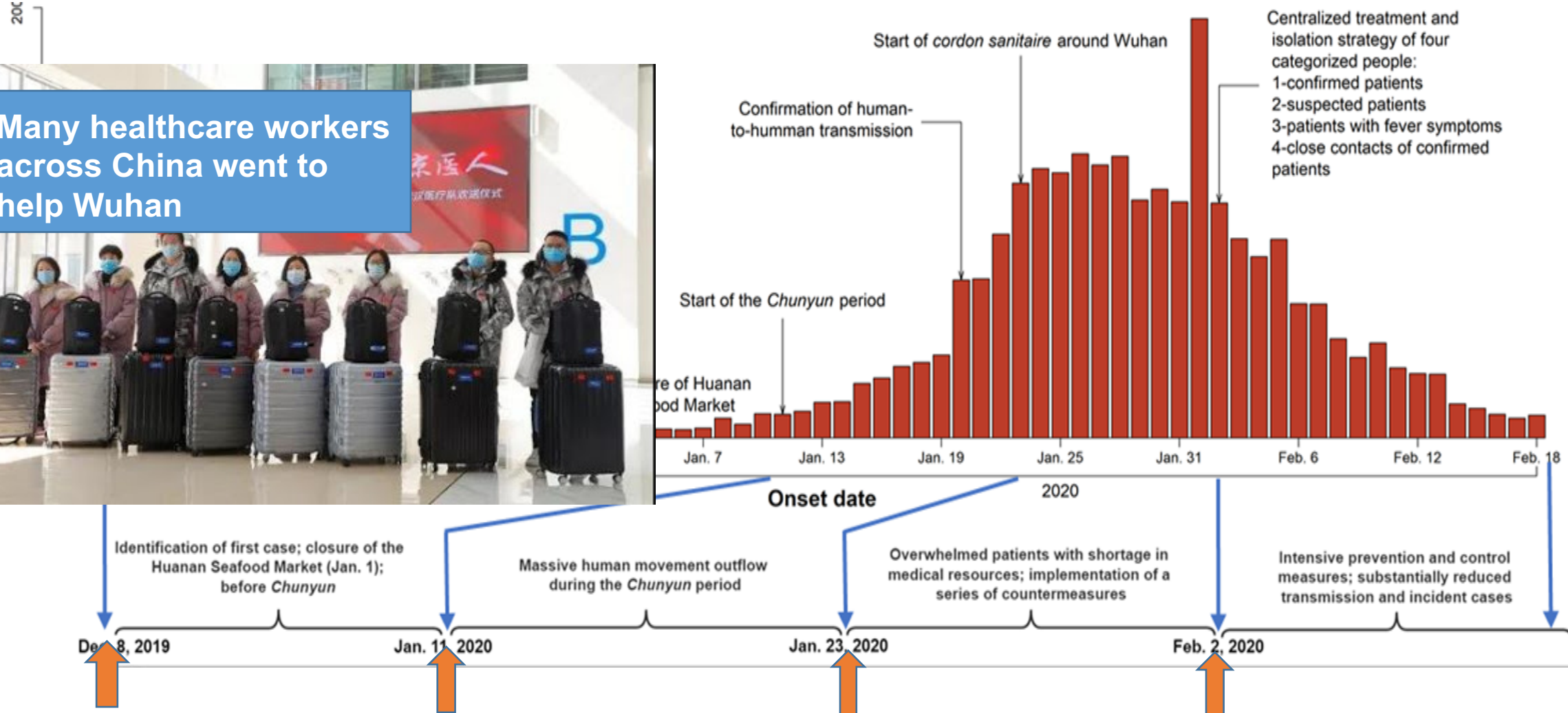
Dec 8, 2019: First case: close to the Huanan Seafood Market

Jan 11, 2020: Start of Spring Festival Travel

Jan 23, 2020 Start of *Cordon Sanitaire*

Feb 2, 2020 2 new and 15 field hospitals launched

Wuhan CDC (n=25,961): December 8 – February 18



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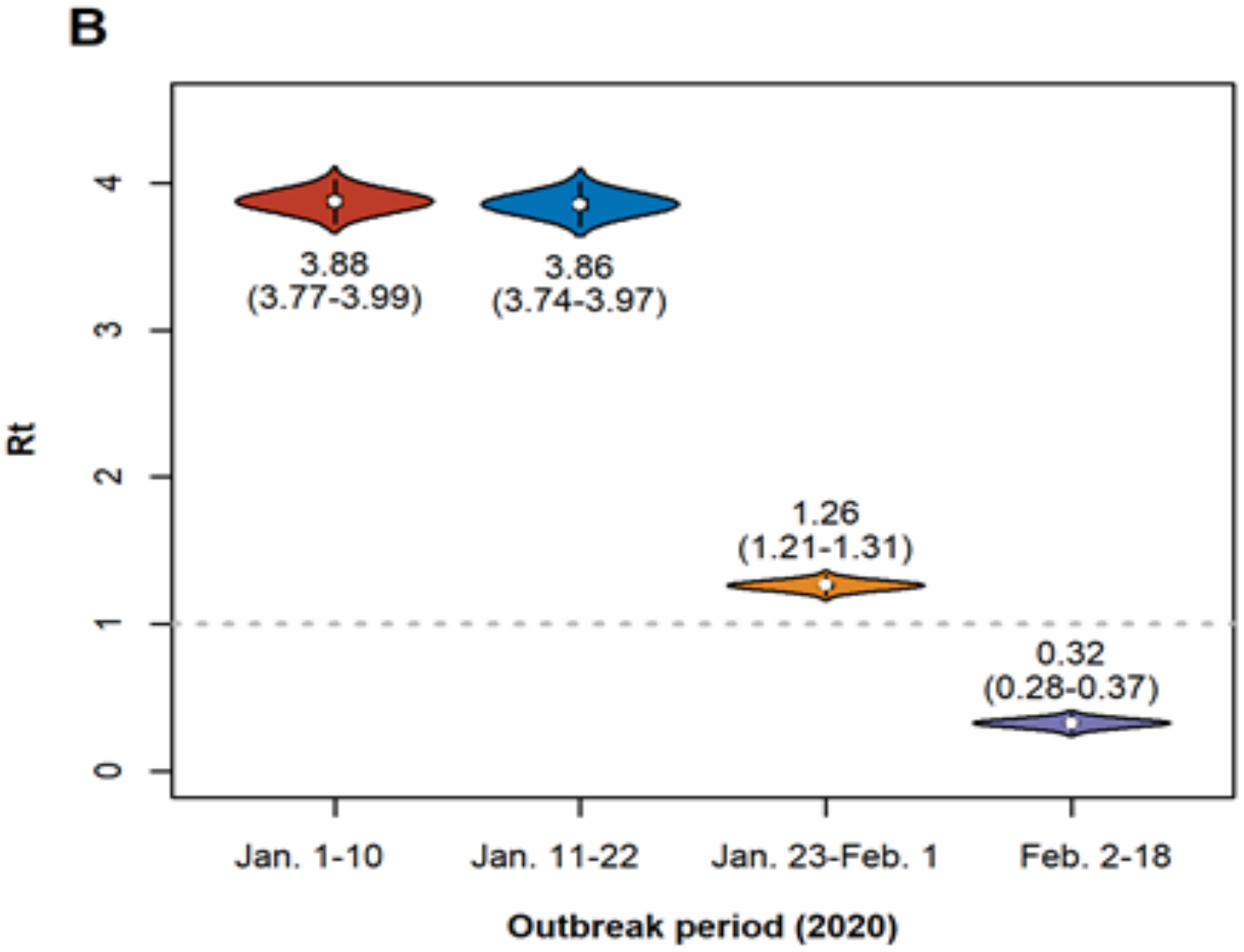
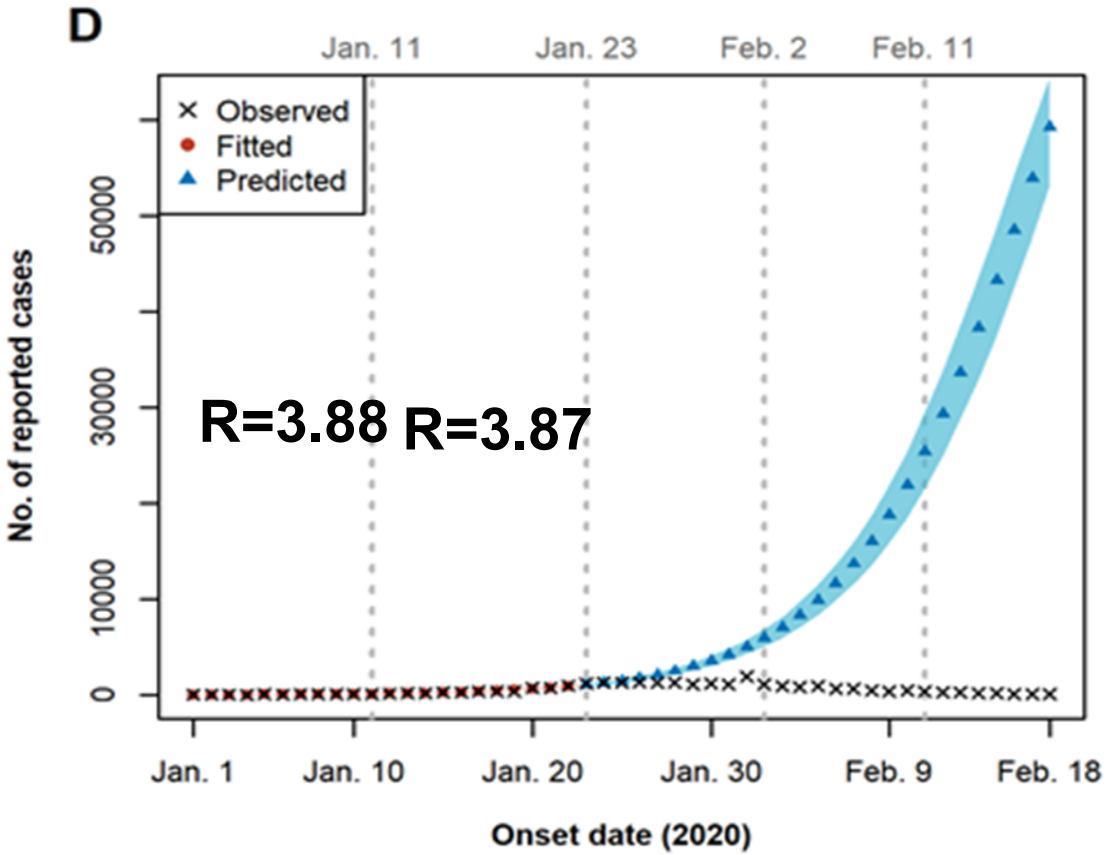
Estimated Effective Reproducible Number R Using Extended SEIR Model



Assume

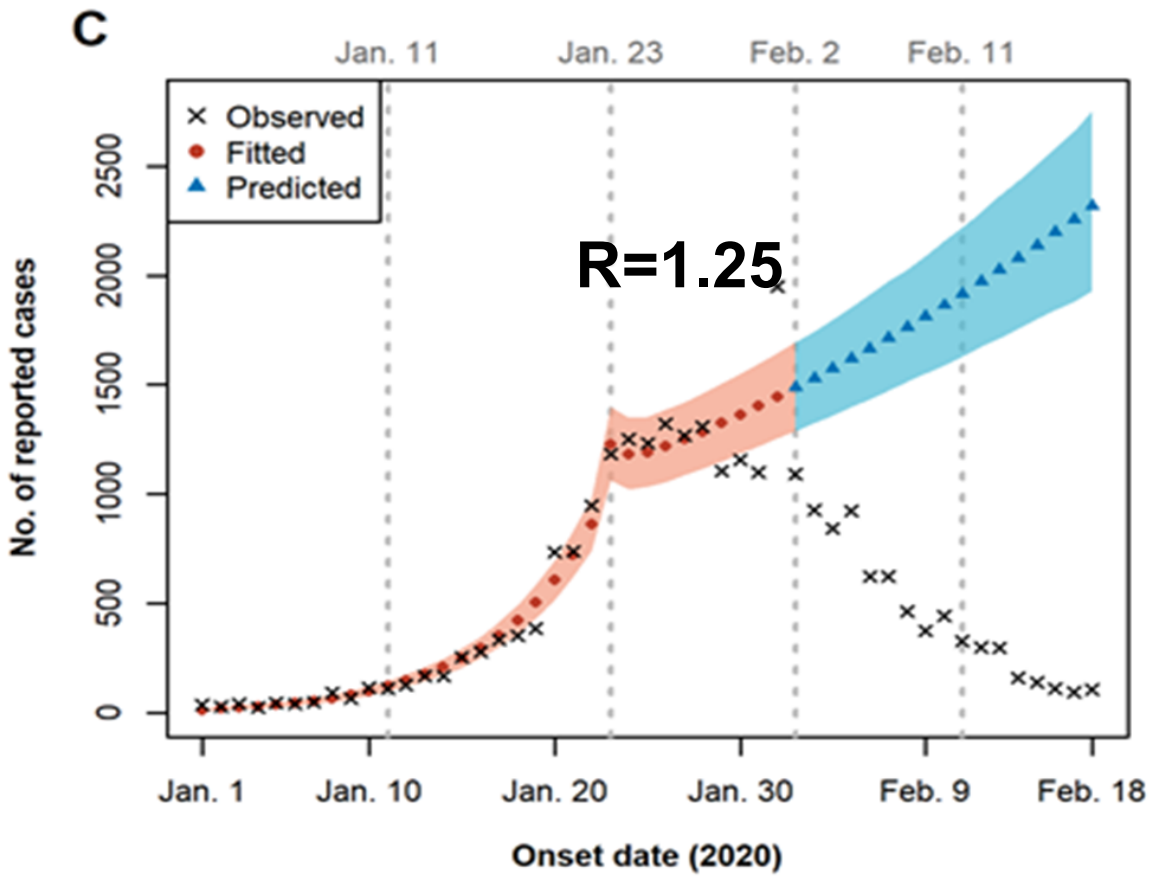
- Incubation period =5.2 days
- Infection period=2.3 days
- # of unascertained cases =# of ascertained cases at the initial stage
- 9 sensitivity analyses

