Claves para entender la pandemia

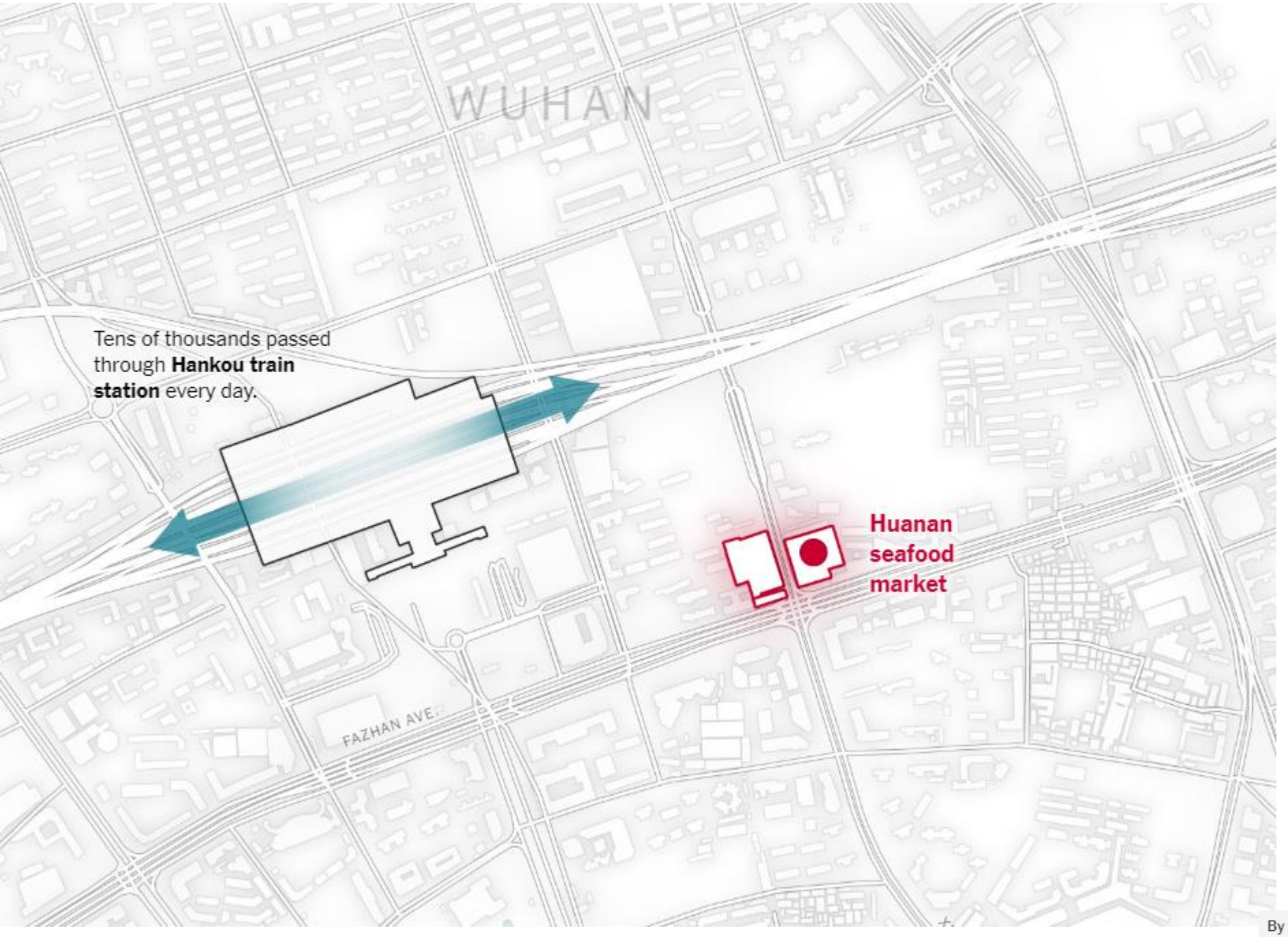
Origen y contexto

Eduardo A. Undurraga
Escuela de Gobierno UC
eundurra@uc.cl
@eundurra

1 abril 2020

Hechos principales

World Health Organization



8 diciembre
cierre mercado Wuhan

31 diciembre
Of regional OMS notifica cluster neumonia virus desconocido (docenas)
SARV-COV-2

11 enero:
notificación primer caso fatal

30 Enero: OMS declara emergencia salud global

https://nyti.ms/2UqrL7i

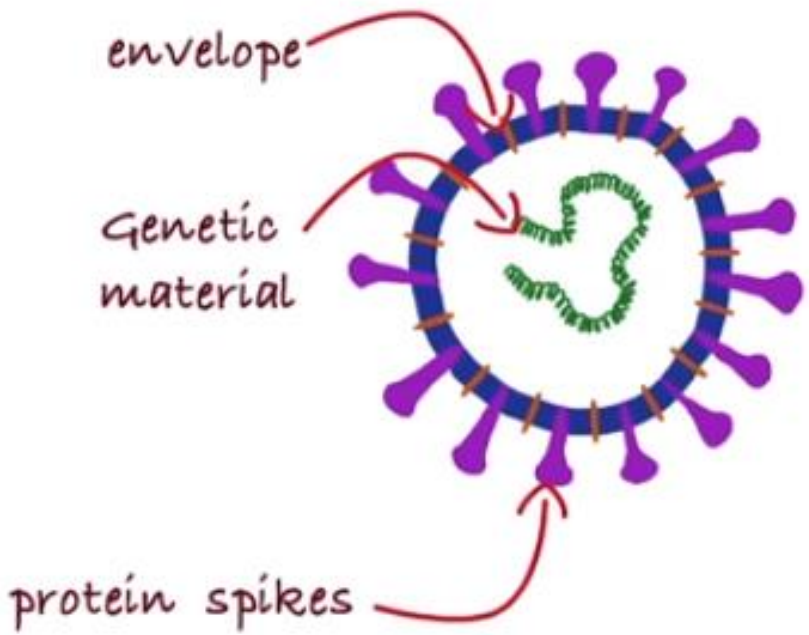
The New York Times

By Jin Wu, Weiyi Cai, Derek Watkins and James Glanz March 22, 2020

World Health Organization

CORONAVIRUSES

large group of viruses



crown = "corona"

ORIGIN OF THE VIRUS

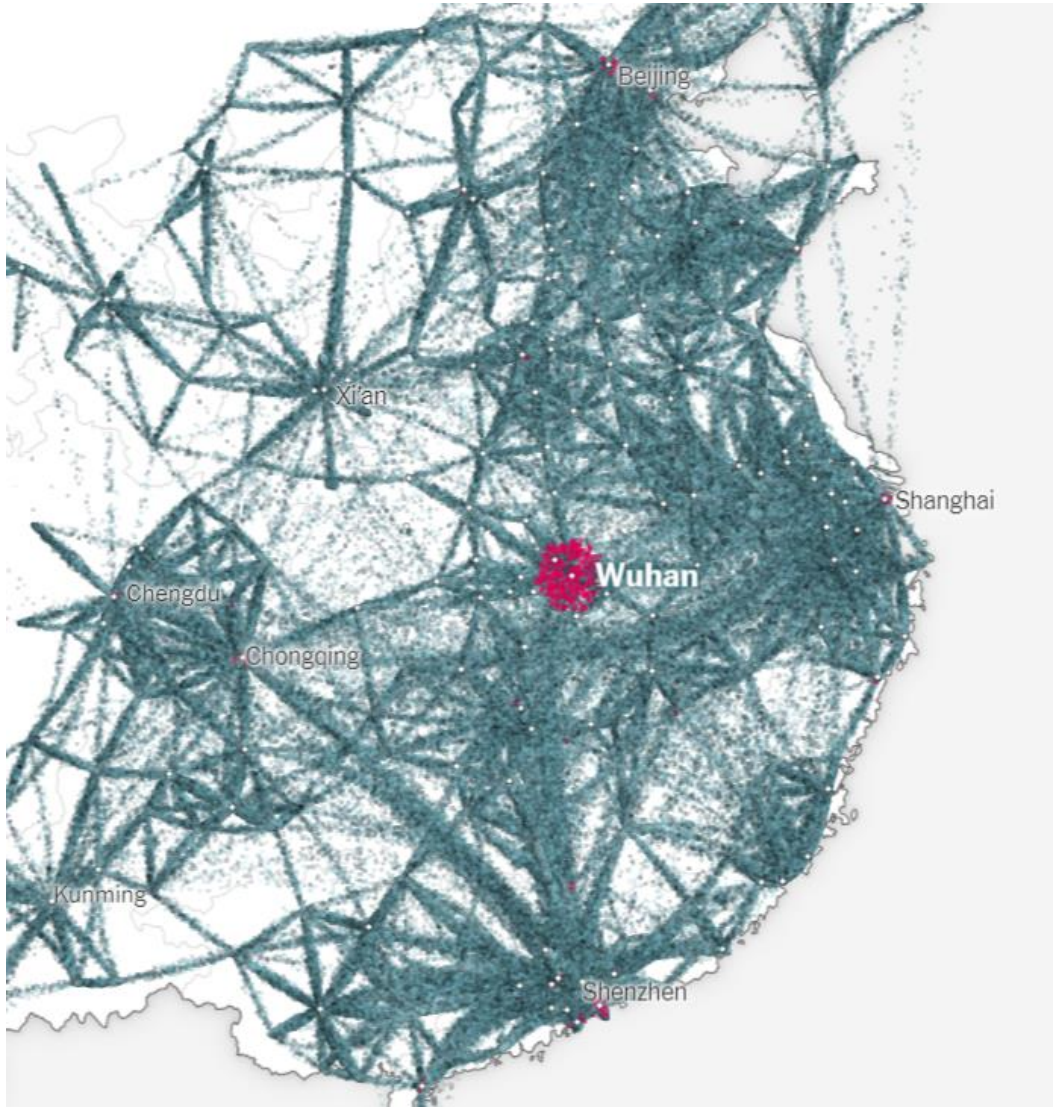
circulate in a range of animals

A pneumonia outbreak associated with a new coronavirus of probable bat origin

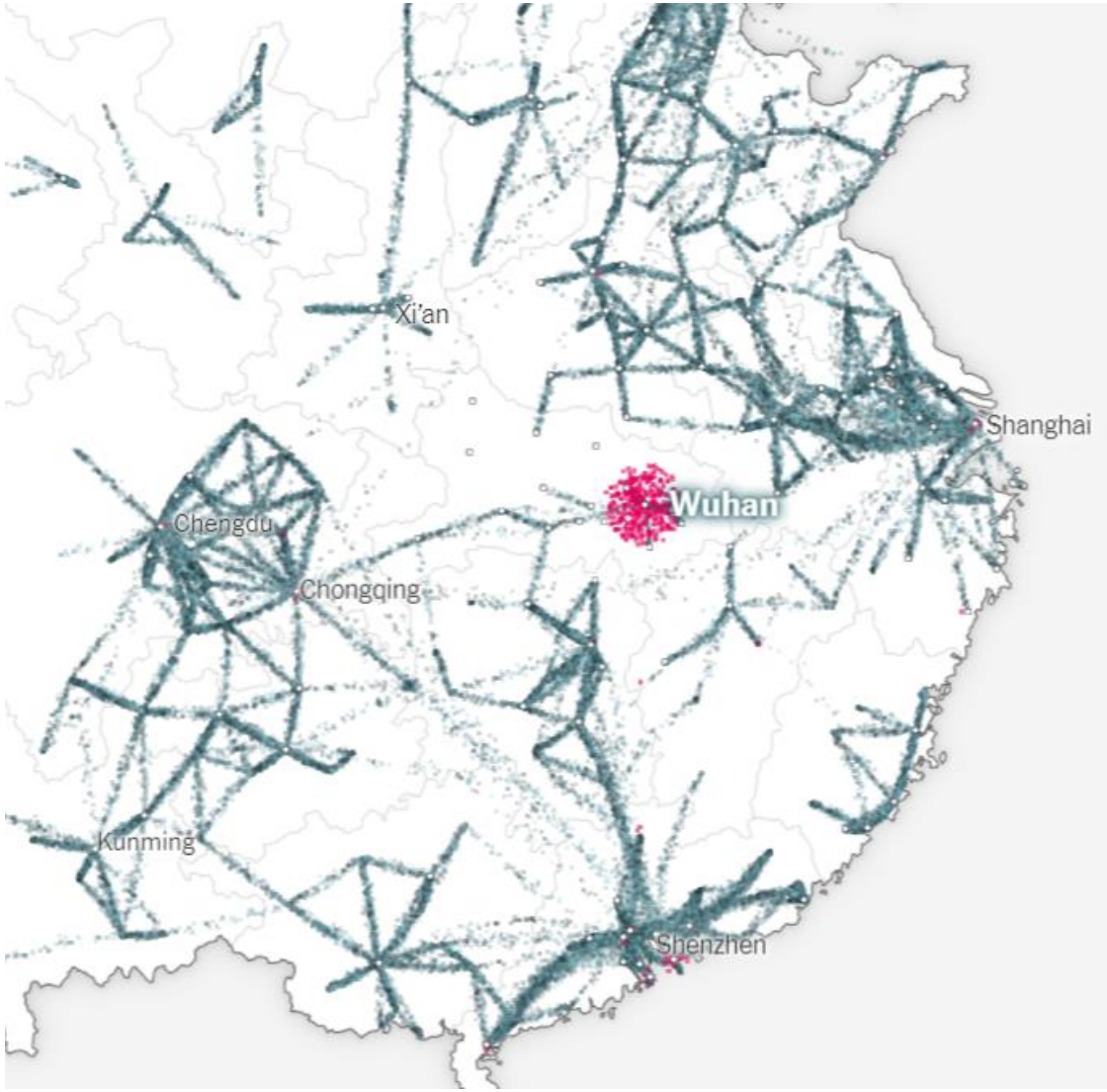
Peng Zhou[1,5], Xing-Lou Yang[1,5], Xian-Guang Wang[2,5], Ben Hu[1], Lei Zhang[1], Wei Zhang[1],

270 | Nature | Vol 579 | 12 March 2020

7MM personas salieron de Wuhan antes de restricción de viaje (23 enero)



