



**UNIVERSITÉ
DE GENÈVE**

FACULTY OF MEDICINE
Institute of Global Health



Le point sur l'épidémiologie du COVID-19

Le déconfinement

Antoine Flahault – 23 avril 2020

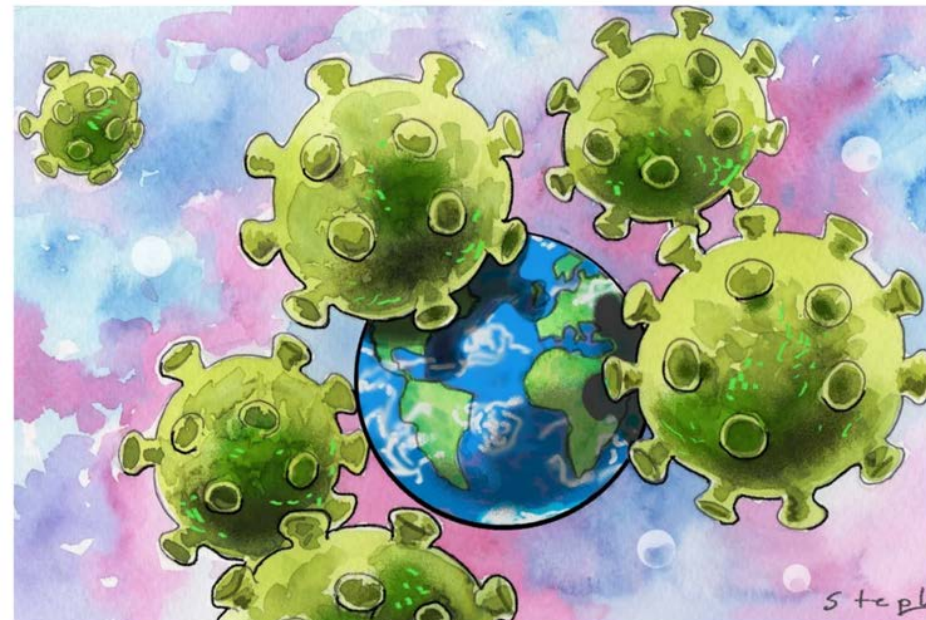
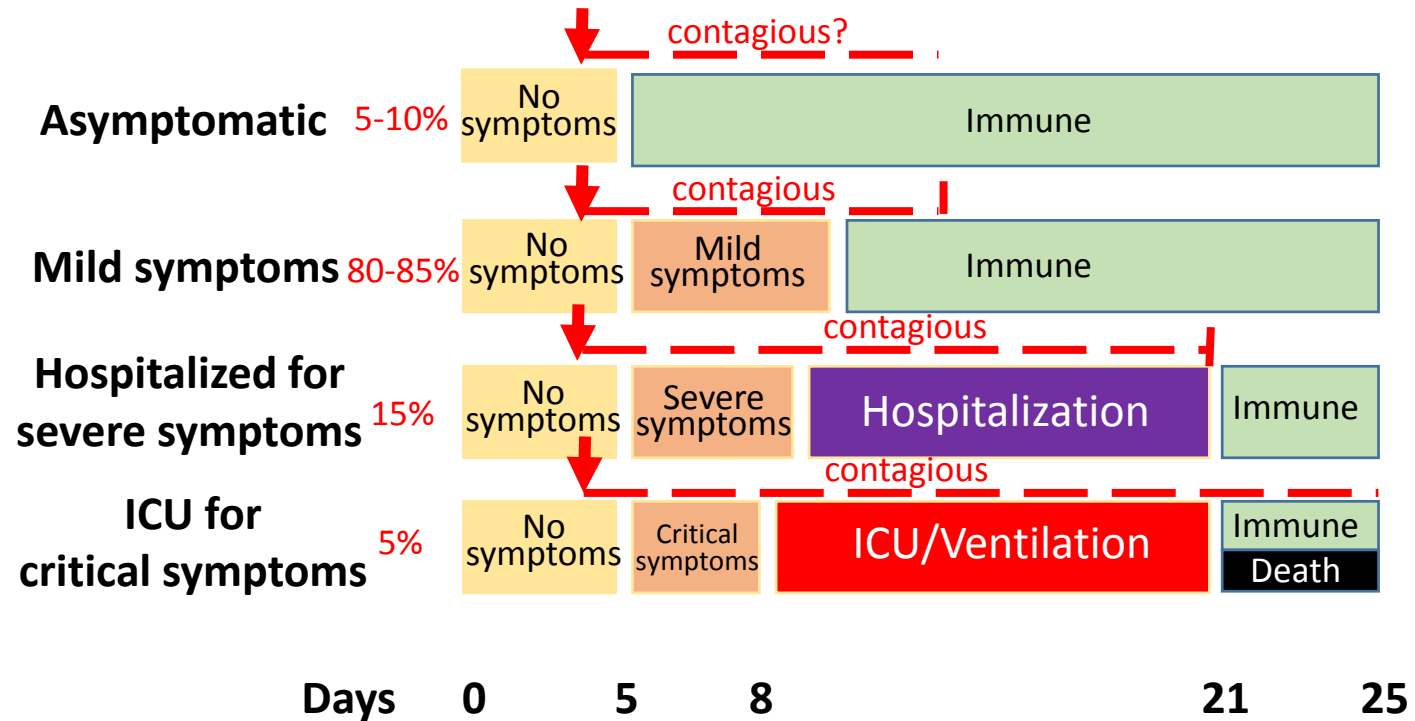


Illustration: Craig Stephens

Histoire naturelle du COVID-19



Credits: Antoine Flahault (UNIGE-HUG) and Frédérique Jacquierioz (HUG)

Source:

http://www.intrahug.ch/sites/intranet/files/structures/directions/communication/Coronavirus-COVID19/Recommandations-Institutionnelles/criteres_de_sortie_transfert_et_levee_des_mesures_covid-19_suspectes_ou_confirmes_2.0.pdf

Diagnostic high-tech



RT-PCR Primers & Probes for SARS-CoV-2 (2019-nCoV) Coronavirus
 Recommended sequences by CDC and WHO for research on the coronavirus



Artificial Intelligence Assisted Radiology Technologies Aid COVID-19 Fight in China

Application of Chinese AI imaging technology has helped speed diagnosis of large numbers of patients with the novel coronavirus COVID-19 pneumonia



AI vendor Infervision's InferRead CT Pneumonia software uses artificial intelligence-assisted diagnosis to improve the overall efficiency of the radiology department. It is being developed in China as a high sensitivity detection aid for novel coronavirus pneumonia (COVID-19).



Perspective

Defining the Epidemiology of Covid-19 — Studies Needed

Marc Lipsitch, D.Phil., David L. Swerdlow, M.D., and Lyn Finelli, Dr.P.H.