Estimated Effective Reproducible Number R Using Extended SEIR Model



Blue = projected trajectory if there were no intervention

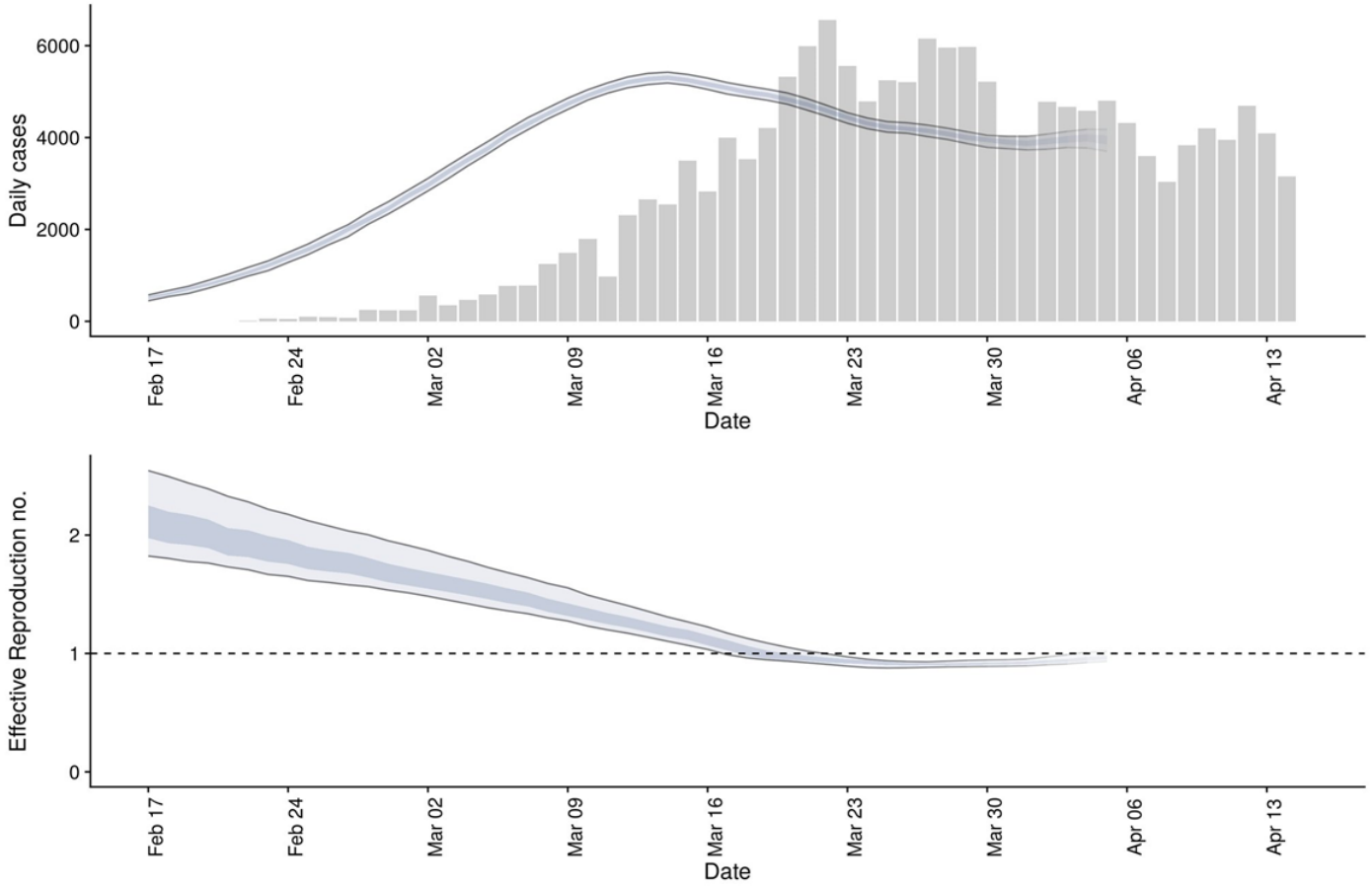
Lab-confirmed cases during lockdown with traffic ban and home quarantine between January 23-Feb 1, 2020



Blue = Projected trajectory if social distancing had continued.

The results that social distancing reduces R to linger around 1 have been replicated in many countries

Italy (Feb 17-April 13)

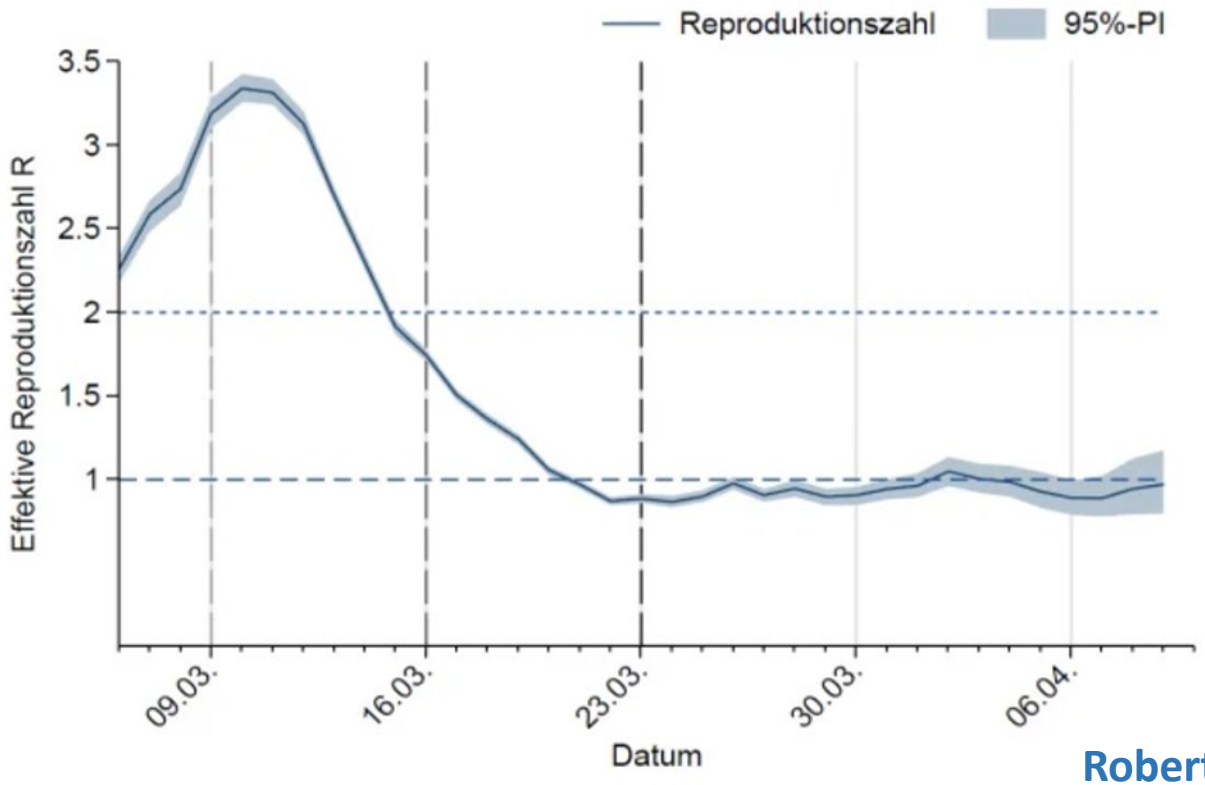


R≈ 1 for a month

https://epiforecasts.io/covid/posts/national/italy/

The results that social distancing reduces R to linger around 1 have been replicated in many countries

Germany (Mar 8-April 6)



R≈ 1 for a month

Robert Koch Institut, Epidemiologisches Bulletin, April 23, 2020

Take home message #1: Social Distancing Greatly Helped Flatten the Curve but Was not Enough

- Social distance helps block community transmission (between-household transmission)
- Family transmission is common.
- Infected cases might infect family members and close contacts, who could infect others in the community.
- Social distancing helped reduce R to be around 1, but was not good enough

Coronavirus Ravages 7 Members of a Single Family, Killing 4

March 18, 2020

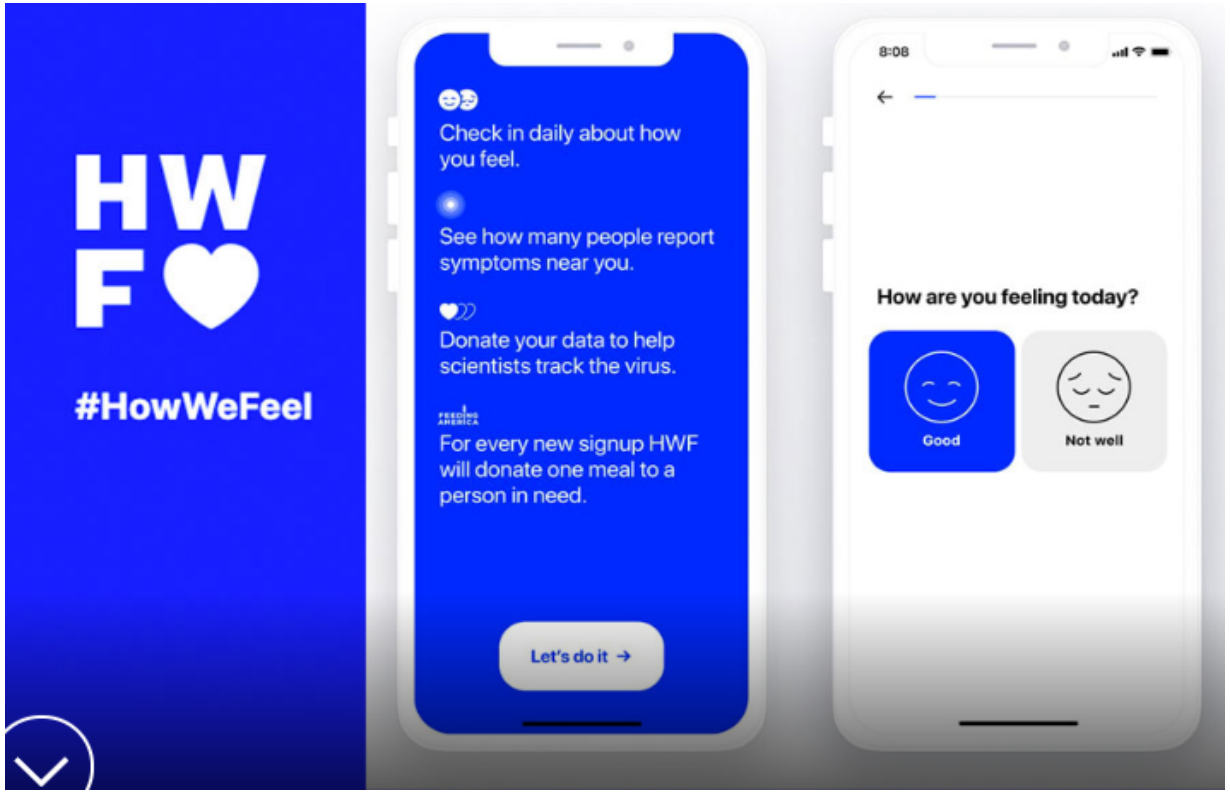
The matriarch of the large New Jersey family died Wednesday night without ever knowing that her two oldest children had died before her.

Family transmission is common

It is critical to develop strategies for preventing family members and close contacts from being infected

How We Feel Project

https://howwefeel.org/



PI: X Lin

- App for COVID symptoms and health status
- Launched on April 4
- Joint with Feng Zhang at Broad Institute and Ben Silberman at Pinterest
- >500K users and >3M responses in US.

