

The SlowCOVIDNC App: Safe and Effective?

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North Carolina's new tool for containing the pandemic



SlowCOVIDNC Exposure Notification App

N.C. Department of Health and Human Services (NC-DHHS), in conjunction with Apple and Google - introduced 10/2020

Covid-19 / SARS-CoV-2

Current pandemic involves a viral disease caused by a novel coronavirus

- SARS-CoV-2, for "serious acute respiratory syndrome, coronavirus #2"

The disease itself is referred to as covid-19

- indicative of 'COronaVIRus Disease 2019'

In turn, the virus' name makes reference back to the original SARS-CoV-1

SARS-CoV-1

SARS-CoV-1 began in late 2002 as a mysterious pulmonary illness

- Had all the hallmarks of a viral disease, but no heretofore known agent was identified
- First known case in Guangdong province China in Nov 2002

Contained by June 2003, with total of about 8,000 cases, 11% mortality

Spread to 29 territories, but <1000 cases were outside China, Taiwan and Hong Kong

SARS-CoV-1

SARS-CoV-1 is a zoonotic virus

- Its normal host is an animal, and only caused disease in humans by "making the leap" across species

The virus exists in a reservoir in cave-dwelling horseshoe bats in Yunnan, China, and spread to humans by way of Asian palm civets, the meat of which is consumed by humans in China

A wonderful book on zoonoses is "Spillover" by David Quammen

- Spillover is more frequent - and terrifying - than we realize
- We should have known that something like covid-19 was almost inevitable and been more prepared

SARS-CoV-1

WHO and its Global Outbreak Alert and Response Network played a major role in scoping and responding to this epidemic

Response was hampered by Chinese officials' initial poor cooperation

However, once all got on the same page, it was brought under control relatively fast

Could have been much worse, including resulting in a major pandemic like we are seeing with SARS-CoV-2

Covid-19

Not going to give a full recap

- We are inundated with information, and most of us are well-informed on the history of its spread

Important points

- Spreads person-to-person via respiratory route - droplets, aerosols, surface transfer
- Facial coverings are effective in reducing spread
- Many cases are asymptomatic, spread without being aware