The epidemic of 2019 novel coronavirus (now called SARS-CoV-2, causing the disease Covid-19) has expanded from Wuhan throughout China and is being exported to a growing num-

ber of countries, some of which have seen onward transmission. Early efforts have focused on describing the clinical course, counting severe cases, and treating the sick. Experience with the Middle East respiratory syndrome (MERS), pandemic influenza, and other outbreaks has shown that as an epidemic evolves, we face an urgent need to expand public health activities in order to elucidate the epidemiology of the novel virus and characterize its potential impact. The impact of an epidemic depends on the number of persons infected, the infection's transmissibility, and the spectrum of clinical severity.

Thus, several questions are especially critical. First, what is the full spectrum of disease severity (which can range from asymp-

tomatic, to symptomatic-but-mild, to severe, to requiring hospitalization, to fatal)?

Second, how transmissible is the virus?

Third, who are the infectors — how do the infected person's age, the severity of illness, and other characteristics of a case affect the risk of transmitting the infection to others? Of vital interest is the role that asymptomatic or presymptomatic infected persons play in transmission. When and for how long is the virus present in respiratory secretions?

And fourth, what are the risk factors for severe illness or death? And how can we identify groups most likely to have poor outcomes so that we can focus prevention and treatment efforts?

The table lists approaches to answering these questions, each of which has shown success in prior disease outbreaks, especially MERS and pandemic H1N1 influenza.¹

Counting the number of cases, including mild cases, is necessary to calibrate the epidemic response. Conventional wisdom dictates that the sickest people seek care and undergo testing; early in an epidemic, case fatality and hospitalization ratios are often used to assess impact. These measures should be interpreted with caution, since it may take time for cases to become severe, or for infected persons to die, and it may not be possible to accurately estimate the denominator of infected people in order to calculate those ratios.² As in past epidemics, the first cases of Covid-19 to be observed in China were severe enough to come to medical attention and result in testing, but the total number of people infected has been elusive. The esti-

1. Les nombres
2. La transmissibilité
3. La sévérité

The impact of an epidemic depends on the number of persons infected, the infection's transmissibility, and the spectrum of clinical severity.

Les nombres officiels (23 avril, 2020)

Coronavirus Cases:

2,639,025

[view by country](#)

Deaths:

184,263



Diamond Princess







712 confirmed cases/3,711 passg+crew

(attack rate=19.2%)

331 (46.5%) of tested were **asymptomatic**

13 deaths / 712 cases **(CFR = 1.8%)**

COVID-19 testing per capita

COUNTRY	POP.	# TESTED (AS OF)	TESTS PER MILLION PEOPLE
Italy	62.4M	1,305,833 (Apr. 18)	20,926 
United States	329.4M	3,893,815 (Apr. 20)	11,821 
South Korea	51.8M	563,035 (Apr. 20)	10,862 
United Kingdom	65.8M	501,379 (Apr. 20)	7,624 
Turkey	84.2M	634,277 (Apr. 19)	7,537 
Japan	125.5M	116,725 (Apr. 20)	930 

Updated as of April 20, 2020 at 1:00 p.m. EST.

Sources: COVID Tracking Project; Korea Centers for Disease Control and Prevention; Japan Ministry of Health, Labour, and Welfare; Italian Ministry of Health; UK Department of Health and Social Care; Turkish Ministry of Health, WHO; NYT; US Census, CIA World Factbook

INSIDER

Incertitude sur les nombres...

<  Search

HEADLINES Published: February 1, 2020 11:25 AM UTC

Official Coronavirus Count Nears 12,000 but This Model Estimates 75,000 Infections

Is it time to panic? The public needs answers



- Home
- Briefings ▾
- Hot Topics
- Analyses
- Reports
- Perspectives
- Newsletter

Death Count: Wuhan Distributed an Estimate of over 40,000 Urns

Prévisions à 8 jours

Number of Cases on 2020-04-22

Countries with fast growth rates (> 25%):

Powered by ISG and SDSC

Country	Growth rate in %
Somalia	32
Maldives	29
Sudan	27

Countries with sustained growth rates (between 15% and 25%):

Powered by ISG and SDSC

Country	Growth rate in %
United Republic of Tanzania	21
Benin	20
Gabon	19
Sierra Leone	19
Belarus	18
Singapore	17
Bangladesh	16
Nepal	15

COVID-19 Epidemic Forecasting

Powered by the [Institute of Global Health](#), Faculty of Medicine, University of Geneva and the [Swiss Data Science Center](#), ETH Zürich-EPFL

Data is from the European [CDC](#) and daily updates happen at 1pm CET.

Forecasts: from Thursday, April 23, 2020 to Thursday, April 30, 2020 for 205 countries and territories

Country selection

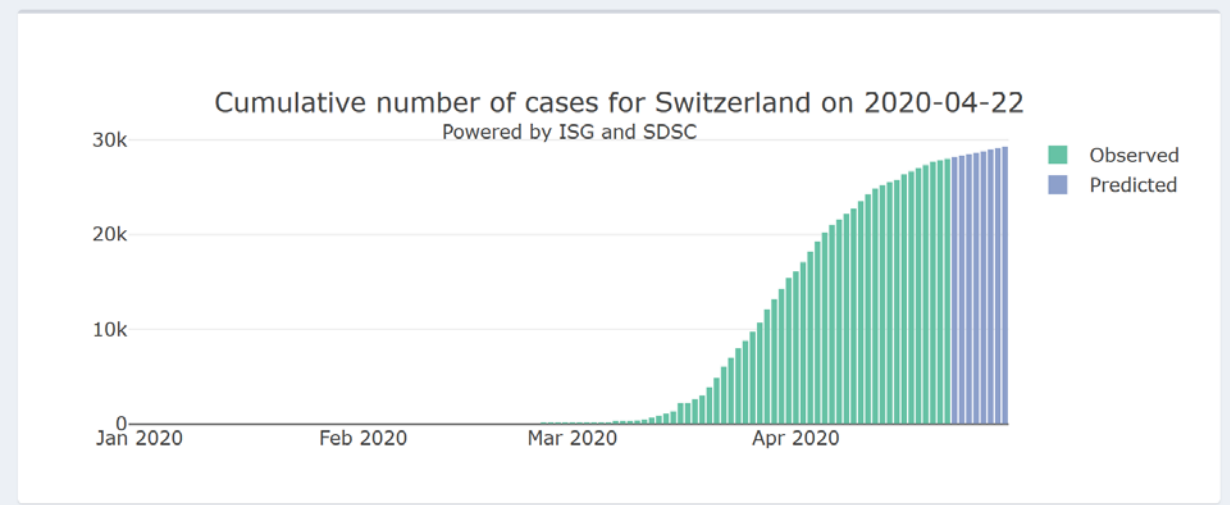
Choose a country:

Switzerland
▼

Growth rates

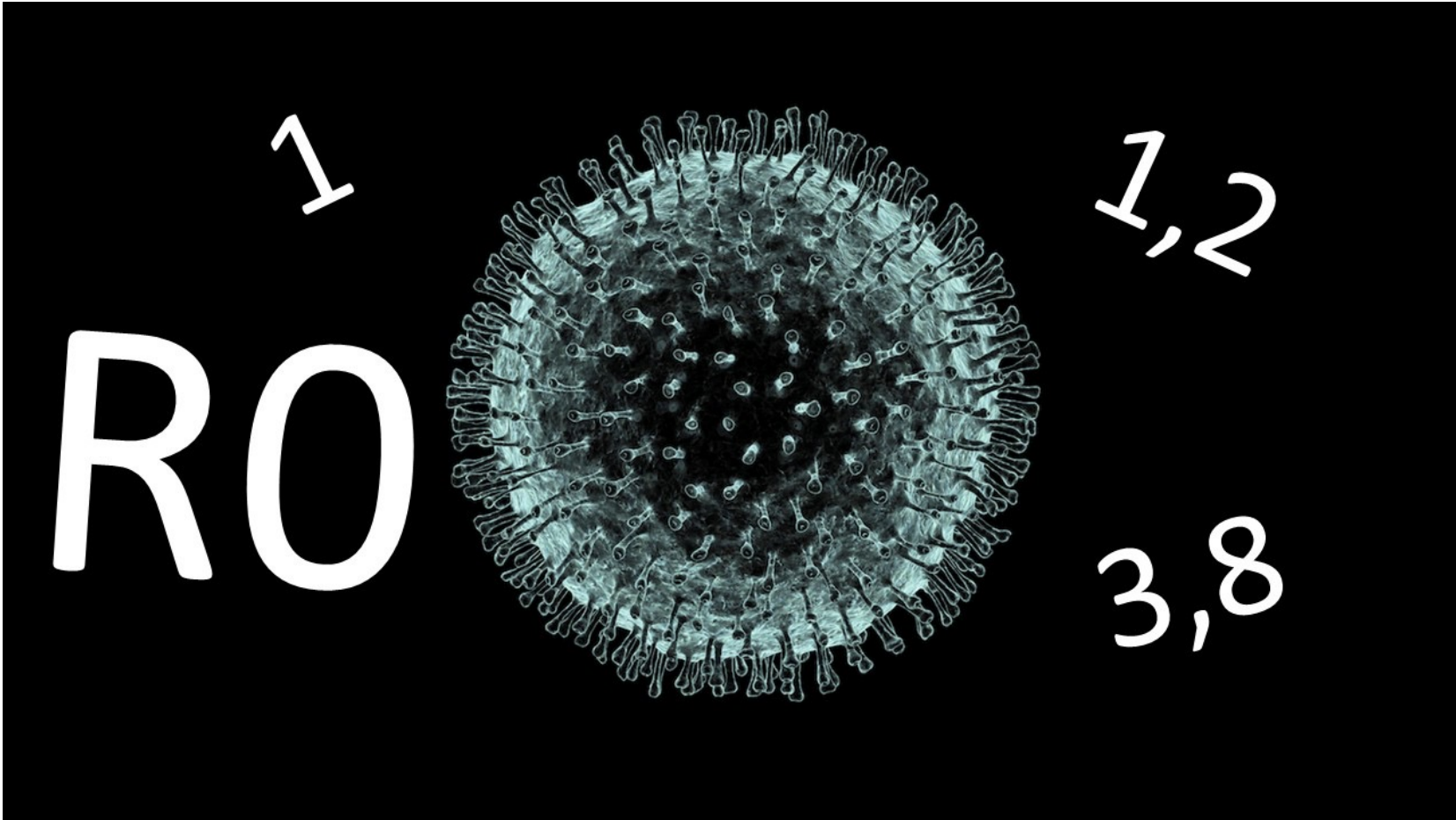
Number of cases:
1%: SLOWING

Number of deaths:
2%: SLOWING





2. La transmissibilité

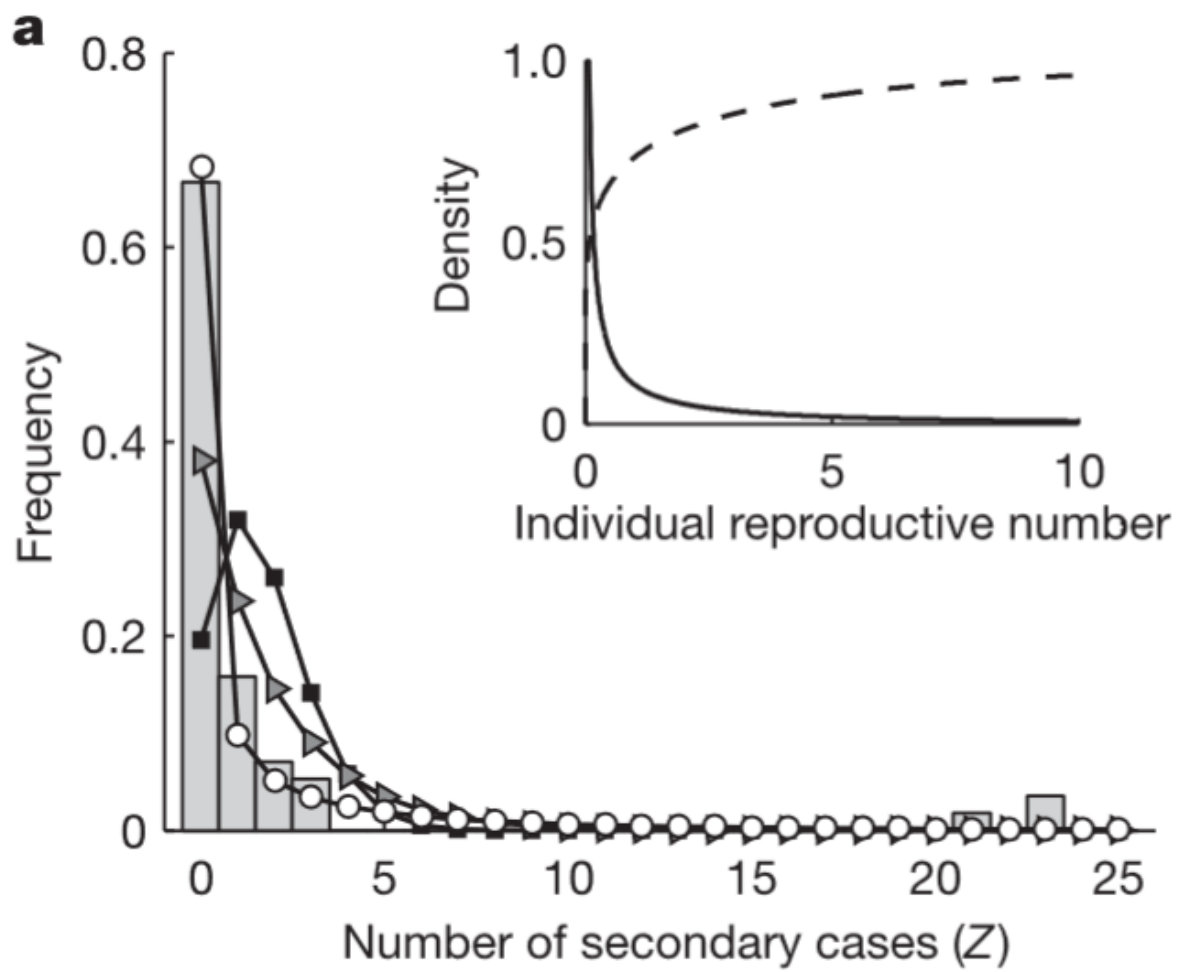


R0, nombre de reproduction de base

R0 est une variable, avec sa propre distribution
R0 = 2.5 en moyenne!

