# How to prepare for the next pandemic?

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*Image: Nextstrain*

“It's tough to make predictions, especially about the future.”

-Yogi Berra

# Emerging (and re-emerging) infectious diseases

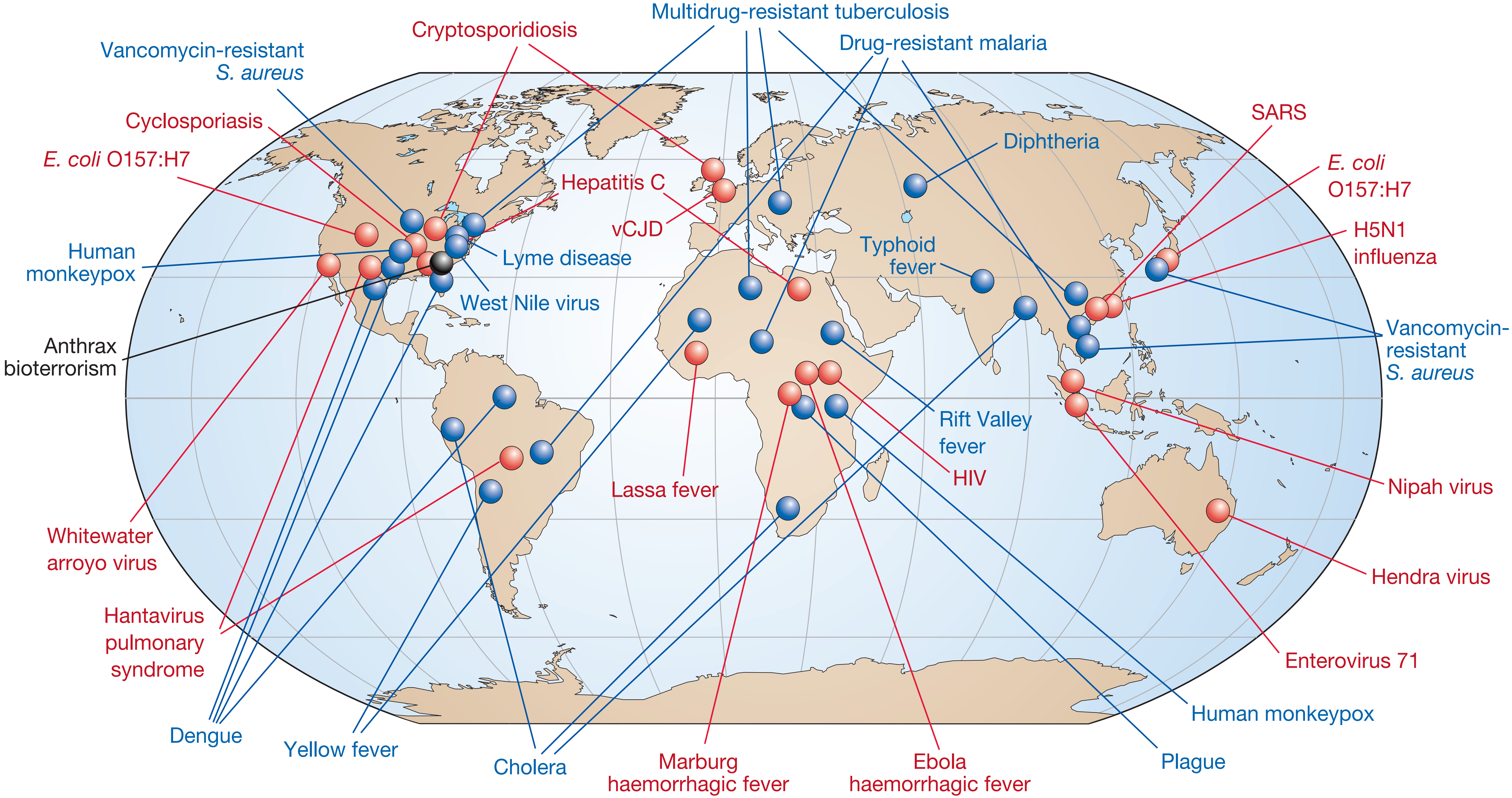
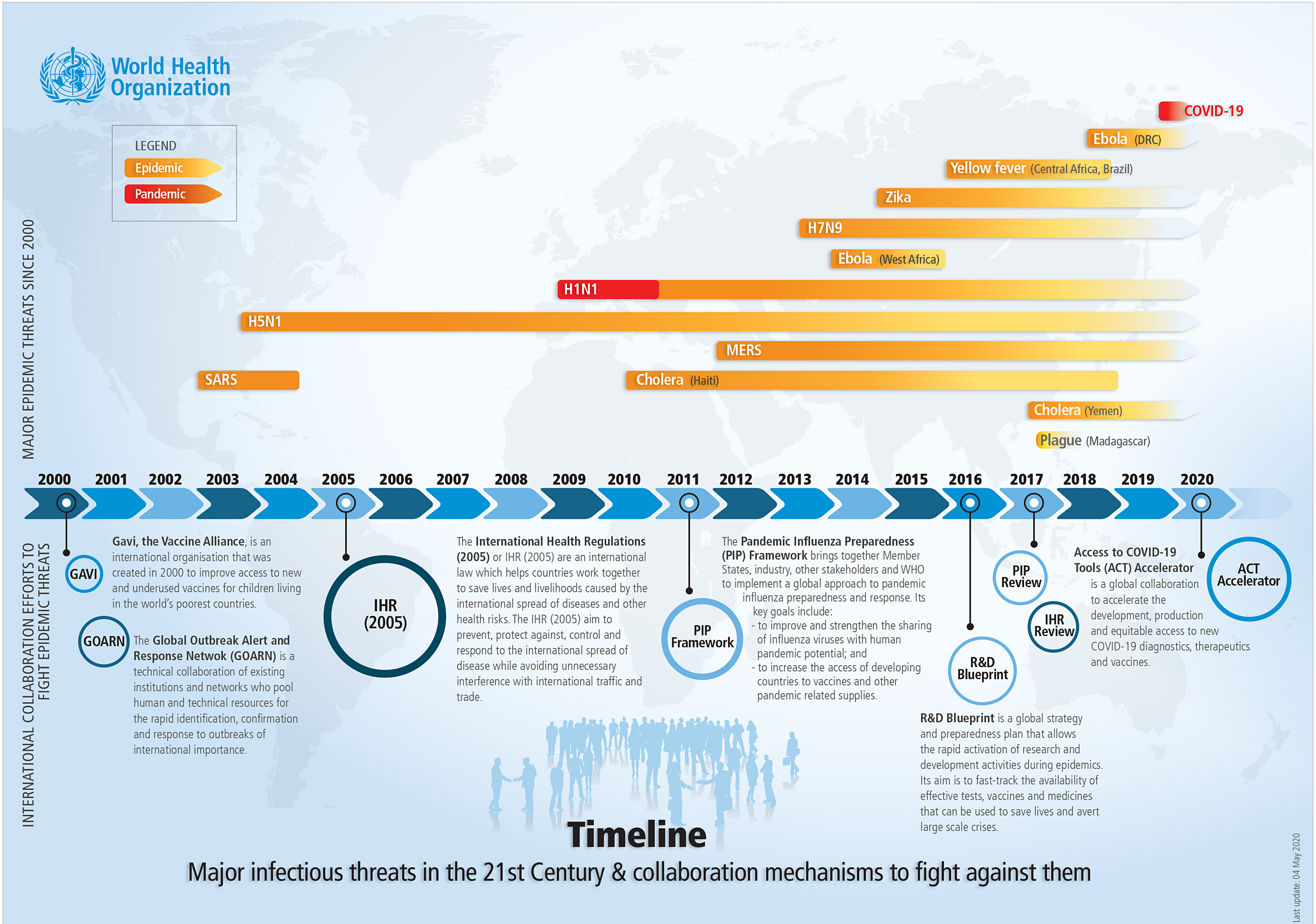
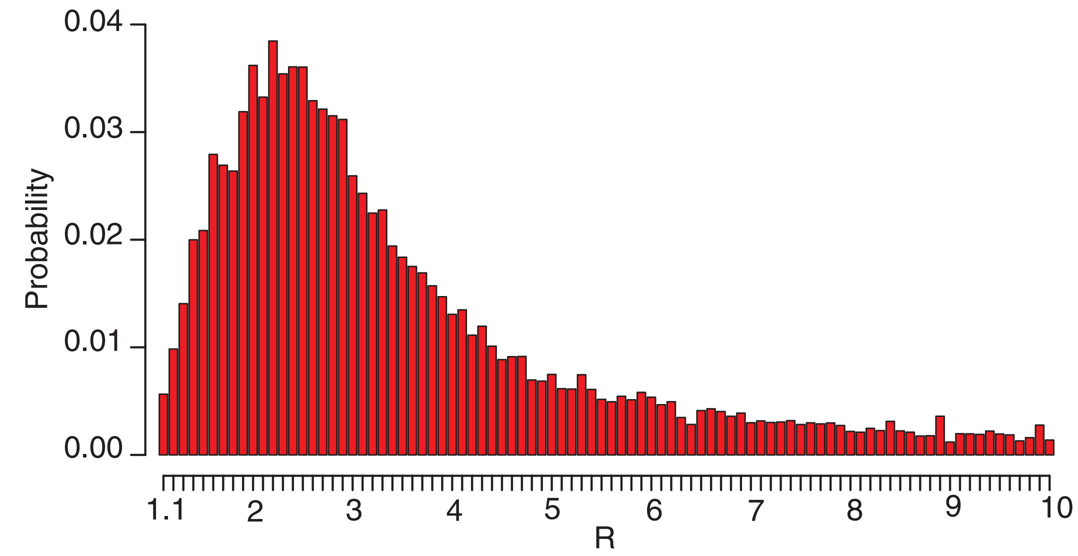


