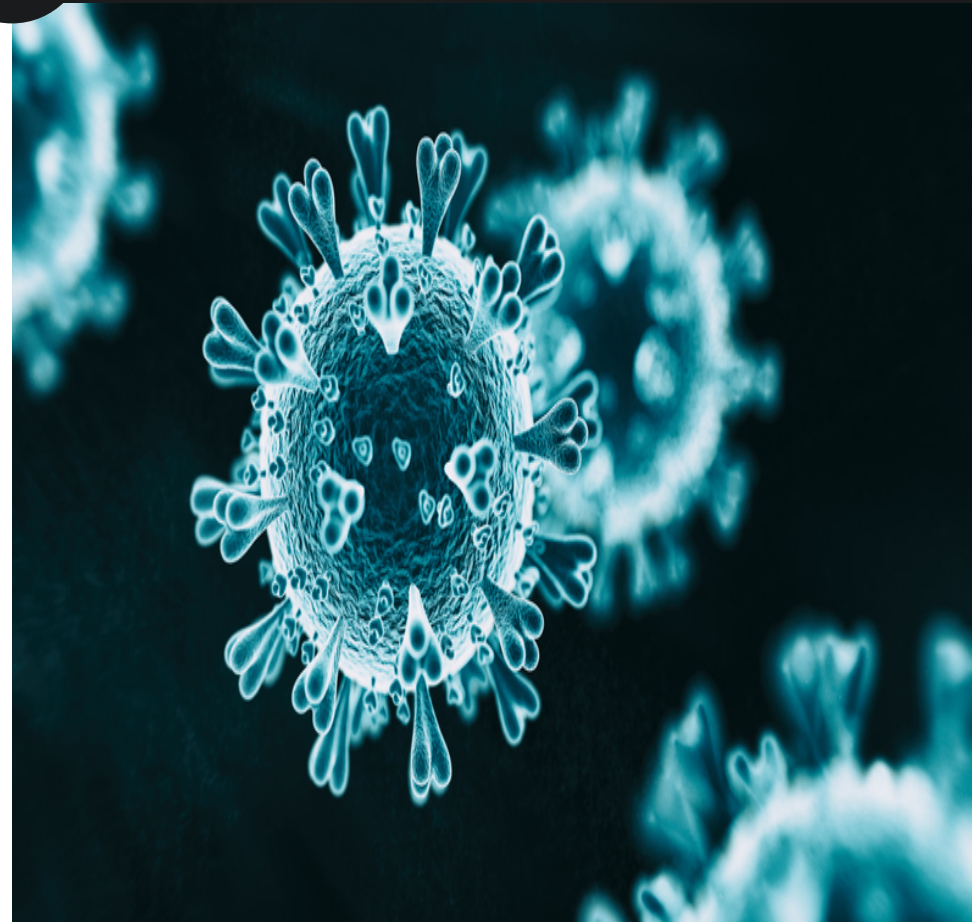




# COVID-19: APRIL 23 UPDATE

April 23, 2020



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## OUTLINE

- Overall Observations
- C19 Case and Death Count Update, by Country
- Latest IHME (Washington University) Projections for United States
- How to Measure the Population Infection Rate (3 Methods)
- Let's Compare the Nordic Countries
- And How are We Doing on Vaccine Development?

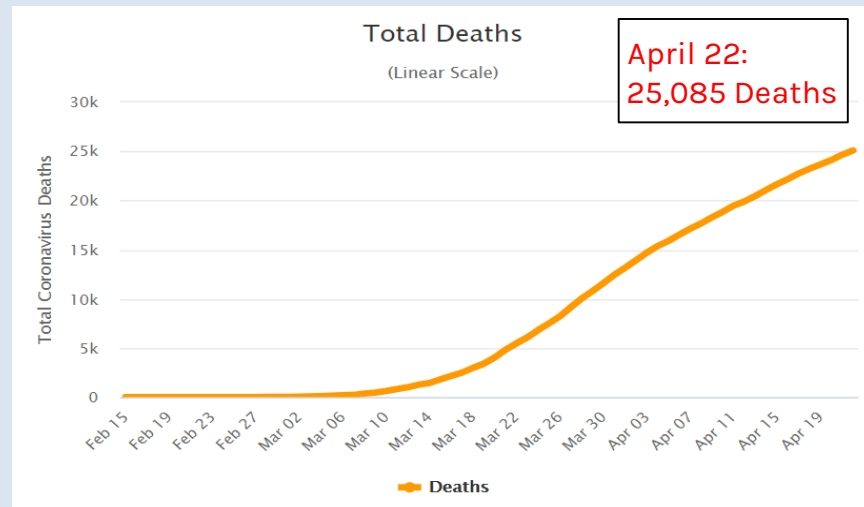
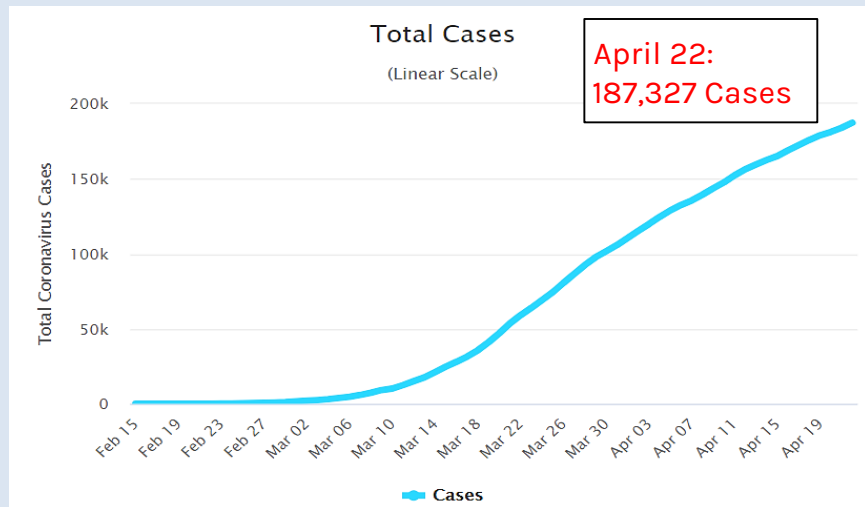
## OVERALL OBSERVATIONS

- Very mixed news on U.S. case & death trends:
  - U.S. daily new cases trend down... but not on a very shallow slope.
  - U.S. daily deaths (all-time high on Tuesday) show no sign yet that “peak” is over.
- Several governors plan to “reopen” their economies according to White House “gates.”
  - But why no “gates” for reclosing? These states will need them!
  - Reopening and reclosing, sadly, is a plan but not a strategy. It is perfectly designed to keep  $R_0$  at one and to keep infections and deaths linear... for the next two years.
- Speaking of the danger of “second waves,” take a look at the new outbreak in Harbin (China), the Wuhan-sized capital of Heilongjiang in Manchuria.
- Did Chinese labs create SAR-CoV-19? Deliberate fabrication, very unlikely. Escape from research lab, very possible... but we may never find out.
- With rigorous test-and-trace containment, New Zealand may become the new Taiwan.