$$d = 6 \text{ days}$$

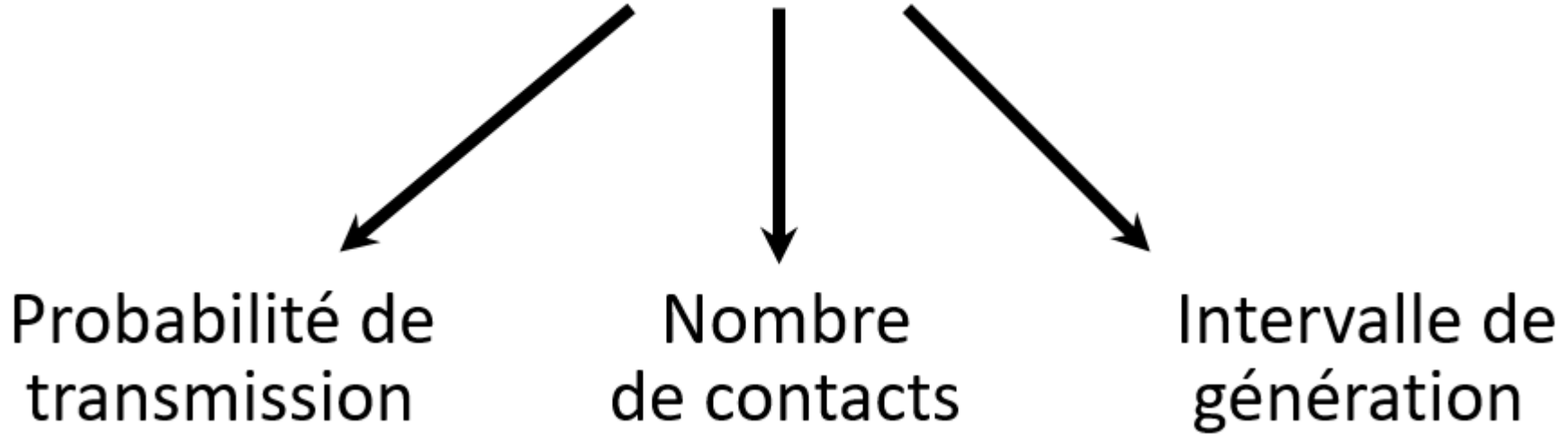
$$T_d = \frac{d \cdot \ln(2)}{R_0 - 1} = 3d \implies R_0 = \frac{d \cdot \ln(2) + T_d}{T_d} \approx 2.4$$



Ro for SRAS in Singapore (Lloyd-Smith, 2005)

Un outil pour planifier les mesures de contrôle

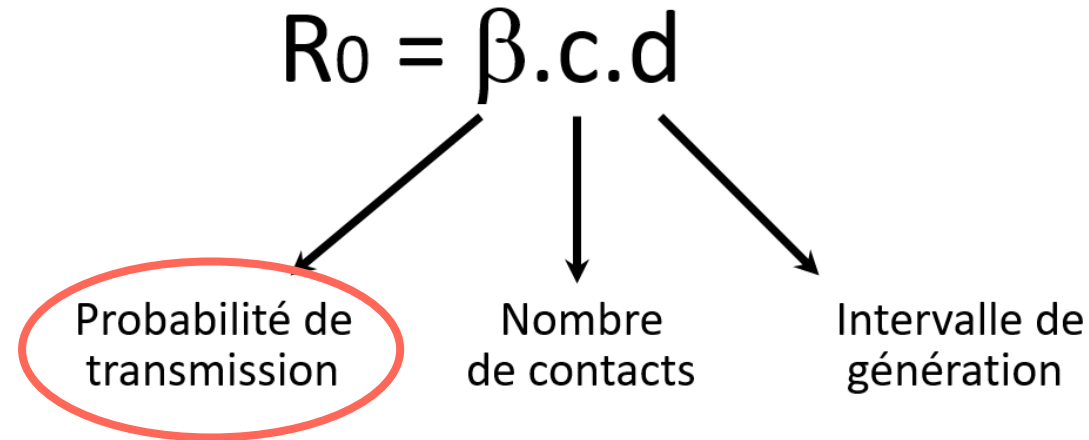
$$R_0 = \beta . c . d$$



$R_0 = 2,5 = 5\%$ x **10** pers x **5** jours

$R\text{-eff} = 0,4 = 4\%$ x **2** pers x **5** jours

Réduire la probabilité de transmission



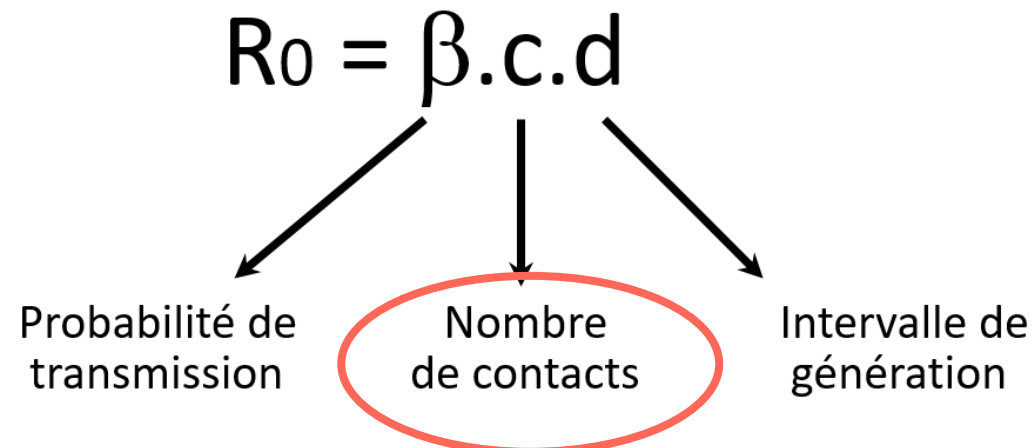
Mesures temporaires individuelles

- Masques de protection
- Lavage des mains
- Mouchage dans le coude, mouchoirs jetables
- Antiviraux

Mesures à long terme

- Vaccins

Restreindre les contacts



Mesures temporaires

Distance sociale personnalisée

- Testing de masse, Tracing exhaustif
- Isolement et séparation après exposition

Distance sociale populationnelle (confinement)

- Fermeture des écoles, des universités,
- Interdiction des rassemblements
- Limitation des déplacements
- Cordons sanitaires