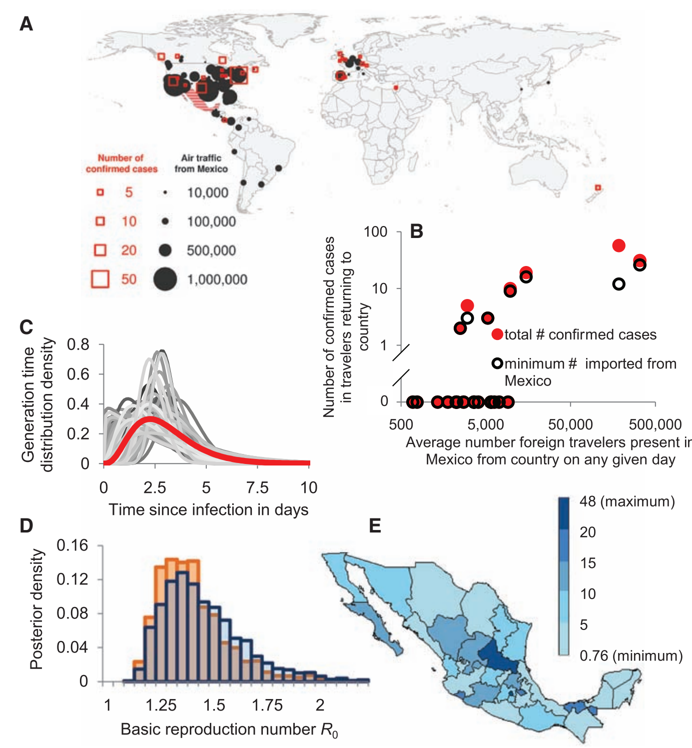

*Figure: Morens et al. (2004, Nature)*

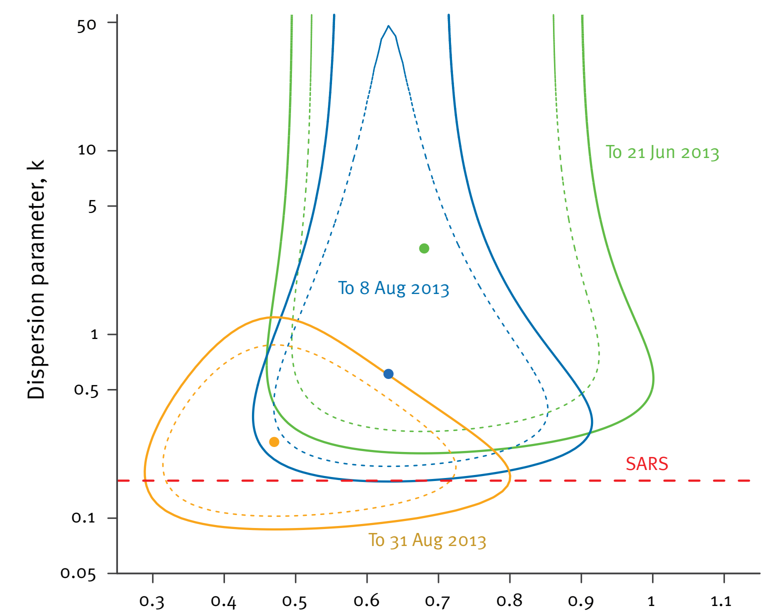

World Health Organization
LEGEND
Epidemic
Pandemic
MAJOR EPIDEMIC THREATS SINCE 2000
COVID-19
Ebola (DRC)
Yellow fever (Central Africa, Brazil)
Zika
H7N9
Ebola (West Africa)
H1N1
H5N1
MERS
SARS
Cholera (Haiti)
Cholera (Yemen)
Plague (Madagascar)
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
INTERNATIONAL COLLABORATION EFFORTS TO FIGHT EPIDEMIC THREATS
GAVI
Gavi, the Vaccine Alliance, is an international organisation that was created in 2000 to improve access to new and underused vaccines for children living in the world's poorest countries.
GOARN
The Global Outbreak Alert and Response Netwok (GOARN) is a technical collaboration of existing institutions and networks who pool human and technical resources for the rapid identification, confirmation and response to outbreaks of international importance.
IHR (2005)
The International Health Regulations (2005) or IHR (2005) are an international law which helps countries work together to save lives and livelihoods caused by the international spread of diseases and other health risks. The IHR (2005) aim to prevent, protect against, control and respond to the international spread of disease while avoiding unnecessary interference with international traffic and trade.
PIP Framework
The Pandemic Influenza Preparedness (PIP) Framework brings together Member States, industry, other stakeholders and WHO to implement a global approach to pandemic influenza preparedness and response. Its key goals include:
- to improve and strengthen the sharing of influenza viruses with human pandemic potential; and
- to increase the access of developing countries to vaccines and other pandemic related supplies.
R&D Blueprint
R&D Blueprint is a global strategy and preparedness plan that allows the rapid activation of research and development activities during epidemics. Its aim is to fast-track the availability of effective tests, vaccines and medicines that can be used to save lives and avert large scale crises.
PIP Review
IHR Review
ACT Accelerator
Access to COVID-19 Tools (ACT) Accelerator is a global collaboration to accelerate the development, production and equitable access to new COVID-19 diagnostics, therapeutics and vaccines.
Timeline
Major infectious threats in the 21st Century & collaboration mechanisms to fight against them
Last update: 04 May 2020

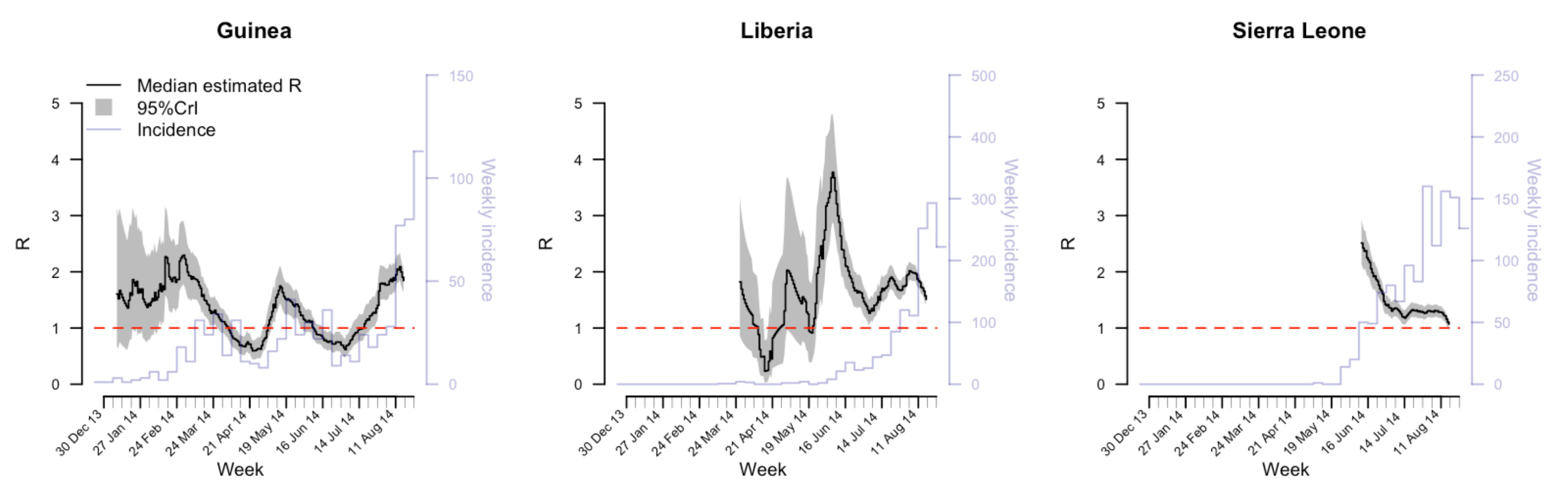
# Outbreak analysis

- **SARS** (*Lipsitch et al., 2003, Science*)
- **H1N1** (*Fraser et al., 2009, Science*)
- **Ebola** (*WHO Ebola Response Team, 2014, N Engl J Med*)
- **MERS** (*Kucharski & Althaus, 2015, Euro Surveill*)