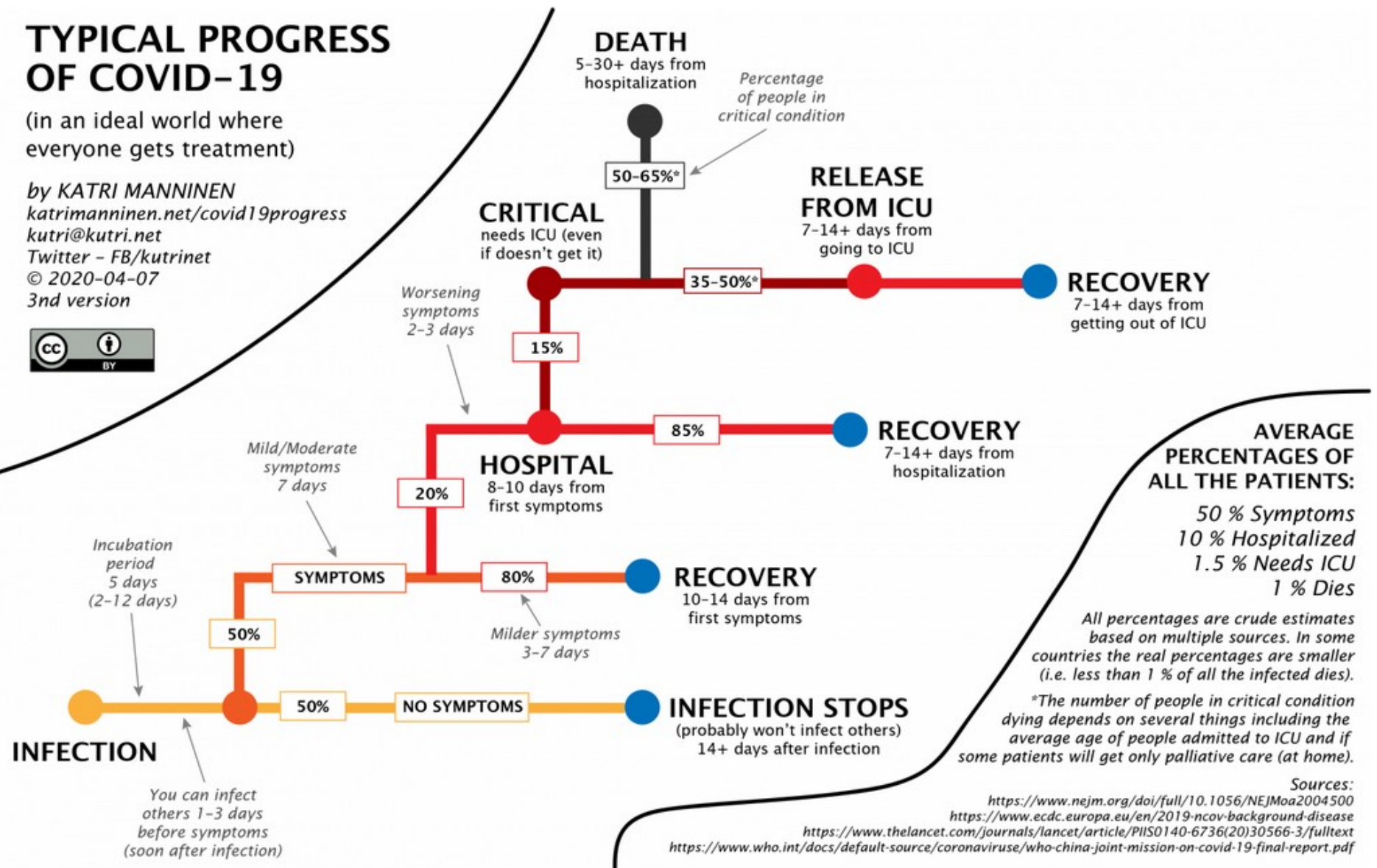
Current statistics

- 35M cases globally; 1.0M deaths; 8.0M active cases
- 7.6M cases in the US; 214K deaths; 2.6M active cases

TYPICAL PROGRESS OF COVID-19

(in an ideal world where everyone gets treatment)

by **KATRI MANNINEN**
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 3rd version



Control of the pandemic

Ultimate goal: Eradication

Interim goal: Containment

- Break the chain of infection
- Testing to diagnose
- Isolation of cases
- Contact tracing
- Immunization
- Herd immunity - default: failure of other techniques -> large number of infections

Contact Tracing

The time-tested means of containing the spread of an infectious disease

An example of "shoe-leather" epidemiology: painstaking gathering of evidence by obtaining information from cases and analyzing it to determine the routes and velocity of spread





Ask about contacts



Test and watch for symptoms during incubation period



If contact shows symptoms or tests positive



Ask about contacts



Test and watch for symptoms during incubation

Repeat cycle until no new patients

contact shows no symptoms after incubation period



Contact not at risk of developing disease

? Missed contact



May spread to new contacts

If contact shows symptoms or tests positive



Ask about contacts

If no contacts, no further spread

Contact tracing finds cases quickly so they can be isolated to reduce spread.

Pause for Questions

Exposure Notification

The recent addition to contact tracing is a new technology: "exposure notification"

Use your smartphone - which I will just refer to as a "phone" - to inform you that you have been exposed to an infected person

Phones were used in China and some other Eastern countries to trace people's movements and correlate them, in order to identify who might have been exposed

- Adjunct to contact tracing
- Invasion of privacy - data obtained could be used for nefarious purposes by the governments
- Not an acceptable solution in Western democracies
- Nevertheless, may have been a critical tool in containing the spread

Something different was needed in the West

Advantages of Phones for Notification

Nearly everyone has a phone now - even kids!

We have our phone with us constantly

Notification works automagically, with no effort on our part

App does not intrude on our time or attention, unless it needs to notify us of an exposure

Bluetooth Low Energy

Tiny radio embedded in phone communicates between two phones at close range

Sends & receives with built-in antenna

Digital message packets

Operates in 2.4 GHz band (microwave)

Range up to about 100 ft

- Signal strength as a proxy for distance between phones

Wide variety of applications (data, audio, proximity, etc)

History of Exposure Notification

Three main approaches to using phones came into being concurrently through collaboration among universities and institutes as covid-19 emerged in late winter 2020

- Pan-European Privacy-Preserving Proximity Tracing (PEPP-PT)
- Decentralized Privacy-Preserving Proximity Tracing (DP-PPT/DP-3T)
- TCN Protocol

All had successful preliminary trials in their regions

Germany, for one, adopted PEPP-PT

History of Exposure Notification

PEPP-PT would, however, require Apple to change settings in iPhones

Google and Apple formed a consortium (GAEN) and came up with a jointly-developed system

Apple refused to change settings for PEPP-PT

Germany decided to go with the GAEN system

It was, largely, game over - GAEN was adopted by Germany and subsequently many other countries by late April, 2020

History of Exposure Notification

The Google-Apple development was initially known as the Privacy-Preserving Contact Tracing Project

However, since actual contact tracing was not involved, the project was renamed the Exposure Notification System (ENS)

ENS more appropriately describes its main function - notifying people who have been exposed to cases

History of Exposure Notification

ENS was unveiled on April 10, 2020

It was first made available on May 20, 2020, as part of iOS update 13.5

Interaction sensing and recording is incorporated into the operating system (iOS, Android) itself to enhance responsiveness and lower burden on the phone

Positive test reporting is customized for each country or state and implemented in the app

Exposure Notification

vs.

Contact Tracing

Contact tracing puts the responsibility on the authorities to identify those exposed to the index case and take appropriate measures (i.e., quarantine, test)

- Loss of privacy inherent, but that loss considered a necessary evil to protect the health and safety of the public

Exposure notification puts responsibility on the citizen who has been notified of their exposure to a case to take appropriate measures

- Privacy generally well protected, but not absolutely guaranteed, depending on technical factors

Exposure Notification

vs.