Viajes 21 enero

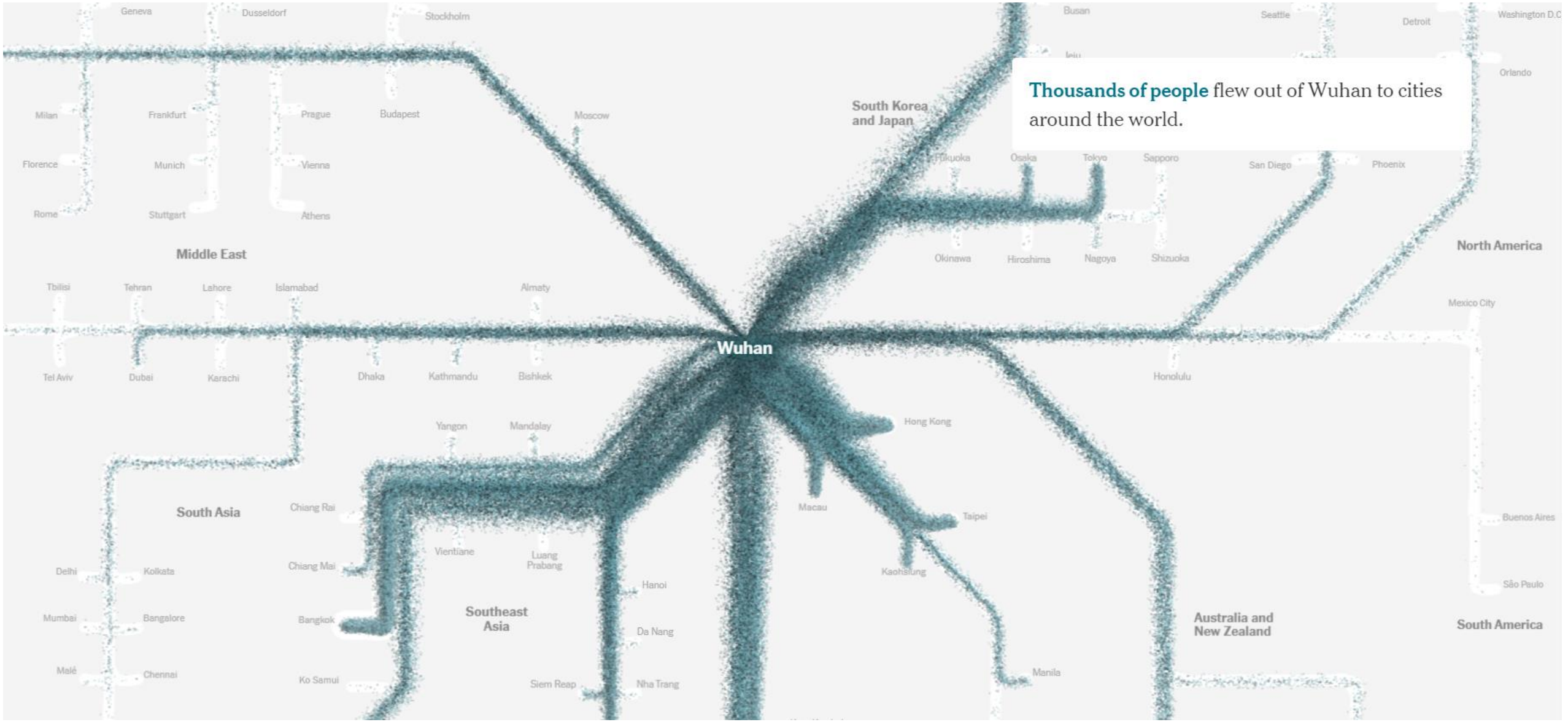


Viajes 4 febrero

https://nyti.ms/2UqrL7i

The New York Times

By Jin Wu, Weiyi Cai, Derek Watkins and James Glanz March 22, 2020



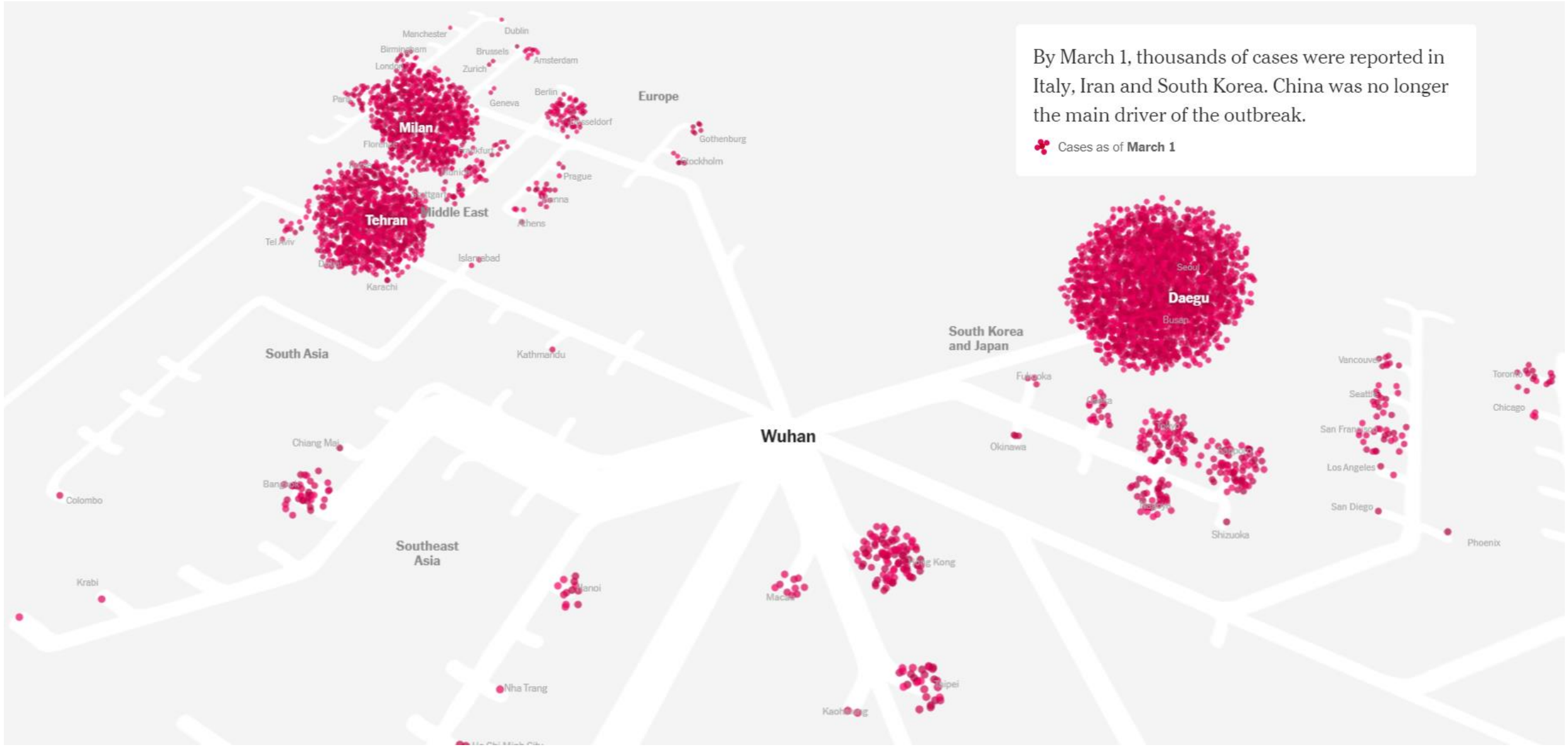
Restricción de vuelos internacionales: fines de enero

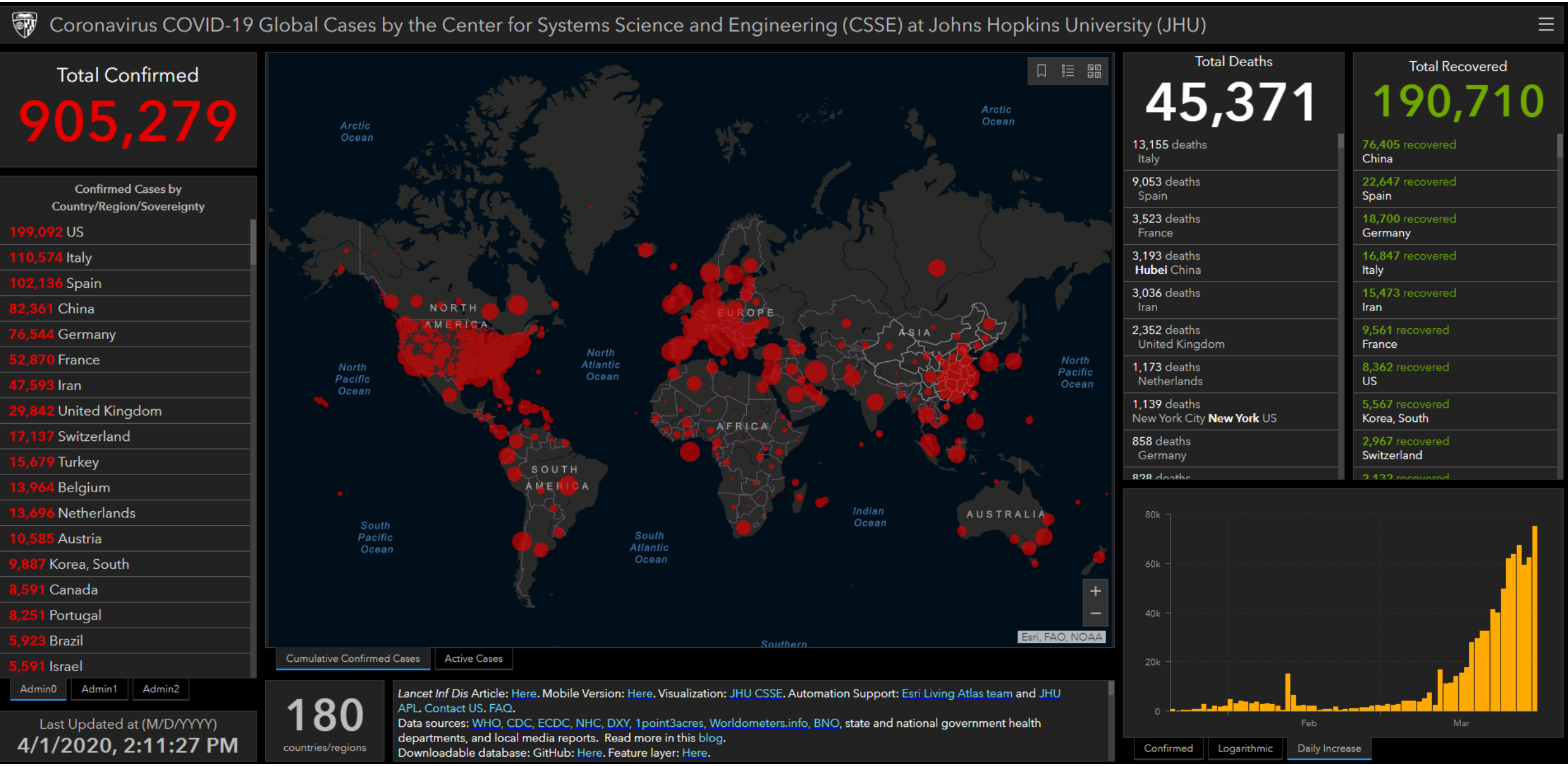
Transmisión epidémica en 26 países

https://nyti.ms/2UqrL7i

The New York Times

By Jin Wu, Weiyi Cai, Derek Watkins and James Glanz March 22, 2020


By March 1, thousands of cases were reported in Italy, Iran and South Korea. China was no longer the main driver of the outbreak.
Cases as of March 1
Europe
Middle East
South Asia
Southeast Asia
South Korea and Japan
Wuhan
Milan
Tehran
Daegu
Seoul
Busan
Manchester
Dublin
Birmingham
Brussels
Amsterdam
London
Zurich
Geneva
Berlin
Paris
Gothenburg
Stockholm
Prague
Vienna
Athens
Tel Aviv
Islamabad
Karachi
Kathmandu
Fukuoka
Okinawa
Shizuoka
Vancouver
Seattle
San Francisco
Los Angeles
San Diego
Chicago
Toronto
Phoenix
Chiang Mai
Bangkok
Colombo
Krabi
Hanoi
Nha Trang
Macau
Hong Kong
Taipei
Kaohsiung



https://bit.ly/2UcHlod

THE LANCET Infectious Diseases

*Ensheng Dong, Hongru Du, *Lauren Gardner*

¿Por qué ahora?

Global rise in human infectious disease outbreaks

Katherine F. Smith[1,†], Michael Goldberg[1], Samantha Rosenthal[2], Lynn Carlson[3], Jane Chen[1], Cici Chen[4,†] and Sohini Ramachandran[1,5,†]

J. R. Soc. Interface **11**: 20140950

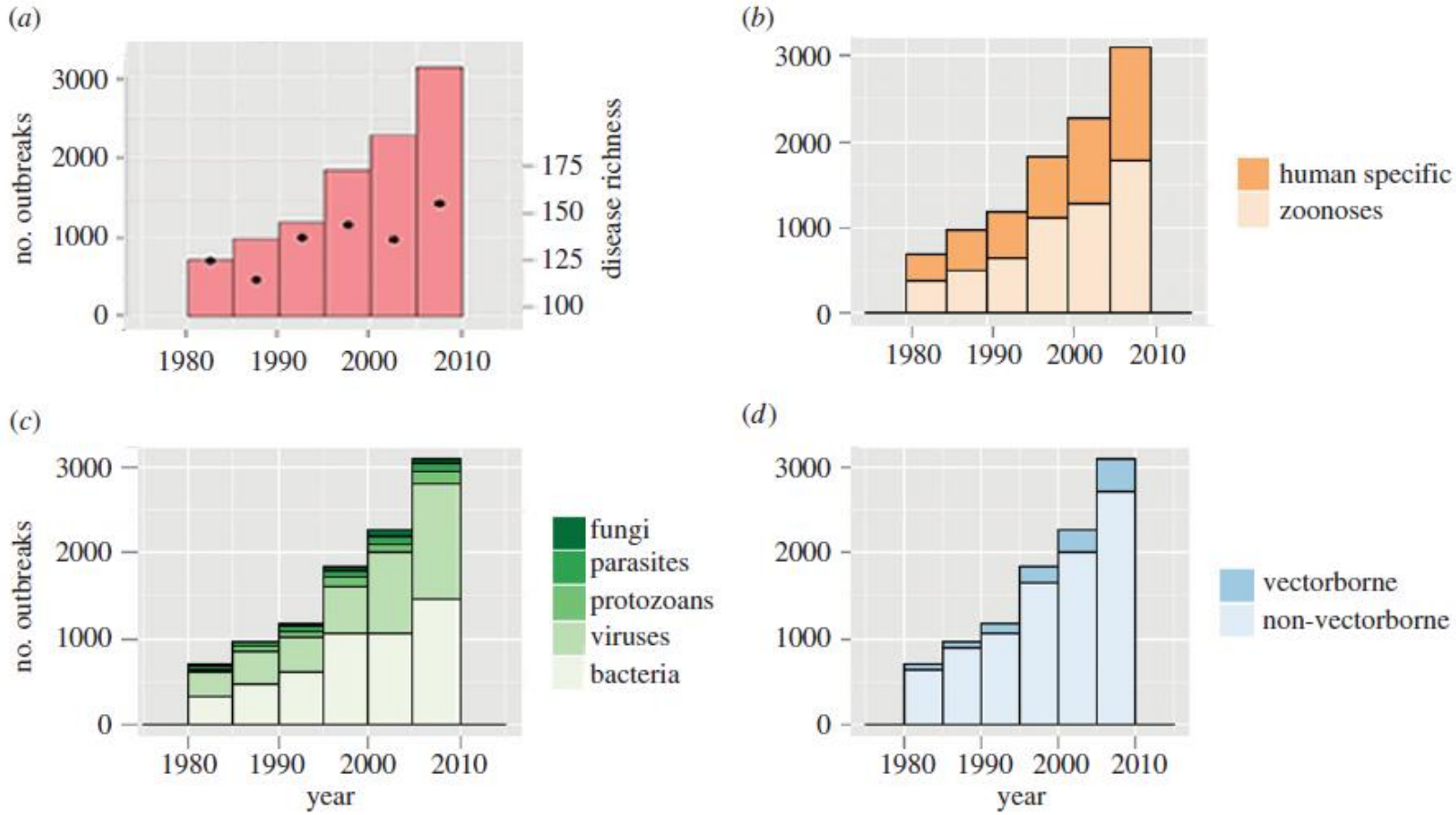


Figure 1. Global number of human infectious disease outbreaks and richness of causal diseases 1980–2010. Outbreak records are plotted with respect to (*a*) total global outbreaks (left axis, bars) and total number of diseases causing outbreaks in each year (right axis, dots), (*b*) host type, (*c*) pathogen taxonomy and (*d*) transmission mode. (Online version in colour.)

Globalización y Tráfico aéreo

1970 310 MM de vuelos

2020 > 4000 MM

Departures

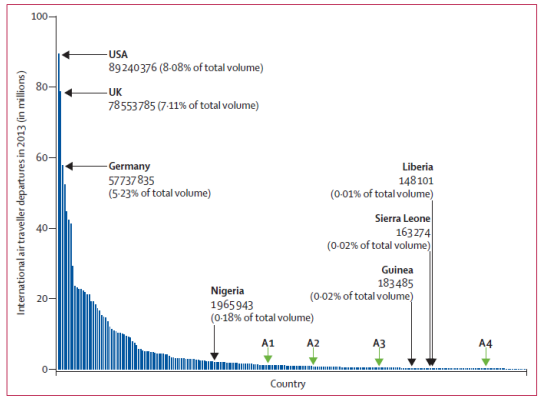


Figure 1: Global volume of international air traveller departures by country, 2013
Countries are shown in decreasing order of air traffic volume. Countries sharing a land border with Guinea, Liberia, and Sierra Leone are shown by green arrows. A1=Senegal (1 022 058; 0·09% of total volume). A2=Côte d'Ivoire (663 438; 0·06% of total volume). A3=Mali (325 983; 0·03% of total volume). A4=Guinea-Bissau (45 702; <0·01% of total volume).