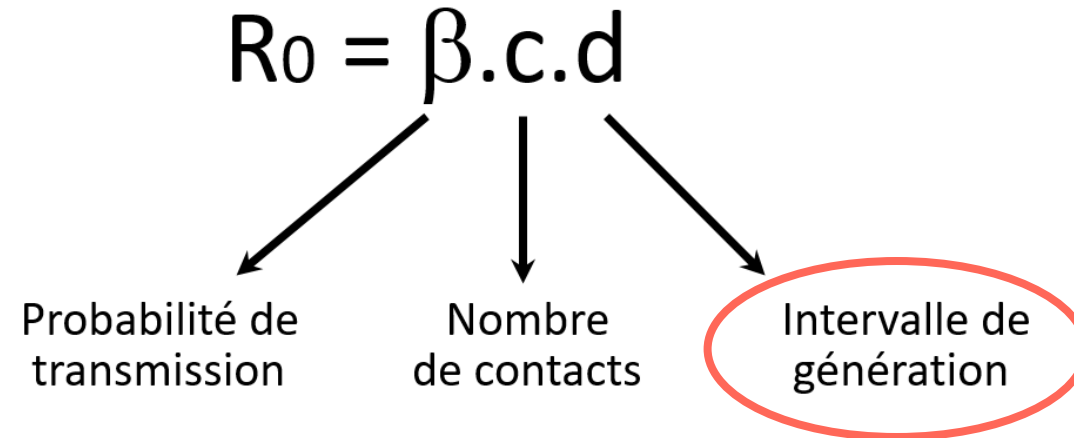
**Nonpharmaceutical Interventions
Implemented by US Cities
During the 1918-1919 Influenza Pandemic**

JAMA, August 8, 2007—Vol 298, No. 6

The *cordon sanitaire* around Wuhan and neighboring municipalities imposed since 23 January 2020 has effectively prevented further exportation of infected individuals to the rest of the country.

WHO, Feb 25, 2020

Ecourter la durée de la période infectieuse



Mesures temporaires individuelles

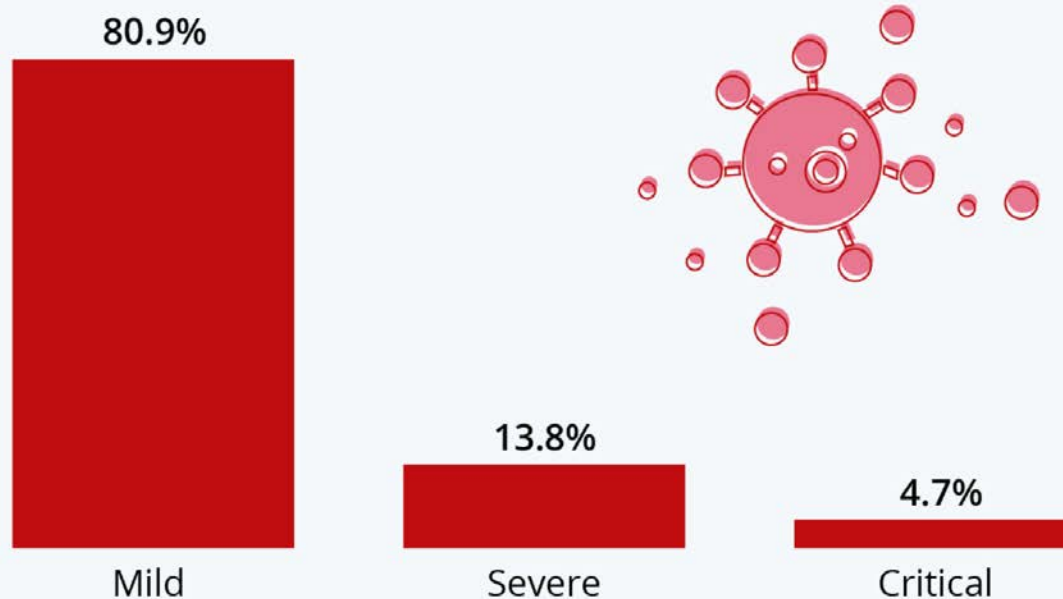
- Antiviraux
- Antitussifs ?

$d = 4-5$ jours

3. La sévérité de l'infection

Study: Majority Of Coronavirus Cases Are Mild

COVID-19 case severity (as of February 11, 2020)



n=44,672 confirmed COVID-19 cases in Mainland China
Source: Chinese Centre for Disease Control and Prevention

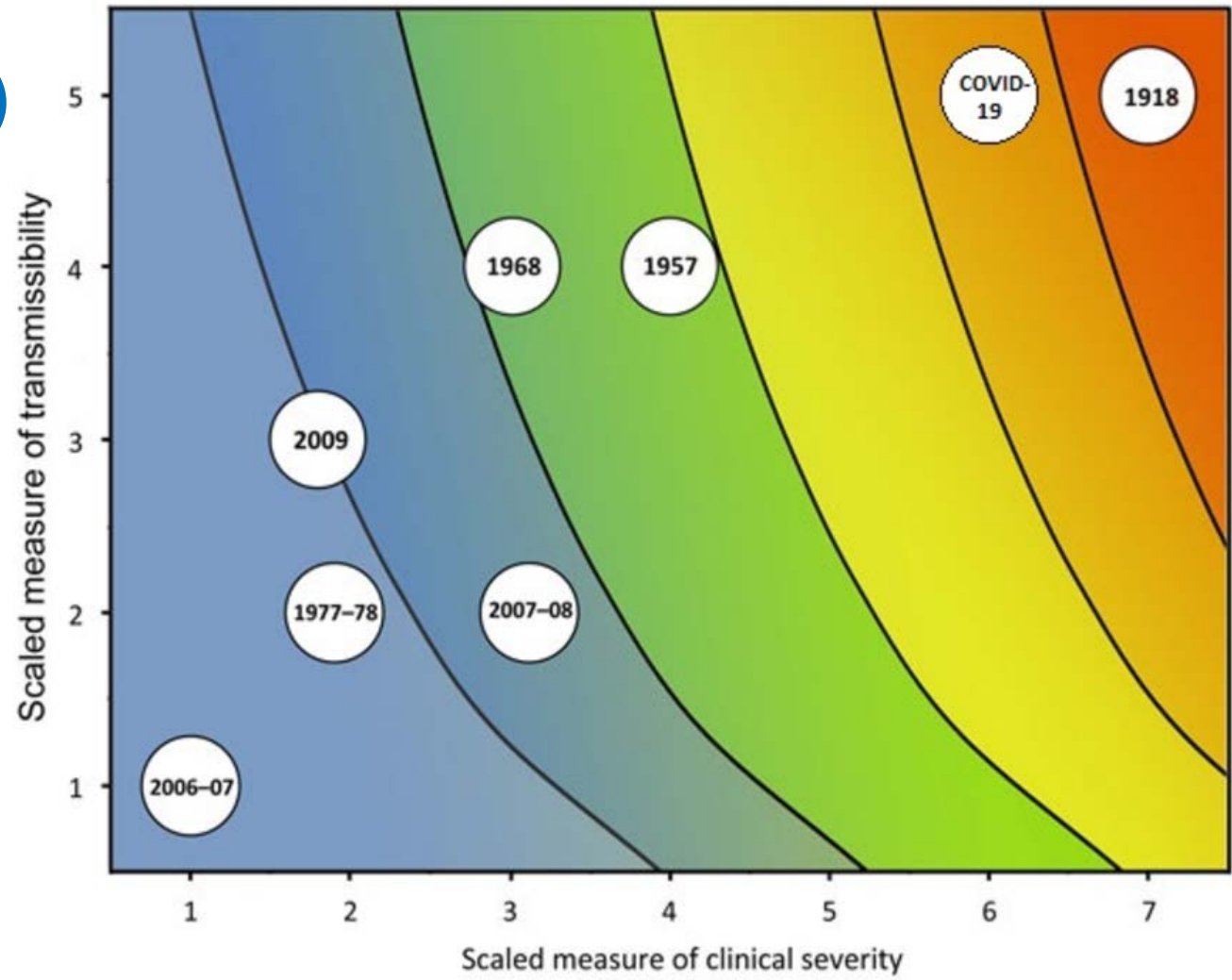
Estimation provisoire
à partir du Diamond Princess
13 décès/712 cas confirmés
(CFR=1,8%)