# THE SITUATION IN... ITALY

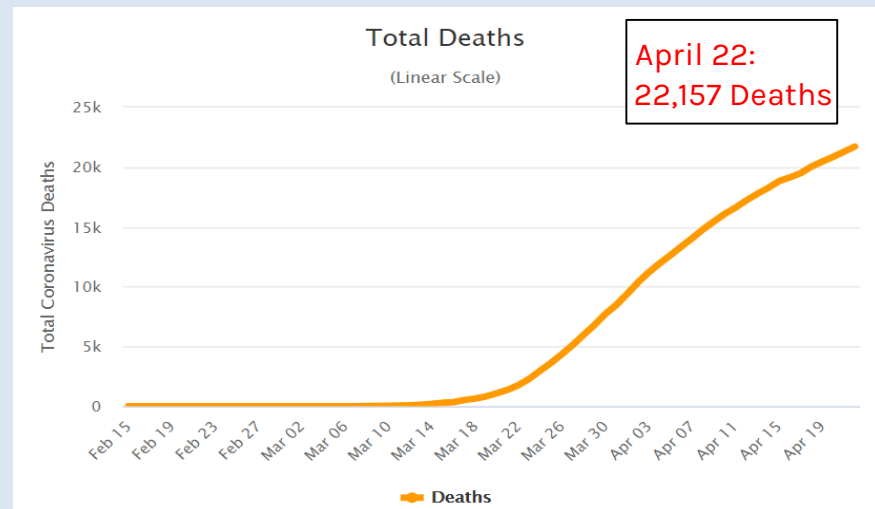
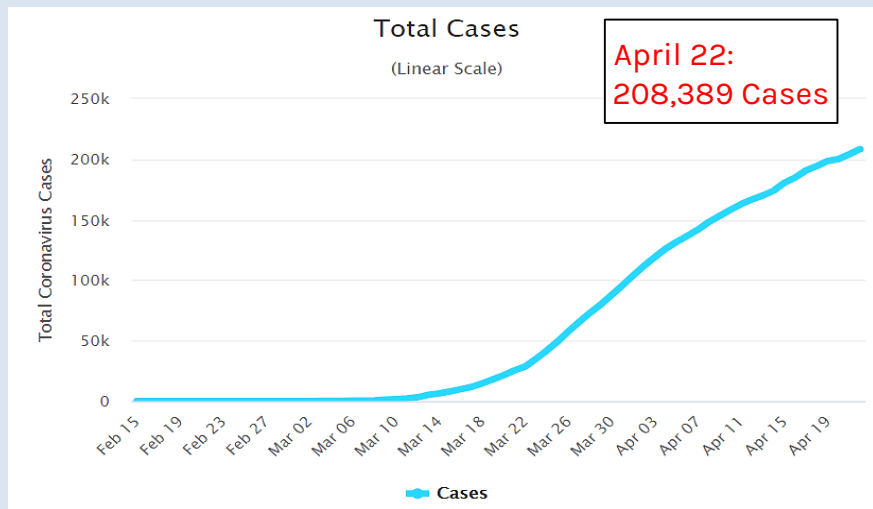
5

## COVID-19 Cases and Deaths in Italy Updated April 23, 2020



# THE SITUATION IN... SPAIN

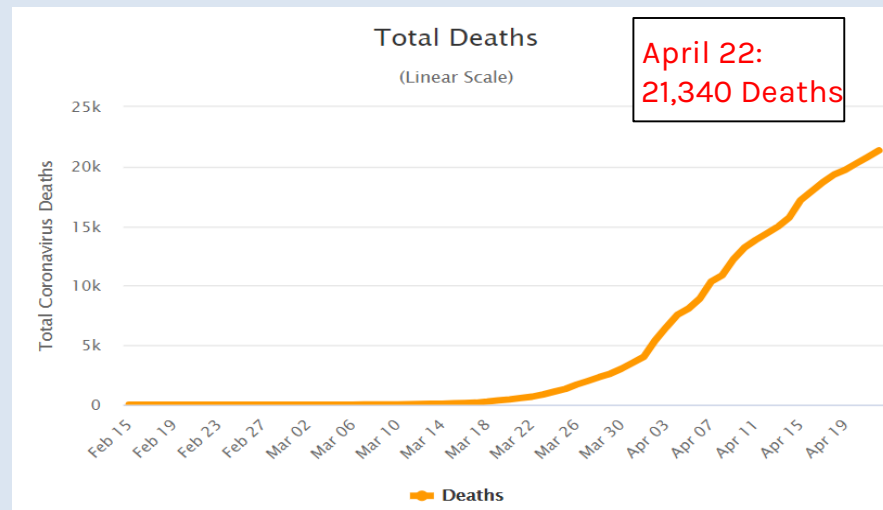
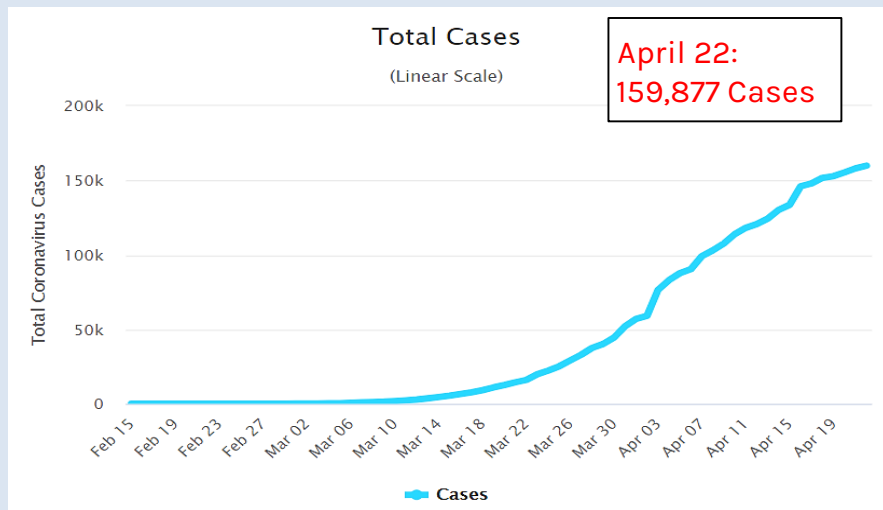
## COVID-19 Cases and Deaths in Spain Updated April 23, 2020