Destinations

Ebola

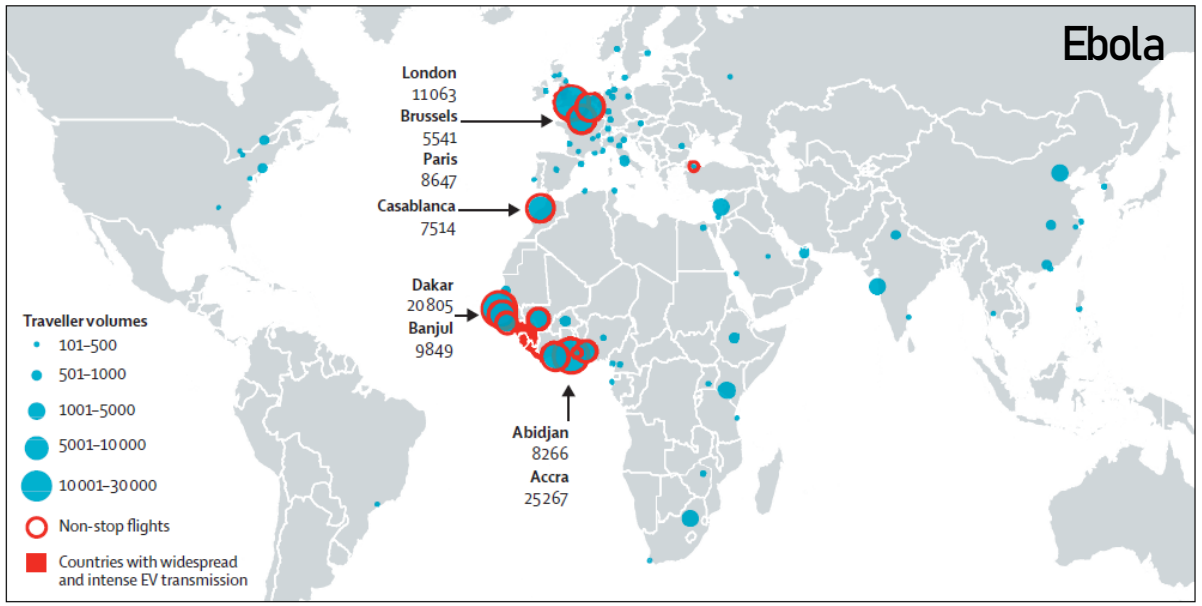
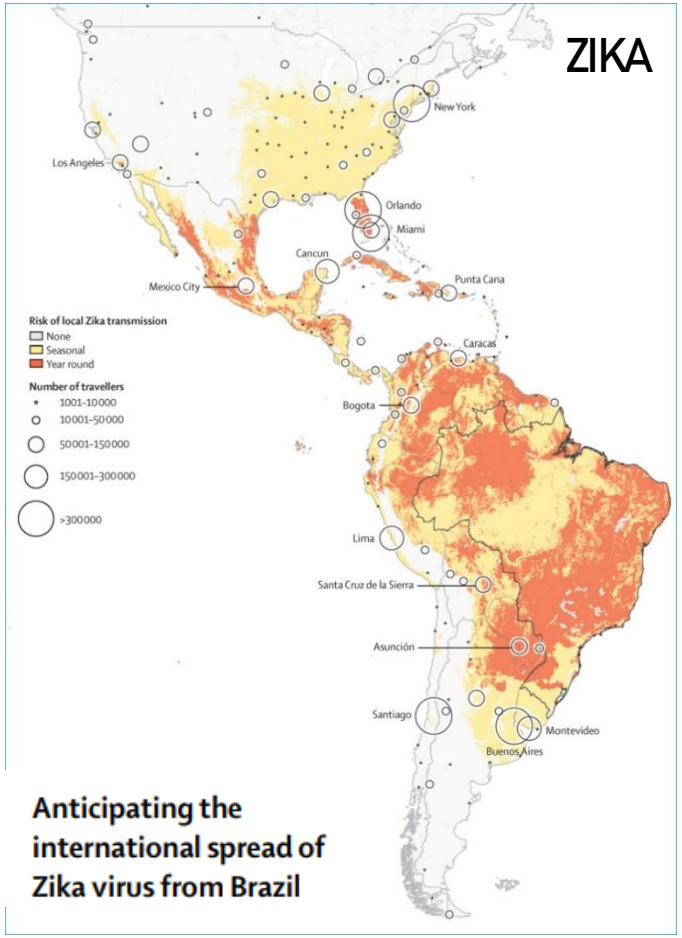


Figure 2: Final traveller destinations, passenger volumes * and scheduled non-stop flights† departing Guinea, Liberia, and Sierra Leone
*From Sept 1, 2013, to Dec 31, 2013. †From Sept 1, 2014, to Dec 31, 2014.

Lancet 2015; 385: 29–35

Destinations

ZIKA



THE LANCET
Volume 387, Issue 10016, 23–29 January 2016, Pages 335-336

In travel

SARS

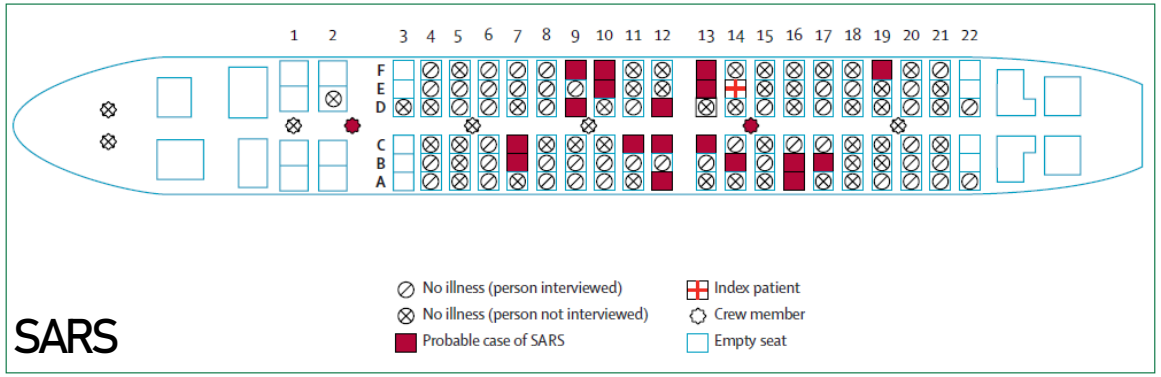


Figure 2: Schematic diagram of SARS outbreak aboard Hong Kong to Beijing flight
From reference 31with permission of the publisher.

Lancet 2005; 365: 989–96

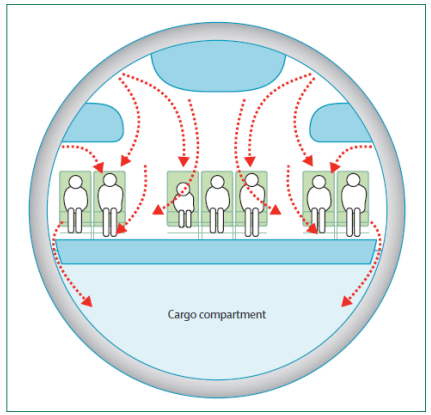


Figure 1: Air circulation pattern in typical airline passenger cabin
From WHO[4] with permission of the publisher. Arrows show air currents.

Alteración de hábitats / cambio climático

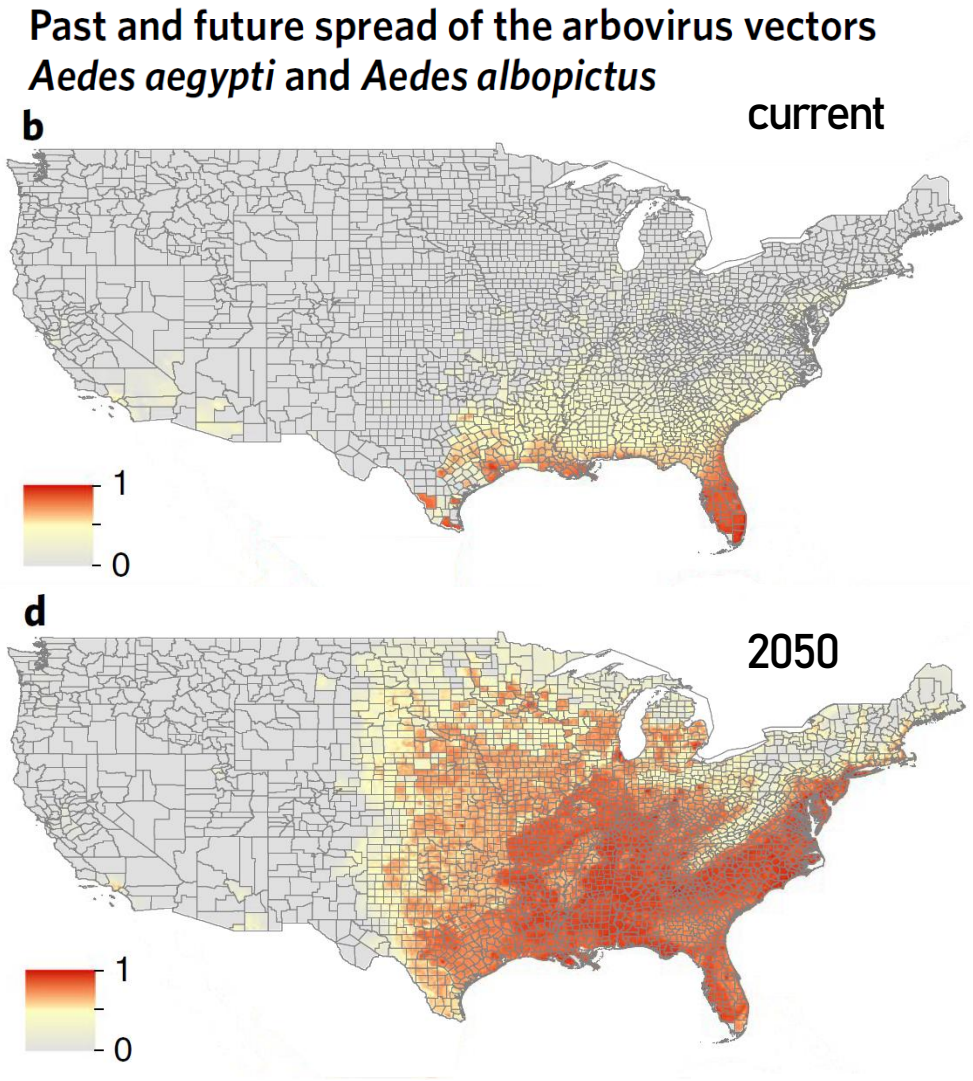


Fig. 2 | Predicted future spread of *Ae. aegypti*

nature microbiology

Projection of climatic suitability for *Aedes albopictus*

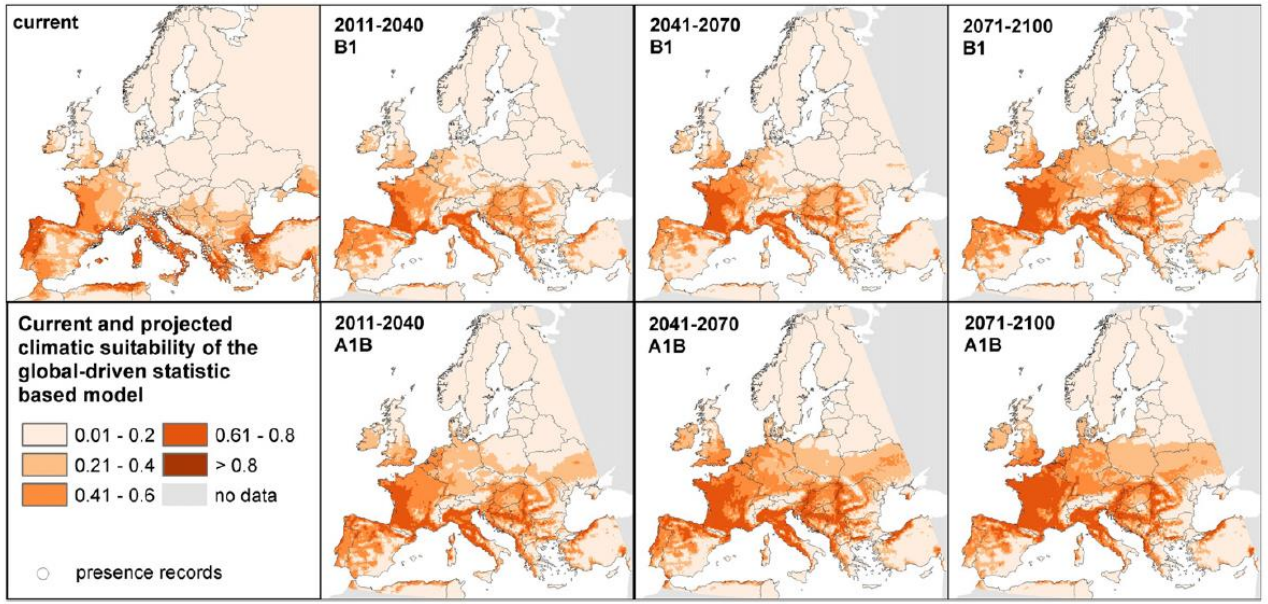


Fig. 5. Current and projected climatic suitability for *Aedes albopictus* in Europe

Global and Planetary Change 78 (2011) 54–64

Global Climate Change and Emerging Infectious Diseases

The NEW ENGLAND JOURNAL of MEDICINE

Jonathan A. Patz, MD, MPH; Paul R. Epstein, MD, MPH; Thomas A. Burke, PhD, MPH; John M. Balbus, MD, MPH

JAMA, January 17, 1996—Vol 275, No. 3

Climate variation drives dengue dynamics

PNAS Proceedings of the National Academy of Sciences of the United States of America

Lei Xu[a,b,1], Leif C. Stige[b,1], Kung-Sik Chan[c], Jie Zhou[d], Jun Yang[a], Shaowei Sang[a], Ming Wang[e], Zhicong Yang[e], Ziqiang Yan[e], Tong Jiang[f], Liang Lu[a], Yujuan Yue[a], Xiaobo Liu[a], Hualiang Lin[g], Jianguo Xu[a,2], Qiyong Liu[a,h,i,2], and Nils Chr. Stenseth[b,2]

PNAS | January 3, 2017 | vol. 114 | no. 1 | 113–118

Urbanización

Mayor densidad

Presión sobre el medio ambiente

Convivencia con animales

Residuos

GLOBAL HEALTH

Urbanization — An Emerging Humanitarian Disaster

Ronak B. Patel, M.D., M.P.H., and Thomas F. Burke, M.D.

N ENGL J MED 361;8

A Doctor Examining a Child in a Slum in Chandigarh, India, 2008.

Urbanisation and infectious diseases in a globalised world

Emilie Alirol, Laurent Getaz, Beat Stoll, François Chappuis, Louis Loutan

Lancet Infect Dis 2010;
10: 131–41

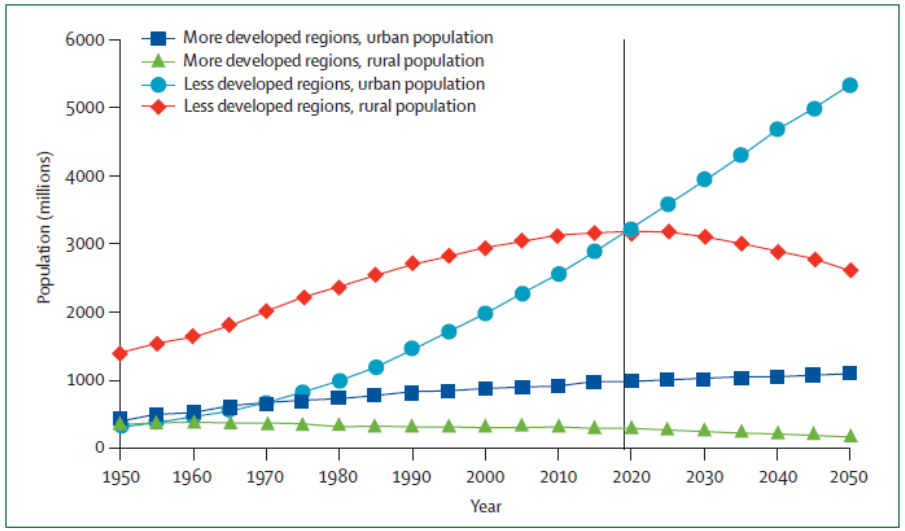


Figure 1: Evolution of urban and rural populations between 1950 and 2050[2]

Manoocher Deghati (www.irinnews.org)

Figure 2: A slum of Kibera
Dwellers of slums live in dire, overcrowded environments, with no access to water or sanitation. In the slum of Kibera, Kenya the number of inhabitants is almost 1 million.

CLINICAL MICROBIOLOGY REVIEWS, Oct. 2007, p. 660–694 Vol. 20, No. 4
0893-8512/07/$08.00+0 doi:10.1128/CMR.00023-07

Severe Acute Respiratory Syndrome Coronavirus as an Agent of Emerging and Reemerging Infection

Vincent C. C. Cheng, Susanna K. P. Lau, Patrick C. Y. Woo, and Kwok Yung Yuen*

CLINICAL MICROBIOLOGY REVIEWS, Oct. 2007, p. 660–694

SHOULD WE BE READY FOR THE REEMERGENCE OF SARS?