Consortium for Coronavirus Census Collective

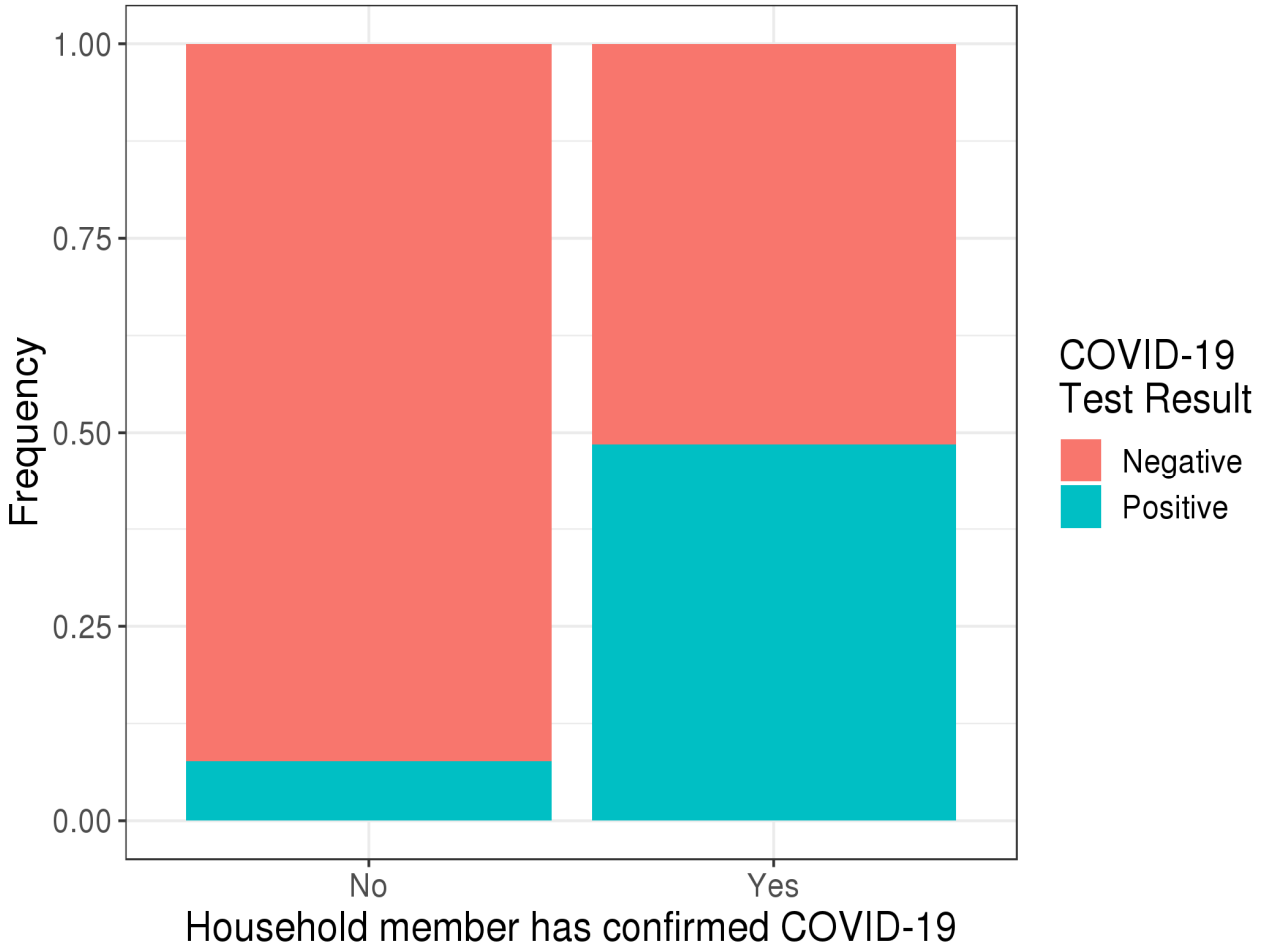
Building an International Consortium for Tracking Coronavirus Health Status

Eran Segal, Feng Zhang, Xihong Lin, Gary King, Ophir Shalem, Smadar Shilo, William E. Allen, Yonatan H. Grad, Casey S. Greene, Faisal Alquaddoomi, Simon Anders, Ran Balicer, Tal Bauman, Ximena Bonilla, Gisel Booman, Andrew T. Chan, Ori Ori Cohen, Silvano Coletti, Natalie Davidson, Yuval Dor, David A. Drew, Olivier Elemento, Georgina Evans, Phil Ewels, Joshua Gale, Amir Gavrieli, Benjamin Geiger, Iman Hajirasouliha, Roman Jerala, Andre Kahles, Olli Kallioniemi, Ayya Keshet, Gregory Landua, Tomer Meir, Aline Muller, Long H. Nguyen, Matej Oresic, Svetlana Ovchinnikova, Hedi Peterson, Jay Rajagopal, Gunnar Ratsch, Hagai Rossman, Johan Rung, Andrea Sboner, Alexandros Sigaras, Tim Spector, Ron Steinherz, Irene Stevens, Jaak Vilo, Paul Wilmes, CCC (Coronavirus Census Collective)

doi: https://doi.org/10.1101/2020.04.02.20051284

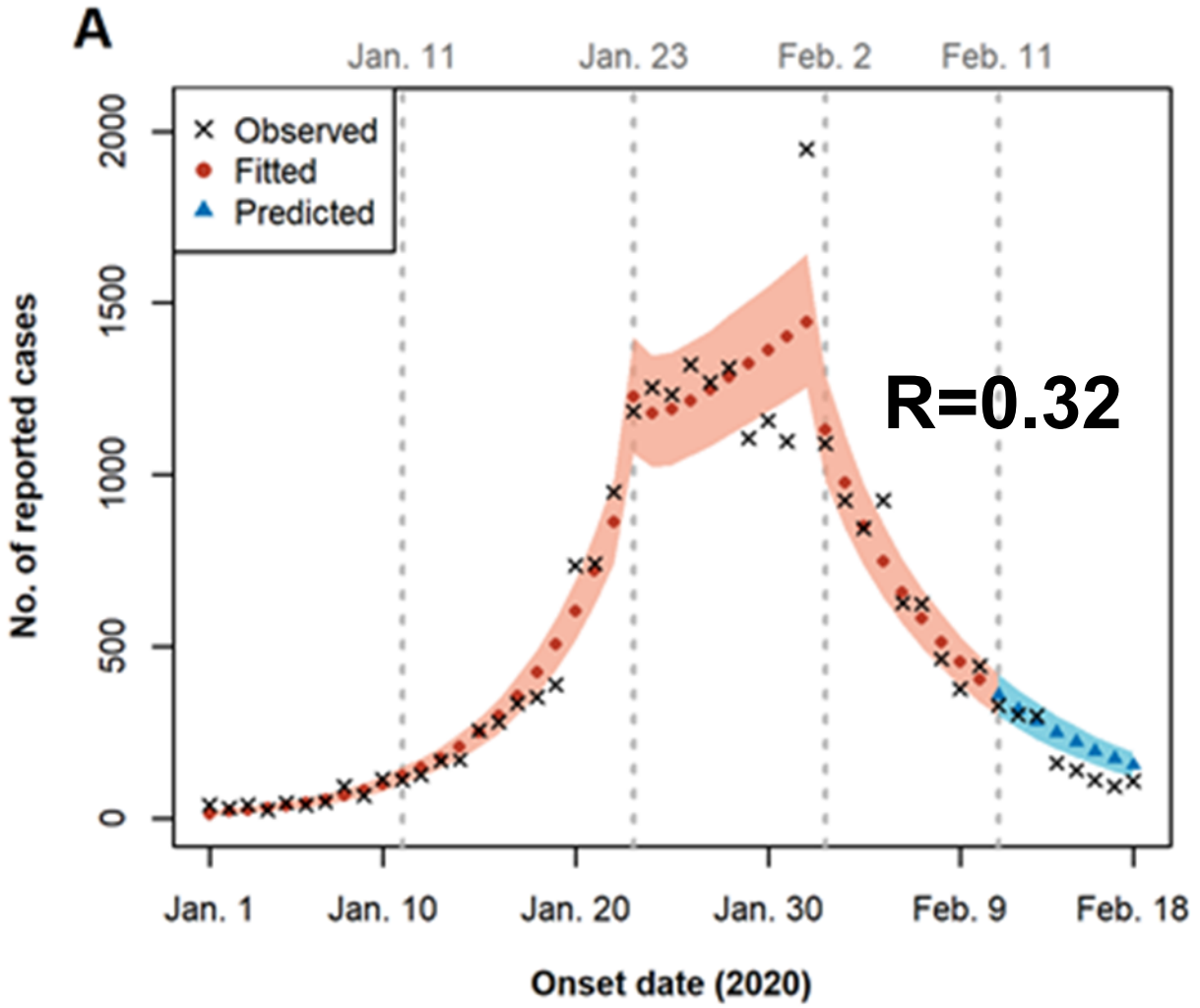
Nature Medicine, in Press

HWF: Estimated Household Transmission Rate



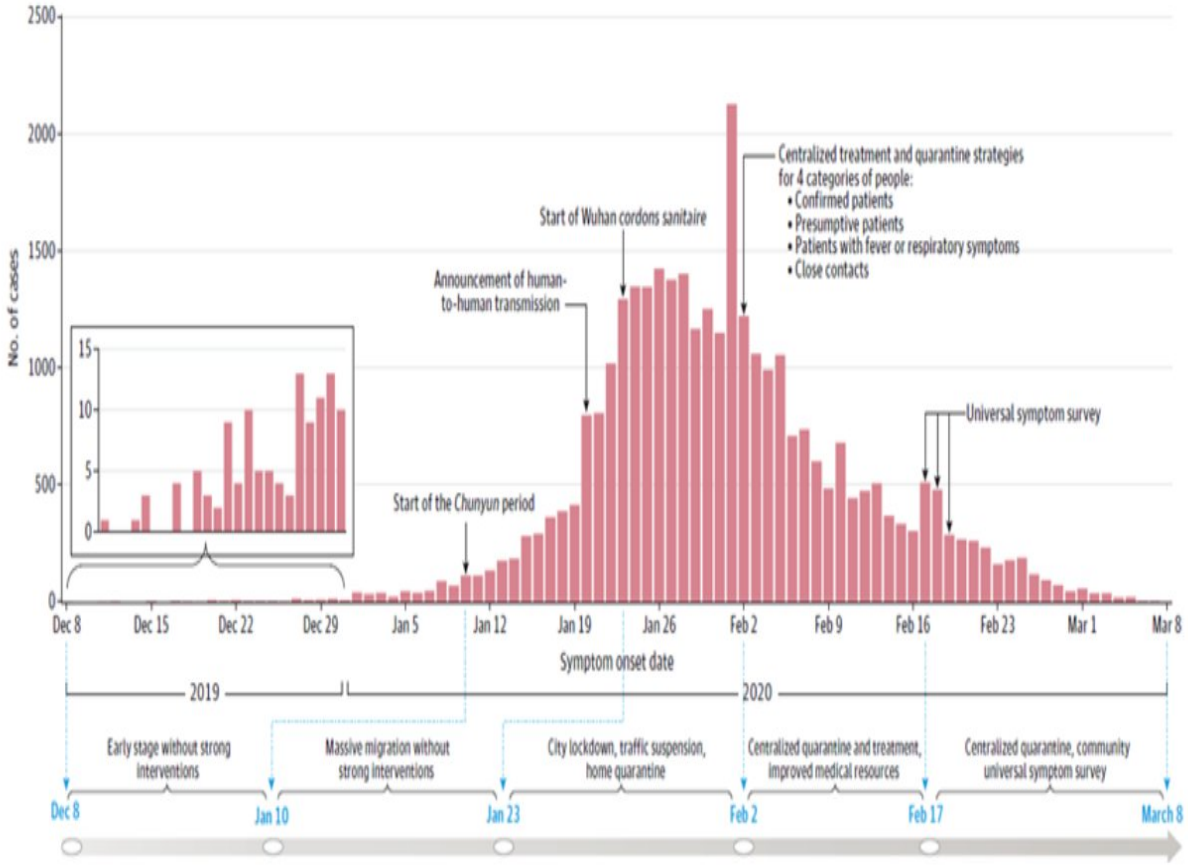
- Adjusted OR of positive test associated with infection in a household with infected members is 11 (CI=7.72 – 15.7).
- Household/congregated place transmission is common and needs to be blocked.

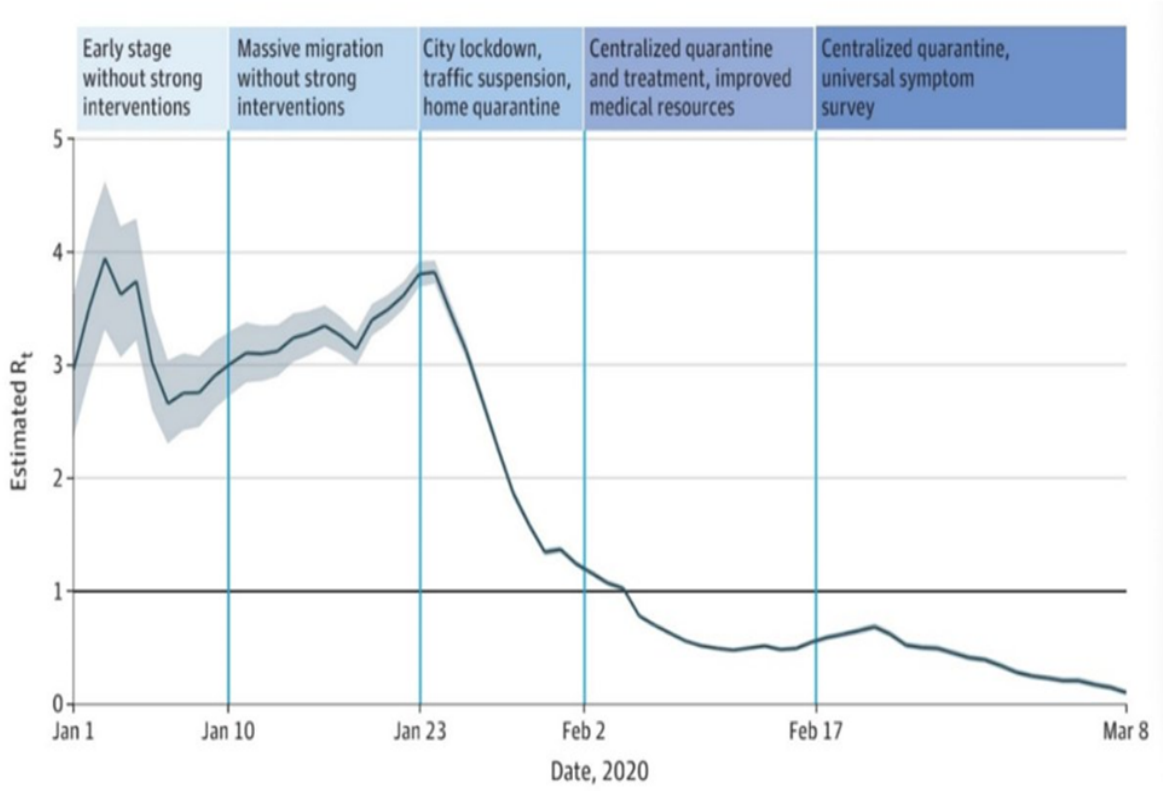
Wuhan: Centralized Quarantine after February 1, 2020



Blue = Projected trajectory if this intervention continues.