# THE SITUATION IN... FRANCE

7

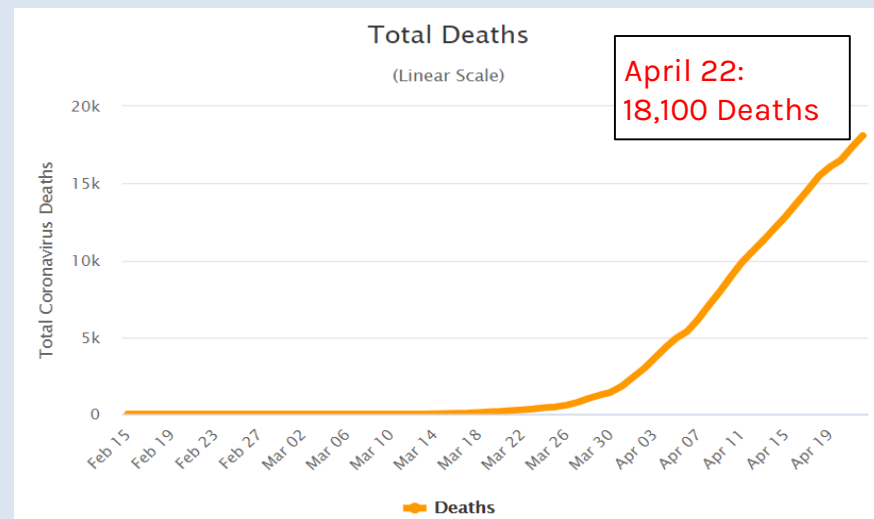
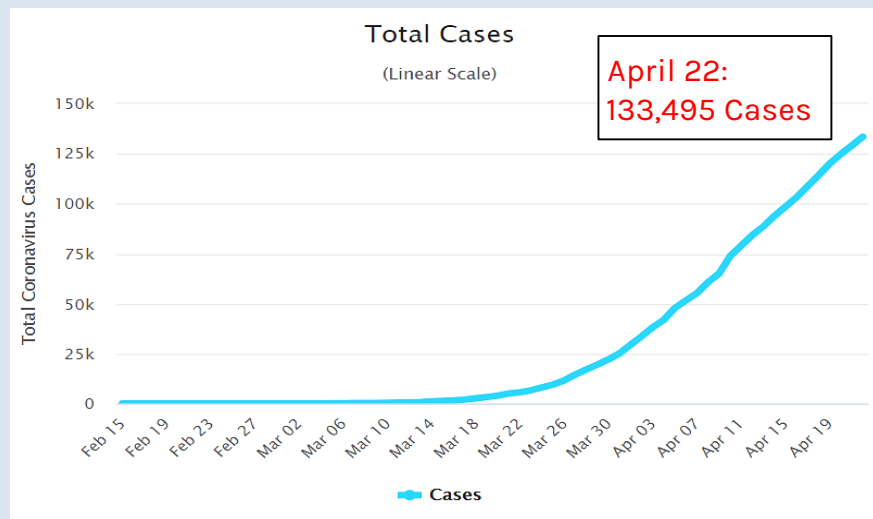
## COVID-19 Cases and Deaths in France Updated April 23, 2020



# THE SITUATION IN... UK

8

## COVID-19 Cases and Deaths in UK Updated April 23, 2020

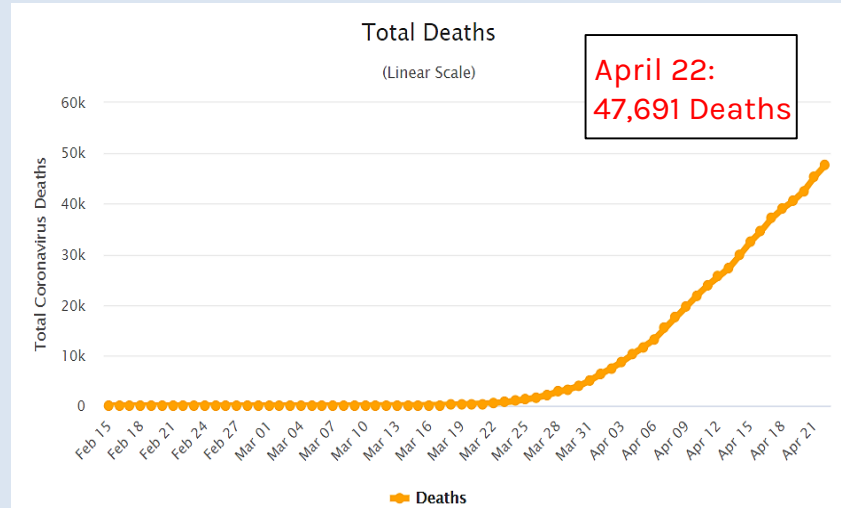
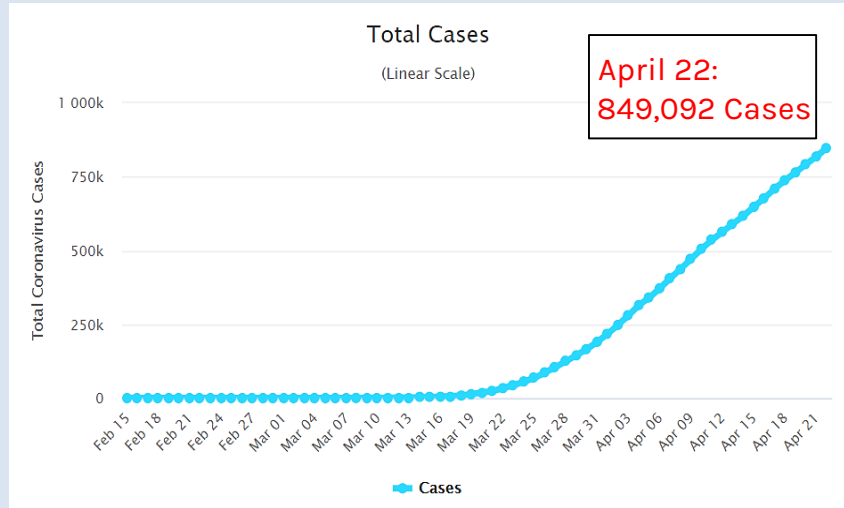