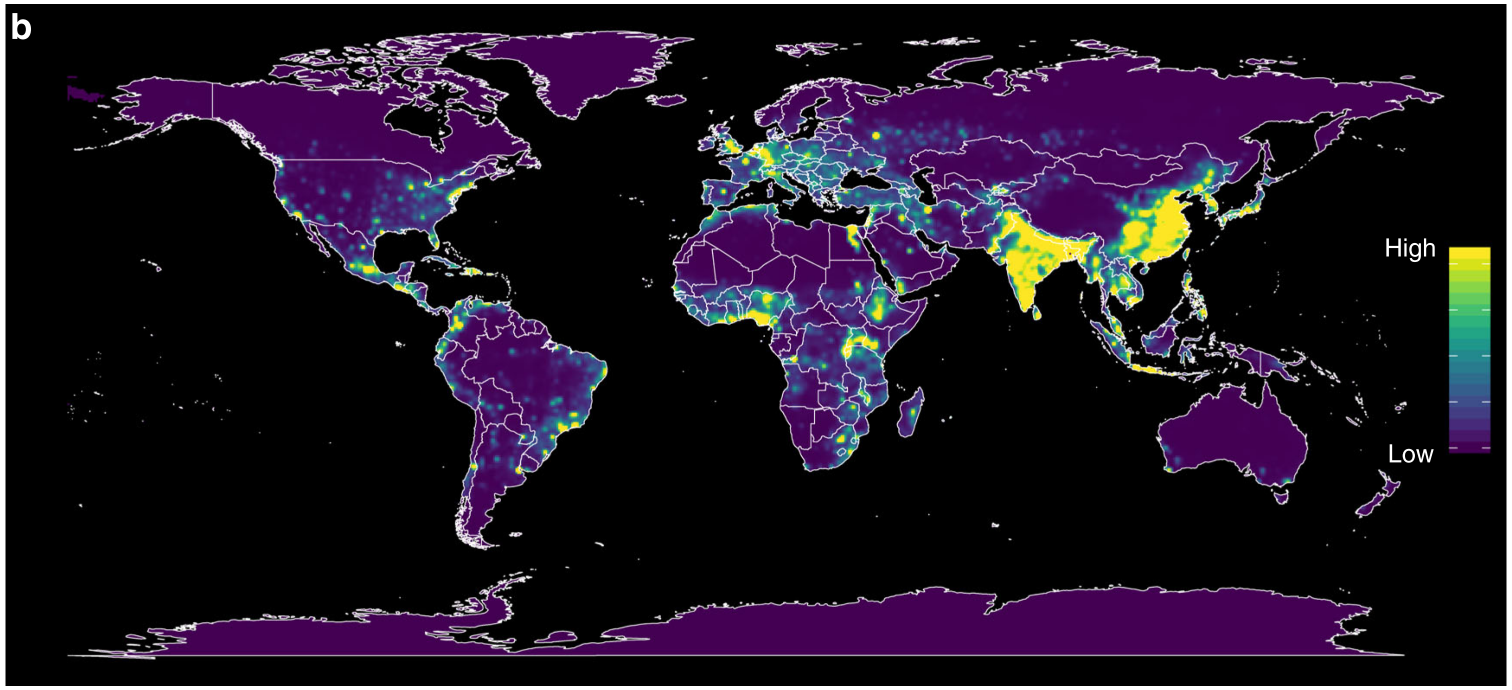


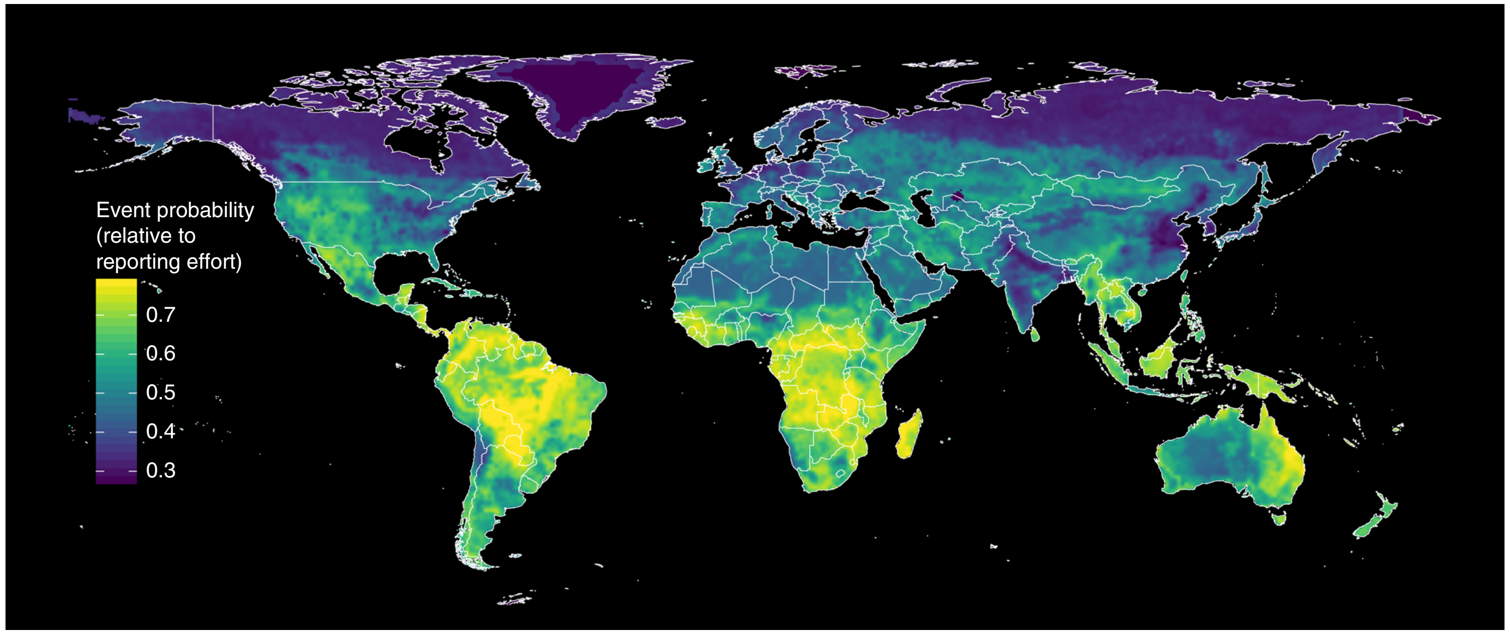



# Global hotspots of emerging zoonotic diseases



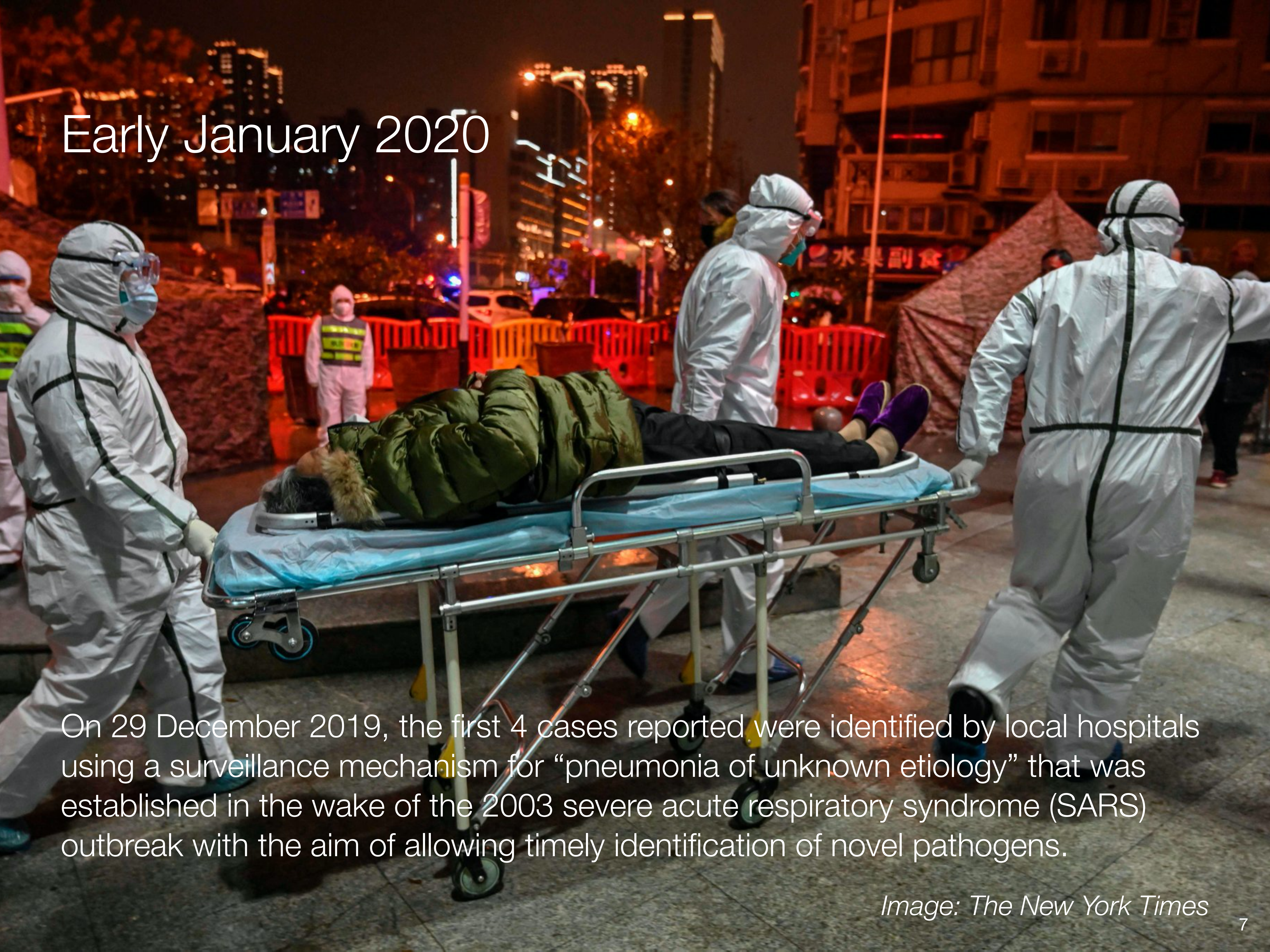

Predicted relative risk of zoonotic EID events




EID risk relative to reporting effort

*Figures: Allen et al. (2017, Nat Commun)*

# Early January 2020



On 29 December 2019, the first 4 cases reported were identified by local hospitals using a surveillance mechanism for “pneumonia of unknown etiology” that was established in the wake of the 2003 severe acute respiratory syndrome (SARS) outbreak with the aim of allowing timely identification of novel pathogens.

*Image: The New York Times*

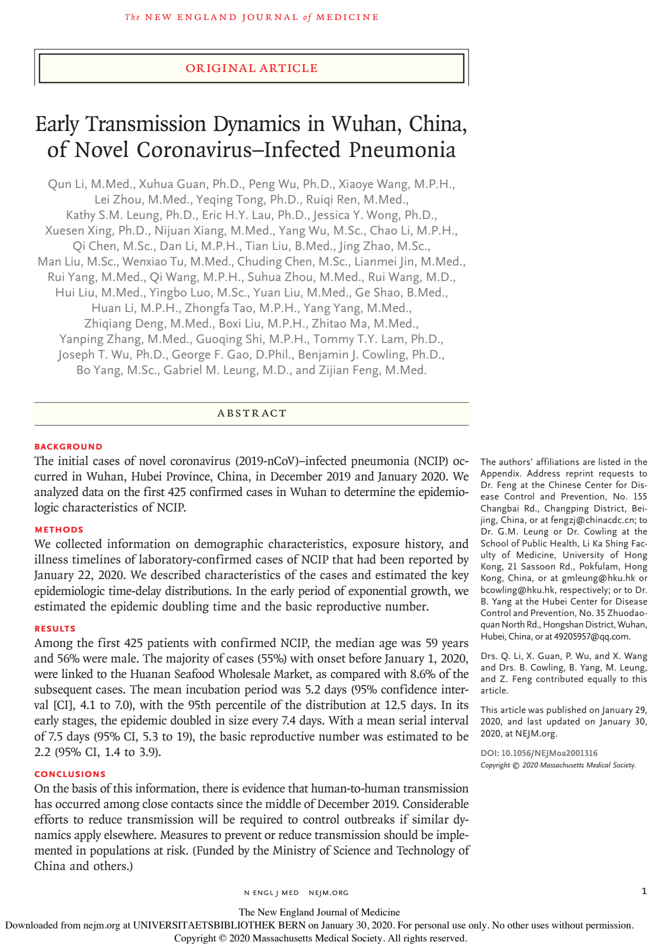
# Key questions for early outbreak response


1. What are the transmission characteristics ($R_0$ and superspreading)?