Contact Tracing

Contact tracing is labor-intensive, hence, expensive, especially at large scale

- Most effective in early stages and before wide spread
- Asymptomatic cases complicate tracing, unless augmented by testing

Exposure notification is automated, requiring relatively little labor or other resources

- Depends on voluntary reporting, requires high level of trust and commitment

Exposure Notification

vs.

Contact Tracing

Not an either-or; rather, a both-and

Exposure notification alone will miss those without phones, those not using the app, and new cases who fail to submit their result

EN can notify exposed persons who the index case may not remember or know (e.g., sat at a nearby table in the same restaurant) in order for them to seek testing or quarantine themselves

Jack and Jill's encounter

Let's illustrate how it works with a story

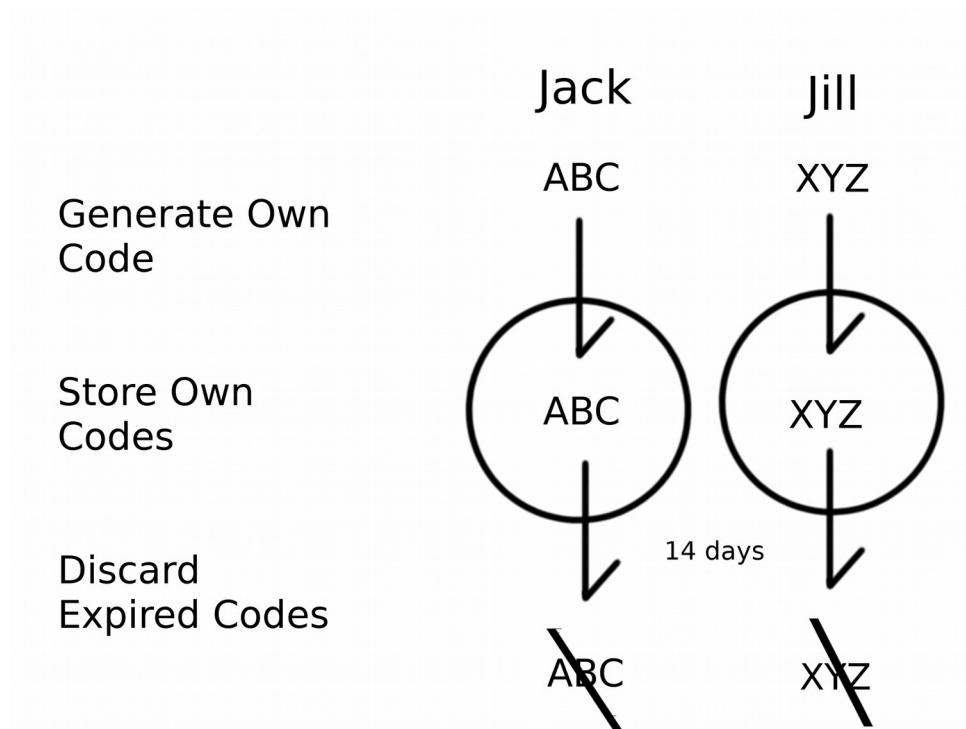
Jack goes out to eat at a restaurant

Jill works at the restaurant and is in Jack's vicinity
much of the time he is there