Updated Analysis Using 32,000 Cases Until March 8 (JAMA, April 8)



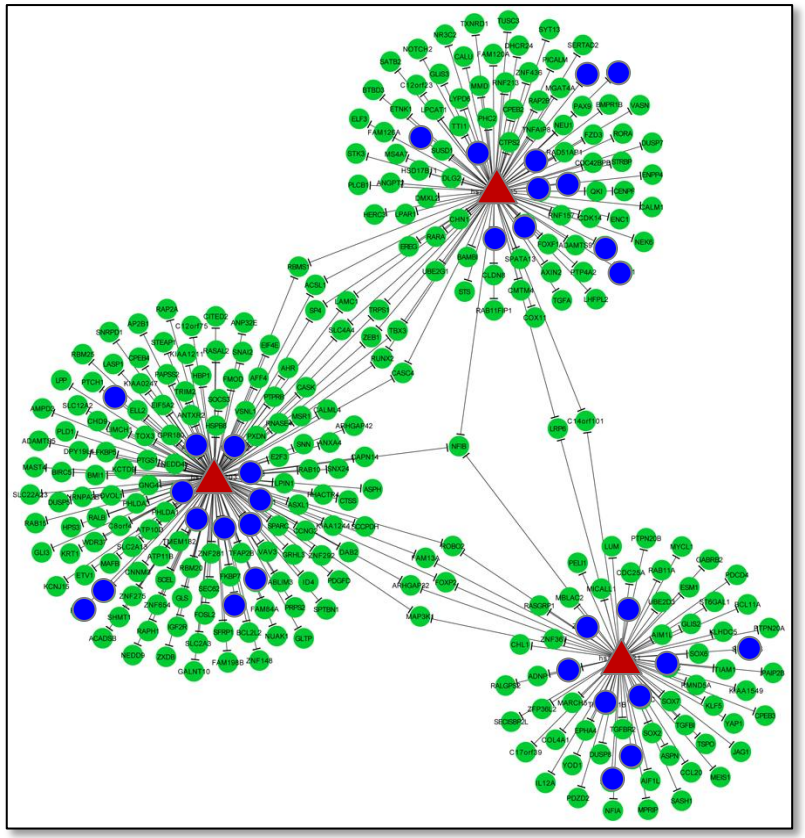


R=0.1 on March 8

Method: Epiestim

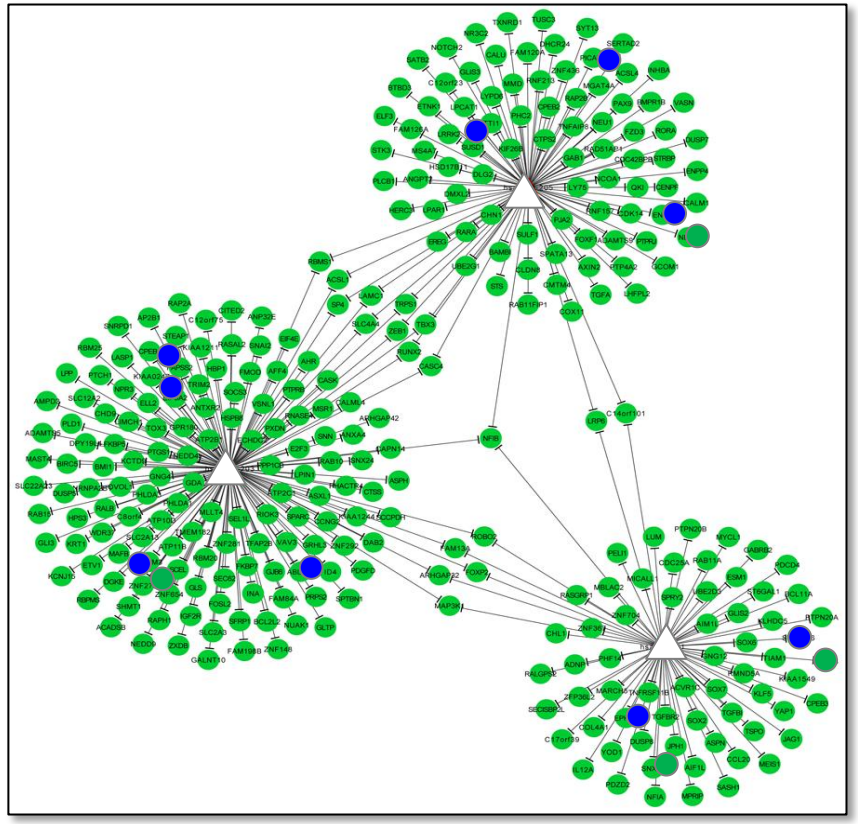
Key Idea: Centralized Isolation of Infected and Centralized Quarantine of Suspected Cases and Close Contacts with Medical Care Provided

Control the source of infection → **Reduce the number of new infections** → **Stop the outbreak**



Red: Infected index cases

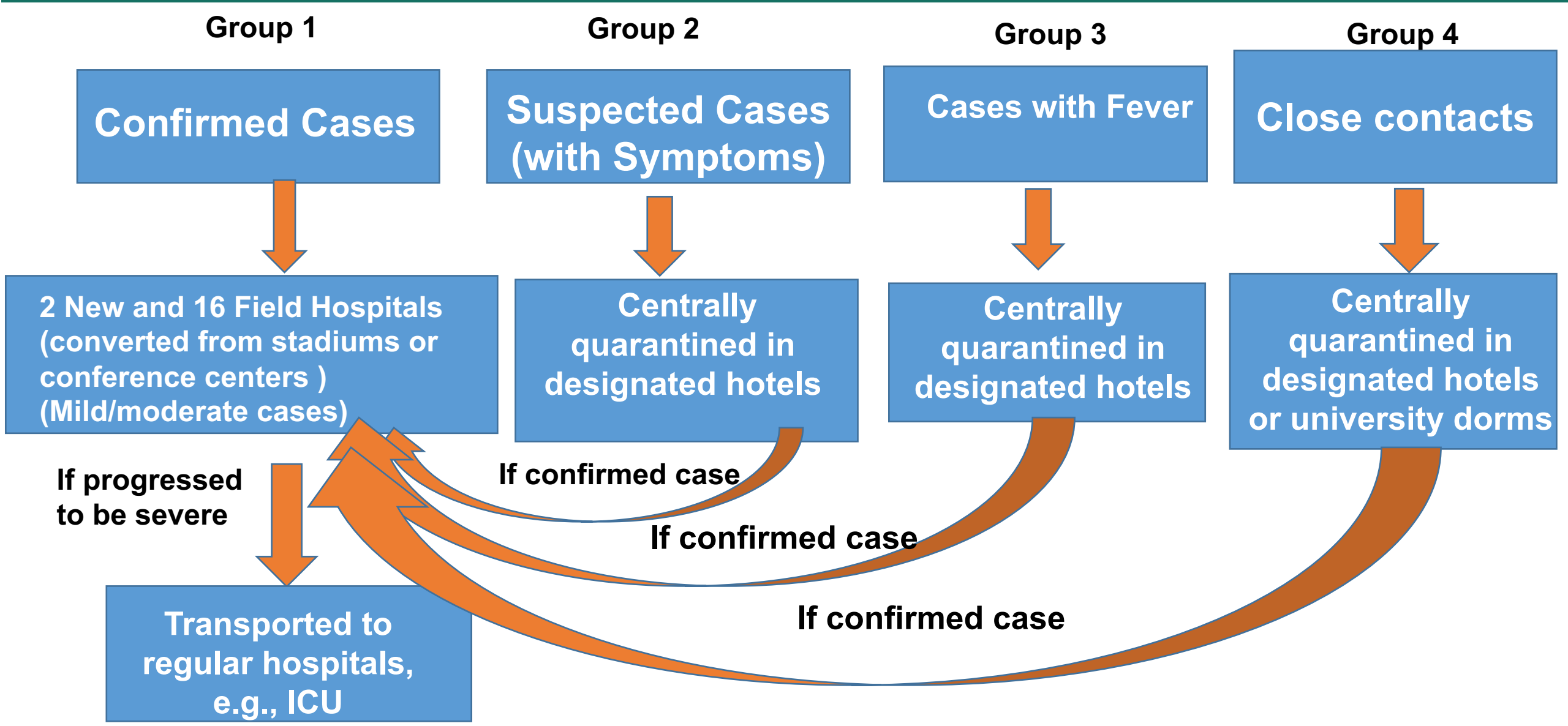
Blue: infected family members, close contacts and community members



Home Quarantine

Centralized Quarantine: Take infected and suspected cases out of home and family network and admit them to new or field hospitals for medical care

Centralized Quarantine Strategy After Feb 1, 2020



Take home message #2: Adding Centralized Isolation and Quarantine to Social Distancing Bended the Curve and Stopped the Epidemic

- **Block within-household transmission**: Prevent infected cases from infecting household members

- **Patients received medical care immediately**
- **Prevention of disease progression**: With timely medical care of mild cases, reduce the chance of progression to becoming severe cases.

Take home message #2: Adding Centralized Isolation and Quarantine to Social Distancing Bended the Curve and Stopped the Epidemic

- **Monitor Progression**: If a patient progressed to become a severe case in a field hospital, he/she was transferred to an ICU in a main hospital.

- **Relief of burden on health care system and ICU**: By reducing the number of new infected cases, it relieved the enormous pressure on the healthcare system, e.g. a lack of ICU capacity, and a shortage of PPEs.

All the 16 Field Hospitals in Wuhan were closed on March 10, 2020: Cleared All Patients

Congratulations, Wuhan!

March 18: No new confirmed cases in Hubei Province
April 8: Wuhan reopened the city

Nature News & Comment
@NatureNews

On 18 March, Hubei, the Chinese province at the centre of the coronavirus outbreak recorded no new cases of COVID-19 for the first time since the beginning of the epidemic.

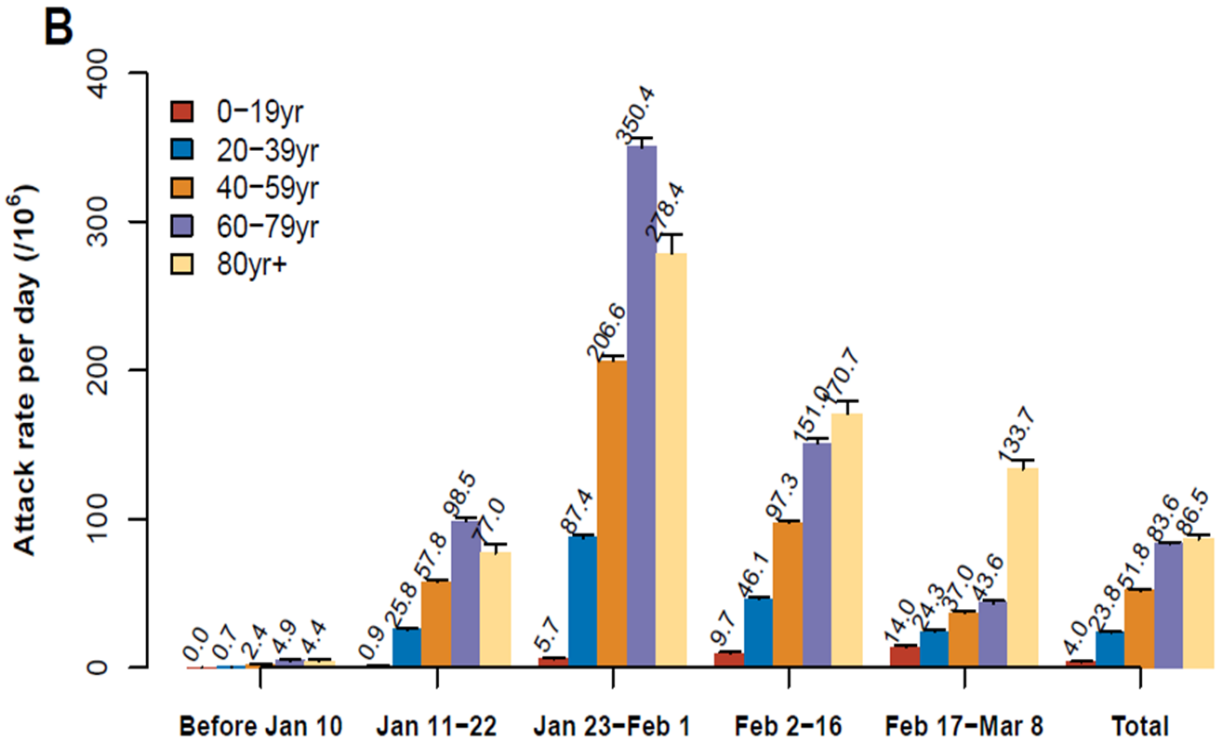
Acknowledgement

Huge thanks go to all the citizens of Wuhan, the local healthcare workers, and the 30,000+ healthcare workers cross the country who went to help Wuhan, for their tremendous sacrifice and efforts.

