L’apport des modélisations dans la lecture d’une pandémie et sa gestion

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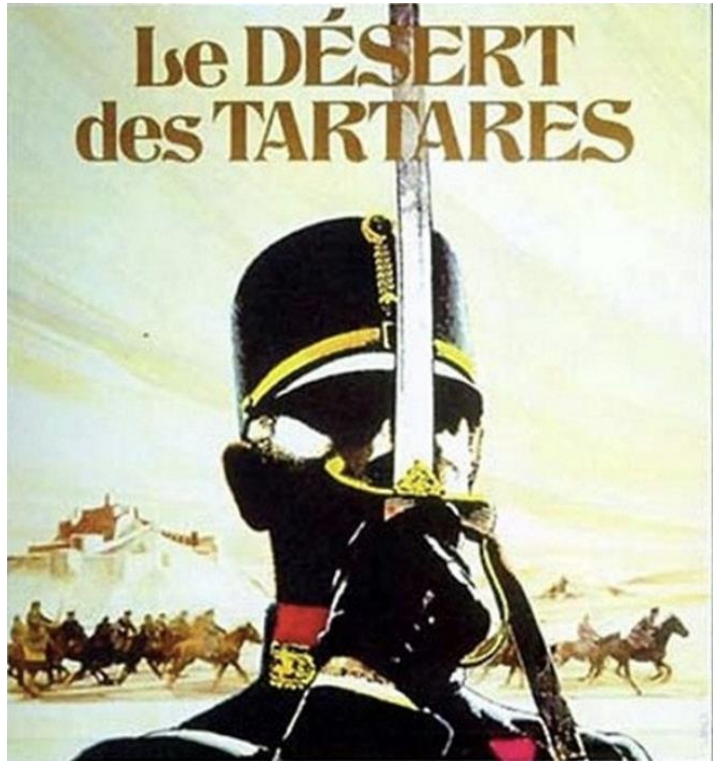
Gestion d’une épidémie, gestion du risque biologique

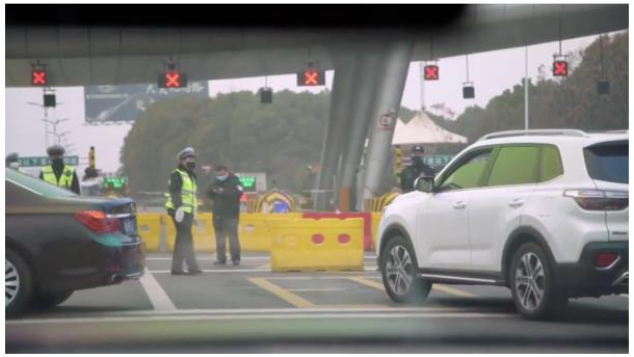
DES-C Pathologie infectieuse et tropicale

Octobre 2024

Premiers temps d’une pandémie



Confinement de Wuhan – 23 janvier 2020



George Gao, Directeur du CDC
26 January 2020

(France 2 – Piégés à Wuhan)

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*

Summary

Background Since Dec 31, 2019, the Chinese city of Wuhan has reported an outbreak of atypical pneumonia caused by the 2019 novel coronavirus (2019-nCoV). Cases have been exported to other Chinese cities, as well as internationally, threatening to trigger a global outbreak. Here, we provide an estimate of the size of the epidemic in Wuhan on the basis of the number of cases exported from Wuhan to cities outside mainland China and forecast the extent of the domestic and global public health risks of epidemics, accounting for social and non-pharmaceutical prevention interventions.

Lancet 2020; 395: 689–97
Published Online
January 31, 2020
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This online publication has been corrected. The corrected version

Findings

In our baseline scenario, we estimated that the basic reproductive number for 2019-nCoV was 2·68 (95% CrI 2·47–2·86) and that 75 815 individuals (95% CrI 37 304–130 330) have been infected in Wuhan as of Jan 25, 2020. The epidemic doubling time was 6·4 days (95% CrI 5·8–7·1). We estimated that in the baseline scenario, Chongqing,

Search International edition
The Guardian
For 200 years

Coronavirus 'could infect 60% of global population if unchecked'