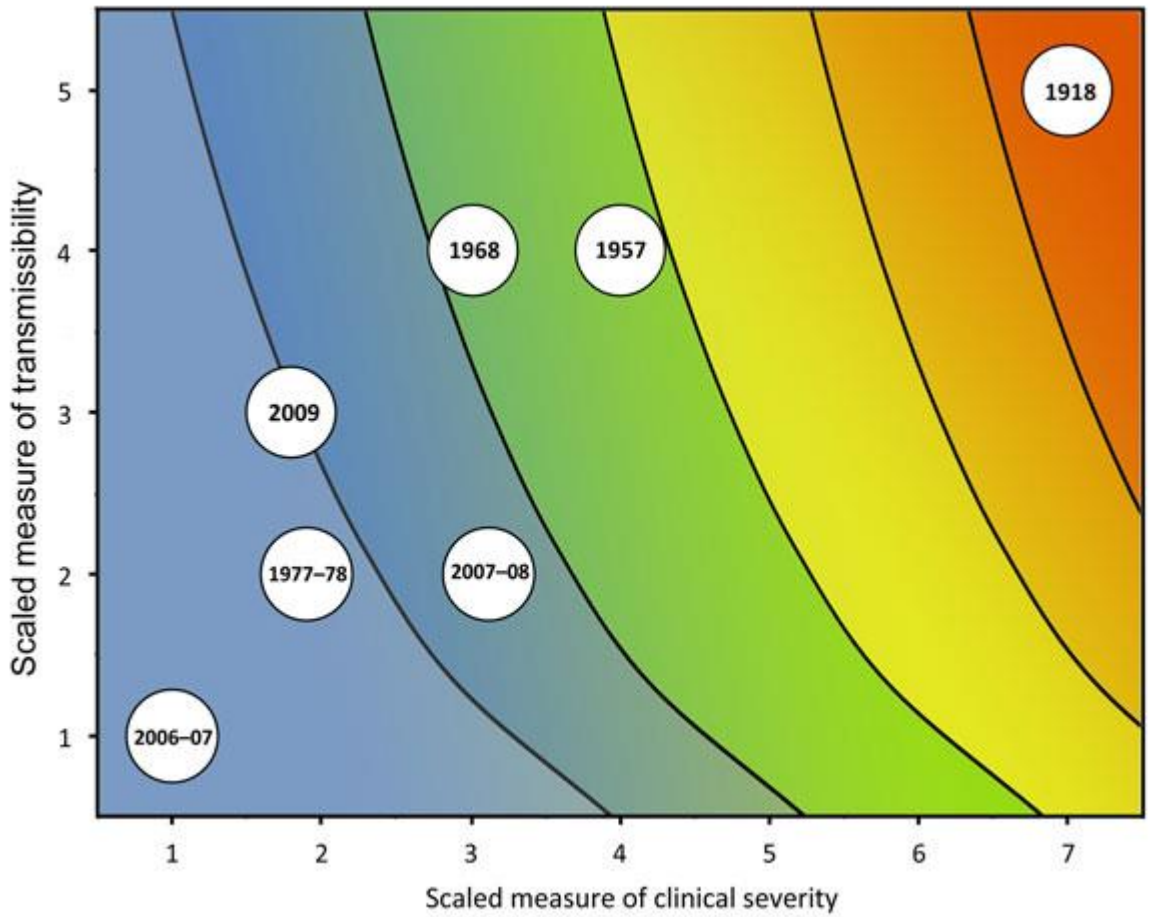
The medical and scientific community demonstrated marvelous efforts in the understanding and control of SARS within a short time, as evident by over 4,000 publications available online. Despite these achievements, gaps still exist in terms of the molecular basis of the physical stability and transmissibility of this virus, the molecular and immunological basis of disease pathogenesis in humans, screening tests for early or cryptic SARS cases, foolproof infection control procedures for patient care, effective antivirals or antiviral combinations, the usefulness of immunomodulatory agents for late presenters, an effective vaccine with no immune enhancement, and the immediate animal host that transmitted the virus to caged civets in the market at the beginning of the epidemic. Coronaviruses are well known to undergo genetic recombination (375), which may lead to new genotypes and outbreaks. The presence of a large reservoir of SARS-CoV-like viruses in horseshoe bats, together with the culture of eating exotic mammals in southern China, is a time bomb. The possibility of the reemergence of SARS and other novel viruses from animals or laboratories and therefore the need for preparedness should not be ignored.

Algunos conceptos sobre epidemias

Novel Framework for Assessing Epidemiologic Effects of Influenza Epidemics and Pandemics

Carrie Reed✉, Matthew Biggerstaff, Lyn Finelli, Lisa M. Koonin, Denise Beauvais, Amra Uzicanin, Andrew Plummer, Joe Bresee, Stephen C. Redd, and Daniel B. Jernigan

EMERGING INFECTIOUS DISEASES®
Volume 19, Number 1—January 2013



GOVERNANCE

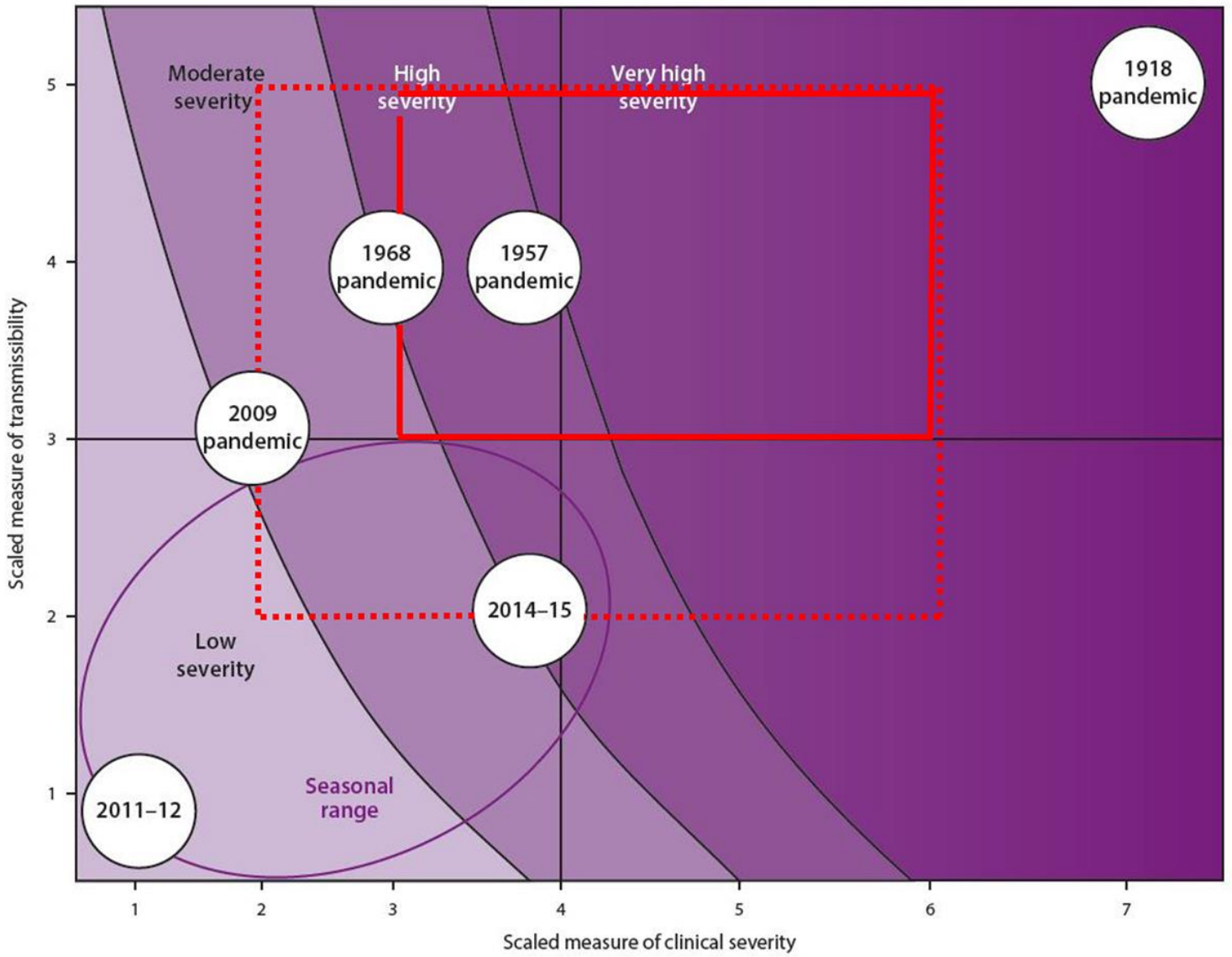
How to Save Lives in a COVID-19 Pandemic

by Cyrus Shahpar

and Amanda McClelland

and Tom Frieden

February 28, 2020



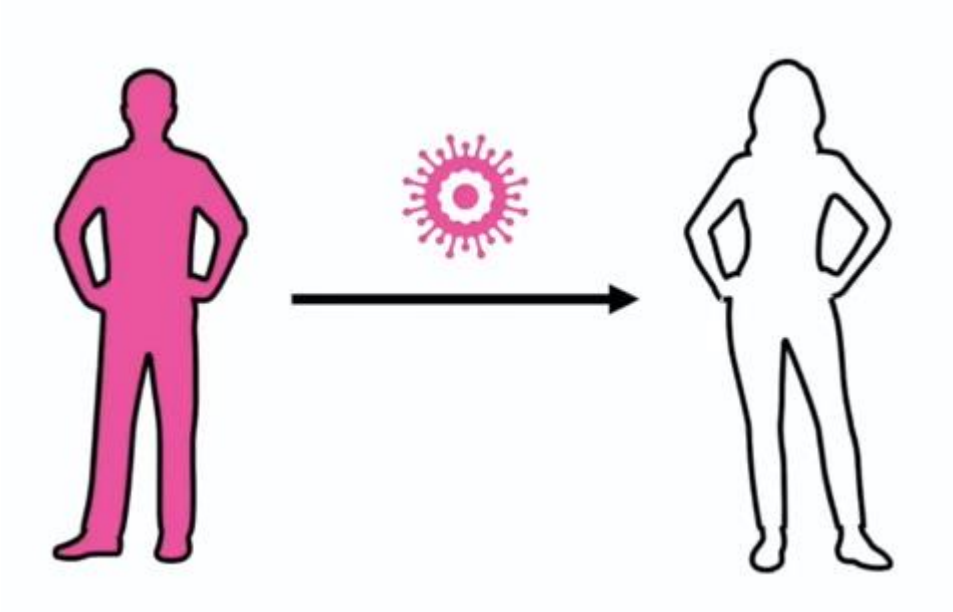
Current COVID-19 estimate

Likely range with new evidence

Transmisibilidad

Ro

Número básico de reproducción en contexto



Ro ≠ R


Dr Pleuni Pennings
San Francisco State University


Dr Senay Yitbarek
UC Berkeley

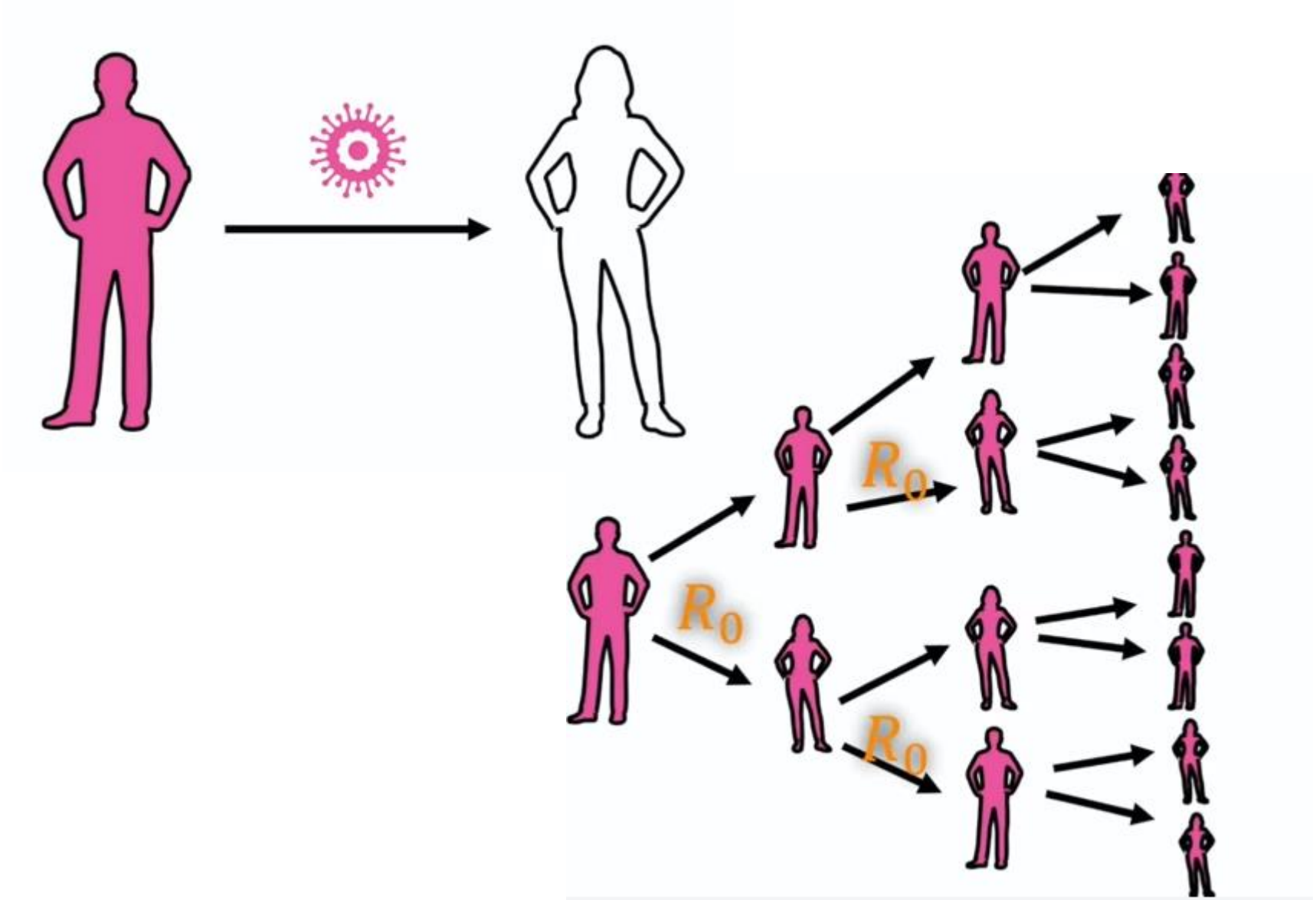

Dr Brandon Ogbunu
Brown University

Transmisibilidad

Ro

Número básico de reproducción en contexto

Ro ≠ R

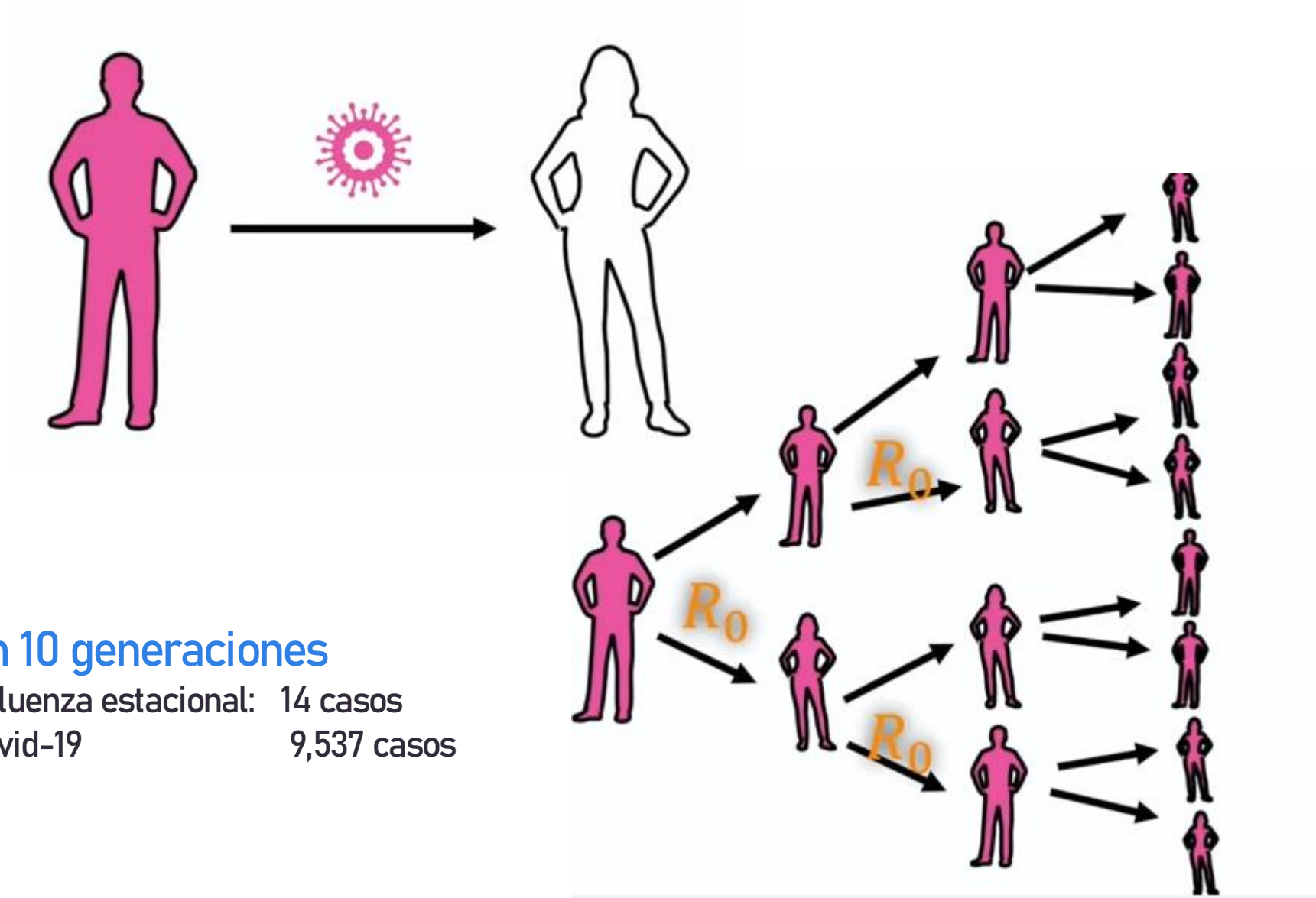


Dr Pleuni Pennings
San Francisco State University
Dr Senay Yitbarek
UC Berkeley
Dr Brandon Ogbunu
Brown University

Transmisibilidad

Ro

Número básico de reproducción en contexto



¿y qué?