2. What is the severity of the disease (infection fatality ratio)?

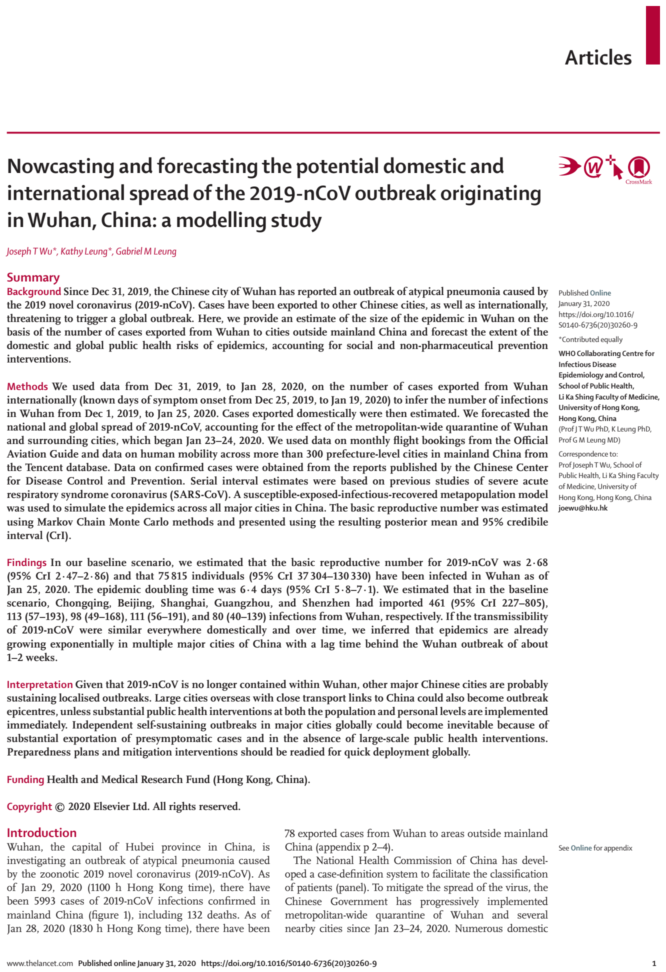
*Image: https://plug-in-digital.itch.io/pandemicio*

# Early publications on SARS-CoV-2 transmission

| 29 January 2020 | 30 January 2020 | 31 January 2020 |
|---|---|---|


The New England Journal of Medicine
ORIGINAL ARTICLE
Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus–Infected Pneumonia


Rapid communication
Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020
Julien Riou, Christian L. Althaus


Articles
Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study
Joseph T Wu, Kathy Leung, Gabriel M Leung

Conclusions: Basic reproduction number $R_0$ ~ 2 - 3, potential for superspreading, high risk of global spread.