They don't know one another and don't have any
direct interactions

Both have downloaded the app and have their
Bluetooth activated

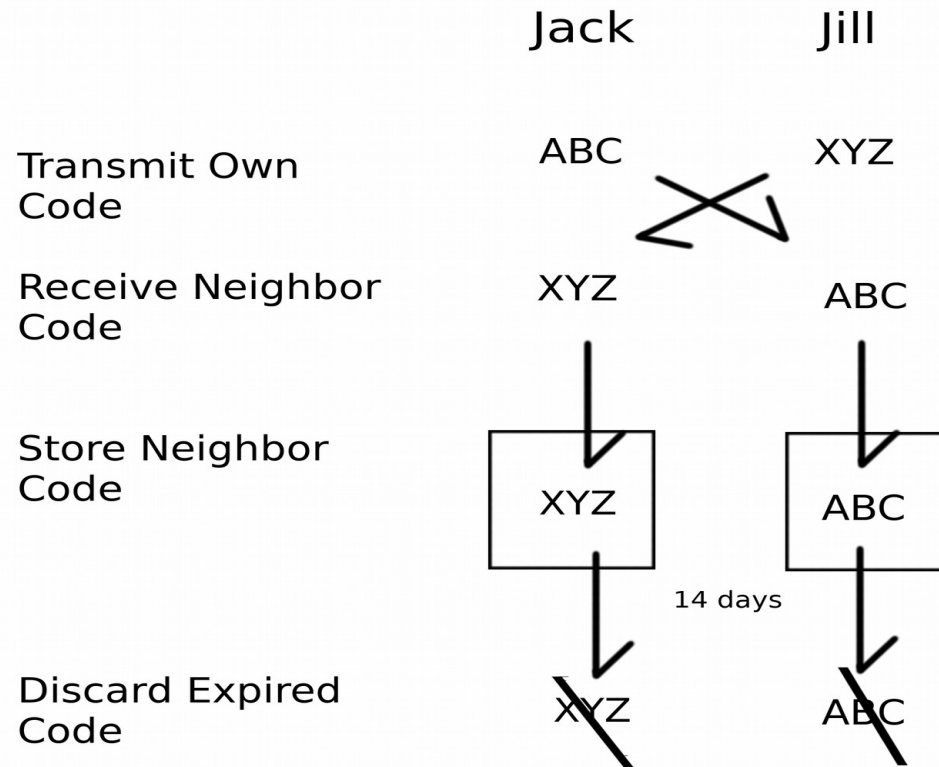
App Own Code Generation and Storage



~150 new random codes are generated daily

User stores codes for 14 days, then discards

App Neighbor Code Transmit, Receive, & Storage



Codes received from neighbor are stored,
along with distance and duration for 14 days

Oh, No! Jack tests positive!

Jack develops a sore throat, cough and fatigue 4 days after the encounter

He gets tested for the virus and is positive

Lab notifies Jack, and it notifies Health Dept if mandated by jurisdiction

Jack enters key code supplied by lab into app

- Prevents malicious users from submitting false results

App transmits Jack's "own" codes from the preceding 14 days to the central server

- Among them is "ABC" his phone sent and was received by Jill's phone

Central server sends all the "own" codes received from positive reports daily to all phones in the network

- Among them is "ABC"

The notification

Jill's phone receives daily report from the central server

Each code in the daily report is matched against every code in Jill's "received" codes from the preceding 14 days

The code "ABC" matches between daily report codes and stored codes

The distance and duration of the ABC code Jill received are compared to criteria for an encounter

- Weak signal or short duration do not merit notification
- Current threshold by NC DHHS: closer than 6 ft, longer than 15 min

If encounter exceeds threshold, Jill is notified by the app that she has been "exposed" and how many days ago the exposure occurred

What should Jill do?

She, and only she, knows that she has been exposed

She knows how many days previous the exposure occurred

She does not know to whom, where or what time of day the exposure occurred, and thereby anonymity is maintained

What should Jill do?

Recommended steps (NC DHHS - current):

- Self-quarantine for 14 days after the last known exposure, including this one; isolate from everyone, including family
- If symptoms occur, get tested immediately
- Get tested 6 days after the last known exposure, even if asymptomatic

In this example (test positive 4 days after encounter), Jill should:

- Get tested immediately if she is symptomatic
- Self-quarantine for another 10 days
- Get tested in 2 days if asymptomatic

Pause for Questions

Is the app effective?

Is it worth going to the trouble to use the app?

To approach the answer to this question, we might look to other jurisdictions that have started using the app

Germany started using it in May, 2020

Germany has many parallels to the US, including state of the economy, level of education, legal system and standard of living

What can we learn from comparing the US and Germany?

U.S. / Germany comparisons: Population

U.S. has 329,877,000 (2020 est.)

Germany has 83,167,000 (2019 est.)

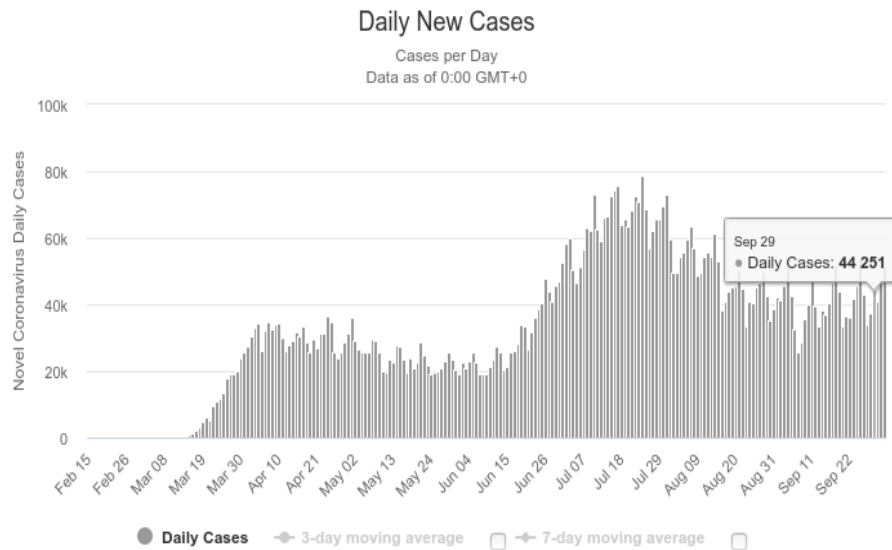
In round numbers, 320M vs. 80M

Germany's population is 1/4 that of U.S.