0.3 – 3%

Case Fatality Rate (CFR)
= Taux de mortalité

Nombre x Transmission x Sévérité

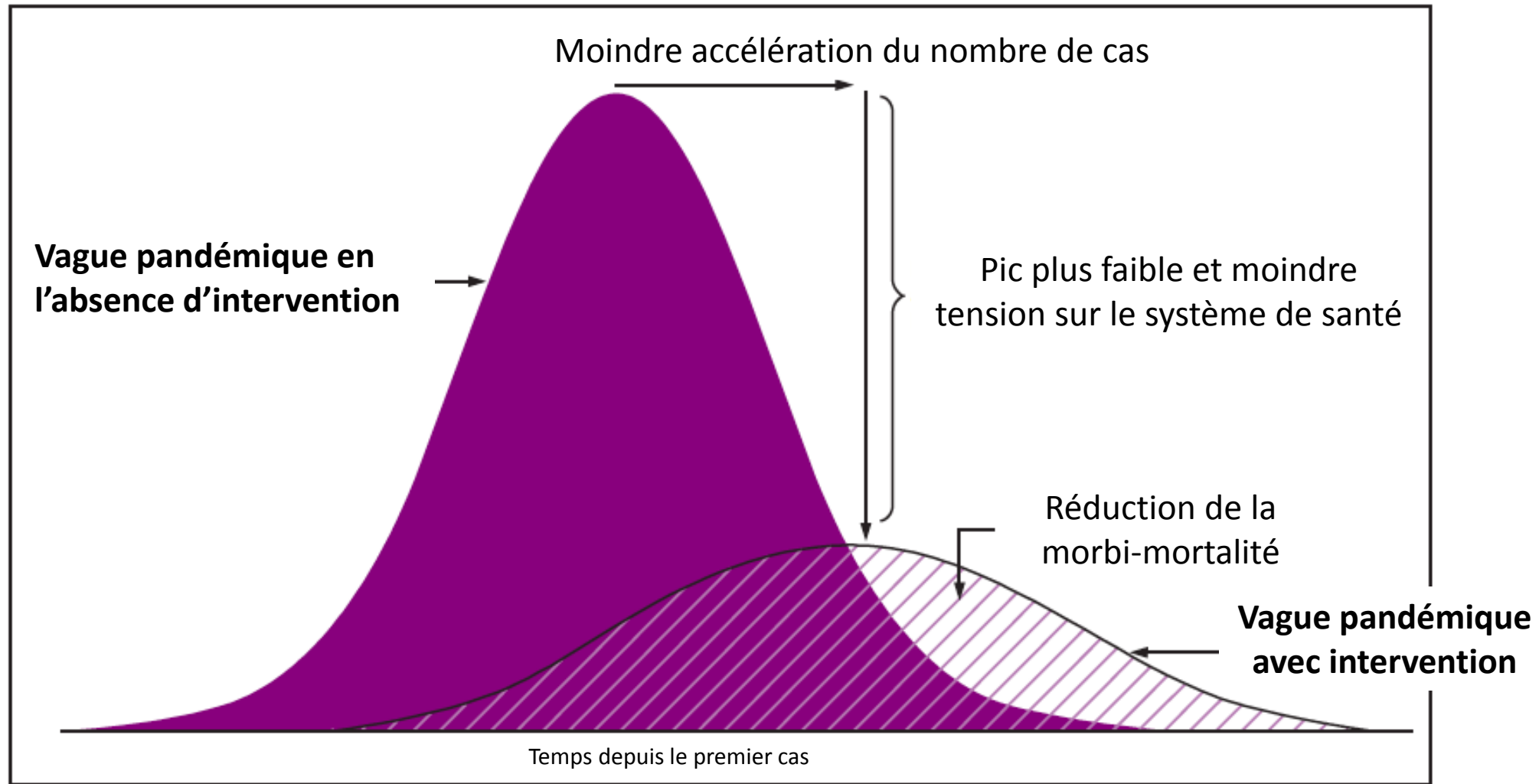
Axe vertical :
transmissibilité (R0)



Axe horizontal
taux de mortalité

Mike Famulare (Institute for Disease Modeling)
v2.0: substantive revision 19 February 2020. (v1.1 February 4; v1.0 January 31.)