# Comparison to MERS, SARS and influenza

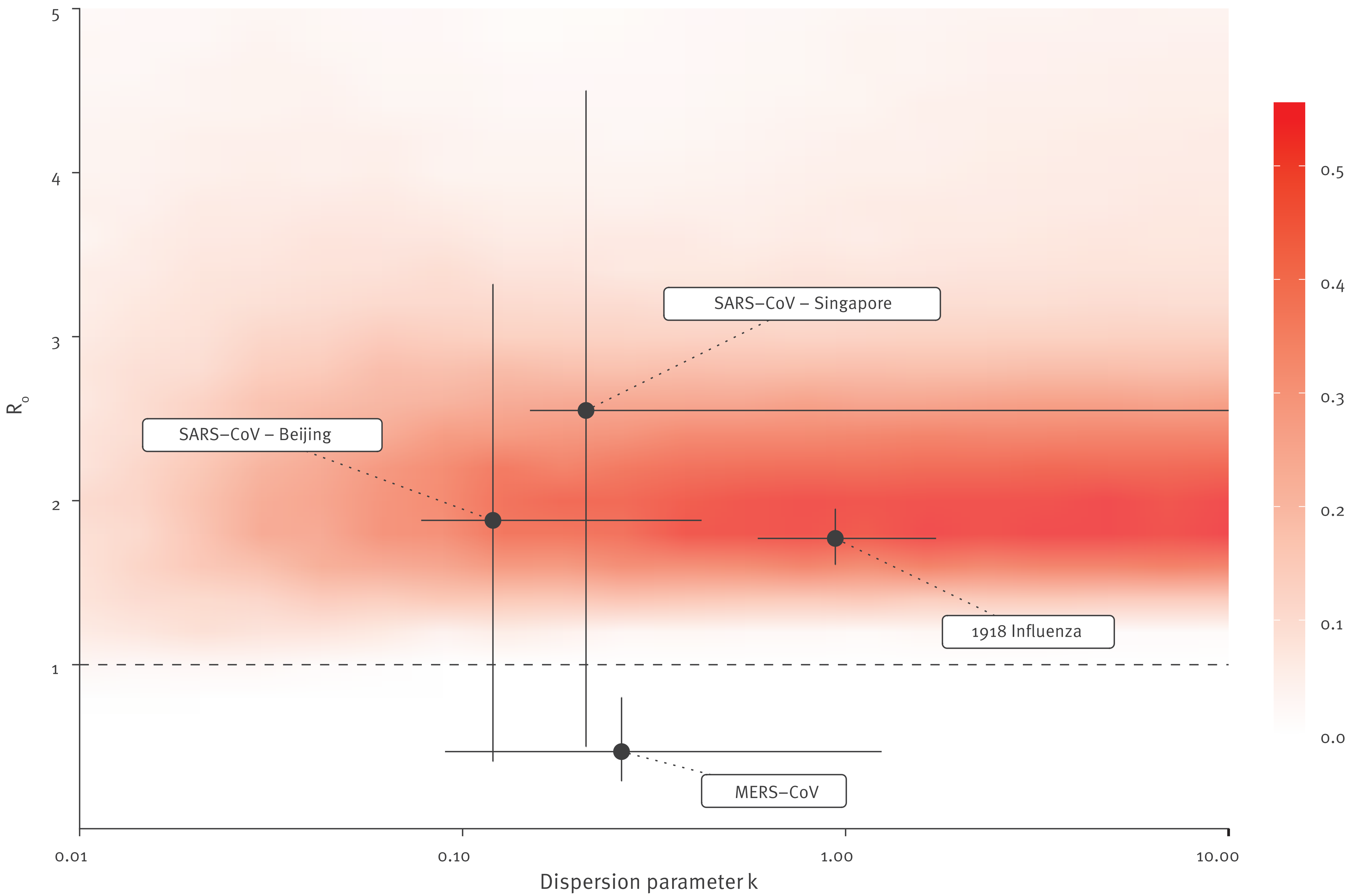



*Figure: Riou & Althaus (2020, Euro Surveill)*


The World Health Organization (WHO) declares the novel coronavirus outbreak a public health emergency of international concern (PHEIC) on 30 January 2020.

*Image: Fabrice Coffrini*

# Report 4: Severity of 2019-novel coronavirus (nCoV)

## (Download Report 4)

Ilaria Dorigatti+, Lucy Okell+, Anne Cori, Natsuko Imai , Marc Baguelin, Sangeeta Bhatia, Adhiratha Boonyasiri, Zulma Cucunubá, Gina Cuomo-Dannenburg, Rich FitzJohn, Han Fu, Katy Gaythorpe , Arran Hamlet, Wes Hinsley, Nan Hong , Min Kwun, Daniel Laydon, Gemma Nedjati-Gilani, Steven Riley, Sabine van Elsland, Erik Volz, Haowei Wang, Yuanrong (Raymond) Wang, Caroline Walters , Xiaoyue Xi, Christl Donnelly, Azra Ghani, Neil Ferguson*. With support from other volunteers from the MRC Centre.[1]

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**Summary Report 4**

We present case fatality ratio (CFR) estimates for three strata of COVID-19 (previously termed 2019-nCoV) infections. For cases detected in Hubei, we estimate the CFR to be 18% (95% credible interval: 11%-81%). For cases detected in travellers outside mainland China, we obtain central estimates of the CFR in the range 1.2-5.6% depending on the statistical methods, with substantial uncertainty around these central values. Using estimates of underlying infection prevalence in Wuhan at the end of January derived from testing of passengers on repatriation flights to Japan and Germany, we adjusted the estimates of CFR from either the early epidemic in Hubei Province, or from cases reported outside mainland China, to obtain estimates of the overall CFR in all infections (asymptomatic or symptomatic) of approximately 1% (95% confidence interval 0.5%-4%). It is important to note that the differences in these estimates does not reflect underlying differences in disease severity between countries. CFRs seen in individual countries will vary depending on the sensitivity of different surveillance systems to detect cases of differing levels of severity and the clinical care offered to severely ill cases. All CFR estimates should be viewed cautiously at the current time as the sensitivity of surveillance of both deaths and cases in mainland China is unclear. Furthermore, all estimates rely on limited data on the typical time intervals from symptom onset to death or recovery which influences the CFR estimates.