Influenza estacional: R~1.3
Covid-19 R~2.5

En 10 generaciones

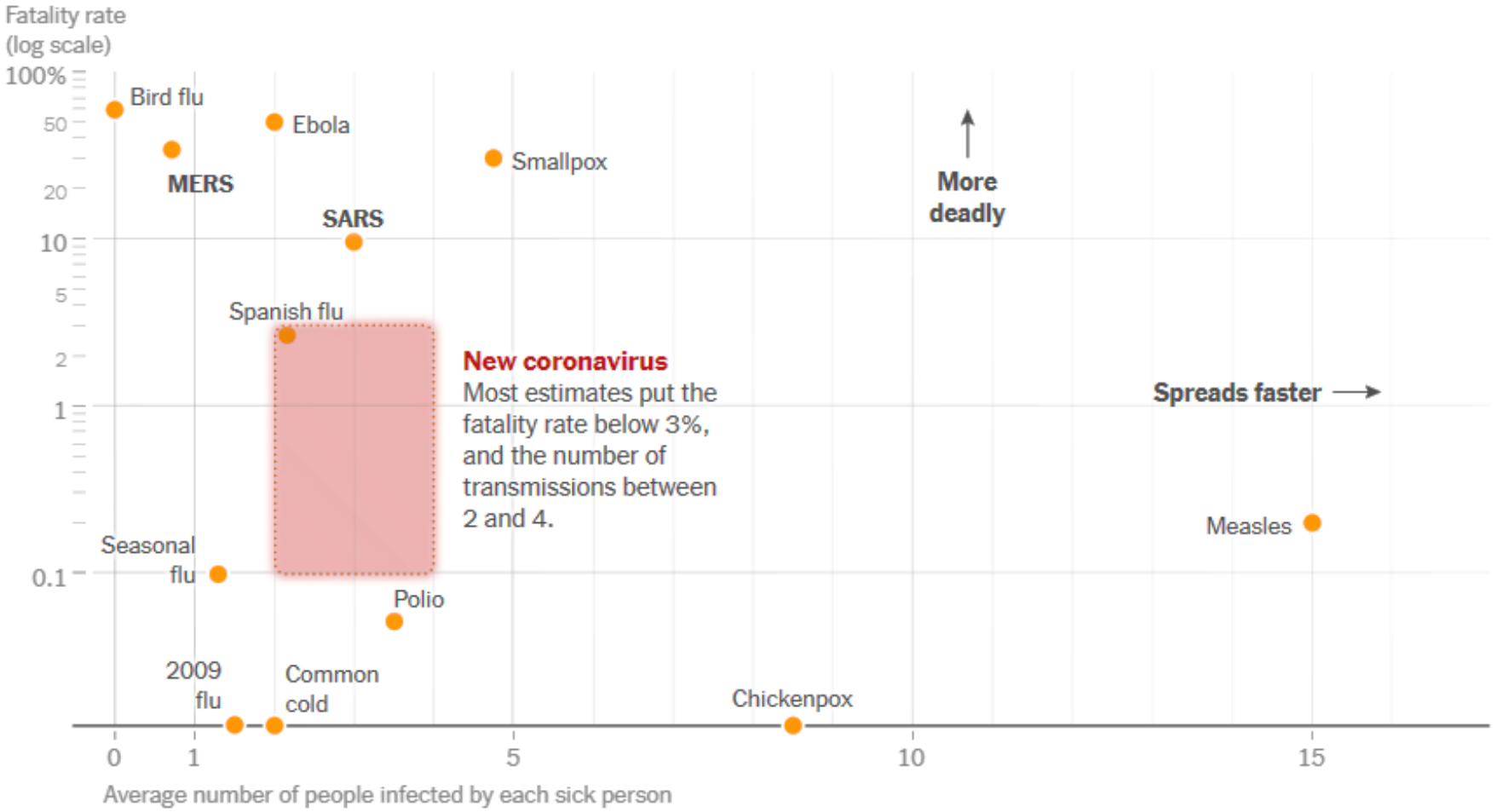
Influenza estacional: 14 casos
Covid-19 9,537 casos

Dr Pleuni Pennings
San Francisco State University
Dr Senay Yitbarek
UC Berkeley
Dr Brandon Ogbunu
Brown University

Severidad clínica

Tasa de letalidad

Proporción de infectados que mueren



Note: Average case-fatality rates and transmission numbers are shown. Estimates of case-fatality rates can vary, and numbers for the new coronavirus are preliminary estimates.

Tasa de letalidad: variación por edad

CHINA CDC WEEKLY
CCDC weekly
中国疾病预防控制中心周报

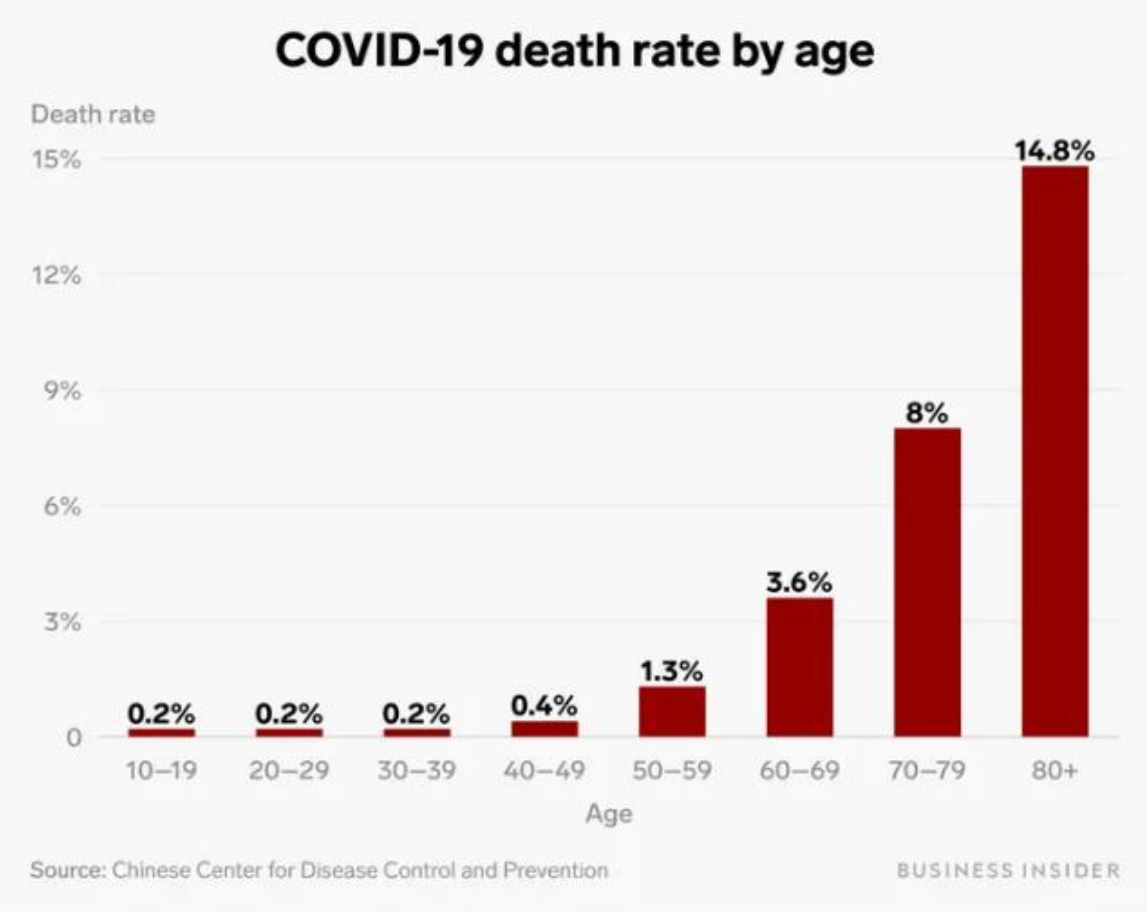
Article Navigation > China CDC Weekly > 2020, 2(8): 113-122

Vital Surveillances: The Epidemiological Characteristics of an Outbreak of 2019 Novel Coronavirus Diseases (COVID-19) — China, 2020

The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team ,

Corresponding author: Yanping Zhang, zhangyp@chinacdc.cn
Online Date: February 17 2020

The study collected data from more than 44,000 confirmed patients in China through February 11. It offers one of broadest depictions of how COVID-19 operates in humans.



Tasa de letalidad: variación por país

COVID-19 death rate in countries with confirmed deaths and more than 1,000 cases

COUNTRY	# CASES	# DEATHS	DEATH RATE
Italy	31,506	2,503	7.94%
Iran	16,169	988	6.11%
Spain	11,309	509	4.50%
China*	81,058	3,230	3.98%
UK	1,960	55	2.81%
Netherlands	1,708	43	2.52%
France	6,664	148	2.22%
US	5,702	96	1.68%
Switzerland	2,700	27	1.00%
South Korea	8,320	81	0.97%
Belgium	1,243	10	0.80%
Sweden	1,190	7	0.59%
Denmark	1,024	4	0.39%
Germany	9,257	24	0.26%
Austria	1,332	3	0.23%
Norway	1,443	3	0.21%

Note: Data as of 4:00 pm EST on March 17, 2020. *Mainland China and Hong Kong

Source: Johns Hopkins

BUSINESS INSIDER

Estructura etárea población

Capacidad del sistema de salud

Severidad de casos reportados

BUSINESS INSIDER

MAR 19, 2020, 00:43 IST

SHAYANNE GAL,AYLIN WOODWARD,ANDY KIERSZ

Tasa de letalidad debe ajustarse

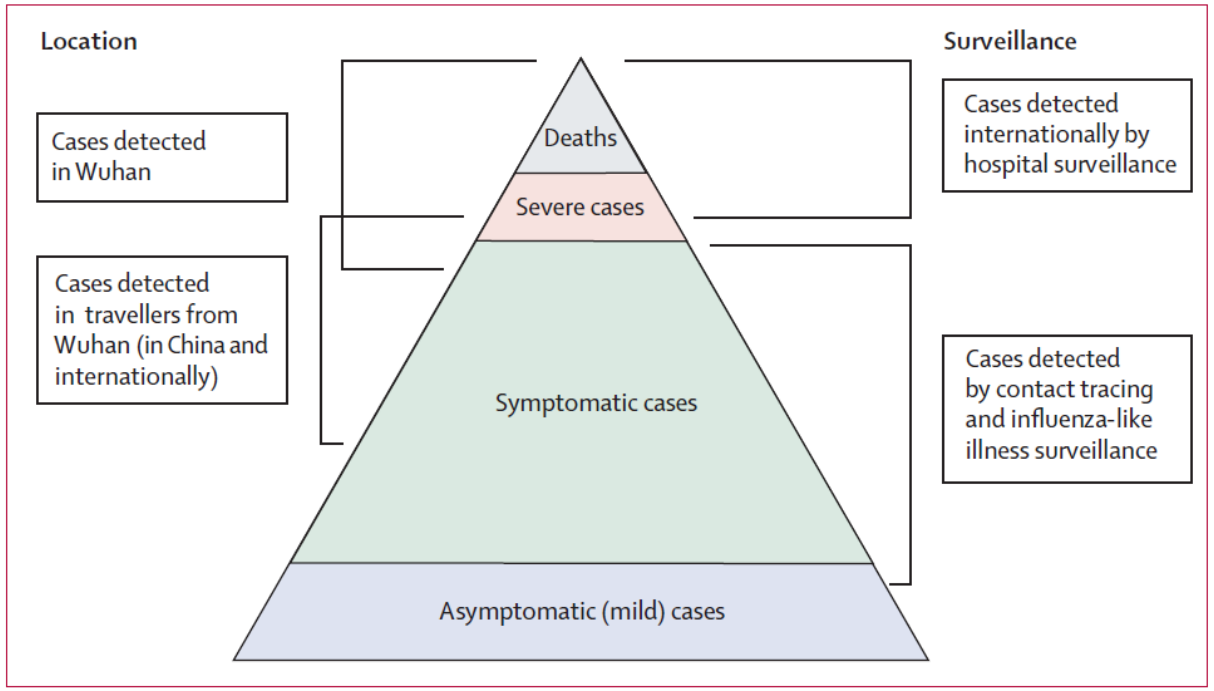
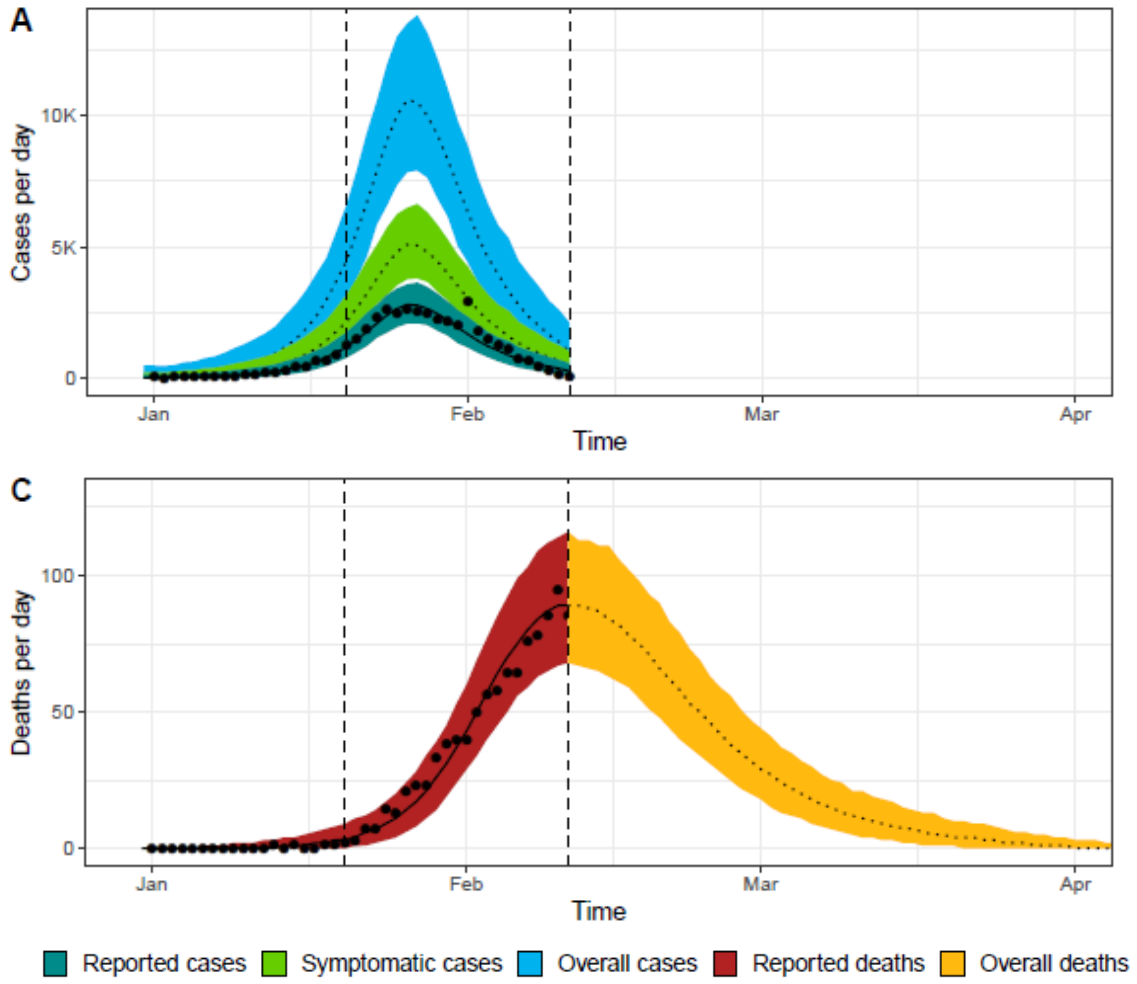