Agir pour aplatir la courbe

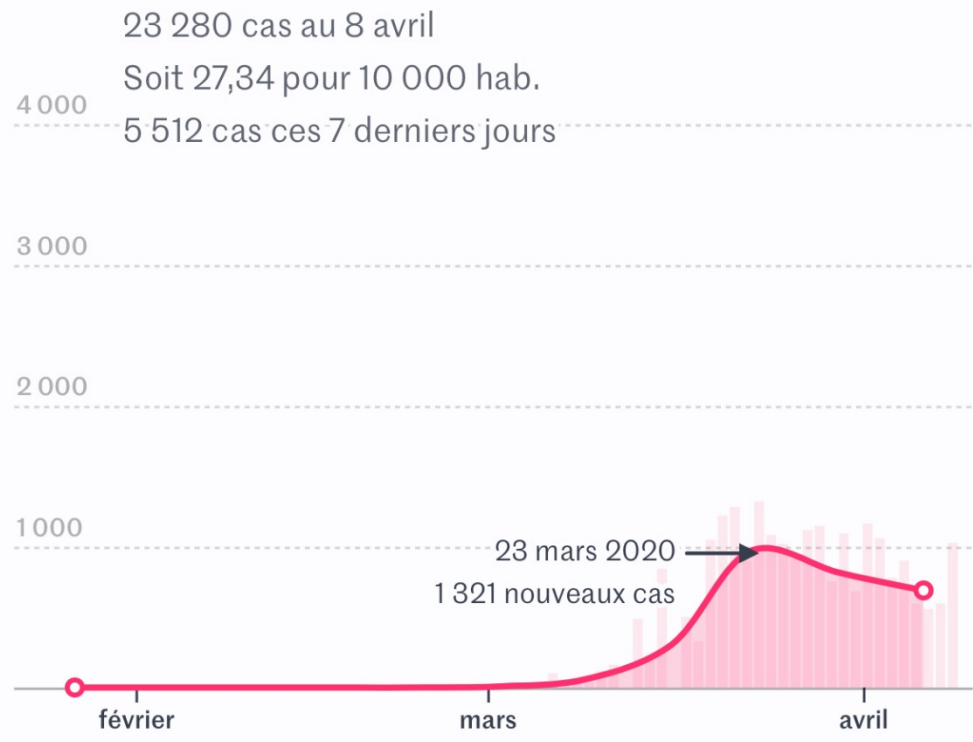


d'après US-CDC, 2017 (pour une pandémie de grippe)