*Source: https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis*

# Modeling scenarios

- Imperial College COVID-19 Response Team (Report 9, 16 March 2020)
- CI: Case Isolation
  HQ: Voluntary home quarantine
  SD: Social distancing
  PC: Closure of schools and universities
- UK reported deaths: ~ 130k
  UK excess mortality: ~ 110k

| | | Total deaths | | | |
|---|---|---|---|---|---|
| $R_0$ | On Trigger | Do nothing | CI_HQ_SD | PC_CI_SD | PC_CI_HQ_SD |
| 2 | 60 | 410,000 | 47,000 | 6,400 | 5,600 |
| | 100 | 410,000 | 47,000 | 9,900 | 8,300 |
| | 200 | 410,000 | 46,000 | 17,000 | 14,000 |
| | 300 | 410,000 | 45,000 | 24,000 | 21,000 |
| | 400 | 410,000 | 44,000 | 30,000 | 26,000 |
| 2.2 | 60 | 460,000 | 62,000 | 9,700 | 6,900 |
| | 100 | 460,000 | 61,000 | 13,000 | 10,000 |
| | 200 | 460,000 | 64,000 | 23,000 | 17,000 |
| | 300 | 460,000 | 65,000 | 32,000 | 26,000 |
| | 400 | 460,000 | 68,000 | 39,000 | 31,000 |
| 2.4 | 60 | 510,000 | 85,000 | 12,000 | 8,700 |
| | 100 | 510,000 | 87,000 | 19,000 | 13,000 |
| | 200 | 510,000 | 90,000 | 30,000 | 24,000 |
| | 300 | 510,000 | 94,000 | 43,000 | 34,000 |
| | 400 | 510,000 | 98,000 | 53,000 | 39,000 |
| 2.6 | 60 | 550,000 | 110,000 | 20,000 | 12,000 |
| | 100 | 550,000 | 110,000 | 26,000 | 16,000 |