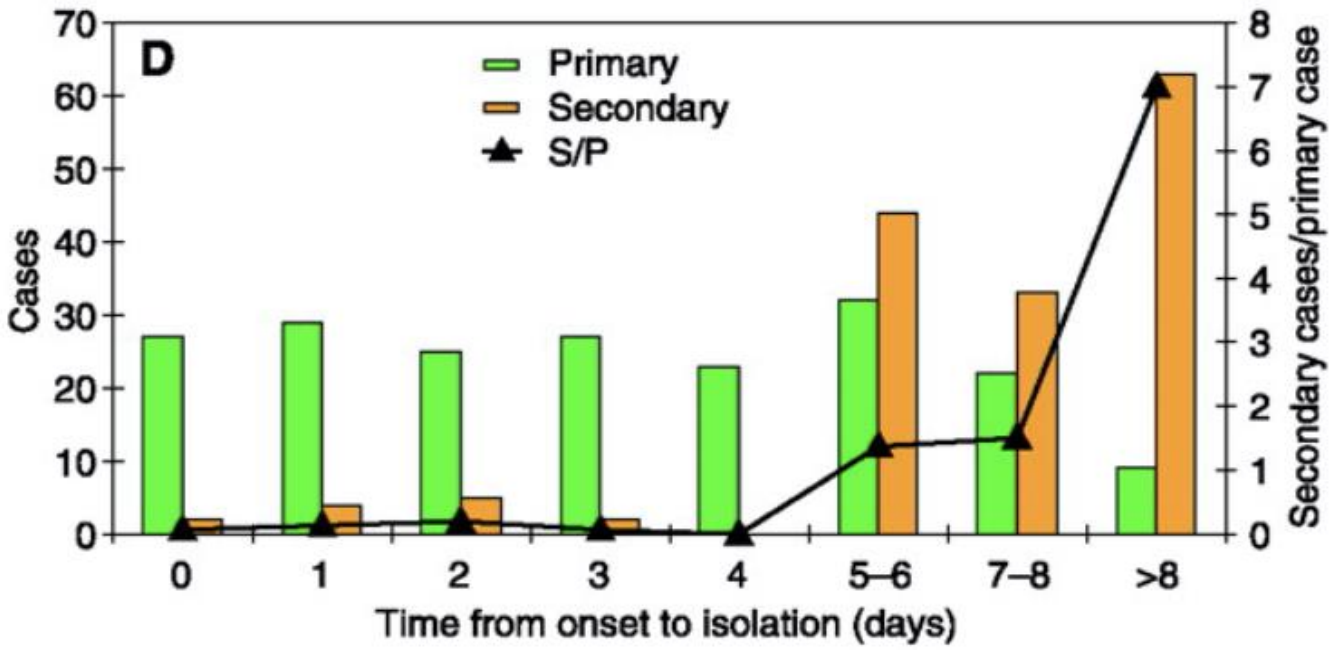
Exclusive: Public health epidemiologist says other countries should consider adopting China-style containment measures

Sarah Boseley *Health editor*

Tue 11 Feb 2020 09.47 GMT

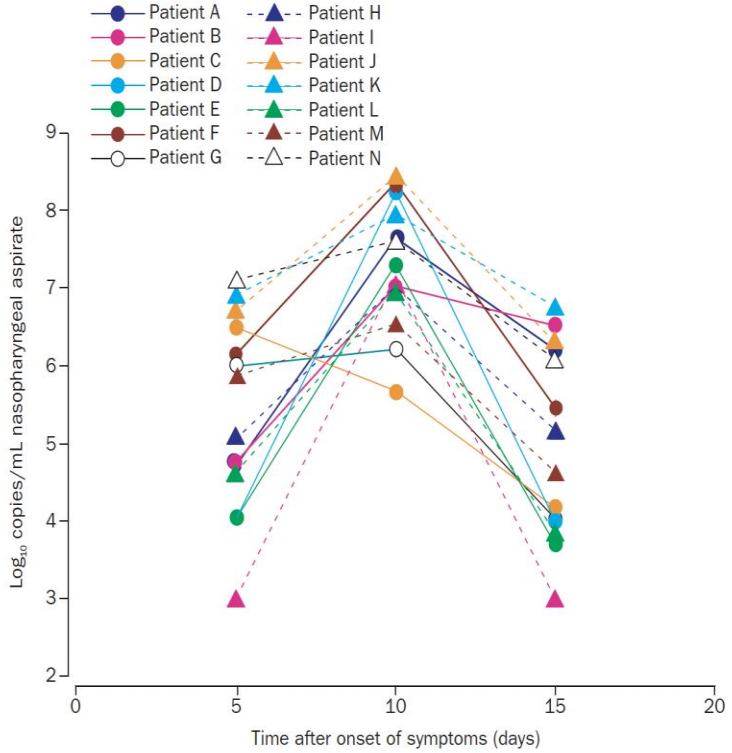
Period of infectiousness - Why were we able to control SARS?

Number of secondary cases per day of isolation – SARS-COV – Singapore, 2003



(Lipsitch et al, Science, 2003)

SARS-CoV viral load in naso-pharyngeal aspirates



(Peiris, Lancet, 2003)

First known cases in France (Europe) – 24 January 2020


SUD OUEST

GASTRONOMIE

Darroze embauche un jeune chef parisien prometteur à Langon

Page 20

SUD-GIRONDE

Bordeaux

Un patient touché par le virus chinois

Jeudi, un patient avait été pris en charge dans un centre de consultation de SOS Médecins Bordeaux. Transféré au CHU, il a été placé en chambre d'isolement.

SANTÉ

Un homme présentant les symptômes du coronavirus, responsable de la mort de près de 30 personnes en Asie, a été admis hier au CHU. Deux autres cas ont été détectés en France. Ce sont les premiers confirmés en Europe

Page 7

Carry-Le-Rouet housing for French people repatriated from Wuhan

Contamines-Monjoie cluster

-the likelihood of observing further limited human-to-human transmission within the EU/EEA is estimated as very low to low if early detection of cases and adherence to appropriate infection prevention and control practices are implemented, particularly in healthcare settings in EU/EEA countries;
-assuming that cases are detected in the EU/EEA in a timely manner and that rigorous IPC measures are applied, the likelihood of sustained human-to-human transmission within the EU/EEA is currently very low to low;
-the impact of the late detection of an imported case in an EU/EEA country without the application of appropriate infection prevention and control measures would be significant, therefore in such a scenario the risk of secondary transmission in the community setting is estimated to be high.