Figure 1: Spectrum of COVID-19 cases

Casos sintomáticos no reportados

Casos actualmente enfermos que van a empeorar



Estimates of the severity of coronavirus disease 2019: a model-based analysis

Robert Verity et al. *Lancet Infect Dis* 2020

ADJUSTED AGE-SPECIFIC CASE FATALITY RATIO DURING THE COVID-19 EPIDEMIC IN HUBEI, CHINA, JANUARY AND FEBRUARY 2020

Julien Riou, Anthony Hauser, Michel J Counotte, Christian L Althaus

Respuesta

Ro es función de las características del virus, de la población, y del comportamiento de la población

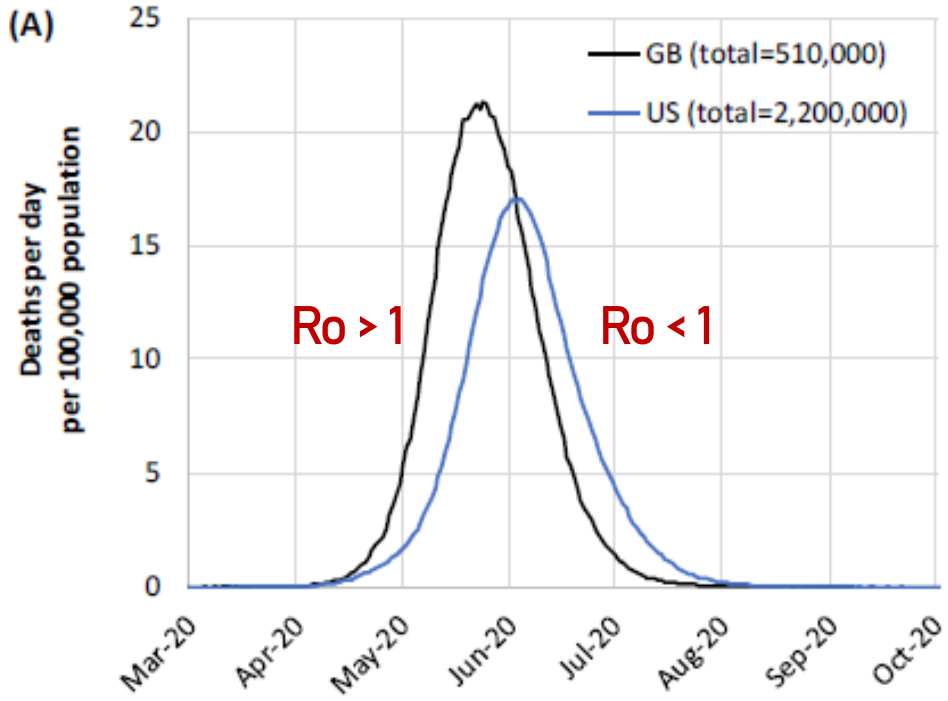


Figure 1: Unmitigated epidemic scenarios for GB and the US.

Imperial College COVID-19 Response Team

Ro > 1 epidemia crece

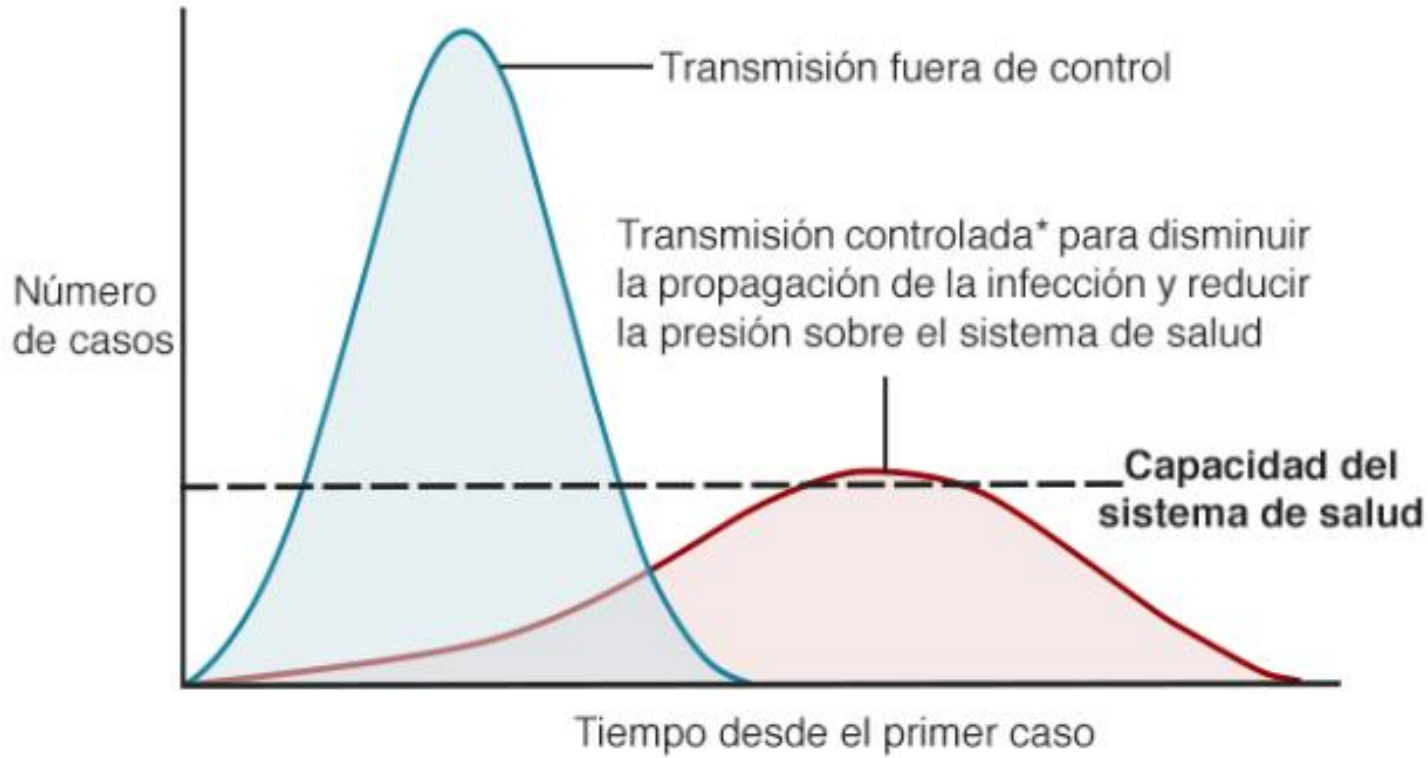
Ro = 1 epidemia se mantiene

Ro < 1 epidemia disminuye

Ro ~ duración infectividad * personas susceptibles que contacta * probabilidad de infección en esos contactos

“Aplanar la curva”

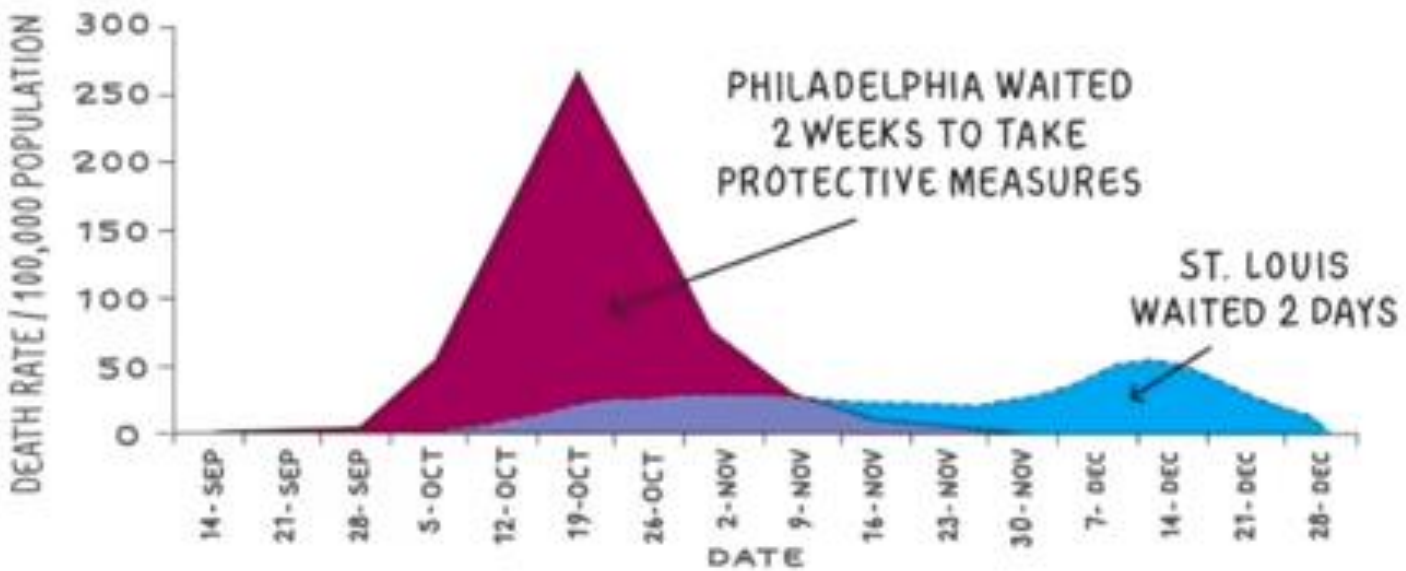
(disminuir R)


Transmisión fuera de control
Transmisión controlada* para disminuir
la propagación de la infección y reducir
la presión sobre el sistema de salud
Número
de casos
Capacidad del
sistema de salud
Tiempo desde el primer caso

Public health interventions and epidemic intensity during the 1918 influenza pandemic

Richard J. Hatchett*†, Carter E. Mecher‡§, and Marc Lipsitch¶

7582–7587 | PNAS | May 1, 2007 | vol. 104 | no. 18



EXCESS PNEUMONIA & INFLUENZA MORTALITY
IN PHILADELPHIA AND ST. LOUIS, SEP-DEC 1918.

Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand

16 March 2020

Neil M Ferguson, Daniel Laydon, Gemma Nedjati-Gilani, Natsuko Imai, Kylie Ainslie, Marc Baguelin, Sangeeta Bhatia, Adhiratha Boonyasiri, Zulma Cucunubá, Gina Cuomo-Dannenburg, Amy Dighe, Ilaria Dorigatti, Han Fu, Katy Gaythorpe, Will Green, Arran Hamlet, Wes Hinsley, Lucy C Okell, Sabine van Elsland, Hayley Thompson, Robert Verity, Erik Volz, Haowei Wang, Yuanrong Wang, Patrick GT Walker, Peter Winskill, Charles Whittaker, Christl A Donnelly, Steven Riley, Azra C Ghani.

Supresión:

Objetivo $R<1$

Eliminar transmisión persona a persona

Requiere mantener estrategia – al menos intermitentemente

Mitigación:

Objetivo $R\sim1$

Reducir el impacto de la epidemia (estrategia influenza pandémica)

Focalizado población vulnerable

Generar inmunidad de rebaño

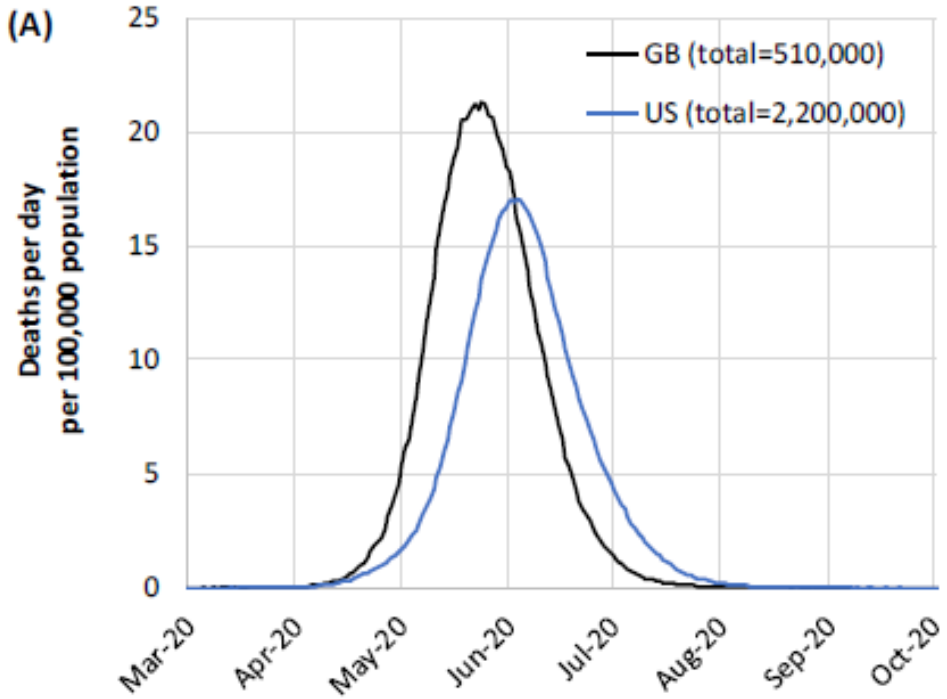
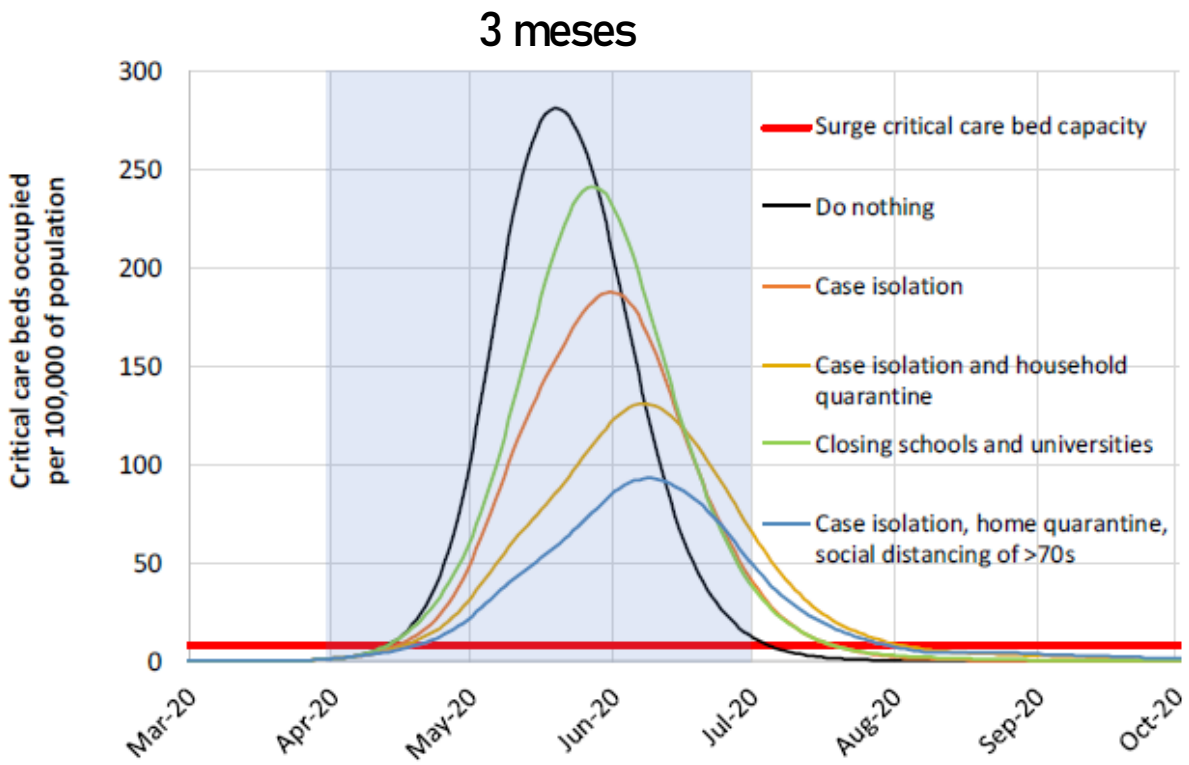


Figure 1: Unmitigated epidemic scenarios for GB and the US.