| | 200 | 550,000 | 120,000 | 39,000 | 30,000 |
| | 300 | 550,000 | 120,000 | 56,000 | 40,000 |
| | 400 | 550,000 | 120,000 | 71,000 | 48,000 |

*Table: https://www.imperial.ac.uk/mrc-global-infectious-disease-analysis/covid-19/report-9-impact-of-npis-on-covid-19/*

# Pandemic risk assessment

- **WHO, 11 February 2020:** *"It can create havoc, politically, economically and socially. (…) That's a window of opportunity so I'm reminding; there is time, the time is ticking and time is of the essence in this outbreak." (Director-General)*

- **Federal Department of Defence, Civil Protection and Sport (DDPS), 3 February 2020:**
  *"Aus Sicht des Oberfeldarztes ist die Verbreitung des 2019-nCoV nicht zu verhindern, sondern allenfalls zu verzögern. (…) Schwere Fälle werden das Spitalwesen belasten." (A. Stettbacher)*

- **Federal Office of Public Health (FOPH), 24 February 2020:**
  *"Virus wird nicht so leicht übertragen wie Grippevirus, darum gute Aussichten, die Situation unter Kontrolle zu bringen." (D. Koch)*

*Source: Tages-Anzeiger, 28 June 2021*

# How to prepare for the next pandemic?

# Identifying regions with 'missing zoonoses'

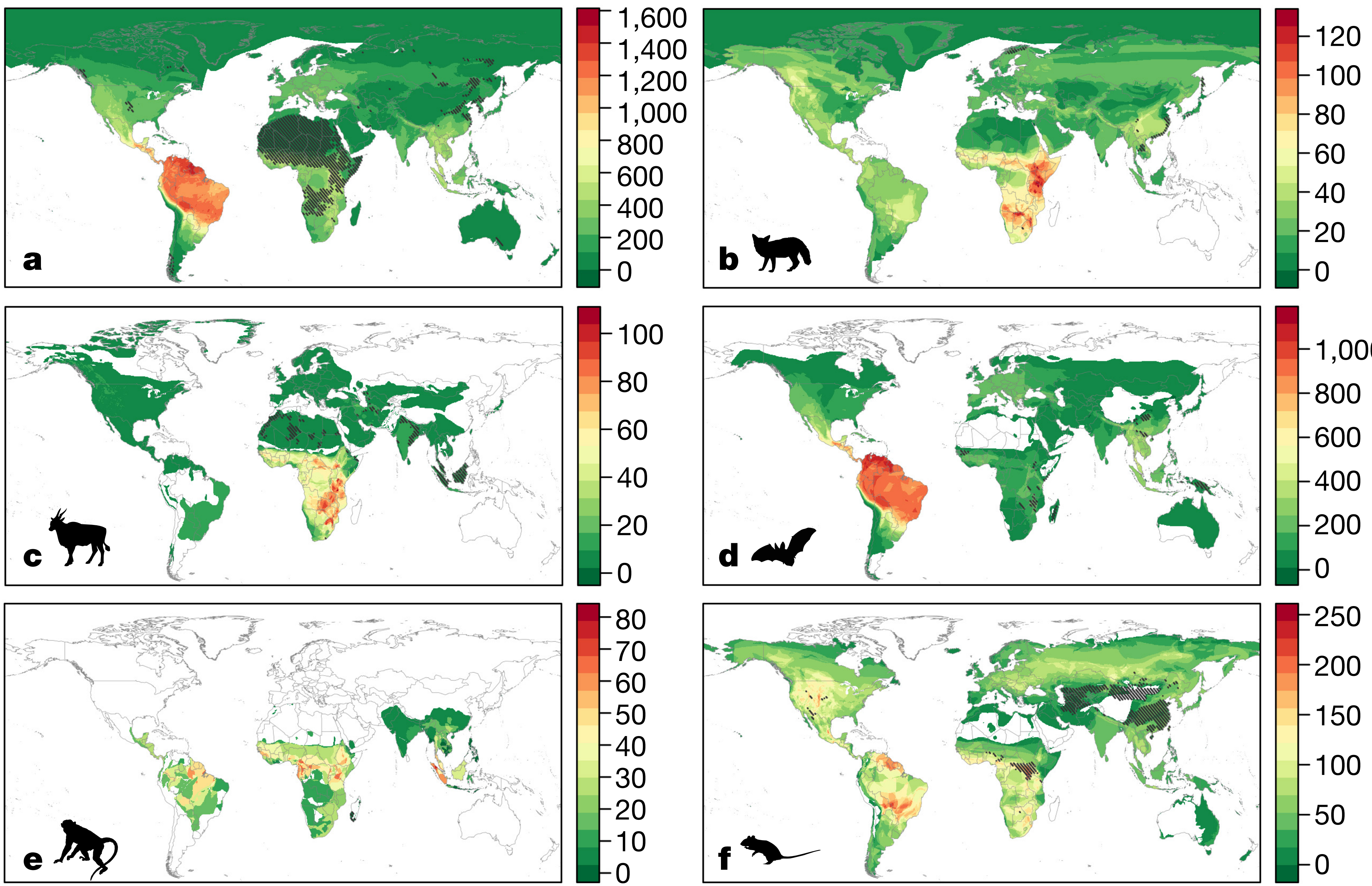
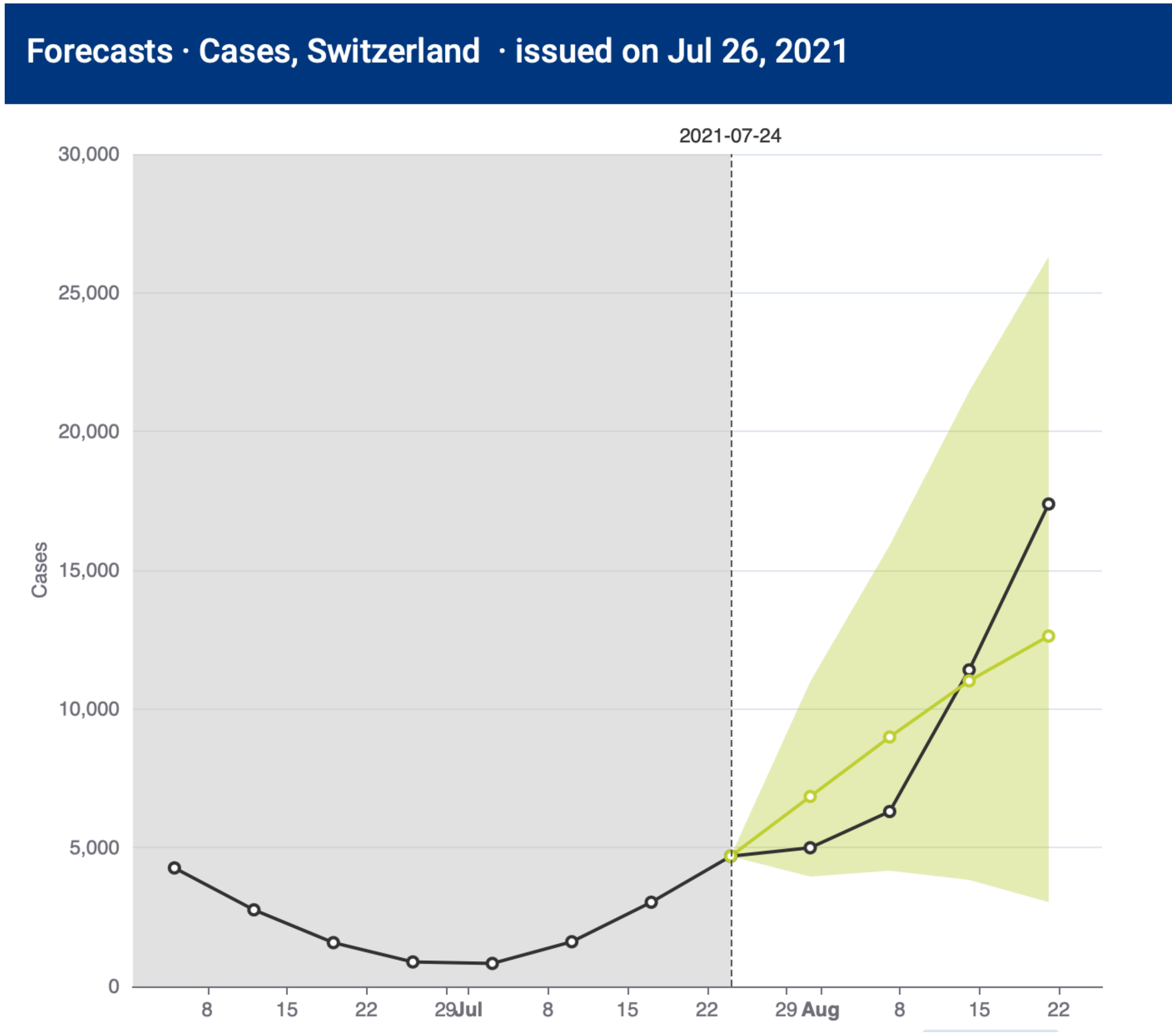