Camilla Rothe, M.D.

The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE

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

This letter was published on January 30, 2020, and updated on February 6, 2020, at NEJM.org.

https://www.nytimes.com/2020/06/27/world/europe/coronavirus-spread-asymptomatic.html

TIME

THE 100 MOST INFLUENTIAL PEOPLE OF 2020

Camilla Rothe

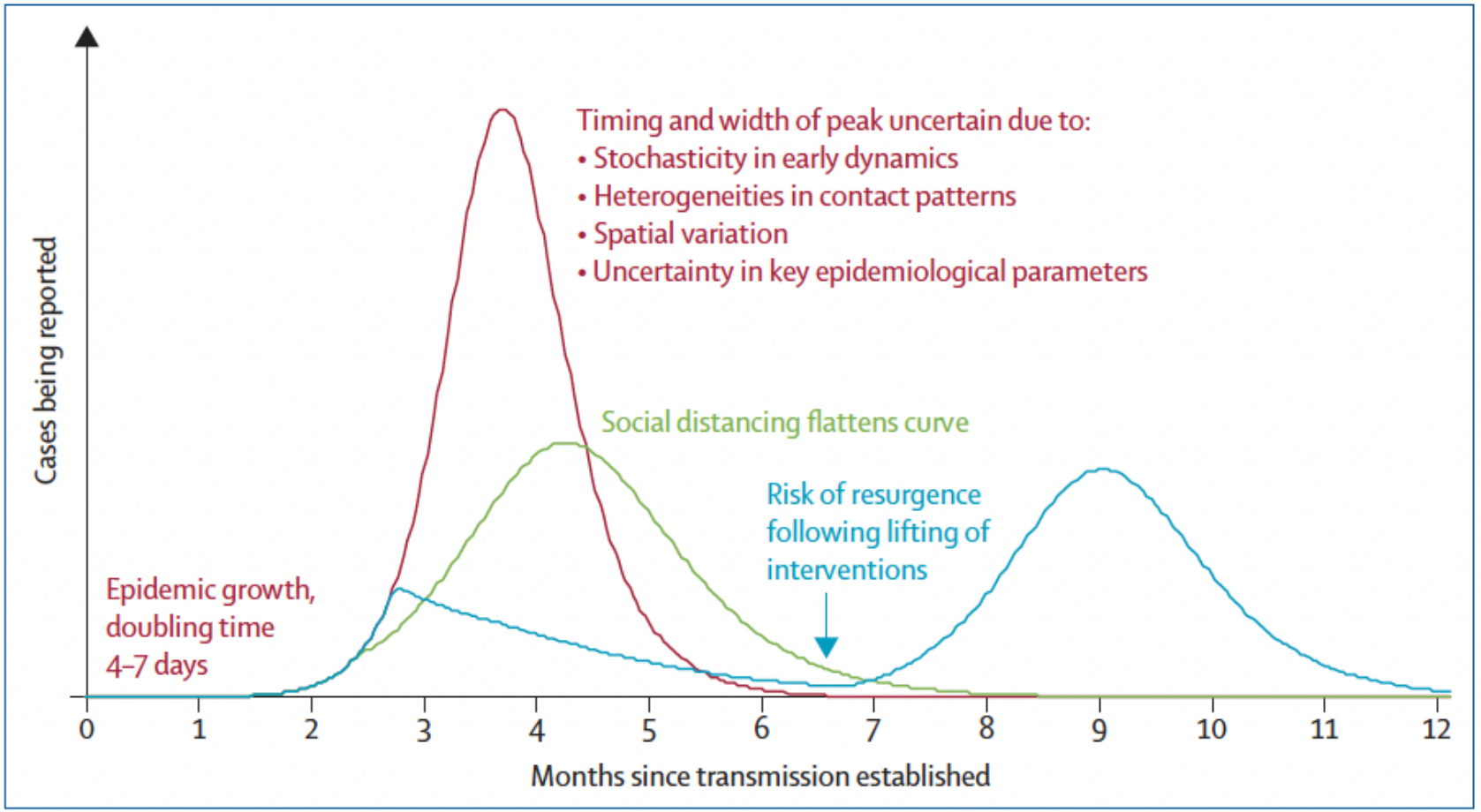
Laetitia Vancon—The New York Times/Redux