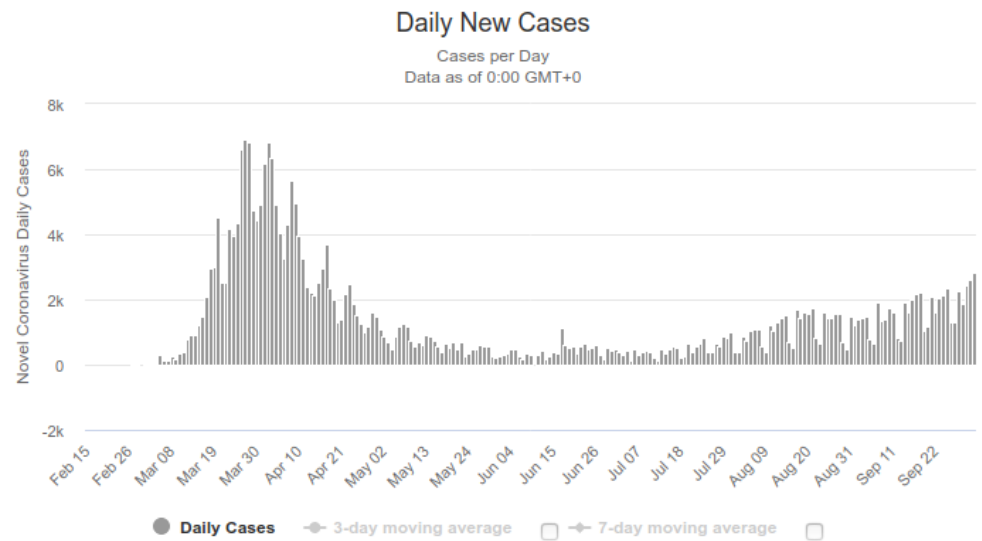
Comparison graphs on following slides are
from www.worldometers.info/coronavirus/

U.S. / Germany comparisons: Daily cases

Daily New Cases in the United States



Daily New Cases in Germany



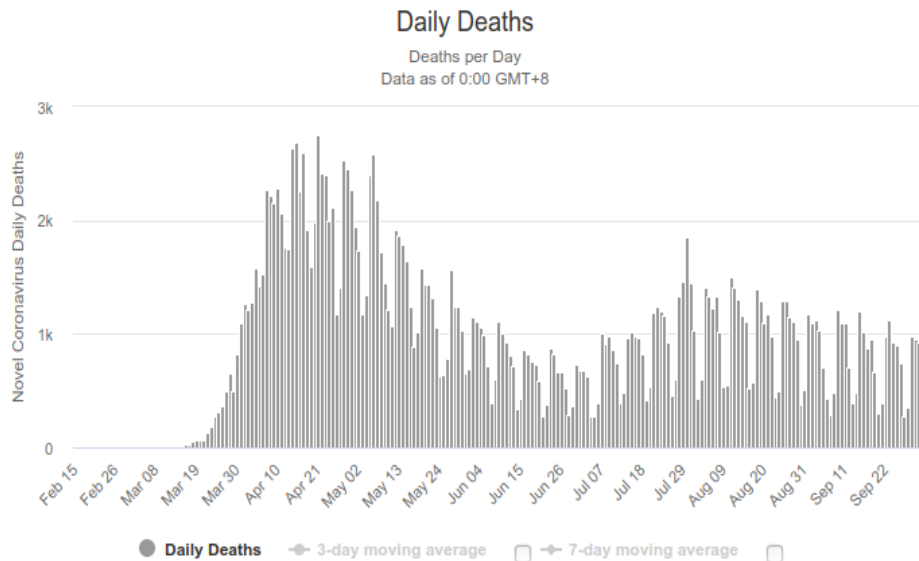
Germany spiked early, dropped low over the summer and increased in the past month

U.S. spiked, plateaued, spiked a second time, plateaued at a higher level

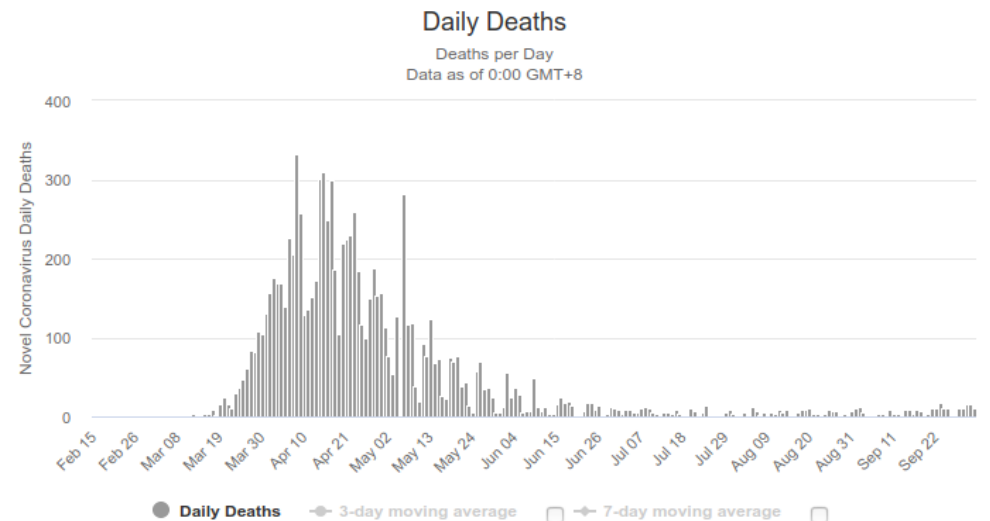
U.S. / Germany ratio currently 20:1 (40K vs. 2K daily); 5x expected