# THE SITUATION IN... USA

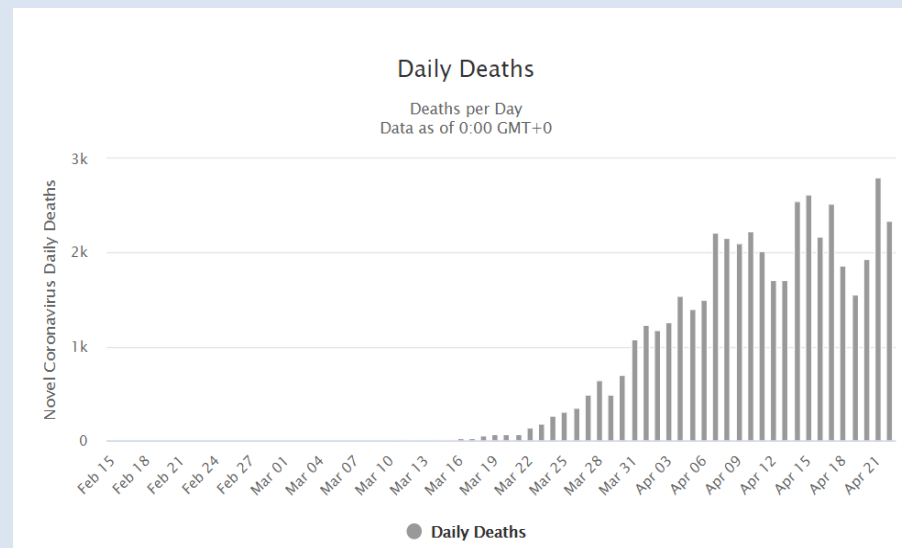
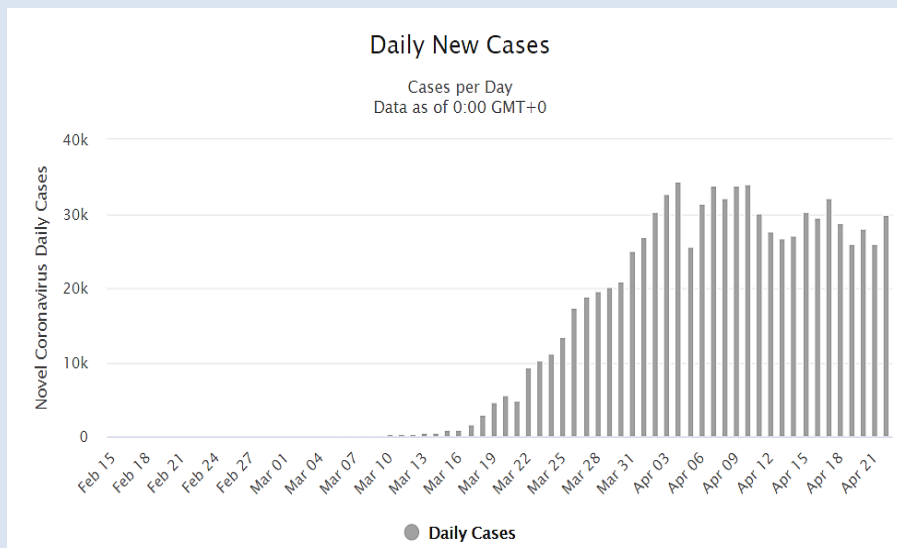
9

## COVID-19 Cases and Deaths in USA Updated April 23, 2020



# THE SITUATION IN... USA

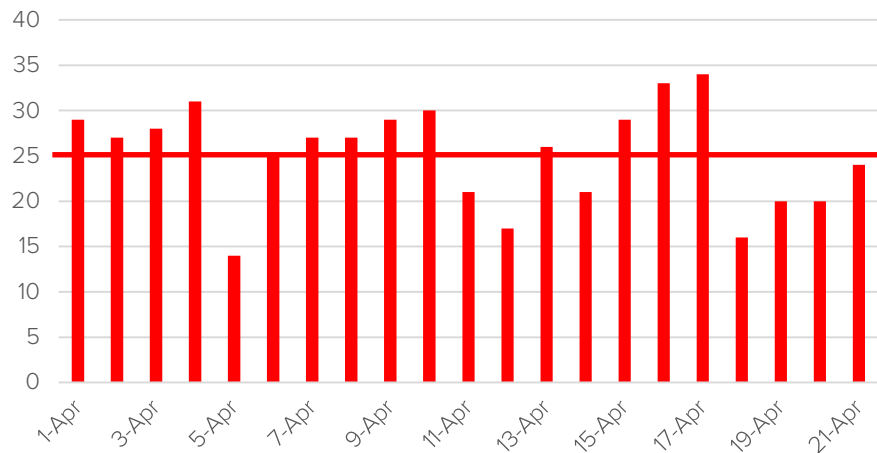
## COVID-19 Daily Cases and Deaths in USA Updated April 23, 2020



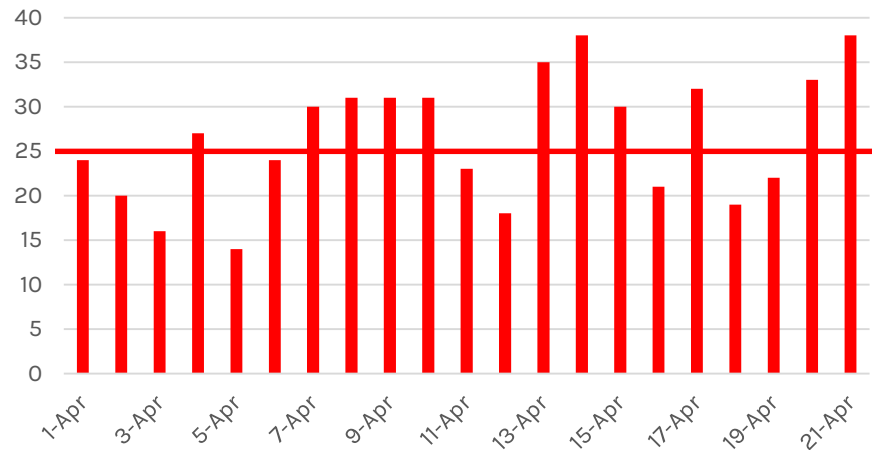
# STATE DIFFUSION INDEX IN CASES & DEATHS

Number of US States Whose Case and Death Count Was Larger or Equal Than Previous Day.