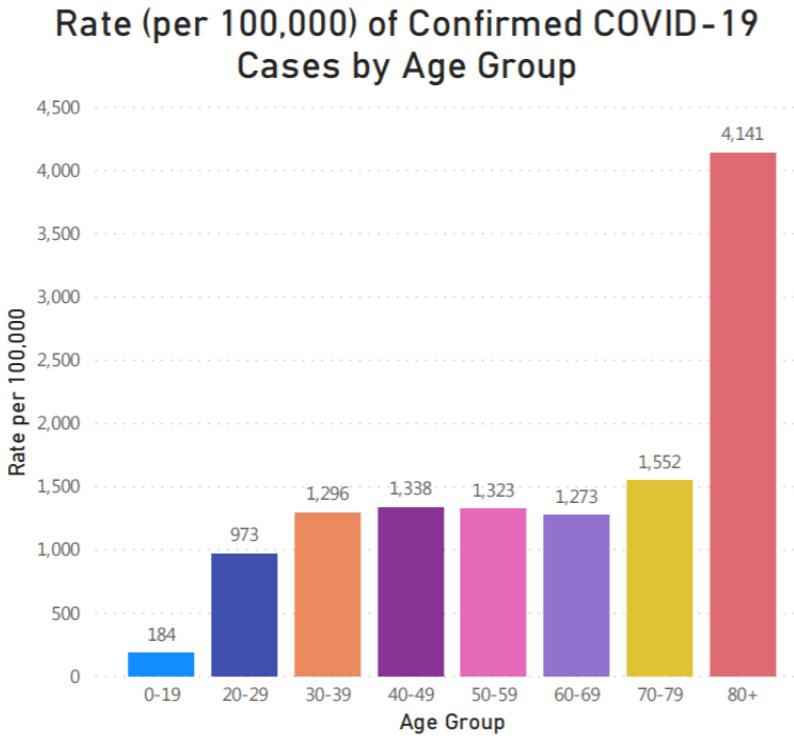
They are my heroes

Epidemiological Characteristics of 32,000+ Lab-Confirmed COVID-19 Cases

Infection Rates by Age



Wuhan



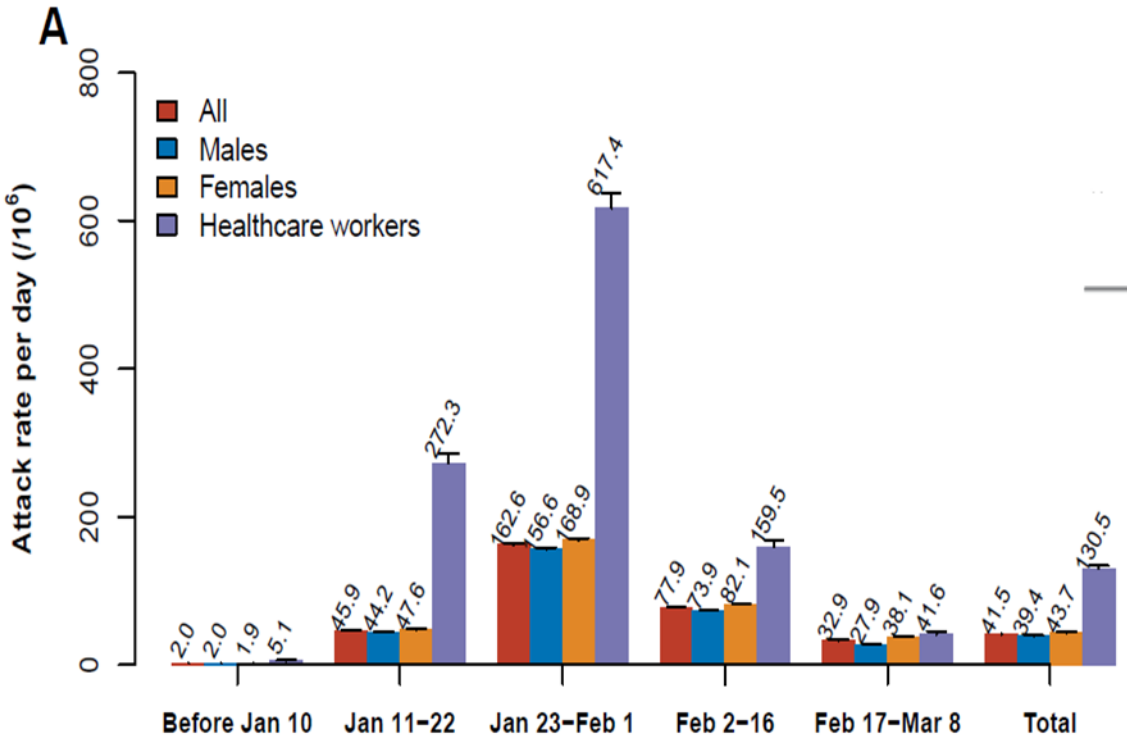
Average age of COVID-19 Cases

53

MA

https://www.mass.gov/doc/covid-19-dashboard-may-12-2020/download

Infection Rates by Gender, Health Care Workers and Essential Workers



Predictor	Baseline	Log Odds Ratio	Odds Ratio	95% CI (Lower, Upper)	
healthcare worker	non-essential		2.10	1.46	3.02
other essential worker			1.72	1.14	2.58

Wuhan

HowWeFeel

Take home message #3: Protection of Health Care Workers with Comprehensive PPEs, Training and PPE Supplies

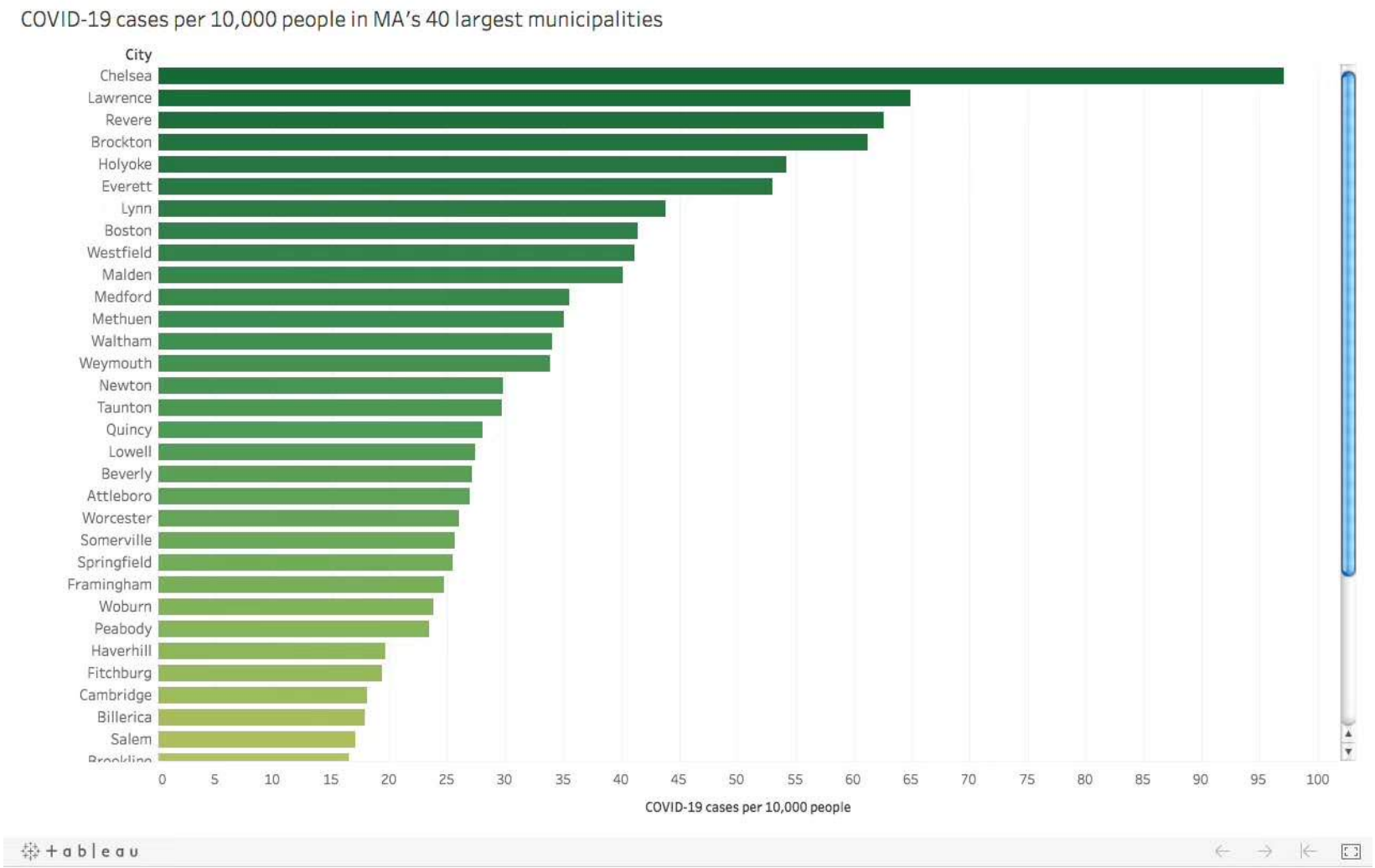
Launched on March 16, 1.7M people have signed.

- **Comprehensive PPE Protection**: masks, protective suit, medical goggle, cap, face shield, and two layers of gloves.

- **Training:** "This is the penultimate lesson we learned from Ebola. Training on donning/doffing of PPE is key to prevention of infection" – *an MD I got to know in March*

- **Speed up supplies in PPEs**: A shortage in PPEs .

COVID-19 Health Disparity: Top 7 MA towns with the highest infection rates are all low income towns with high % of URMs

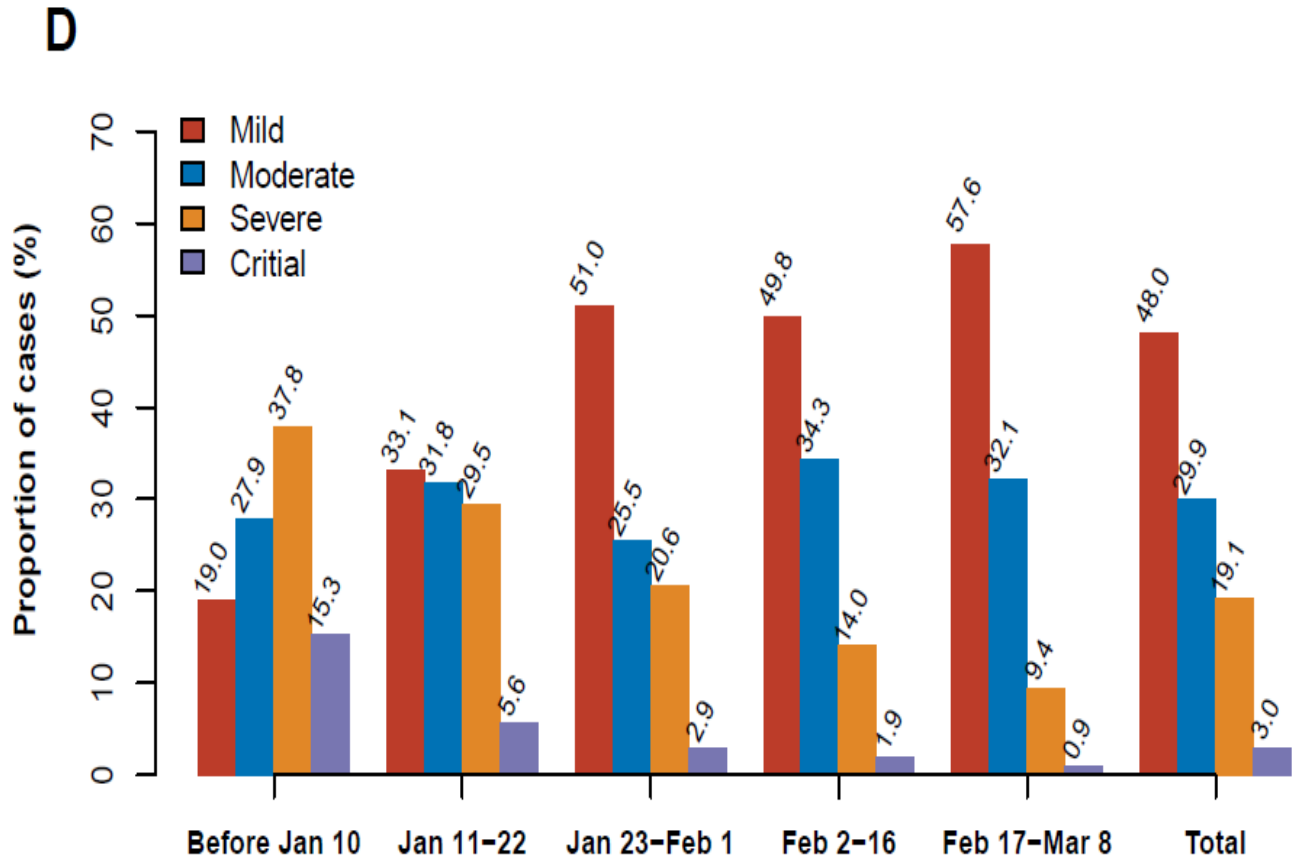


- Chelsea
- Lawrence
- Revere
- Brockton
- Holyoke
- Everett
- Lynn

Take home message #4: Protect the Five Vulnerable Groups

- Healthcare workers
- Elderly people
- Family members and close contacts of infected cases
- Essential workers
- Low income families, especially those under-represented minorities: They usually have poor housing conditions and need to go to work