U.S. / Germany comparisons: Daily deaths

Daily New Deaths in the United States



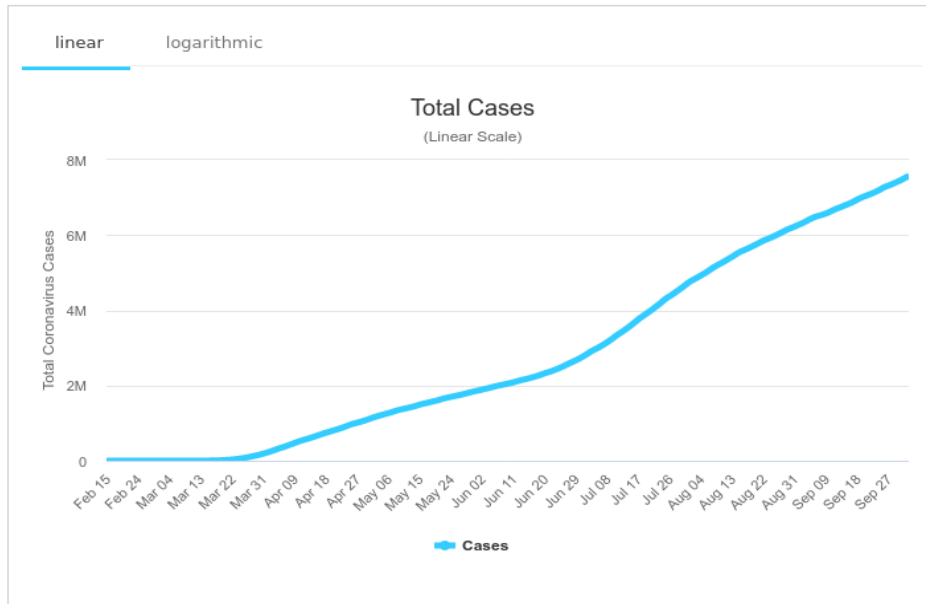
Daily New Deaths in Germany



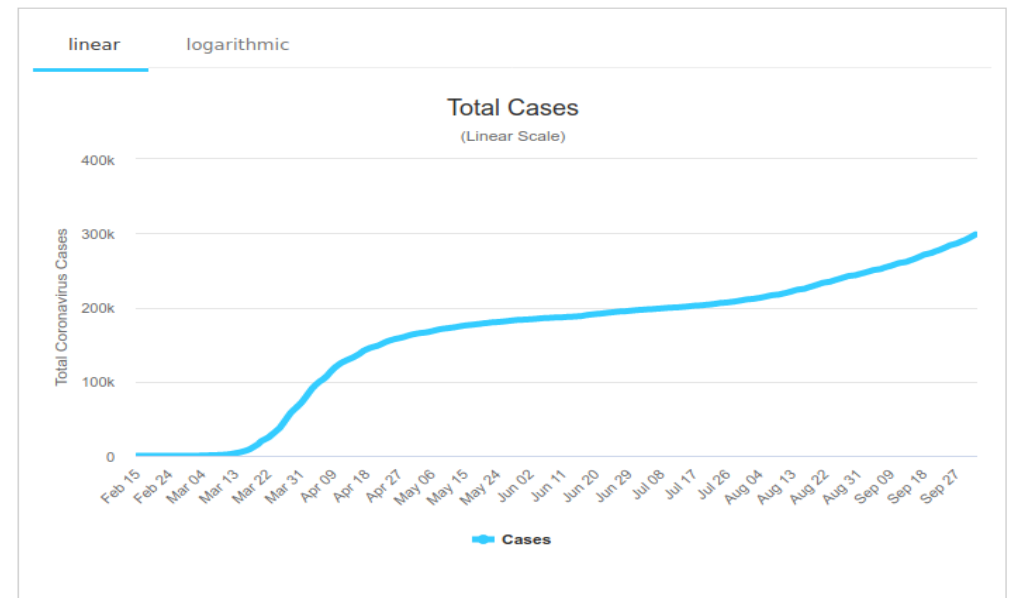
Germany spiked early, dropped low over the summer and remained low
U.S. spiked, plateaued, spiked a second time, plateaued at a higher level
U.S. / Germany ratio currently 50:1 (500 vs. 10 daily); 12x expected