Cases

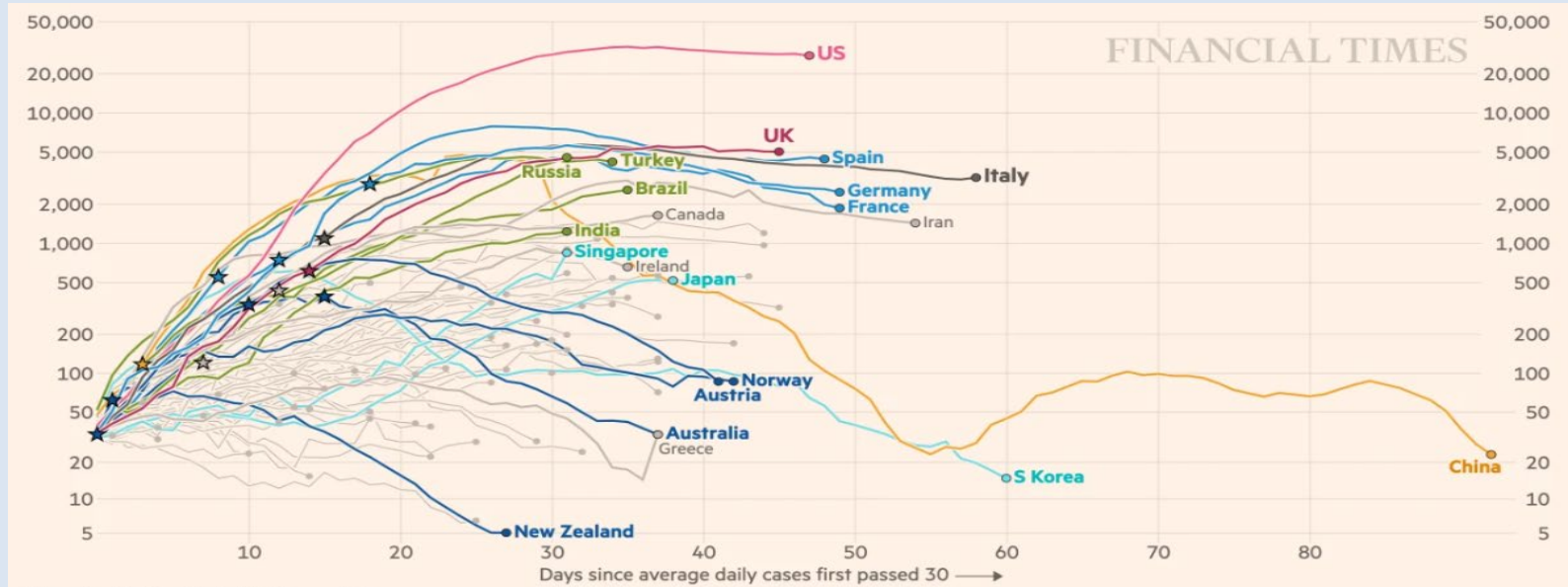


Deaths



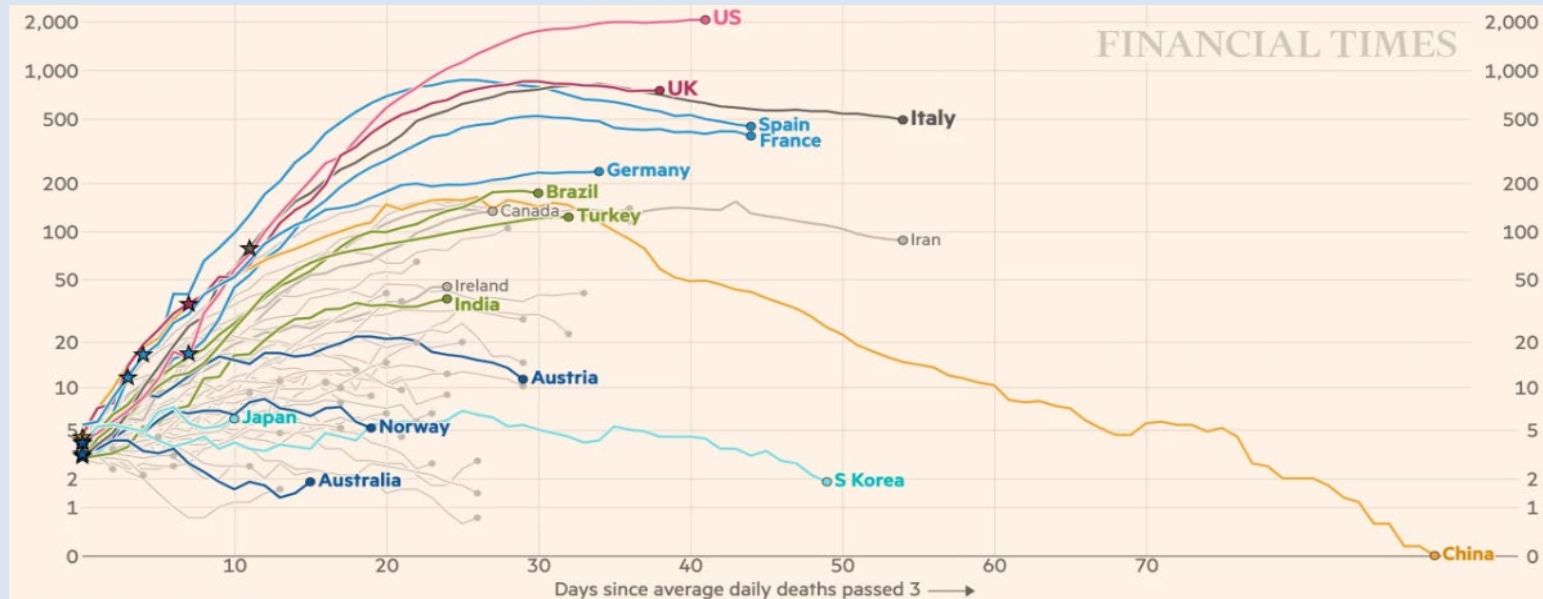
# U.S. STAYS ABOVE THE REST

Daily COVID-19 Cases, Seven Day Rolling Average.  
Updated April 23, 2020.