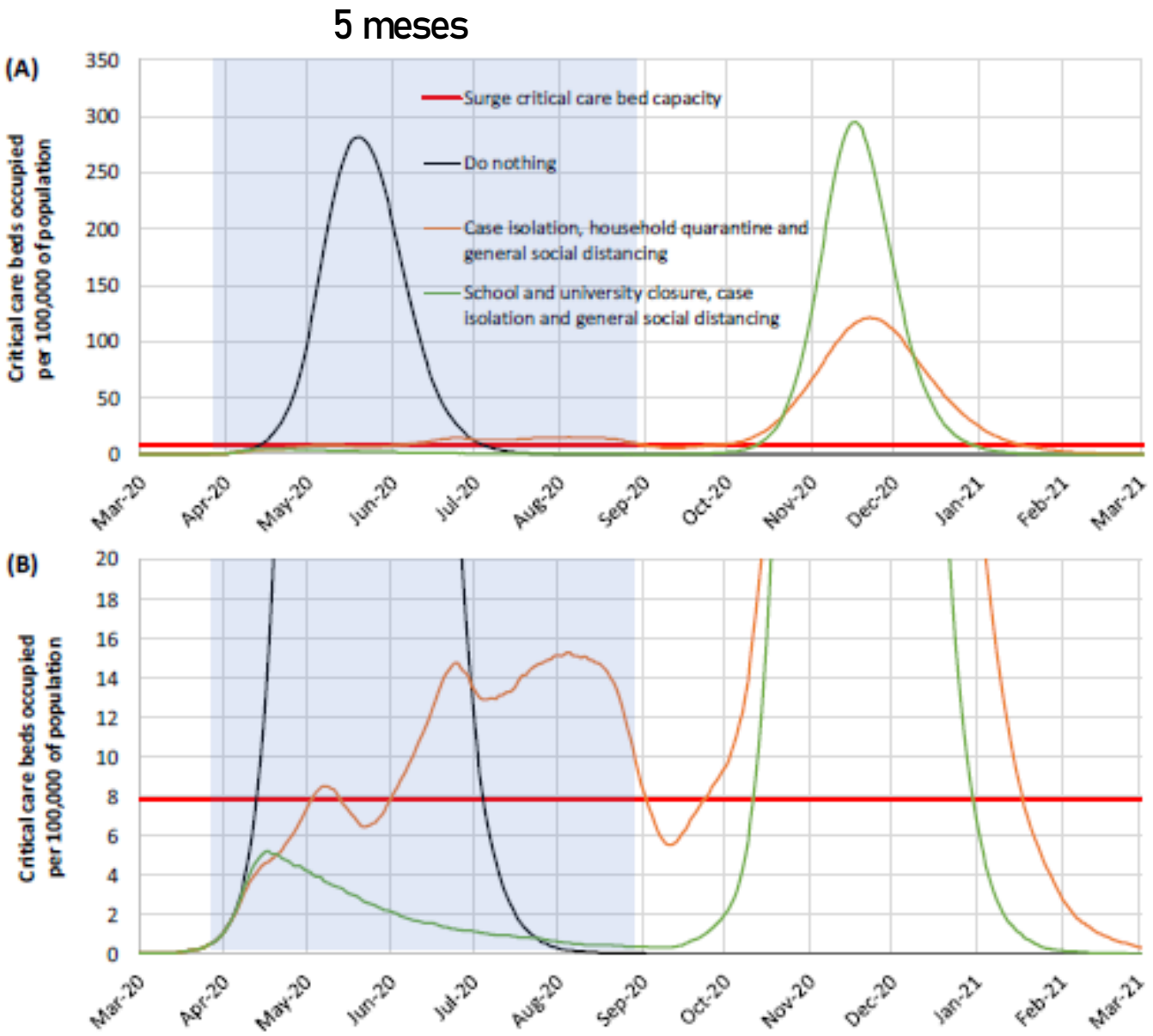
Table 2: Summary of NPI interventions considered.

Label	Policy	Description
CI	Case isolation in the home	Symptomatic cases stay at home for 7 days, reducing non-household contacts by 75% for this period. Household contacts remain unchanged. Assume 70% of household comply with the policy.
HQ	Voluntary home quarantine	Following identification of a symptomatic case in the household, all household members remain at home for 14 days. Household contact rates double during this quarantine period, contacts in the community reduce by 75%. Assume 50% of household comply with the policy.
SDO	Social distancing of those over 70 years of age	Reduce contacts by 50% in workplaces, increase household contacts by 25% and reduce other contacts by 75%. Assume 75% compliance with policy.
SD	Social distancing of entire population	All households reduce contact outside household, school or workplace by 75%. School contact rates unchanged, workplace contact rates reduced by 25%. Household contact rates assumed to increase by 25%.
PC	Closure of schools and universities	Closure of all schools, 25% of universities remain open. Household contact rates for student families increase by 50% during closure. Contacts in the community increase by 25% during closure.

Mitigación

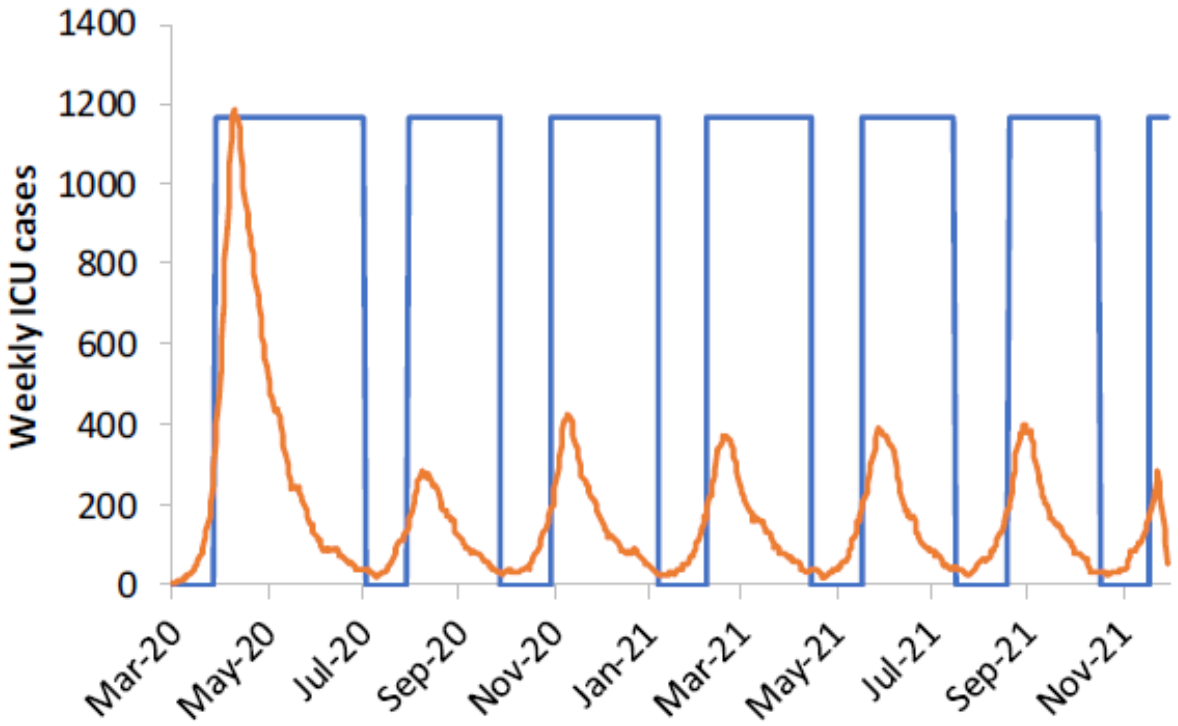


Supresión



Imperial College COVID-19 Response Team

Adaptive triggering of supression



Trigger

On – 100 casos COVID19 en UCI

Off – 50 casos COVID19 en UCI

Efecto

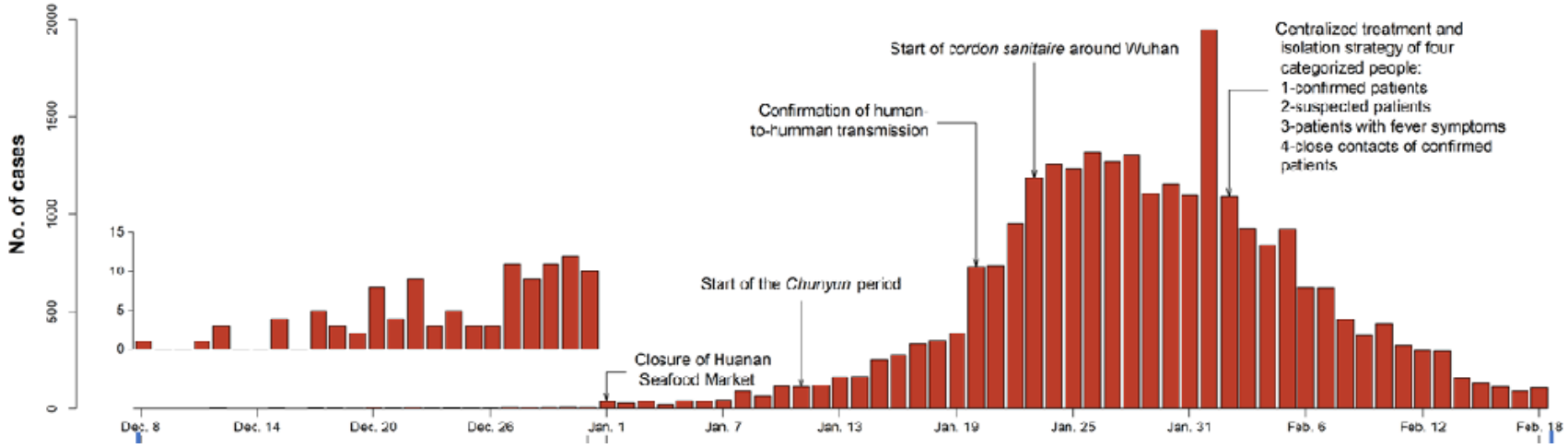
Distanciamiento social

Cierre colegios y universidades

La epidemia se puede parar

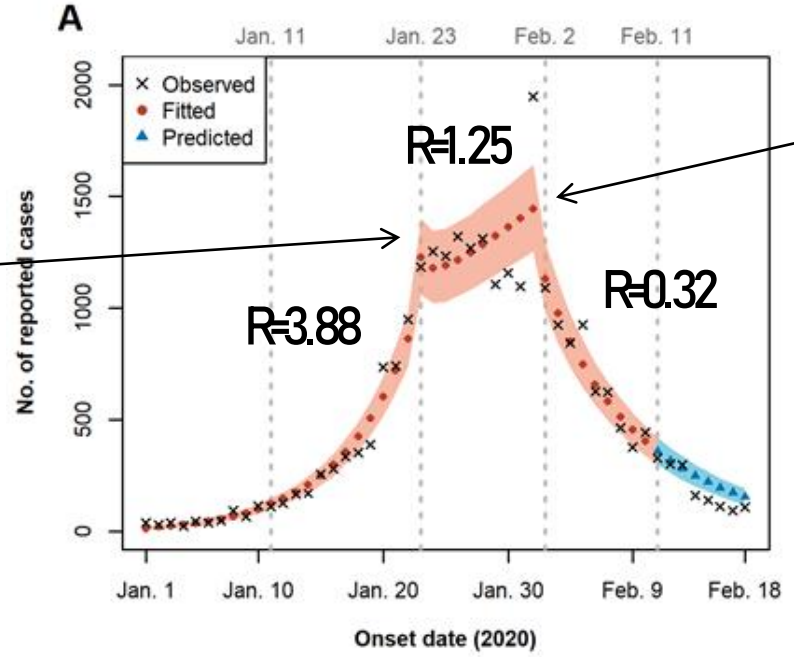
Evolving Epidemiology and Impact of Non-pharmaceutical Interventions on the Outbreak of Coronavirus Disease 2019 in Wuhan, China

Wang et al. 2020 MedRxiv



N = 26,000 casos

R = Número efectivo de reproducción



Cordón sanitario Wuhan

Distanciamiento social
Cuarentena en casas
Cierre salidas
Clausura transporte público
Tránsito vehicular