U.S. / Germany comparisons: Cumulative cases

Total Coronavirus Cases in the United States



Total Coronavirus Cases in Germany



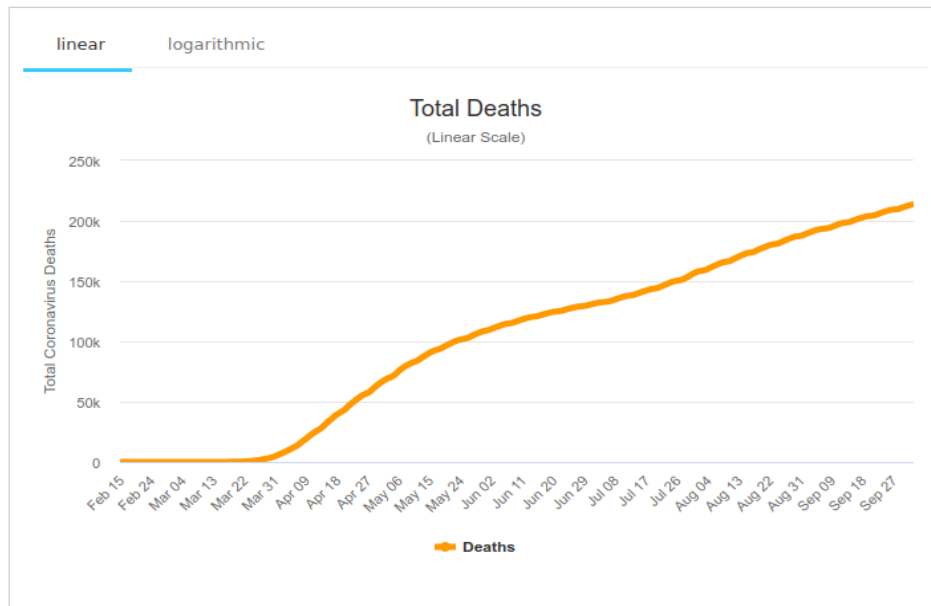
Germany rose early, steadied in early summer and resumed late summer

U.S. continuous rise, varying slope, constantly rising

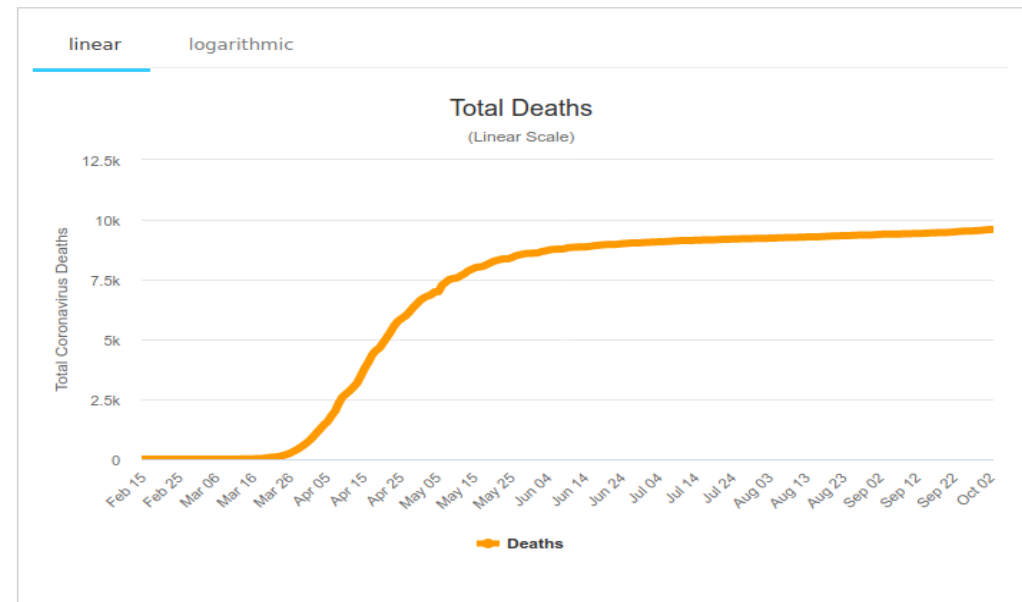
U.S. / Germany ratio currently 26:1 (8000K vs. 300K); 6.7x expected

U.S. / Germany comparisons: Cumulative deaths

Total Coronavirus Deaths in the United States



Total Coronavirus Deaths in Germany



Germany spiked early, plateaued from May onward

U.S. has continued a steady rise up to the present

U.S. / Germany ratio currently 20:1 (200K vs. 10K); 5x expected

U.S. / Germany comparisons: Discussion

Germany now has $1/5$ the number of daily cases per thousand population, compared to the U.S., but only $1/12$ the number of daily deaths

Germany's recent rise in cases, while the death rate remains low, reflects more cases in younger persons and catching more asymptomatic cases from wider testing

Pause for questions

Why Germany?