Wuhan: Severity Risk Factors



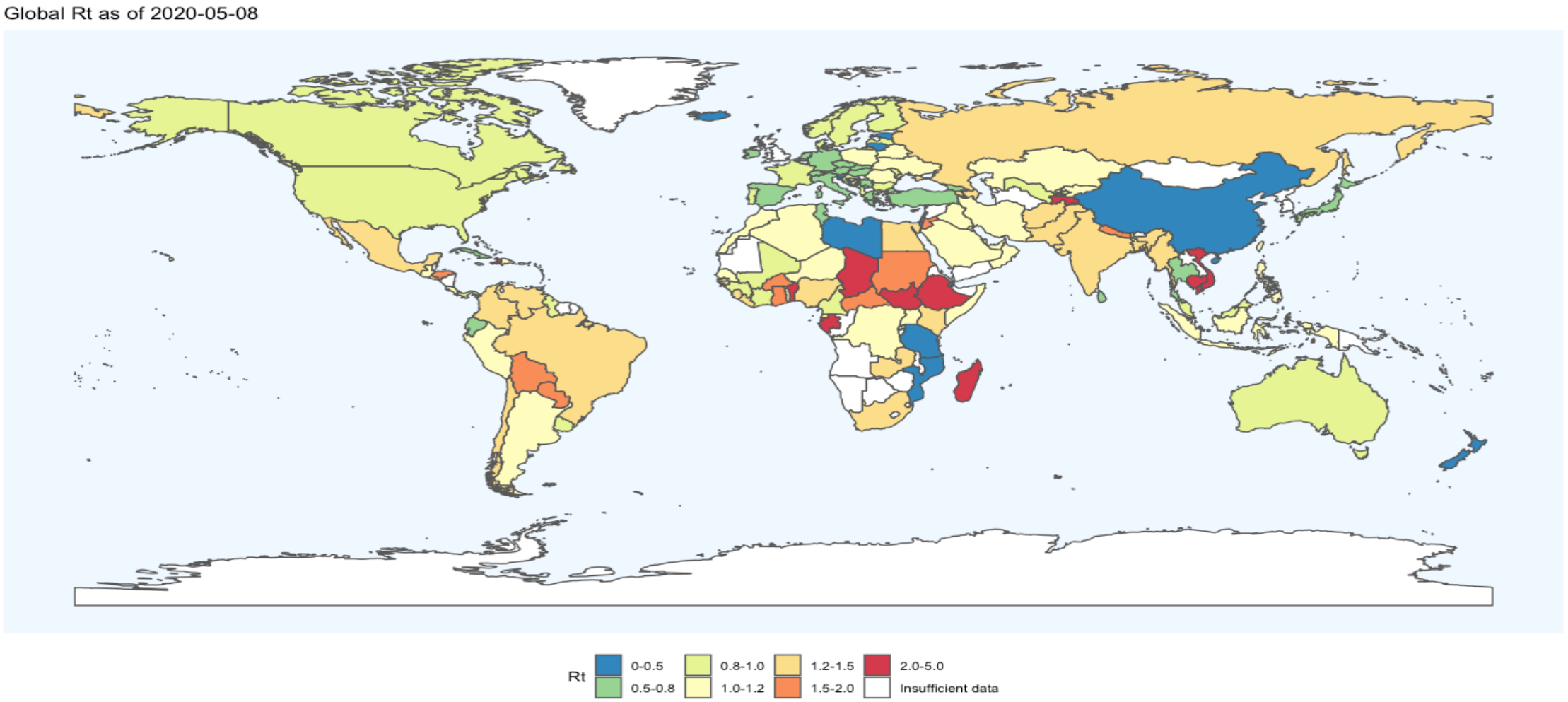
- **Elderly** are at a much higher risk of becoming severe (RR=3 for 60-79 and RR=6 for 80+, p-value<0.0001)
- Similar age results using MA data.
- **Women** have a lower risk of becoming severe than men (RR=0.9, p-value=0.002)

Take home message #5: Early Diagnosis and Early Medical Care

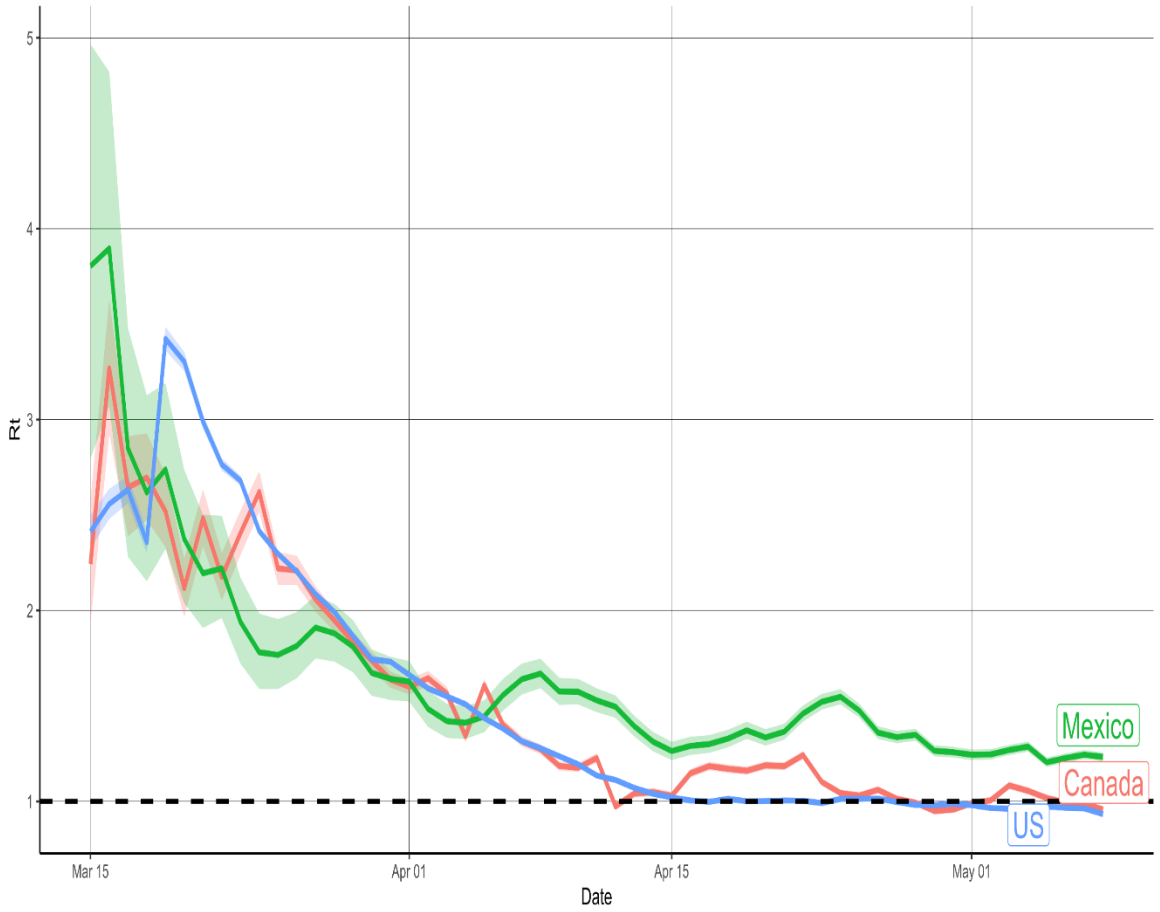
- Early diagnosis and early medical care will help prevent cases from progressing to become severe cases, who have a much higher risk of death, like ARDS patients

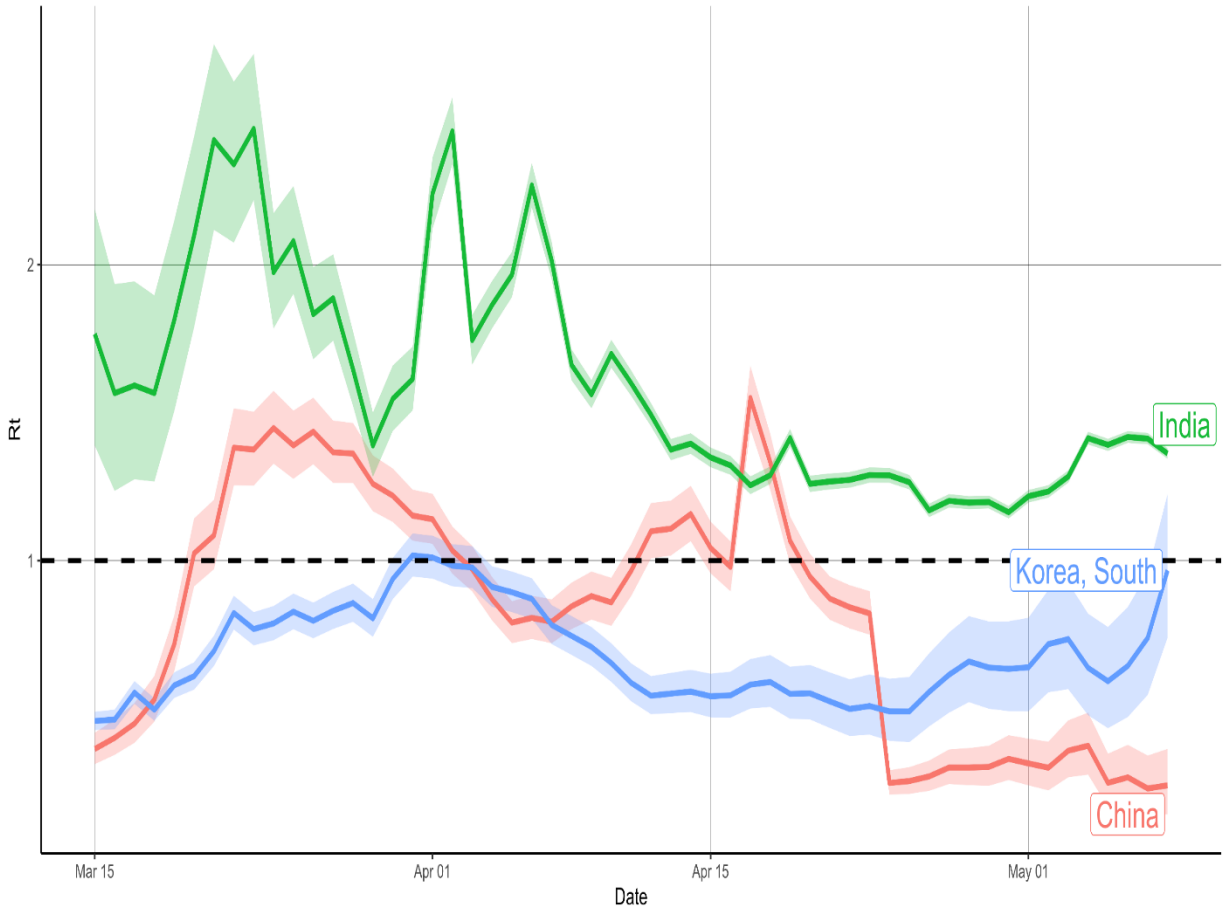
- Especially for the five vulnerable groups.

Estimated R Values Around the World (May 8, 2020)

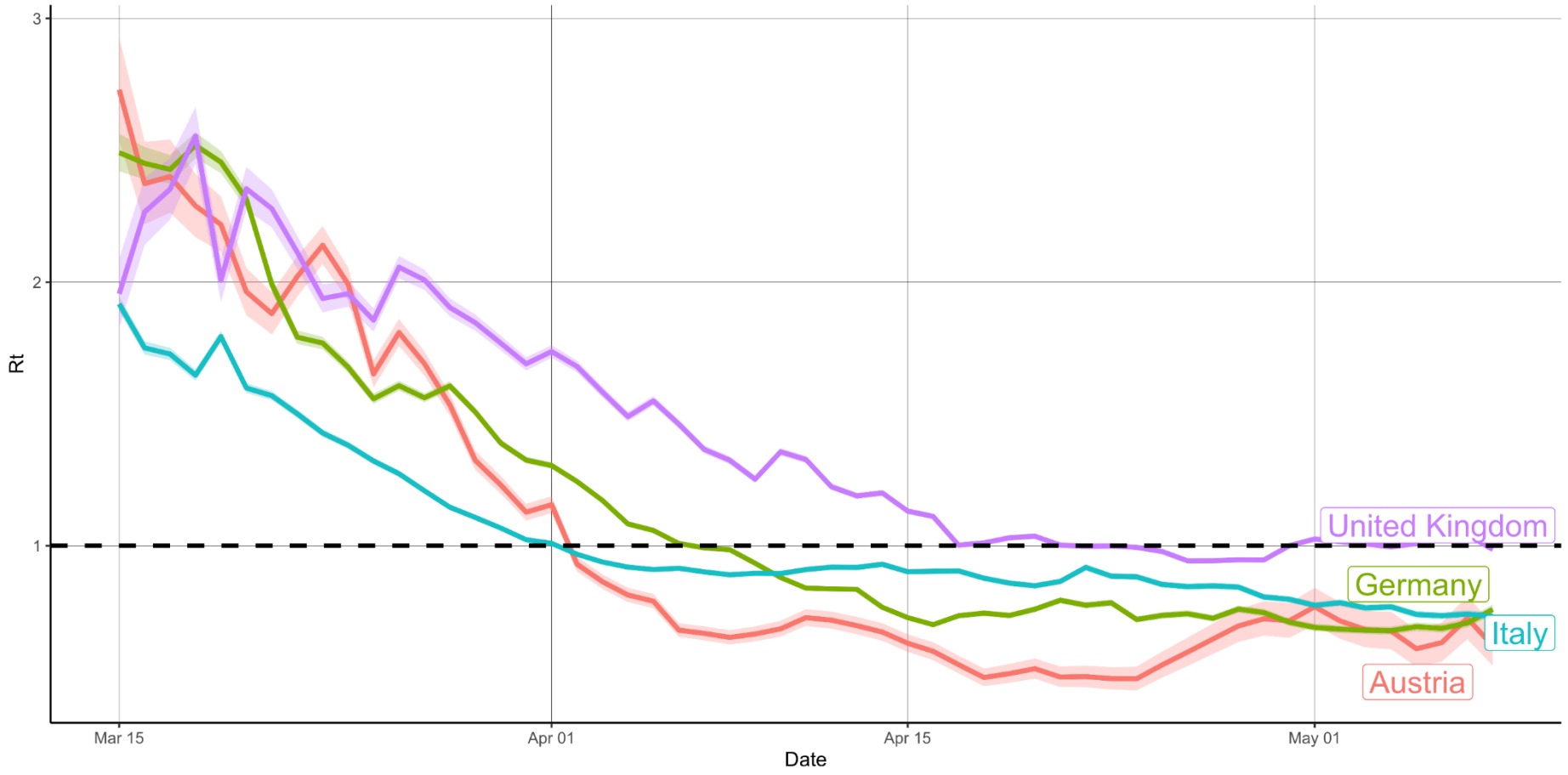


Estimated R Curves in America and Asia (May 8, 2020)





Estimated R Curves in Europe (May 8, 2020)



Take home message #6: A Multi-pronged Approach is needed to control the epidemic

Six pillars:

- Mask wearing
- Social distancing
- Widespread testing
- Contact tracing
- Isolation and quarantine
- Treat infected patients

The New York Times

Opinion

The United States Needs a 'Smart Quarantine' to Stop the Virus Spread Within Families

Evidence from around the world shows that stay-at-home orders take us only so far.

By Harvey V. Fineberg, Jim Yong Kim and Jordan Shlain

Dr. Fineberg, Dr. Kim and Dr. Shlain specialize in public health.