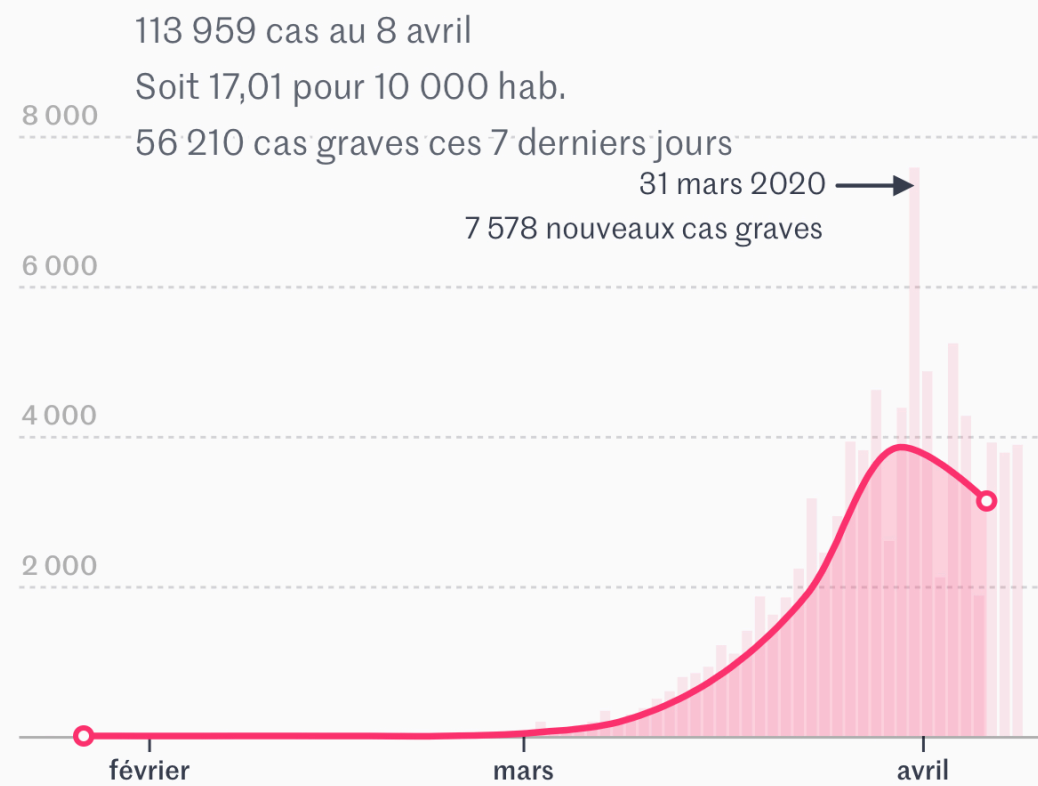
Notion de pics et de plateaux

Le Monde

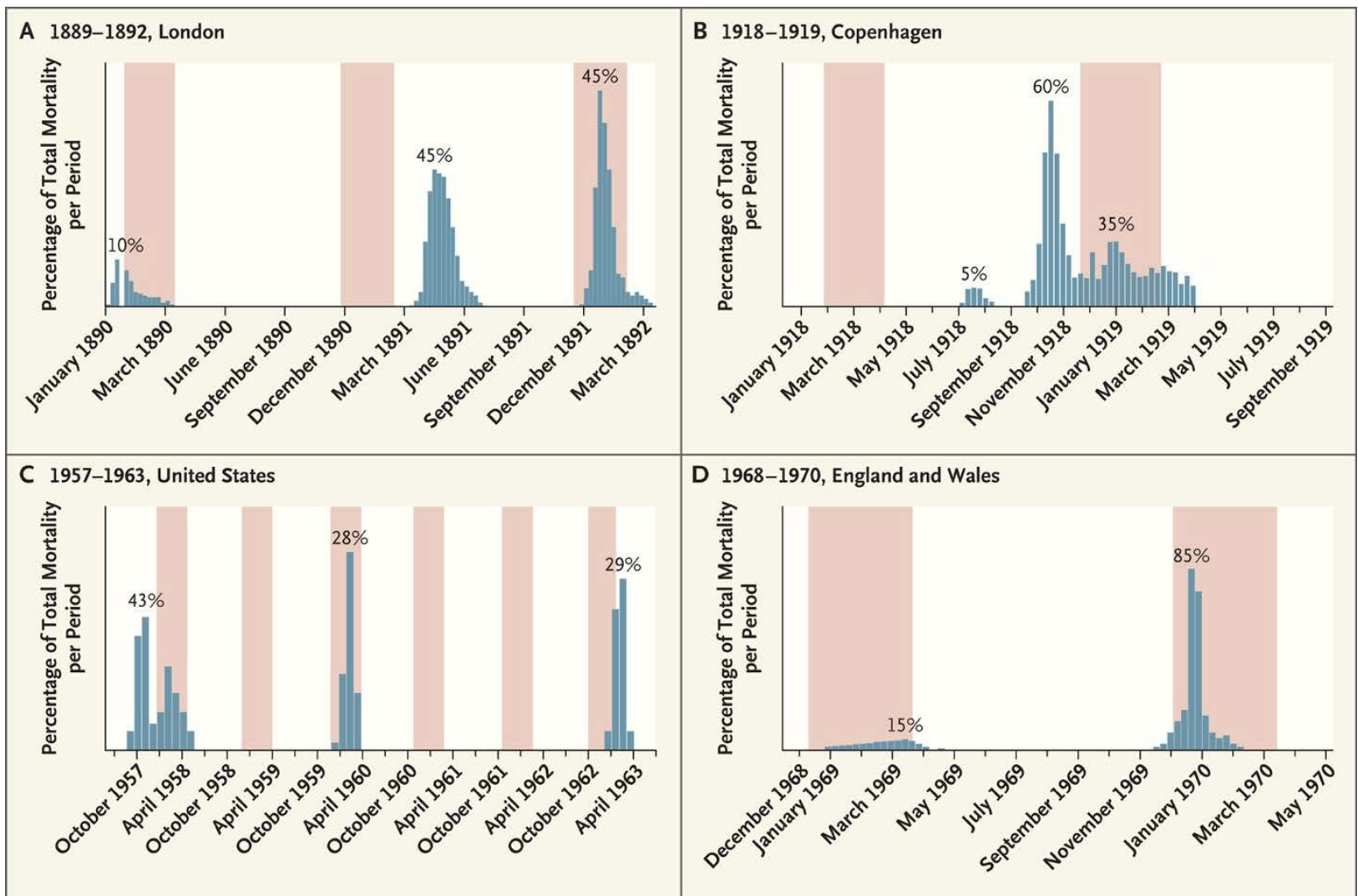
Suisse



France



Risque de nouvelles vagues





Le déconfinement



Déconfinement : les préalables

1. Pourquoi le confinement ?

- Suppression de la pandémie
- Eviter l'engorgement des hôpitaux

2. Quand déconfiner ?

- Pas durant le plateau
- À la décrue

3. Y-aura-t-il un freinage estival ?

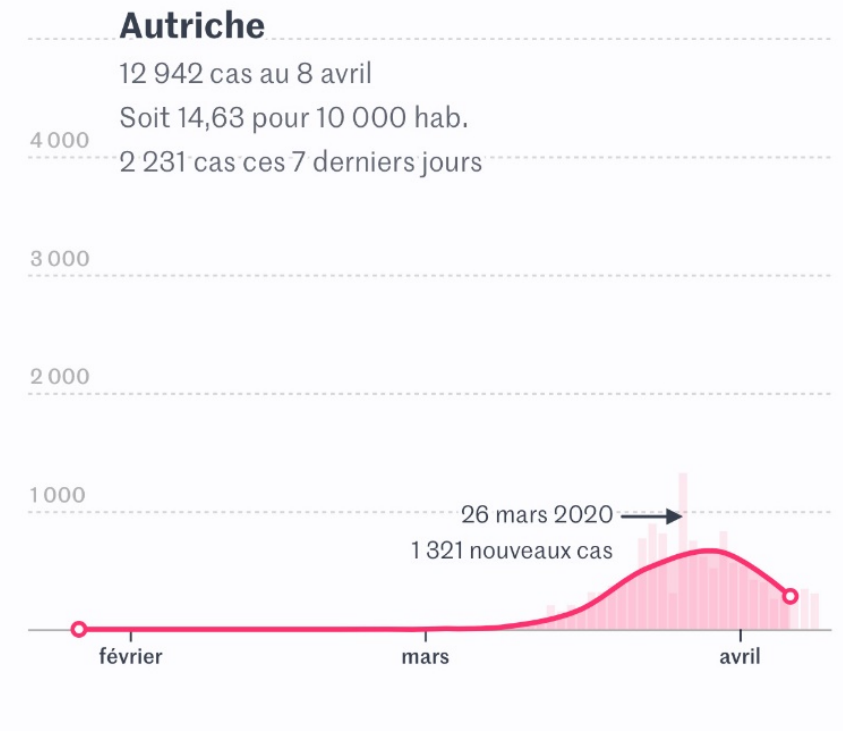
- Oui, puissant
- Oui, limité
- Non

4. Quel niveau d'immunité protectrice dans la population ?

- Immunité grégaire (70% de la population)
- Immunité faible (10-15%)
- Situation hétérogène

5. Quel risque de flambée épidémique lors du déconfinement

- Haut risque : pas de frein saisonnier ou immunité faible
- Faible risque : frein saisonnier puissant ou immunité grégaire atteinte et générale



Déconfinement : les options

$$R\text{-eff} = \beta \cdot c \cdot d < 1$$

Probabilité de transmission

Nombre de contacts

Intervalle de génération

Mesures temporaires individuelles

- Masques de protection
- Lavage des mains
- Mouchage dans le coude, mouchoirs jetables
- Antiviraux

Mesures à long terme

- Vaccins

Distance sociale personnalisée

- Testing de masse, Tracing exhaustif
- Isolement et séparation après exposition

Confinement +/- strict

- Fermeture des écoles, des universités,
- interdiction des rassemblements
- Limitation des déplacements
- Cordons sanitaires

Mesures temporaires individuelles

- Antiviraux
- Antitussifs ?

R-eff = 0,4 = 4%

x

2 pers

x

5 jours

R-eff = 0,5 = 1%

x

10 pers

x

5 jours

SARS-CoV-2 Testing



Example of a swab used by providers

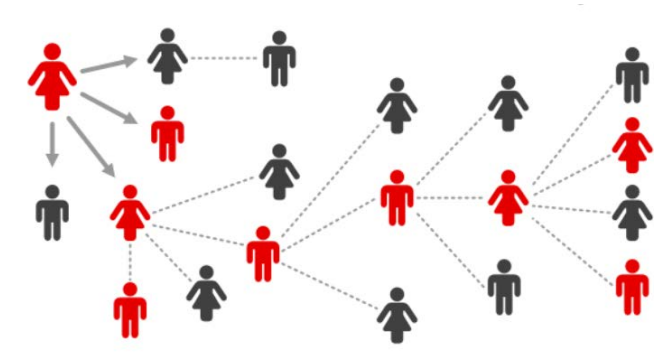


Example of a CDC diagnostic panel

RT-PCR



Contact tracing



Isolation/quarantaine



Isolation or Quarantine?



ISOLATION IF YOU ARE SICK

Separates sick people with a contagious disease from people who are not sick.



- You must stay away from others for at least 7 days after your symptoms started and until all your symptoms have gone away.

7 DAYS

QUARANTINE IF EXPOSED

Separates people and restricts their movement if they were exposed to a contagious disease to see if they become sick.



- For people who are not sick, but may have been exposed (in close contact with someone) who is sick.
- You must stay away from others for 14 days to see if you get sick.

14 DAYS





 **PEPP-PT**

Pan-European
Privacy-Preserving
Proximity Tracing

<https://www.pepp-pt.org/>

**EPFL and ETH Zurich advance digital
contact tracing project**

<https://actu.epfl.ch/search/ic/>

Conclusions

- Le risque est élevé de **nouvelles vagues** pandémiques
- Rappel à propos de la **Chine** : un régime autoritaire et violent
 - Le confinement strict est une «invention» chinoise
- Les pays de langue française regroupe parmi les plus anciennes **démocraties** du monde
 - Les **droits de l'homme** sont au cœur de nos valeurs
- L'enjeu est de concilier **valeurs** démocratiques et humanistes et lutte efficace contre la pandémie
- Le recours aux **technologies de l'information** doit se faire dans le respect le plus strict des règles de confidentialité et de respect de la personne (PEPP-PT ou dp3t ?)
- Il sera probablement nécessaire de **combiner, sans dogme**, certaines mesures de **confinement**, le port de **masques**, **lavage des mains** et des mesures de **distanciation sociale personnalisées**



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