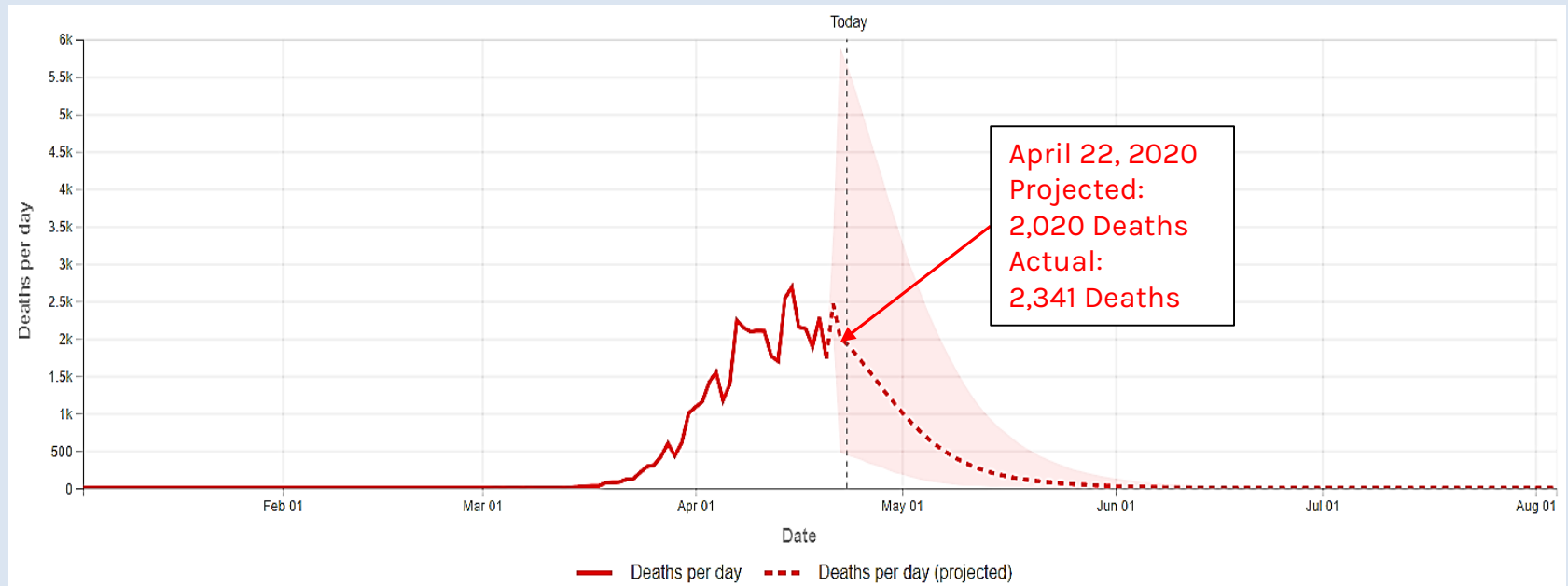
# U.S. STAYS ABOVE THE REST

Daily COVID-19 Deaths, Seven Day Rolling Average.  
Updated April 23, 2020.



# THE PEAK IS OVER?

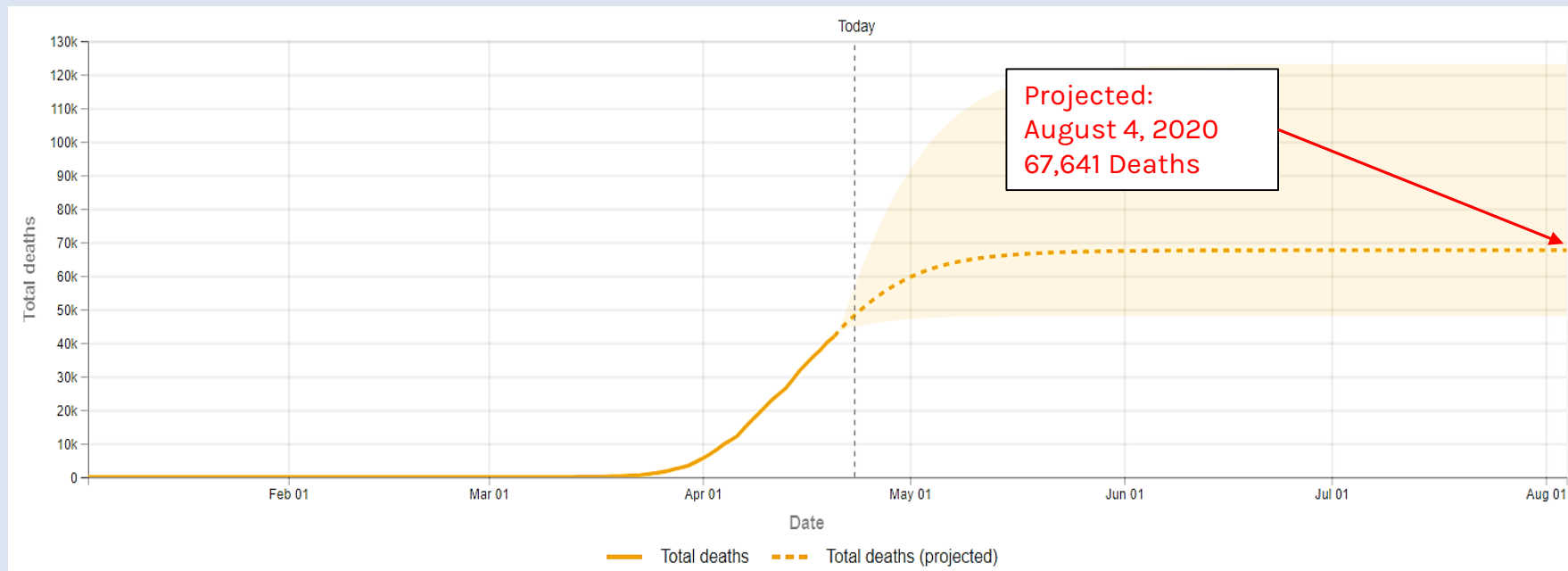
## Projection of Daily COVID-19 Deaths, Last Update April 22, 2020.



“Current social distancing assumed until infections minimized and containment implemented.”

# THE PEAK IS OVER?

## Projection of Total COVID-19 Deaths, Last Update April 22, 2020.



“Current social distancing assumed until infections minimized and containment implemented.”

# TRIANGULATING THE TRUE INFECTION RATE

## HOW TO MEASURE THE POPULATION INFECTION RATE... THREE METHODS

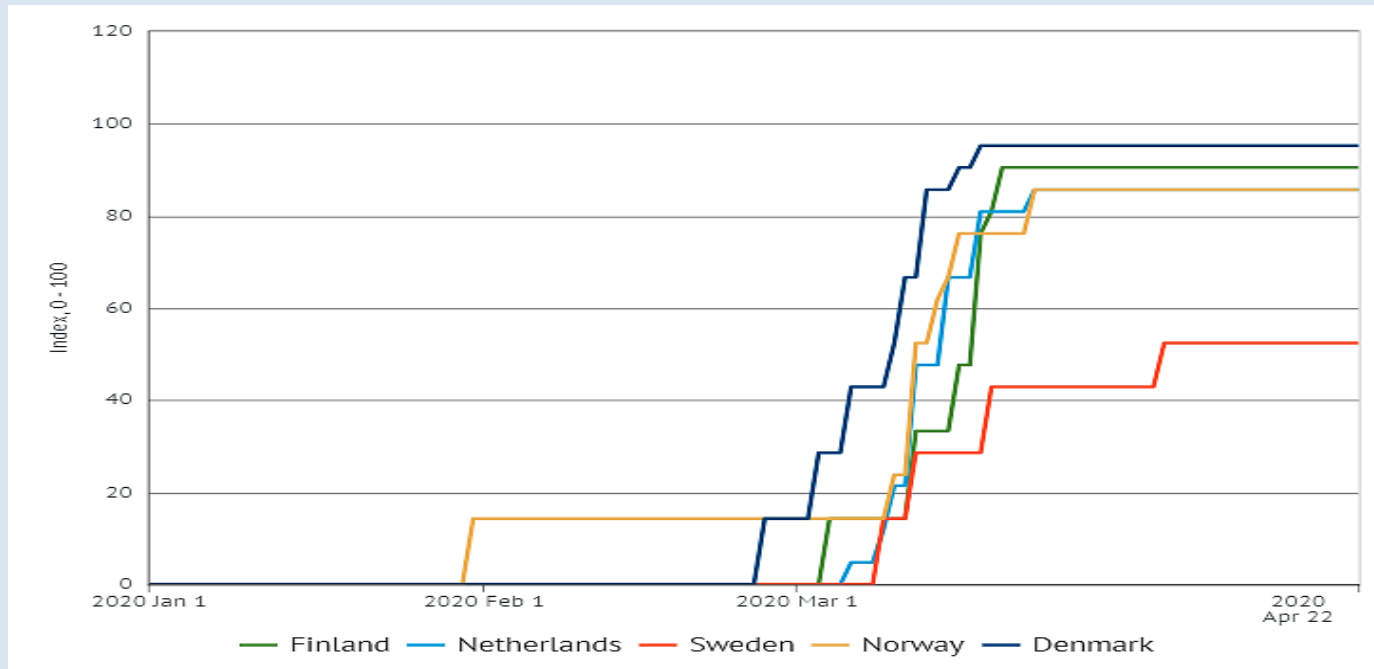
- METHOD ONE: DIRECT MEASUREMENT WITH PCR TESTING
  - Universal or Random PCR tests: Vo, Italy (3%); Shanghai (2%)
  - Much higher than highest national Rates: Iceland (0.6%); Luxembourg (0.6%); Spain (0.4%); etc.
- METHOD TWO (BETTER): DIRECT MEASUREMENT WITH SERUM ANTIBODY TESTING
  - Santa Clara, CA (3,300): 2.5-4.0%
  - San Miguel County, CO (2,583): 0.7-2.3%
  - Los Angeles County, CA (1,100): 2.8-5.6%
- METHOD THREE (INDIRECT): WORK BACKWARD FROM INFECTION FATALITY RATE (IFR)
  - We know the IFR\* ranges from 0.5% to 0.9% [see earlier COVID-19 reports!]
  - Given  $\approx 2,000$  deaths/day, that implies 220K-400K new cases/day 21 days earlier
  - Which implies new cases/day 7X to 13X greater than reported cases ( $\approx 30,000$ /day)
  - AND implies total cases of 6.0M to 11.1M, or 1.8% to 3.4% of US population.