Italy,
March 2020

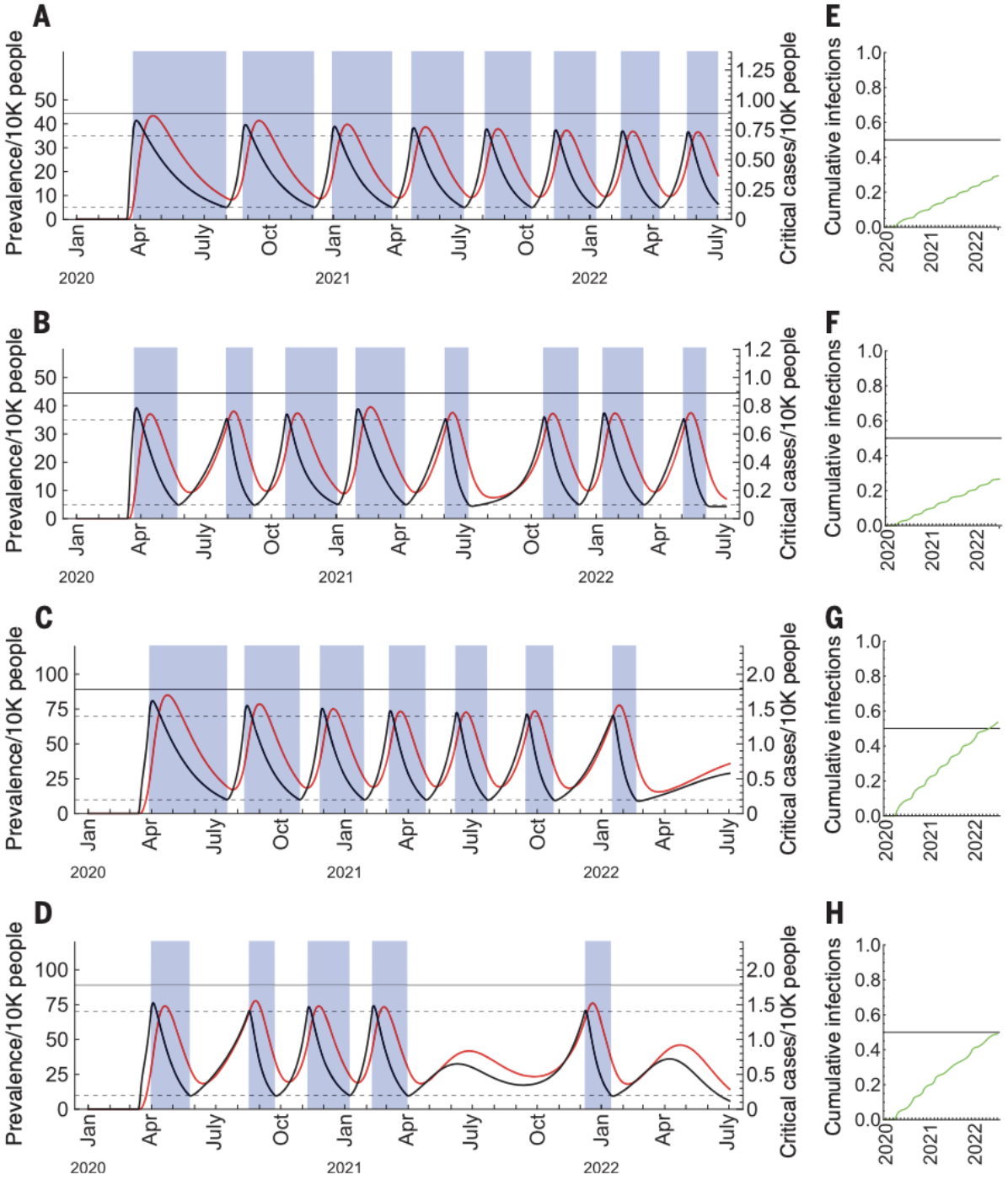
Patients awaiting test results in March at a hospital in Brescia, Italy, one of the first parts of Europe to be hit hard by the coronavirus.

Credit...Alessandro Grassani for The New York Times

Flattening the curve and reach herd immunity ?



(Anderson, The Lancet, 6 March 2020)



SARS-CoV-2 scenarios 2020-2022

Herd immunity acquisition by alternating « social distancing » and « non intervention » periods

(Kissler et al., Science, 2020; preprint on 6 March 2020)

