COVID-19 pandemic
What shall we do now?

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COVID-19
1st epidemic wave
France, 2020

4.4% of the population infected
R0 = 2.9
Herd immunity: 1 - (1/2.9) = 66%

(Salje et al., 2020, Science)
Seasonal coronaviruses
HIVE cohort
Ann Harbor, Michigan
2010-8

(Monto et al., JID, 2020)
Seasonal coronaviruses
HIVE cohort
Ann Harbor, Michigan
2010-8

(Monto et al., JID, 2020)

SARS, 2003

(Source: WHO)
Seasonal coronaviruses
HIVE cohort
Ann Harbor, Michigan
2010-8

229E
HKU1
NL63
OC43

(Monto et al., JID, 2020)

SARS, 2003
(Source: WHO)

MERS, 2012-7
(Source: WHO)
Temperature effect – SARS-CoV-2

Table. Stability of SARS-CoV-2 at different environmental conditions.

<table>
<thead>
<tr>
<th>Time</th>
<th>4°C Mean ±SD</th>
<th>22°C Mean ±SD</th>
<th>37°C Mean ±SD</th>
<th>56°C Mean ±SD</th>
<th>70°C Mean ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
<td>N.D.</td>
<td>6.51 ±0.27</td>
<td>N.D.</td>
<td>6.65 ±0.1</td>
<td>5.34 ±0.17</td>
</tr>
<tr>
<td>5 mins</td>
<td>N.D.</td>
<td>6.7 ±0.15</td>
<td>N.D.</td>
<td>4.62 ±0.44</td>
<td>U</td>
</tr>
<tr>
<td>10 mins</td>
<td>N.D.</td>
<td>6.63 ±0.07</td>
<td>N.D.</td>
<td>3.84 ±0.32</td>
<td>U</td>
</tr>
<tr>
<td>30 mins</td>
<td>6.51 ±0.27</td>
<td>6.52 ±0.28</td>
<td>6.57 ±0.17</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>1 hr</td>
<td>6.57 ±0.32</td>
<td>6.33 ±0.21</td>
<td>6.76 ±0.05</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>3 hrs</td>
<td>6.66 ±0.16</td>
<td>6.68 ±0.46</td>
<td>6.36 ±0.19</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>6 hrs</td>
<td>6.67 ±0.04</td>
<td>6.54 ±0.32</td>
<td>5.99 ±0.26</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>12 hrs</td>
<td>6.58 ±0.21</td>
<td>6.23 ±0.05</td>
<td>5.28 ±0.23</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>1 day</td>
<td>6.72 ±0.13</td>
<td>6.26 ±0.05</td>
<td>3.23 ±0.05</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>2 days</td>
<td>6.42 ±0.37</td>
<td>5.83 ±0.28</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>4 days</td>
<td>6.32 ±0.27</td>
<td>4.99 ±0.18</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>7 days</td>
<td>6.65 ±0.05</td>
<td>3.48 ±0.24</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
<tr>
<td>14 days</td>
<td>6.04 ±0.18</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>U</td>
</tr>
</tbody>
</table>

A) Temperature*

(Chin et al., medRxiv, 2020)
Spanish flu Copenhagen, 1918-9

1st epidemic wave (summer):
• R: 2.2-3.0
• CFR: 0.35%
• Excess mortality: 15-44 years

2nd wave (autumn):
• R: 1.2-1.3
• CFR: 2.3%
• Excess mortality: 15-44 years

3rd wave (winter):
• CFR: 1.7%
• Excess mortality: balanced

(Andreasen et al., J Infect Dis, 2008)
H1N1 pandemic flu pdm09, 2009-2010

New York State

(Viboud et al, PLoS One, 2009)
H1N1 pandemic flu pdm09, 2009-2010

New York State

United Kingdom

(Viboud et al, PLoS One, 2009)

(Dorigatti, PNAS, 2013)
SARS-CoV-2 scenarii 2020-2022

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

(Kissler et al., Science, 2020)
SARS-CoV-2 scenarii 2020-2022

Herd immunity acquisition through a single social distancing period (seasonal effect)

$R_0 = 2.2$ and $1.3$

Duration social distancing period: 4, 8, 12, 20 weeks and infinite

Social distancing period efficacy: 0%, 20%, 40%, 60%
SARS-CoV-2 scenarii
2020-2022

What shall we do now?

$R_0 = 2.2$ and $1.3$

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Social distancing period efficacy: $0\%, 20\%, 40\%, 60\%$
SARS-CoV-2 scenarii 2020-2022

What shall we do now?
We look for a treatment and a vaccine

R0 = 2.2 and 1.3
Duration social distancing period: 4, 8, 12, 20 weeks and infinite
Social distancing period efficacy: 0%, 20%, 40%, 60%