\* Note: This IFR is based on “confirmed cases”; to make them comparable to CDC statistically inferred IFRs, they would be 2X greater, i.e., 1.0% to 1.8%.



# TAKE A LOOK AT THE NORDIC COUNTRIES

Nordic Countries by Government Stringency, Updated April 22, 2020.



# TAKE A LOOK AT THE NORDIC COUNTRIES

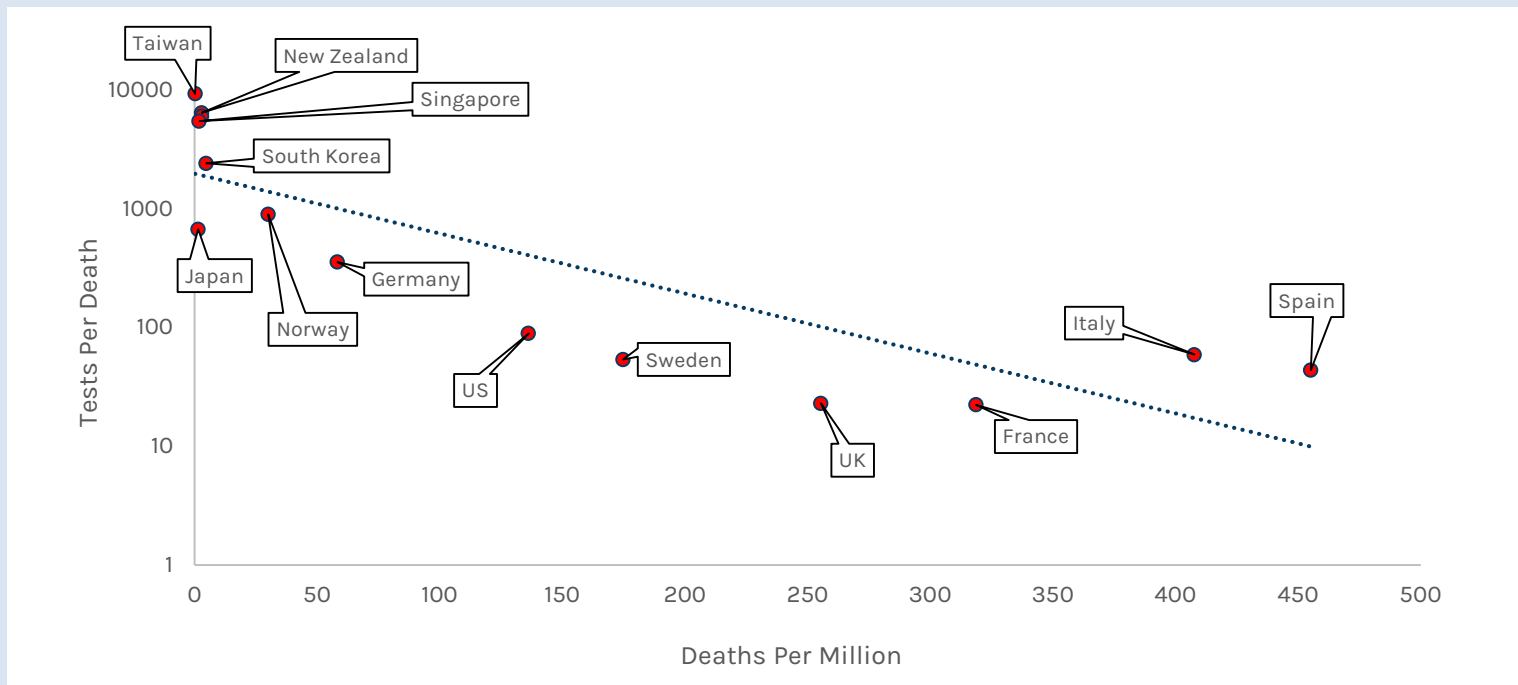
## Nordic Countries by Stringency, Mobility, and Cases/Deaths Per Million

|                    | Denmark | Finland | Norway | Netherlands | Sweden |
|--------------------|---------|---------|--------|-------------|--------|
| Stringency Index   | 92      | 90      | 85     | 85          | 52     |
| Retail Mobility    | -31%    | -51%    | -43%   | -46%        | -41%   |
| Workplace Mobility | -23%    | -30%    | -36%   | -24%        | -24%   |
| Transit Mobility   | -52%    | -54%    | -55%   | -51%        | -36%   |
| Cases per Million  | 1,366   | 745     | 1,342  | 2,033       | 1,585  |
| Deaths per Million | 66      | 27      | 316    | 237         | 192    |