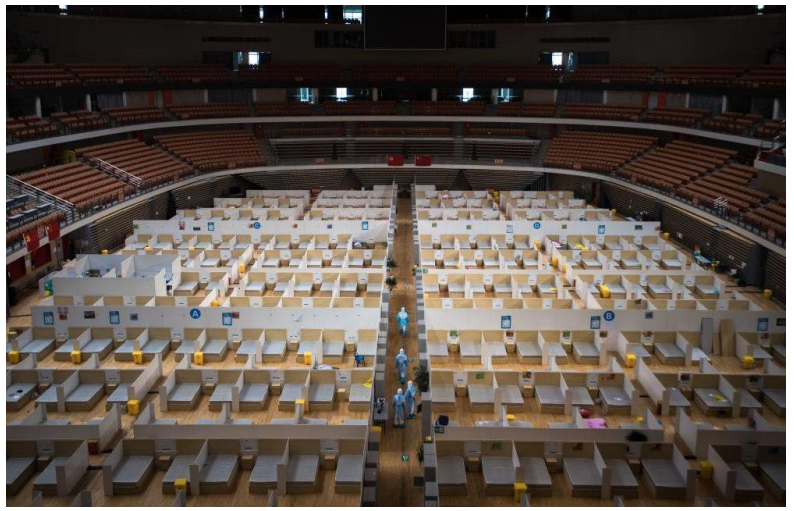
Cuarentena centralizada y aislación

(Hospitales y recintos designados)
Pacientes confirmados

1. Pacientes sospechosos
2. Pacientes con fiebre
3. Contactos

Cordón sanitario

Aumento capacidad sistema



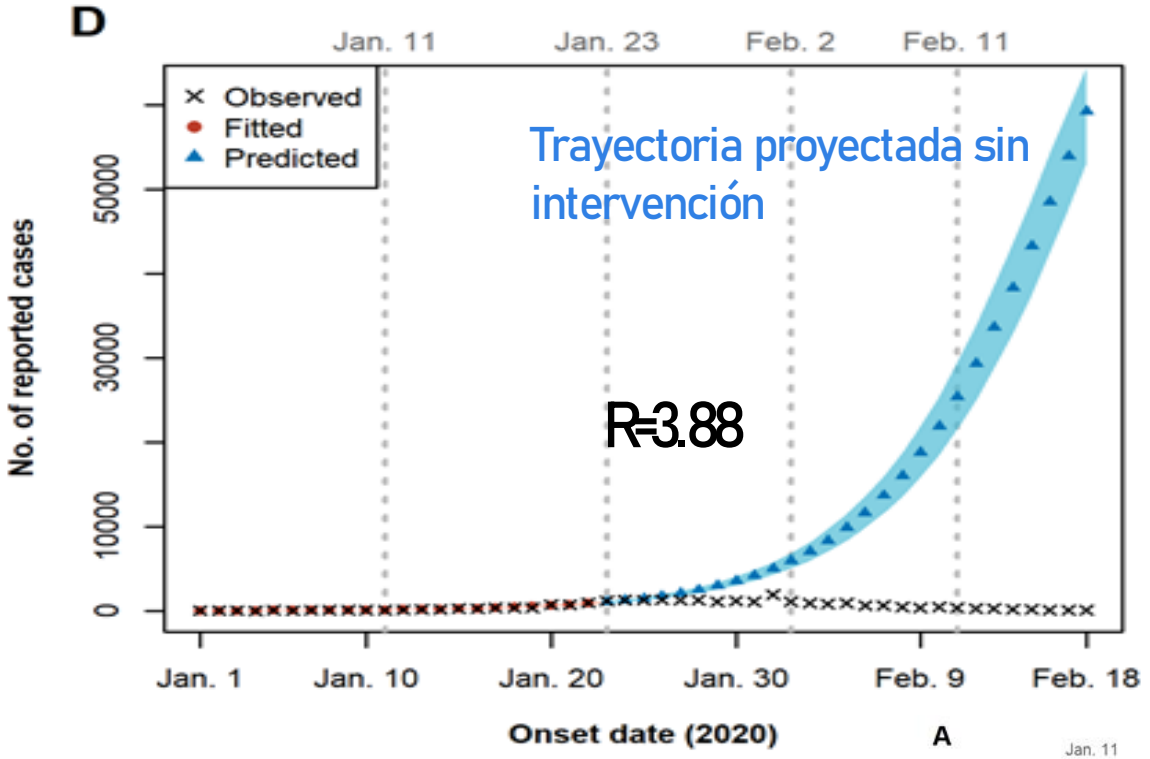
Aumento recursos humanos y materiales

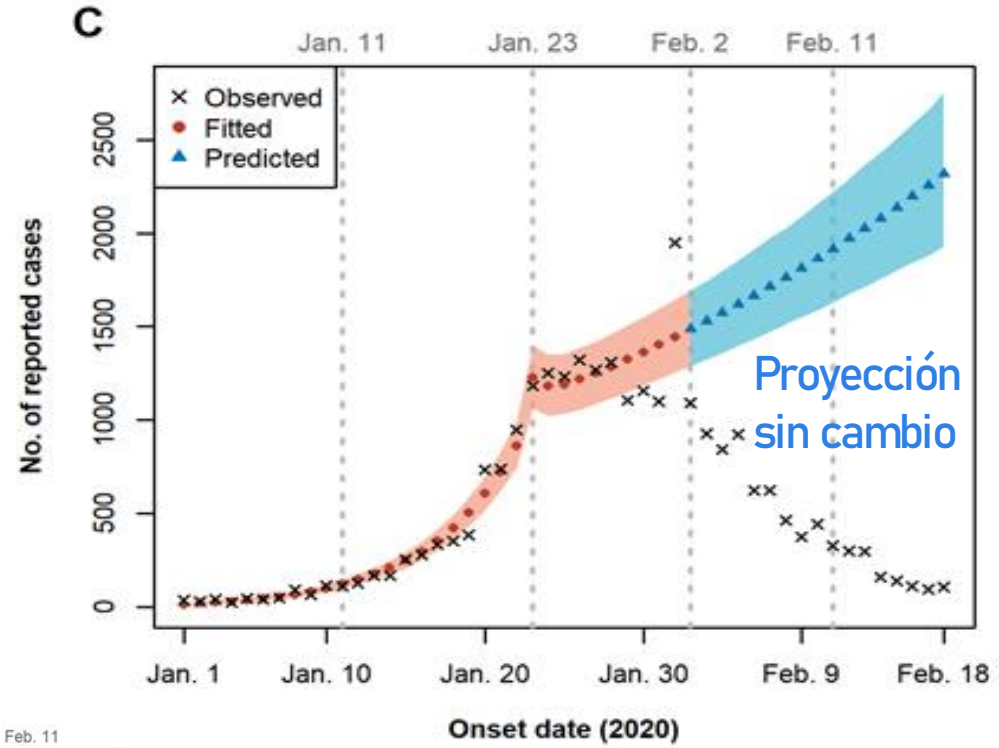
Learning from 26,000 cases of COVID-19 in Wuhan

Xihong Lin

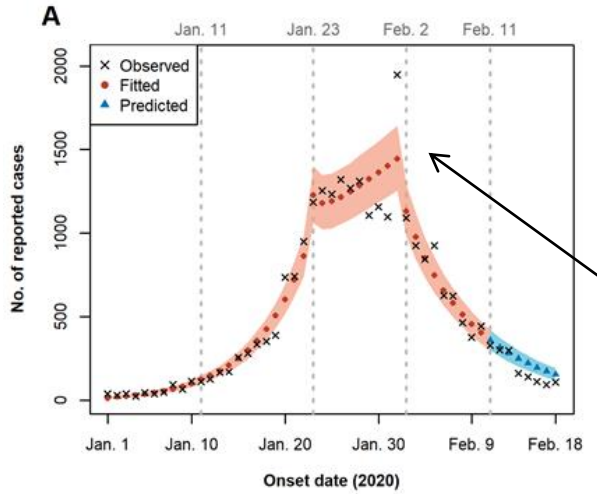
Evolving Epidemiology and Impact of Non-pharmaceutical Interventions on the Outbreak of Coronavirus Disease 2019 in Wuhan, China

Wang et al. 2020 MedRxiv





Cordón sanitario Wuhan



Cuarentena centralizada y aislación

Control de la fuente de infección

The New York Times

China Hits a Coronavirus Milestone: No New Local Infections

All of the new cases reported on Thursday involved people who had come to China from elsewhere, the government said.

March 18, 2020

China to Ease Coronavirus Lockdown on Hubei 2 Months After Imposing It

March 24, 2020

Algunos aportes modelación

17 January 2020 *Imperial College London COVID-19 Response Team*

Estimating the potential total number of novel Coronavirus cases in Wuhan City, China

Natsuko Imai, Ilaria Dorigatti, Anne Cori, Steven Riley, Neil M. Ferguson

60 casos reportados – 1700 estimados

Estimation of COVID-2019 burden and potential for international dissemination of infection from Iran

Posted February 25, 2020.

Ashleigh R. Tuite, Isaac Bogoch, Ryan Sherbo, Alexander Watts,
David N. Fisman, Kamran Khan

Irán posiblemente tiene una epidemia mucho más grande que lo detectado

Pattern of early human-to-human transmission of Wuhan 2019-nCoV

Julien Riou, Christian L. Althaus

January 23, 2020

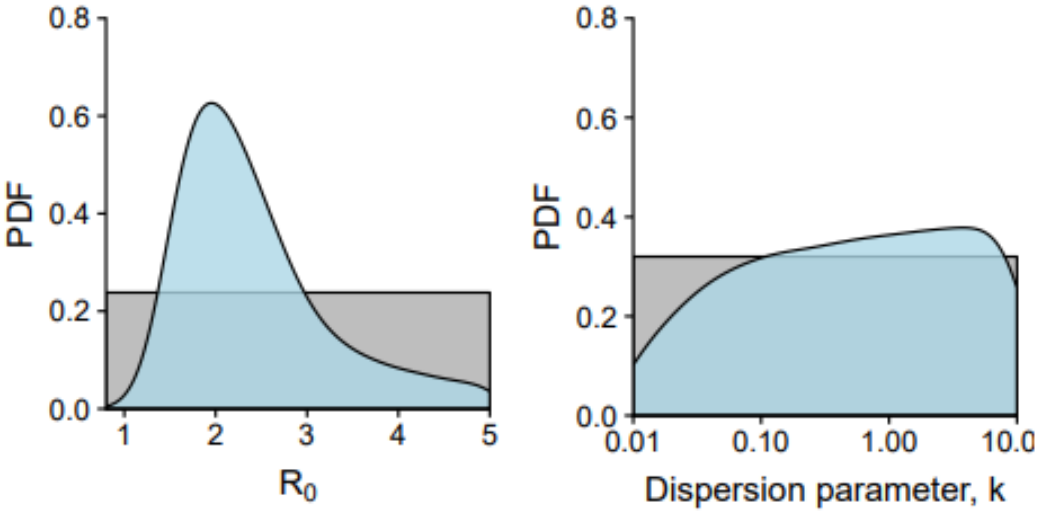


Table 1: Parameter ranges for stochastic simulations of outbreak trajectories.

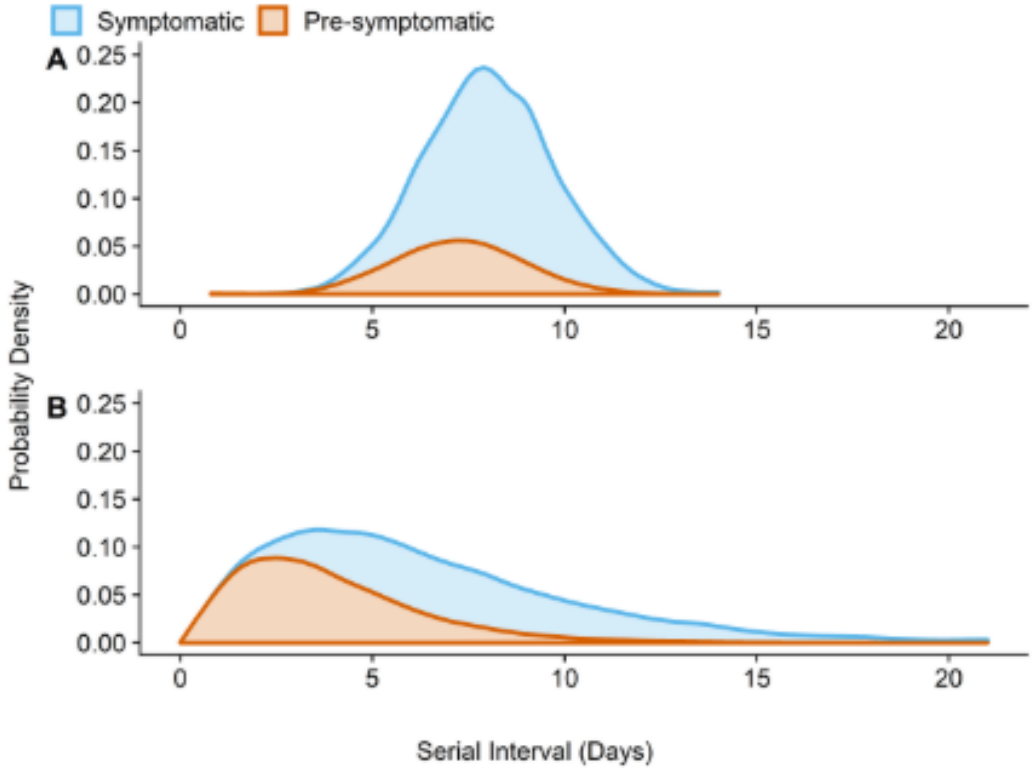
Parameter	Description	Range
R_0	Basic reproduction number	[0.8 – 5.0]
k	Dispersion parameter	[0.01 – 10]
D	Generation time interval	[7 – 14]
n	Initial number of index cases	[1 – 50]
T	Date of zoonotic transmission	[20 Nov 2019 – 4 Dec 2019]

Figure 1: Values of R_0 and k most compatible with epidemic data available on 2019-nCoV as of January 23, 2020 (in blue). The basic reproduction number R_0 quantifies human-to-human transmission. The dispersion parameter k quantifies the risk of a superspreading event (lower values of k are linked to a higher probability of superspreading).

The Contribution of Pre-symptomatic Transmission to the COVID-19 Outbreak

First online: 02-03-2020

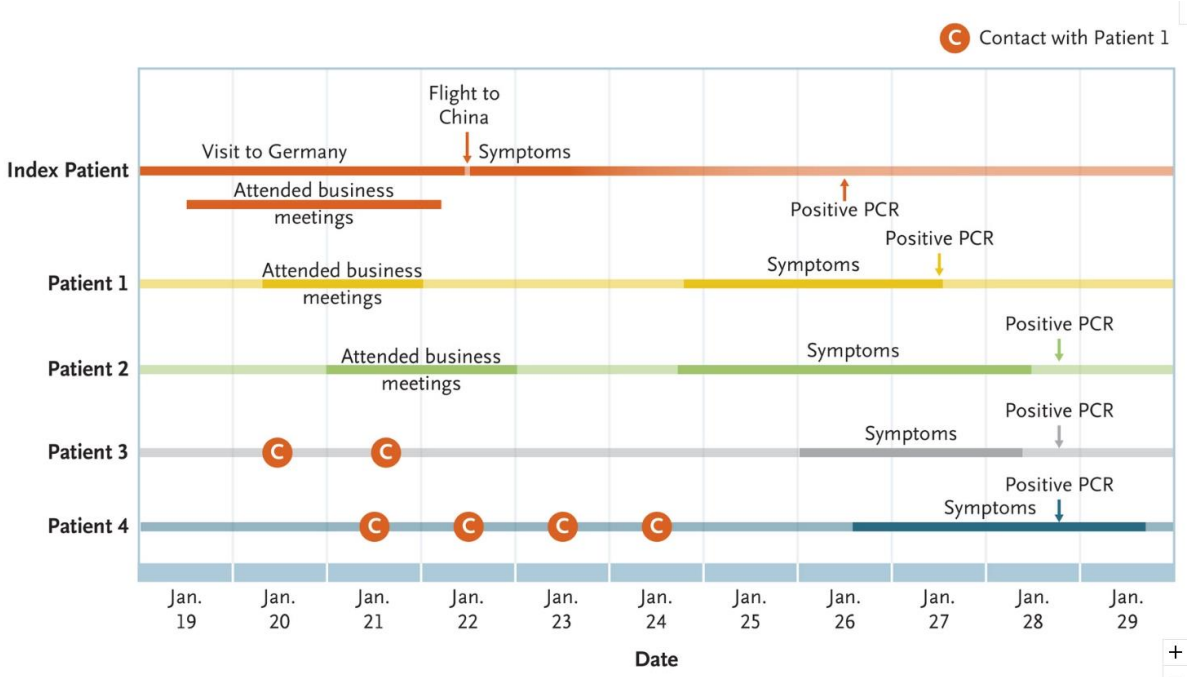
Authors: *Yang Liu, CMMID nCov working group, Sebastian Funk & Stefan Flasche.*



Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany

N ENGL J MED 382;10 NEJM.ORG MARCH 5, 2020

Rothe C, Schunk M, Sothmann P, et al.



Estimates of the severity of coronavirus disease 2019: a model-based analysis

March 30, 2020

Robert Verity, Lucy C Okell*, Ilaria Dorigatti*, Peter Winskill*, Charles Whittaker*, Natsuko Imai, Gina Cuomo-Dannenburg, Hayley Thompson, Patrick G T Walker, Han Fu, Amy Dighe, Jamie T Griffin, Marc Baguelin, Sangeeta Bhatia, Adhiratha Boonyasiri, Anne Cori, Zulma Cucunubá, Rich FitzJohn, Katy Gaythorpe, Will Green, Arran Hamlet, Wes Hinsley, Daniel Laydon, Gemma Nedjati-Gilani, Steven Riley, Sabine van Elsland, Erik Volz, Haowei Wang, Yuanrong Wang, Xiaoyue Xi, Christl A Donnelly, Azra C Ghani, Neil M Ferguson**

Promedio días desde inicio síntomas a muerte: 18·8 días (15.7-49.7)

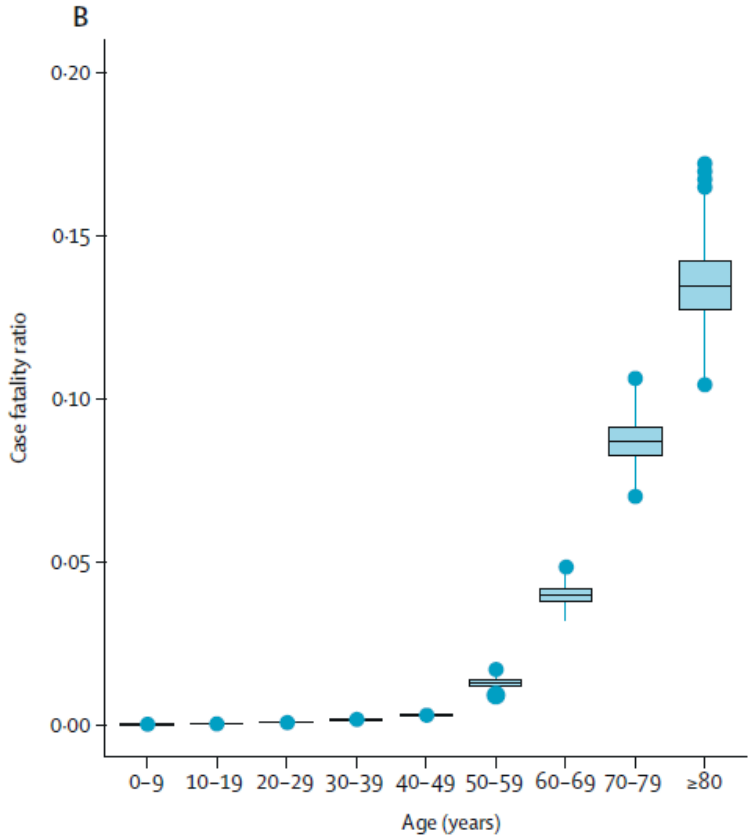
Letalidad

Cruda (casos totales/muertes): 2.29%

Ajustada x casos actuales que empeoran (censurados): 3.67%

Ajuste censurados, demografía, y subreporte : 1.38%

Censurados, demografía, subreporte, + sin síntomas aparentes: 0.65%



Las estimaciones dependen de la calidad de los datos disponibles

Gracias!

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@eundurra

Figure 1. Epidemic Curve of the Confirmed Cases of Coronavirus Disease 2019 (COVID-19)