Modeling for projections and estimating impact of interventions COVID-19 UK

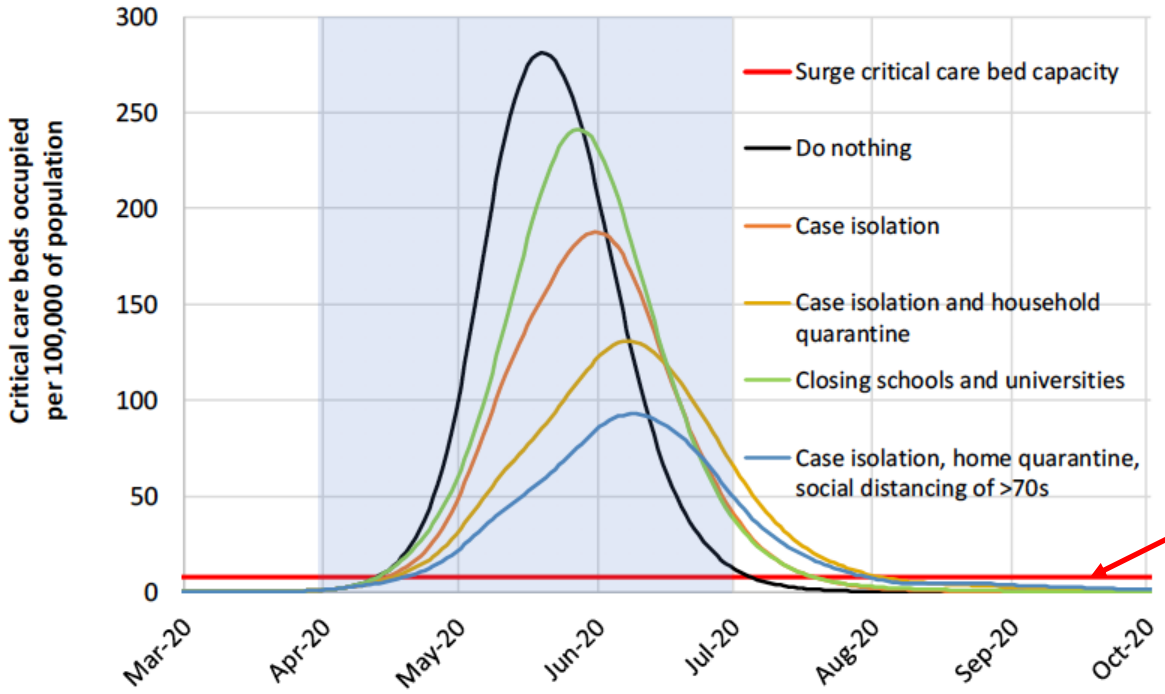


Figure 2: Mitigation strategy scenarios for GB showing critical care (ICU) bed requirements. The black line shows the unmitigated epidemic. The green line shows a mitigation strategy incorporating closure of schools and universities; orange line shows case isolation; yellow line shows case isolation and household quarantine; and the blue line shows case isolation, home quarantine and social distancing of those aged over 70. The blue shading shows the 3-month period in which these interventions are assumed to remain in place.

« We therefore conclude that epidemic suppression is the only viable strategy at the current time »

maximum ICU bed capacity

(Ferguson et al., Imperial College Response Team, 16 March 2020)

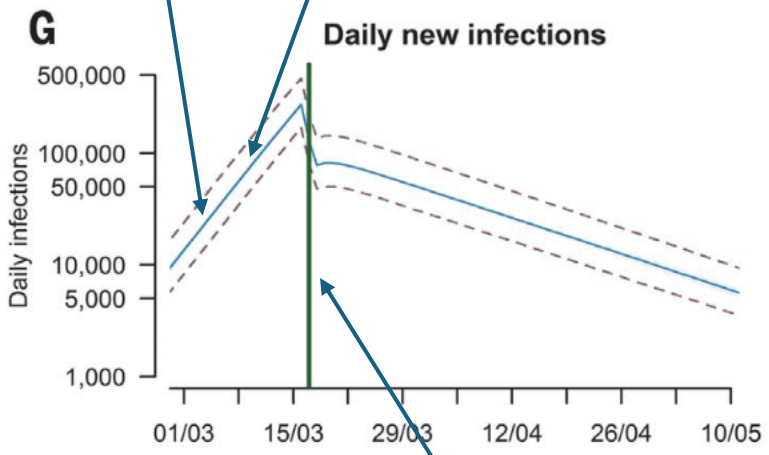
Du coup, la France se résout à l’impensable

- Après l’Italie (9 mars) et l’Espagne (14 mars), on se résout au confinement en France (17 mars)

Que se serait-il passé si… ?
Analyse rétrospective

Temps de doublement =
3 jours

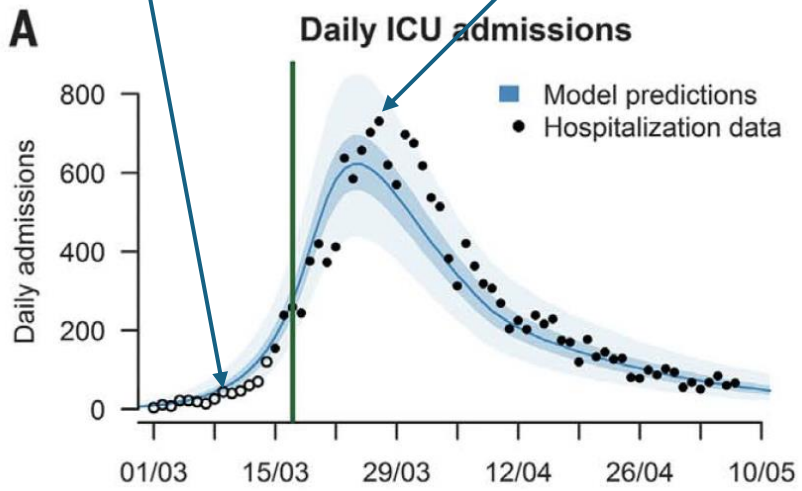
Nombre d'infections quotidiennes =
100,000 le 11 mars 2020