April 7, 2020

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THE NEW YORKER

MEDICAL DISPATCH

IT'S NOT TOO LATE TO GO ON OFFENSE AGAINST THE CORONAVIRUS

By Jim Yong Kim

April 20, 2020

Test-Trace-Isolate: Bend the Curve

Community Tracing Collaborative

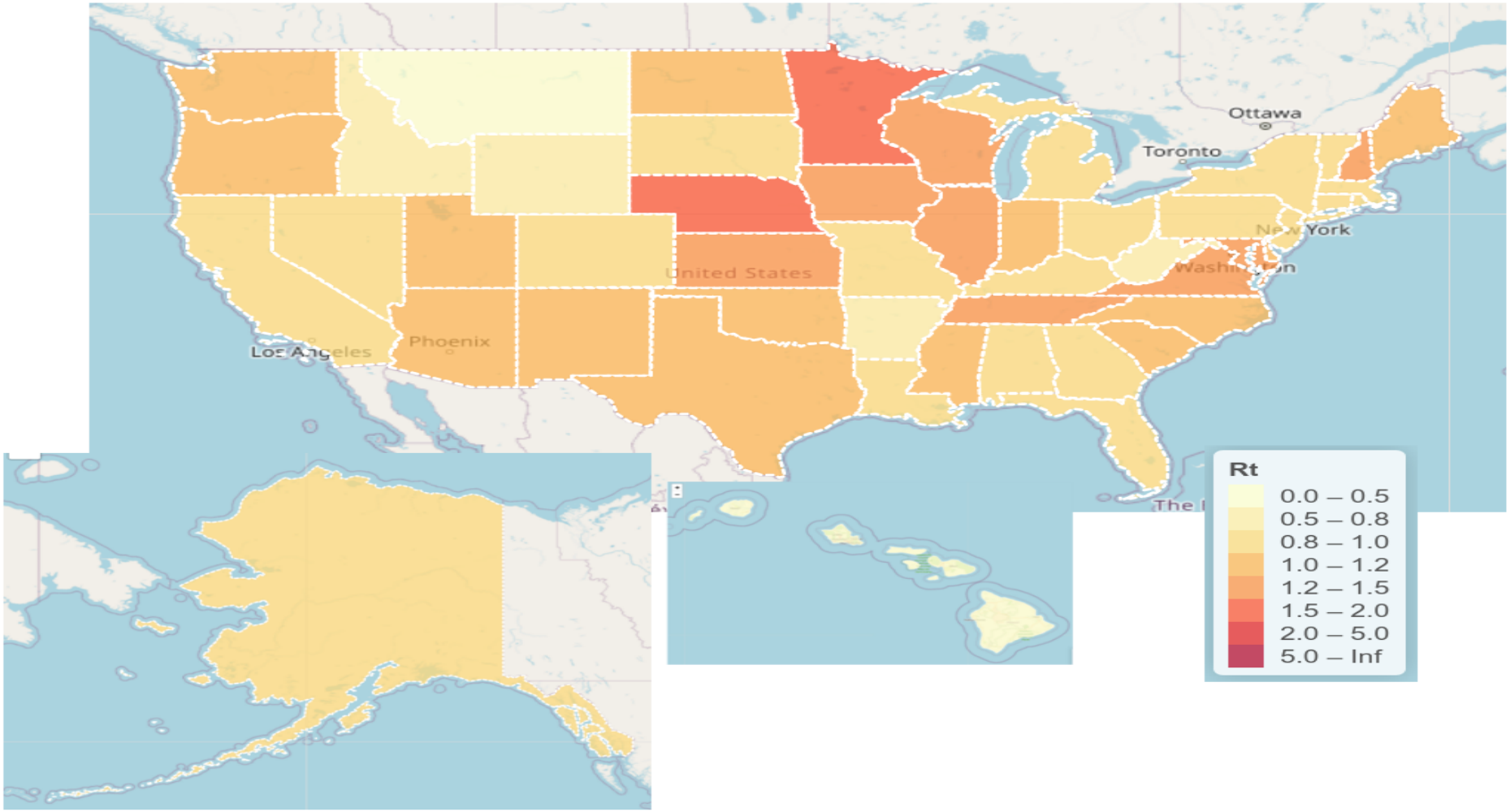
Partners In Health

MA launched the first contact tracing program

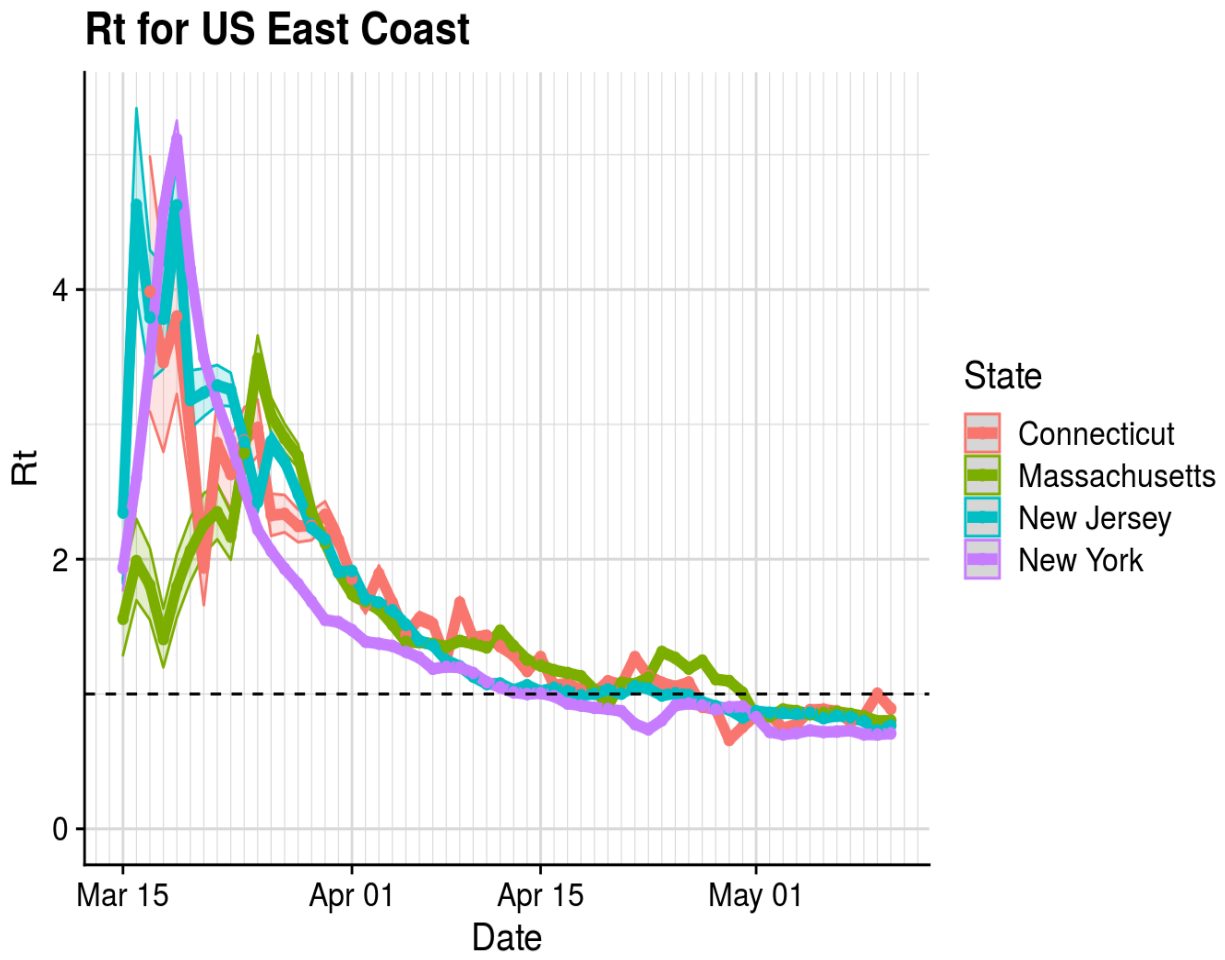
Tri-states (MA, NJ, NY) launched COVID test and trace programs

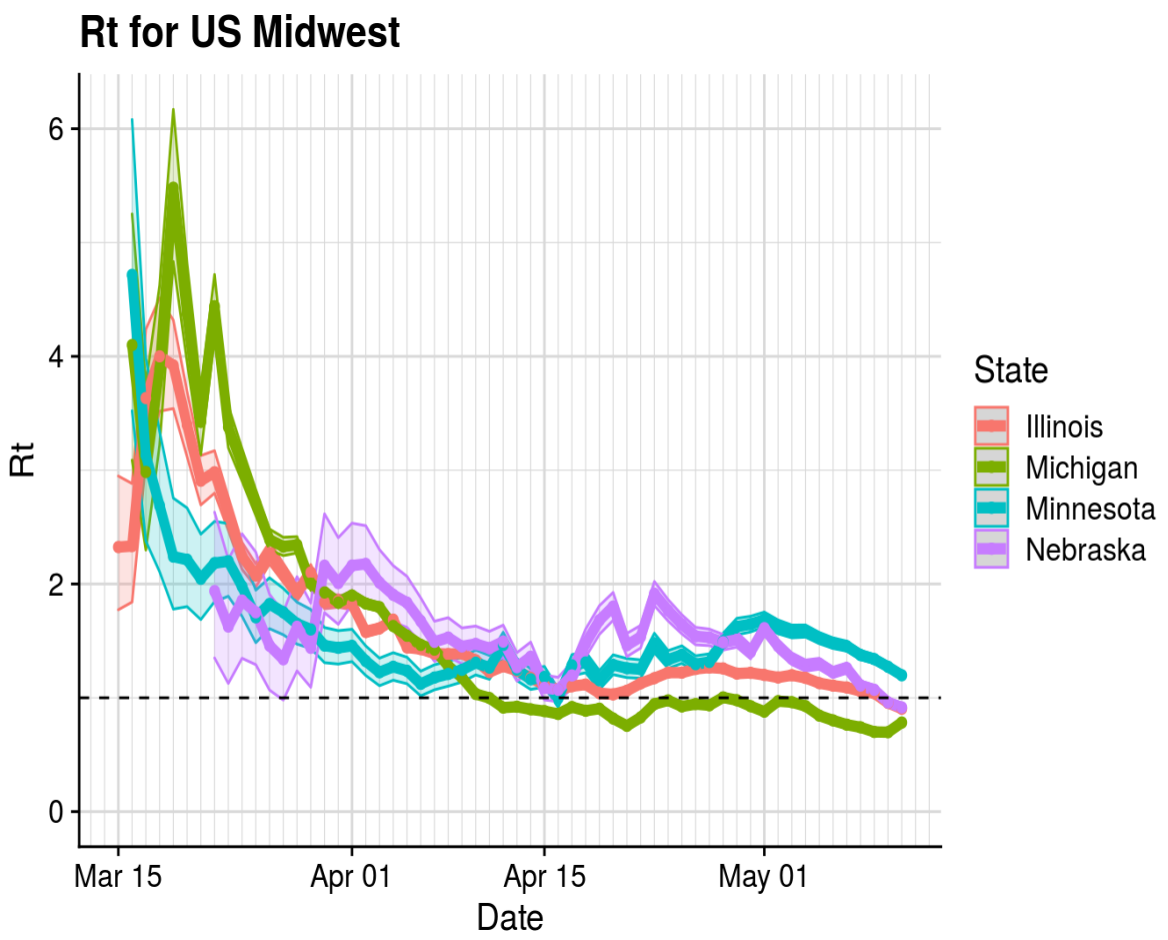
WHO

Estimated R-Value Map in US (May 8, 2020)