*Figure: Olival et al. (2017, Nature)*

# Early detection for early action

- Hospital surveillance systems (globally)
- Further development of real-time modeling and disease monitoring systems
- Systematic evaluation of short-term forecasting systems (European Covid-19 Forecast Hub)




URL: *https://covid19forecasthub.eu*

# National pandemic plans

- Improve diagnostic capacities
- Stockpiling of personal protective equipment, PPE (e.g., masks)
- Early education of the general public on the disease and their role in preventing its spread
- Test-Trace-Isolate-Quarantine (TTIQ)
- Consider targeted use of NPIs (e.g., physical distancing)

# Dialogue between politics and science

# Kritik von oberster Stelle: Politik hört zu wenig auf Wissenschaft

**Covid** Bundeskanzler Walter Thurnherr, der die Regierung eng begleitet, zieht in deren Auftrag Lehren aus der Pandemie.

**Raphaela Birrer**
und **Philipp Loser**

Regierung und Wissenschaft arbeiten in der Schweiz zu schlecht zusammen. Zu diesem Schluss kommt Bundeskanzler Walter Thurnherr in seiner grossen Bilanz zur Corona-Krise. So habe der Bundesrat in der Pandemie die Covid-Taskforce der Wissenschaft erst am 30. März 2020 eingesetzt – «das war eindeutig zu spät», urteilt Thurnherr im Interview mit dieser Zeitung.

Der Bundeskanzler erkennt darin ein grundsätzliches Malaise. Das Verhältnis zwischen Politik und Wissenschaft sei in der Schweiz generell «zu wenig geklärt, zum Teil angespannt». Kontakte zwischen Vertretern beider Sphären seien «rar». Die Schweizer Politik funktioniere «im Wesentlichen mehrheits-, nicht evidenzbasiert». Konkret habe die Politik bisher nur auf die Wissenschaft zurückgegriffen, wenn deren Argumente die eigene Position gestützt hätten. «Dass die Wissenschaft der Politik widersprechen könnte, war hingegen eher weniger vorgesehen.»

**Sorge um die Debattenkultur**

Thurnherr, selber studierter Physiker, will diese Zusammenarbeit nun verbessern. Denn die nächste Krise komme bestimmt. Der Austausch zwischen Politik und Wissenschaft müsse darum «intensiver und institutionalisierter werden».

Als Bundeskanzler nimmt Thurnherr an jeder Bundesratssitzung teil und hat so die Entscheide in der Corona-Pandemie hautnah miterlebt und mitgeprägt. Er ist nun vom Gesamtbundesrat beauftragt worden, das ganze Krisenmanagement einer umfassenden Evaluation zu unterziehen. Diese solle mehrere Jahre dauern, sagt Thurnherr. Bereits jetzt sei aber klar, dass die Zusammenarbeit von Wissenschaft und Politik ein zentraler Punkt sei.

Besorgt äussert sich der Bundeskanzler zur Debattenkultur in der Schweiz. Er zieht dabei sogar eine Parallele zu den USA unter Donald Trump. Worte von Politikern könnten schlimme Folgen haben – «das gilt nicht nur in den USA, sondern auch in unseren Breitengraden», sagt er in Bezug auf die Diktatur-Rhetorik der SVP. Das Gespräch mit Thurnherr ist das erste einer Reihe von Interviews zur Frage, was die Pandemie verändert. **Seite 2, 3**

*Source: Tages-Anzeiger, 19 July 2021*

# Bottom line

Make efficient use of available tools and ensure an all-of-government and all-of-society approach to limit the health, economic and societal impact of future pandemics.

⇨ "Public Health"