Date du confinement

Pic le 27 mars autour de
750 admissions par jour

Le 11 mars

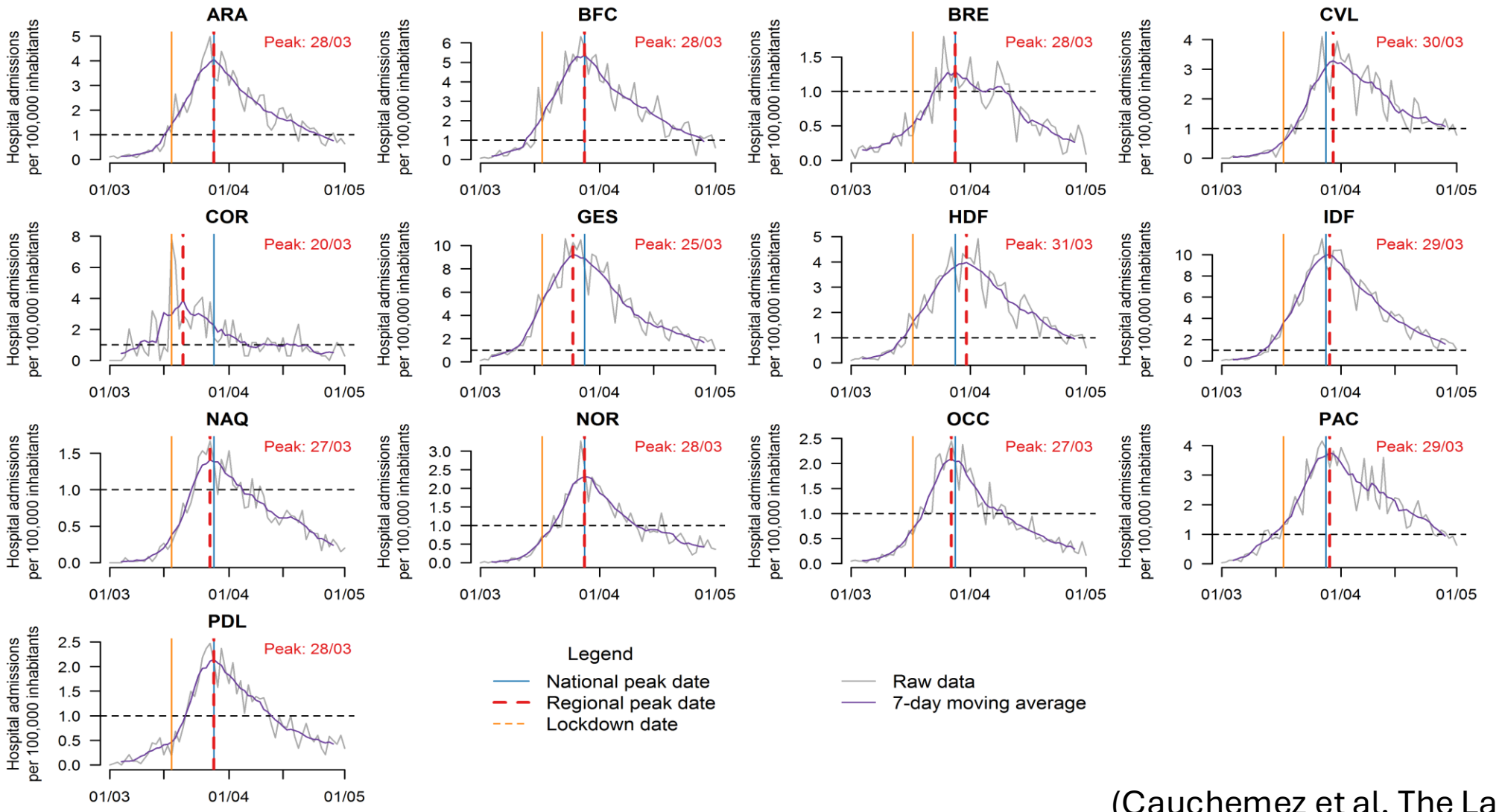


Avec un temps
de doublement
de 3 jours…

(Salje et al, Science, 2020)

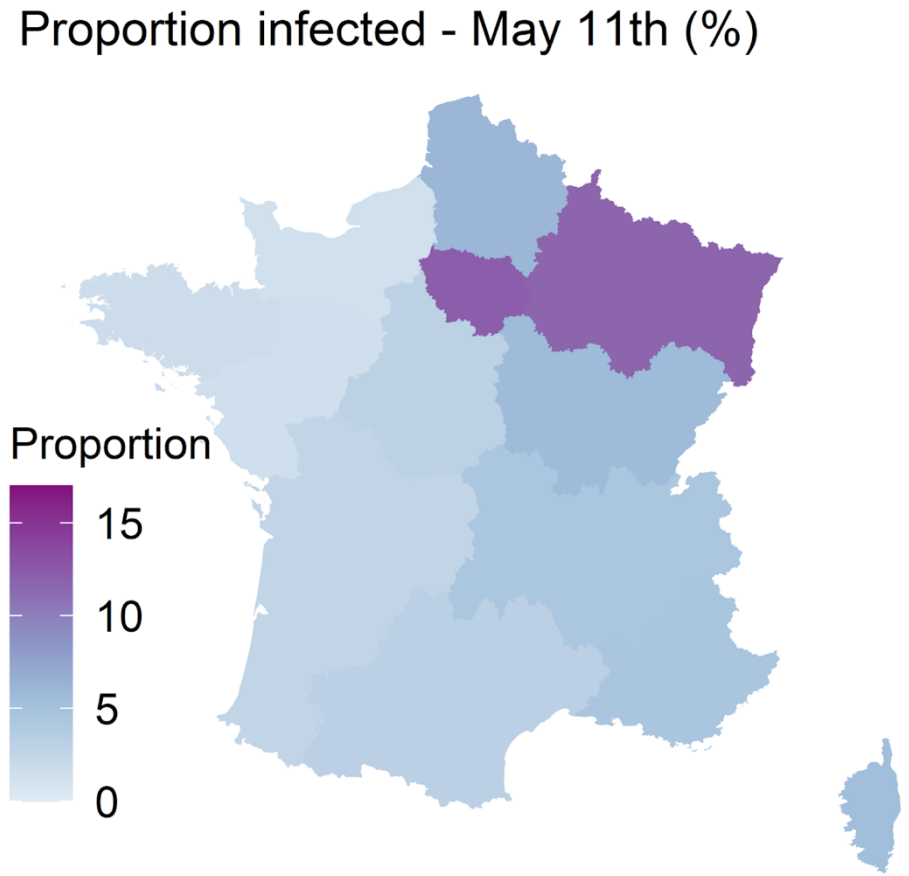
How did the lockdown work in France?