# AHEAD ON TESTS... BEHIND ON DEATHS

19

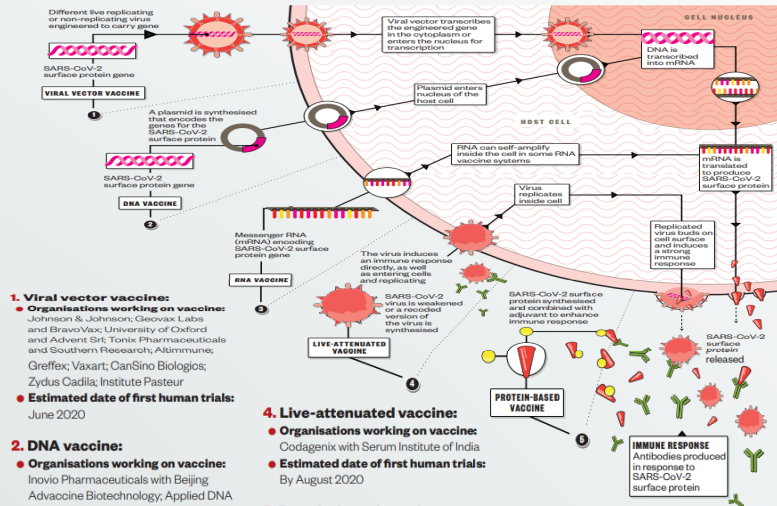
## COVID-19 Tests per Death VS Deaths Per Million Persons



# VACCINES... THE BASIC PLATFORMS

## Vaccine development

There are five main approaches being taken to develop a vaccine against SARS-CoV-2, with several biotechnology companies, academic organisations and pharmaceutical companies employing different technologies in the race to bring their vaccine candidate to clinical trials. The World Health Organization (WHO) hopes that a vaccine will be available by October 2021.



- 1. Viral vector vaccine:**
- Organisations working on vaccine: Johnson & Johnson; Geovax Labs and Bravovax; University of Oxford and Advent Srl; Tonix Pharmaceuticals and Southern Research; Altimmune; Greffex; Vaxart; CanSino Biologics; Zydus Cadila; Institute Pasteur
  - Estimated date of first human trials: June 2020

- 2. DNA vaccine:**
- Organisations working on vaccine: Inovio Pharmaceuticals with Beijing Advaccine Biotechnology; Applied DNA Sciences; Takis Biotech and Evvix; Zydus Cadila
  - Estimated date of first human trials: April 2020

- 3. RNA vaccine:**
- Organisations working on vaccine: CureVac; Moderna and US National Institute of Allergy and Infectious Diseases; Stermira Therapeutics; Tongji University and Chinese Center for Disease Control and Prevention; Imperial College London; Aroturus and Duke-NUS Medical School; Singapore; BioNTech and Pfizer
  - Date of first human trials: March 2020

- 4. Live-attenuated vaccine:**
- Organisations working on vaccine: Codagenix with Serum Institute of India
  - Estimated date of first human trials: By August 2020

- 5. Protein-based vaccine:**
- Organisations working on vaccine: Novavax; Clover Biopharmaceuticals with GSK; Baylor College of Medicine, University of Texas Medical Branch, New York Blood Center and Fundan University, China; University of Saskatchewan, Canada; University of Queensland, Australia, GSK and Dynavax; Vaxart; Genex; ExpreS2ion; Vaxil Bio; Sanofi Pasteur; iBio/OCC-Pharming; Genex and EpiVax; Walter Reed Army Institute of Research and United States Army Medical Research Institute of Infectious Diseases; EpiVax and University of Georgia
  - Estimated date of first human trials: By June 2020

### Immune response:

- It is not known how strong the immune response needs to be to protect against SARS-CoV-2; therefore, some of the vaccines being developed may not work.
- Before candidates reach clinical trials, investigators must also ensure they induce protective immunity, not immunopathology, as was seen in early attempts to develop a SARS-CoV vaccine after it emerged in 2002.

## FIVE BASIC TYPES OF VACCINE PLATFORM

### 1. Live-Attenuated or Inactivated Vaccine

Either a tweaked/recoded (& harmless) version of SARS-CoV-19 itself. Or a “weakened” version of the virus.

### 2. Protein-Based (Antibody) Vaccine

Synthesize surface protein from SAR-CoV-19; add adjuvant; and mass produce.

### 3. Viral-Vector Vaccine

Make a different (harmless) vaccine that contains recombinant gene for replicating surface protein.

### 4. DNA Vaccine

Make a plasmid that contains recombinant gene for replicating surface protein.

### 5. RNA Vaccine

Make mRNA that directly replicated the surface protein.

OLD TECHNOLOGY

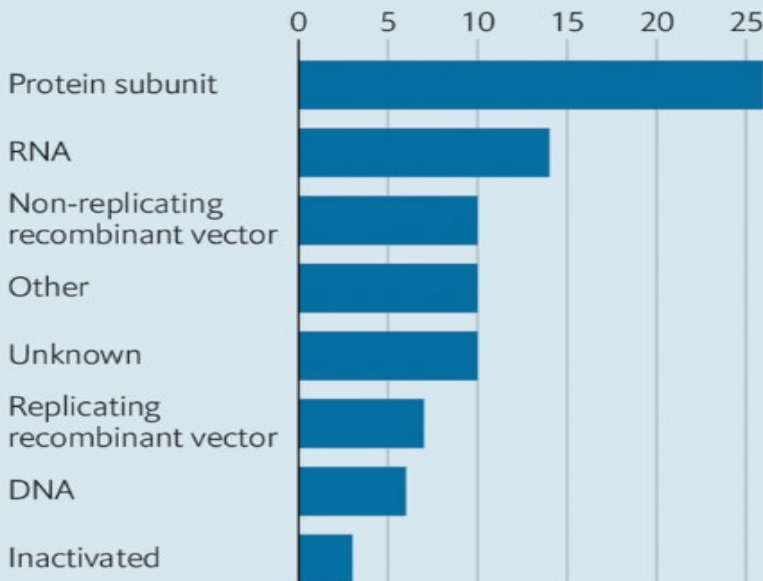
NEW TECHNOLOGY

# VACCINES... PERILS & OPPORTUNITIES

## On the oche

Covid-19 vaccines reported to be in development

Total=86, at April 15th 2020, by type



Source: Milken Institute

## OBSTACLES TO VACCINE DEVELOPMENT & DEPLOYMENT

1. Typically, virus vaccines takes many years (even decades) to develop. Safe & effective vaccines for some viruses has never been discovered.
2. Development typically requires TIME... to avoid (a) spotty effectiveness, (b) induced auto-immunity; (c) antibody dependent enhancement (ACE); (d) unrelated negative side-effects; or (d) rapid viral evasion via mutation.
3. Once successful candidates are identified, scaling up production for billions in < one year would be without precedent. Few firms currently maintain excess capacity.
4. Will national “winners” share vaccine access across borders? Brace for terrific propaganda battles over sharing the spoils of R&D.