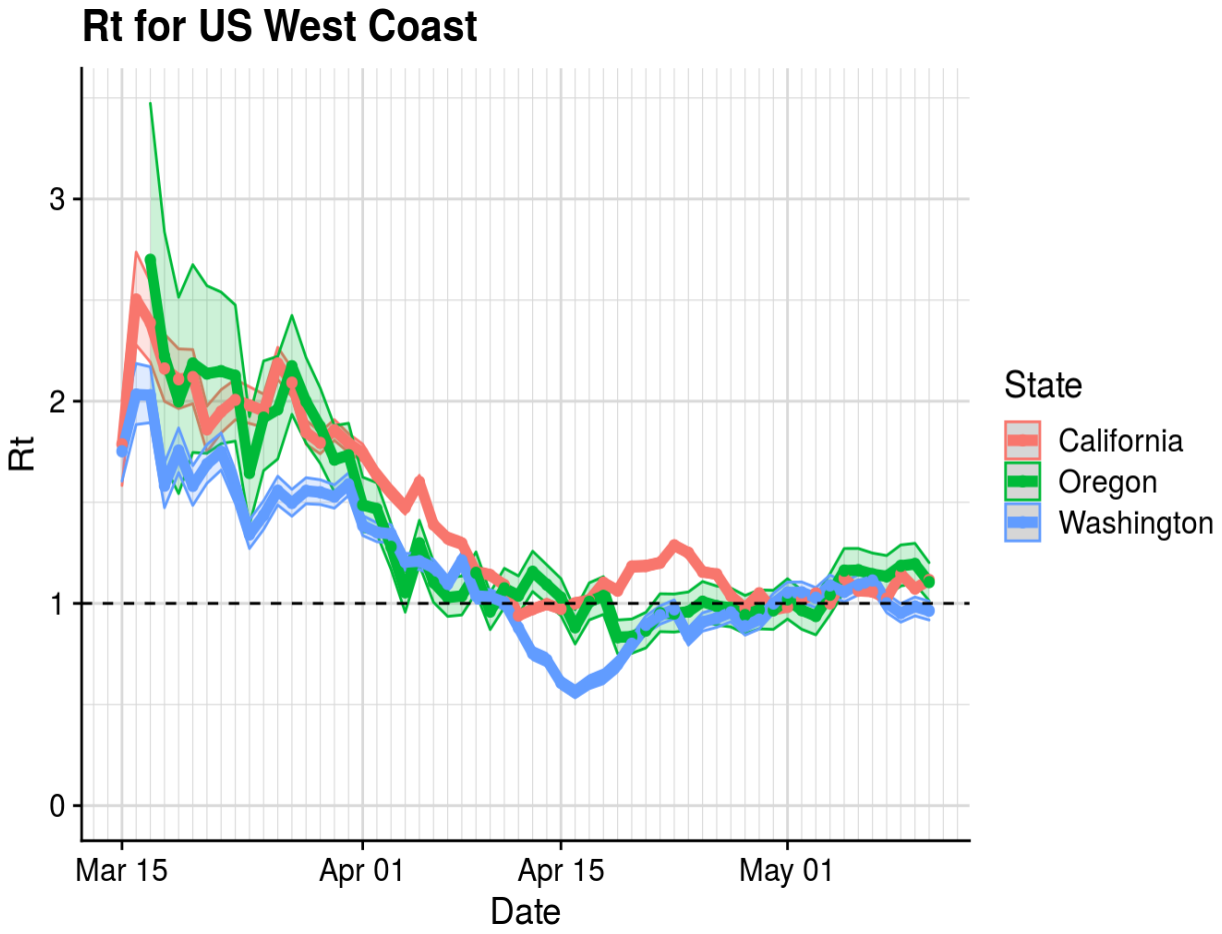


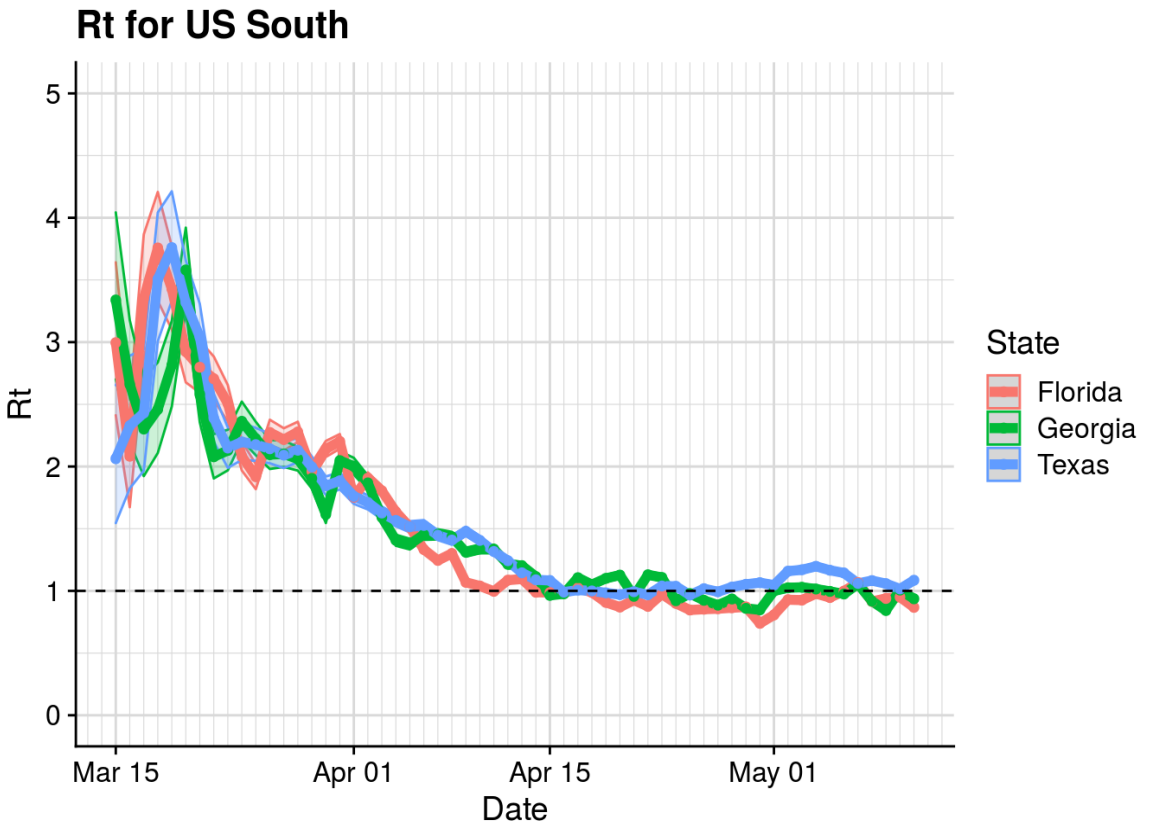
Estimated R Curves in US: East Coast and Midwest (May 8, 2020)





Estimated R Curves in US: West coast and South (May 8, 2020)



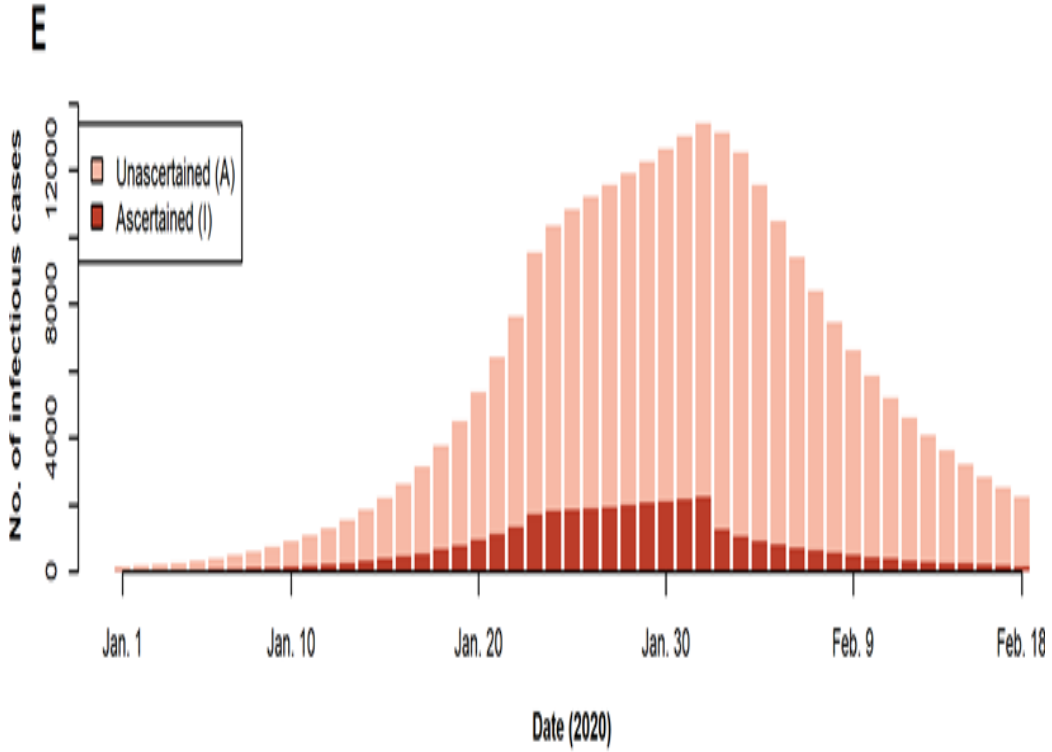


Take home message #7: Give testing priority to the five vulnerable groups including asymptomatic and pre-symptomatic cases

- Shortage of testing capacity and supplies, e.g., swabs
- Current testing priorities: symptomatic subjects
- With increasing testing capacity, consider giving priority to the five vulnerable groups, especially asymptomatic and pre-symptomatic cases.

Testing

Wuhan: Estimated Proportion of Ascertained and Un-ascertained Cases



Full-spectrum dynamics of the coronavirus disease outbreak in Wuhan, China: a modeling study of 32,583 laboratory-confirmed cases

Xingjie Hao, Shanshan Cheng, Degang Wu, Tangchun Wu, Xihong Lin, Chaolong Wang

doi: https://doi.org/10.1101/2020.04.27.20078436

>60% of daily new cases were unascertained (asymptomatic or with mild symptoms

PRC Tests and Antibody Tests

- PCR test: tell whether a person is currently infected.

- Antibody (IgG and IgM) test:
    - Tell whether a person was infected before
    - Does not tell whether a person is currently exposed

Antibody≠ Immunity

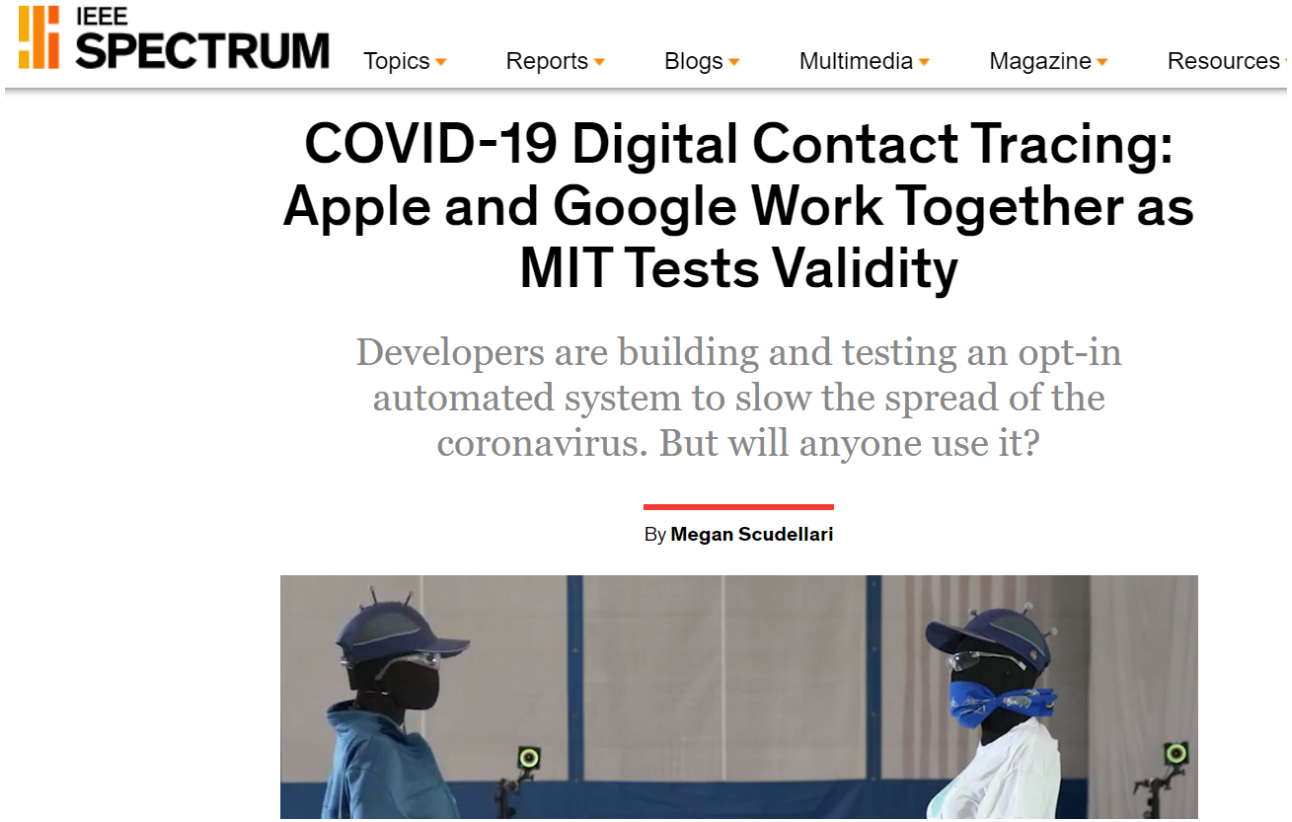
- Very good sensitivity of antibody tests using ELISA **after 20 days** of symptom onset.

- Serological study (Antibody test): Estimate % of population with antibody -> prevalence estimation

Take home message #8: Wide contact tracing is critical and can be empowered by integrating humanity and technology

- Protect privacy
- Human manpower and humanity
- Leverage technology
- Address fear of immigrants

Contact Tracing



IEEE SPECTRUM Topics Reports Blogs Multimedia Magazine Resources

COVID-19 Digital Contact Tracing: Apple and Google Work Together as MIT Tests Validity

Developers are building and testing an opt-in automated system to slow the spread of the coronavirus. But will anyone use it?

By **Megan Scudellari**

Take home message #9: Develop feasible and effective isolation strategies

- Allow for in-home isolation for those with sufficiently good housing conditioning + strong social and medical support
- Provide out-of-home isolation facilities to those whose housing conditioning is insufficient.
- Address fear of immigrants

Isolation

City of New York COVID-19 Hotel Program

Share

Print

The City of New York's COVID-19 Hotel Program provides free hotel stays to eligible New Yorkers who cannot isolate where they live and frontline workers in the healthcare industry who wish to reduce the risk of transmission at home. This will help New York City stop the spread of COVID-19.

- If you are a healthcare worker or volunteer in a healthcare setting and are unable to live apart from others in your household, **make your hotel reservation**.
- If you are a healthcare provider authorized to refer patients to hotels, access the **healthcare providers portal**

In a Crowded City, Leaders Struggle to Separate the Sick From the Well

The New York Times

Chelsea, Mass., has an infection rate higher than any other community in the state. With families in cramped housing, it is difficult to contain the spread.

Take home message #10: Important to effectively educate and communicate with the general public

- **Effective public education and communication** is critically important by sharing gained and understandable scientific knowledge with the general public to help them make good decisions for themselves, loved ones, and communities.

- Because every country is different, effective implementation of the six control measures must be **adapted to each country's situation and culture** via public health implementation, health care implementation, and society implementation.

Be United: Everyone is a team member to fight for COVID-19

Go Boston!

- Wuhan experience helps us not start from zero.
- Let the data speak and use evidence-based strategies
- **Single take home message:**
  - Unite the community.
  - Everyone is a team member to contribute and work together
  - Multi-stakeholder approach: Government, international organizations, academia, business, community and citizens

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- Xin Jin, Harvard Society of Fellows
- Mireille Kamariza, Harvard Society of Fellows
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