COVID-19 hospital admission data by regions, March-April 2020



(Cauchemez et al, The Lancet)

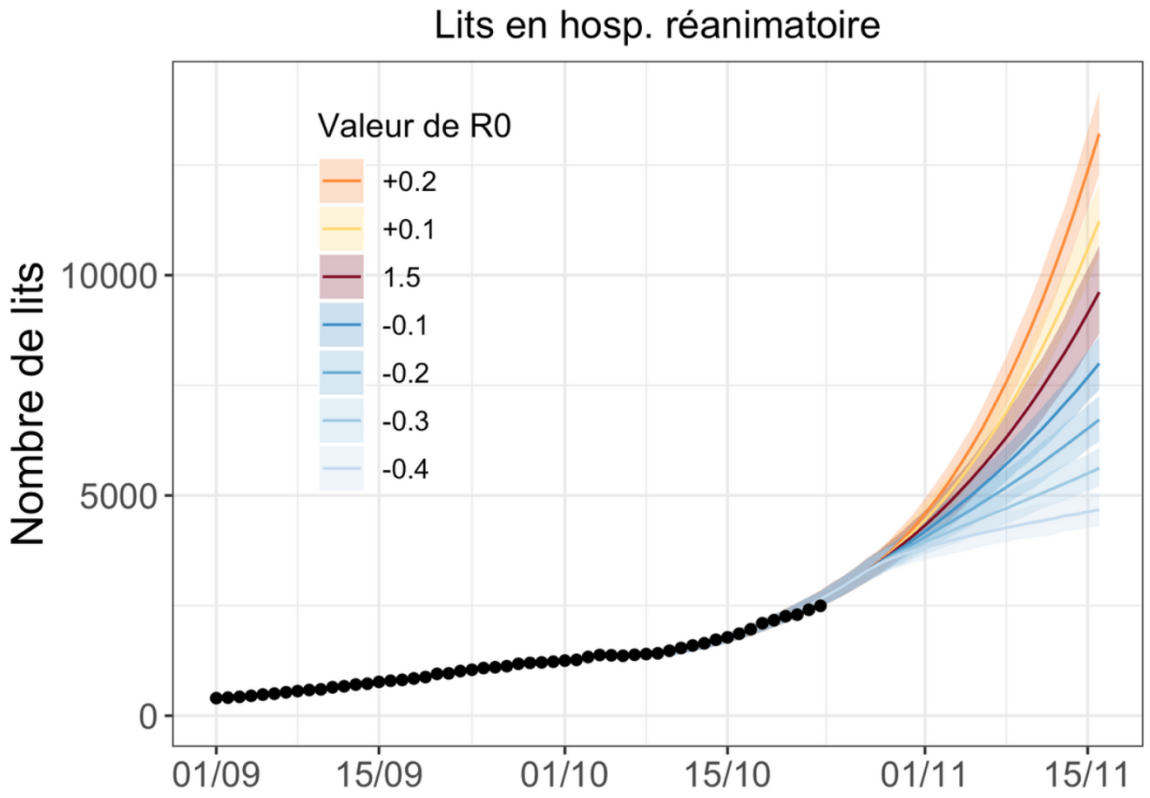
COVID-19 1st epidemic wave, France, 2020



5.3% of the population infected

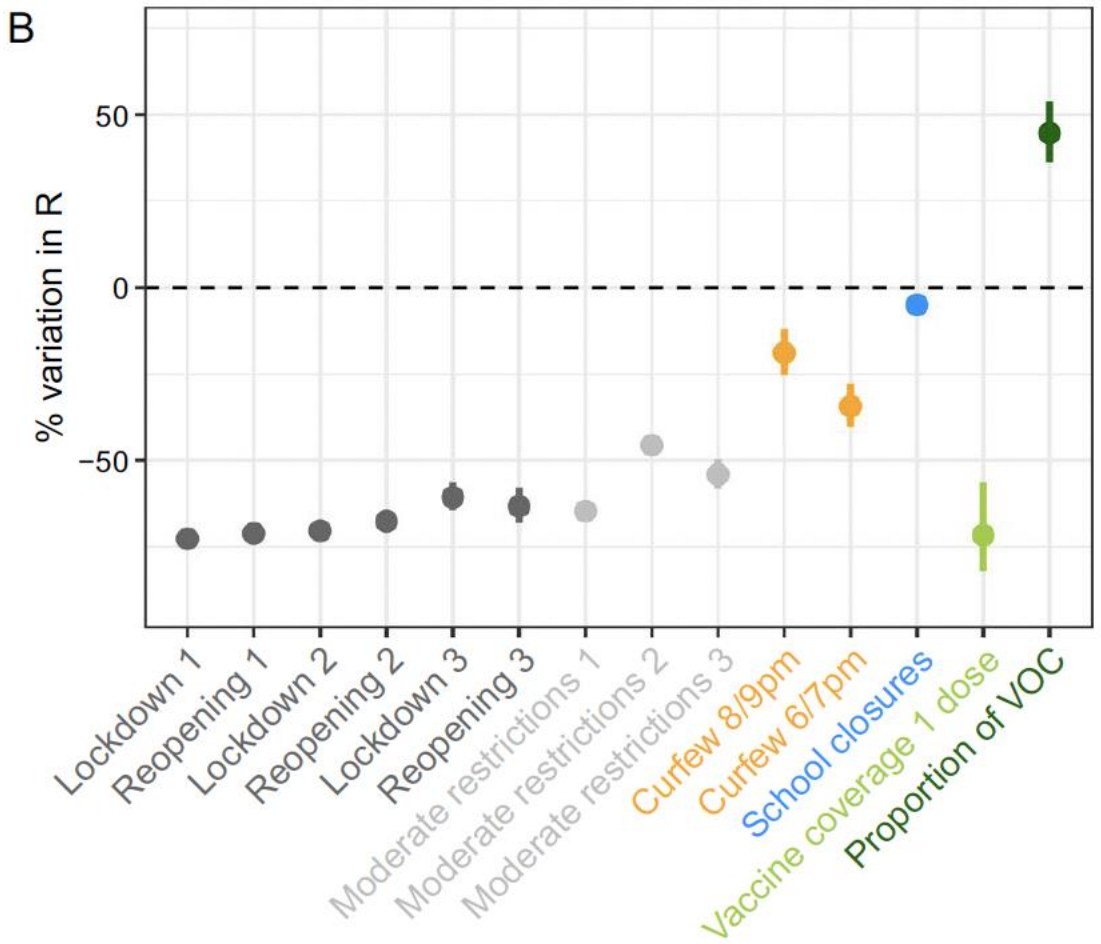
(Salje et al., 2020, Science)

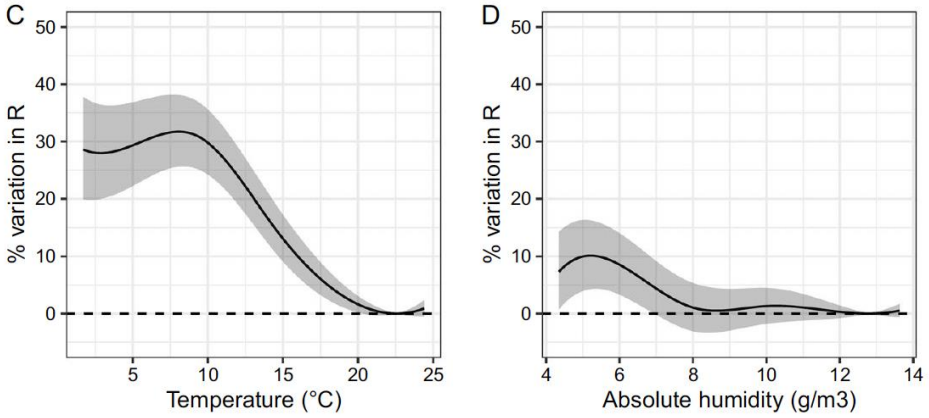
Projections ICU beds – Fall 2020, France

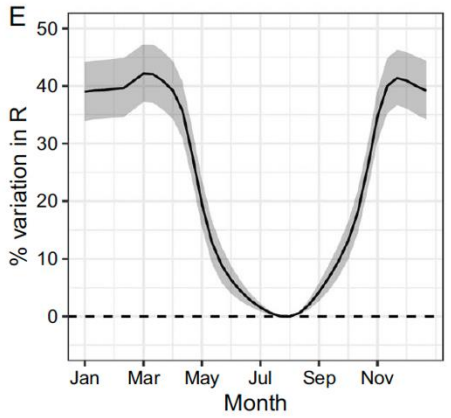


https://modelisation-covid19.pasteur.fr/realtime-analysis/hospital/

% variation in R associated with interventions and climate, France, 2020-2021







(Paireau, BMC Infect Dis, 2023)

Take-home message

- La modélisation a joué un rôle essentiel pendant la pandémie COVID-19
- Permet d'avoir des perspectives court terme (admissions hospitalières à 3-6 semaines) et long terme (on sortira de la phase épidémique quand…)
- Attention aux boîtes noires. Intérêt de la transparence (site web de Simon Cauchemez)
- Etre très prudent sur les projections (se limiter au court terme)
- Intérêt des analyses rétrospectives