I learned about Germany's EN app in June, and have followed it with interest since

It was developed and deployed by the Robert Koch Institute, Germany's equivalent of our CDC

On its face, it seemed to be a very promising adjunct to contact tracing

RKI is updating, evaluating and making public the results of the app daily

How is the corona app doing in Germany?

They have a four month head start

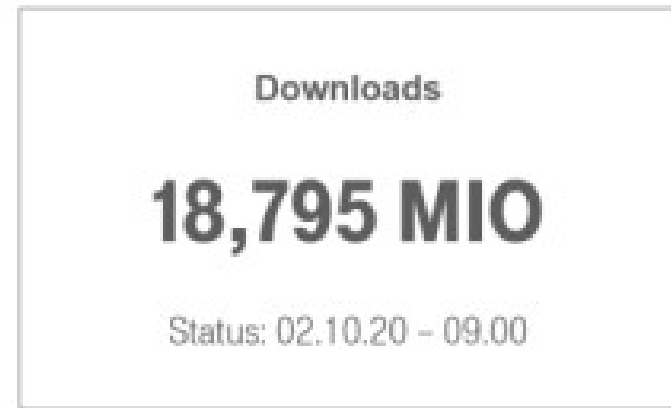
Perhaps we can learn something from their experience to guide our implementation

Under the hood, the back end of their app is the same as ours, developed by the Google-Apple consortium

The only difference is the front end, the notification piece, which each health authority has tailored to its individual specifications

Results to date: Germany

As of Friday, Oct 2, the app, known in Germany as Corona-Warn-App has been downloaded almost 19 million times in a country of 83 million (~23% of population)



Results to date: Germany

90% of lab results are accessible to the app

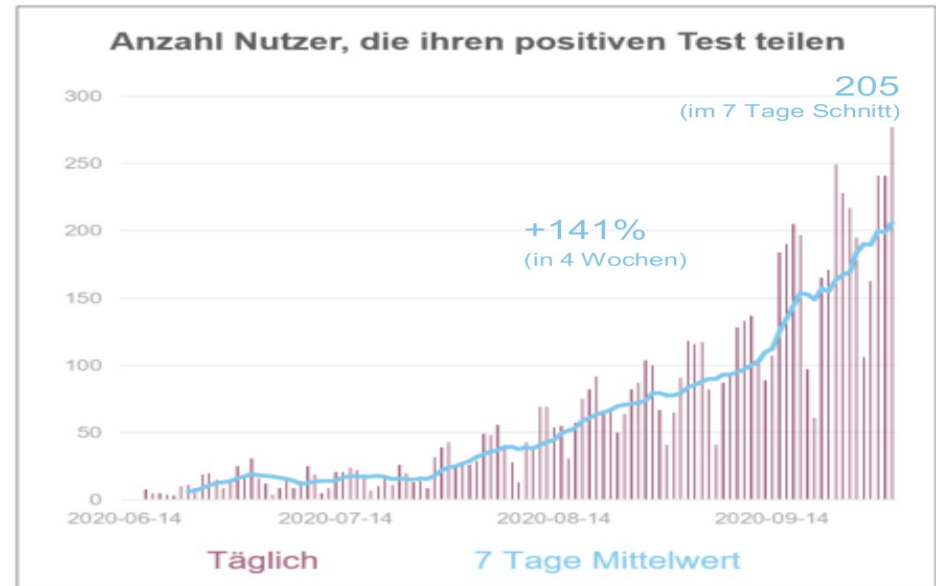
So far, 1.34 million lab results have been reported to the system from 141 labs



Results to date: Germany

Voluntary sharing of test results

- Users decide if they are willing to report
- During first month, only 10-20 cases per day were shared
- Rapid increase in next two months
- Currently 200 new cases reported a day on average (about 10% of daily new cases in Germany)



Results to date: Germany

Cumulatively, 7,120 cases have self-reported since inception, with 4,302 just in recent 4 weeks

Currently, daily new cases in Germany are running around 2,000

The app, with reporting, is capturing about 10% of new cases, but rising rapidly



Results to date: Germany

How many people have been notified as a result of the app?

How many of those have taken actions that would help reduce the spread?

How many infections have been prevented as a result of the app?

Is it effective in breaking the chain of infection?

These and similar questions are unanswerable, because notification is decentralized and anonymous



The App: Safe and effective?

Safety (privacy)

- Compared to the massive amount of personal data being collected on us as we surf, use social media and shop online, the app seems amazingly safe
- Compromising the privacy of users would be a massive undertaking. There are so many more rewarding data to be mined. Why bother?

Effectiveness

- Too few users yet to move the needle in the US
- Germany - four months of experience - provides insight into acceptance
- Privacy provisions make it nigh impossible to ascertain cause and effect relationships
- Modeling studies suggest that it could be a useful adjunct to - but not a replacement for - conventional contact tracing

Summary

SlowCOVIDNC is a phone app designed to notify an individual of exposure to someone who has tested positive for covid-19

The app is supplied and managed by the NC Dept of Health and Human Services, derived from a globally used platform developed by a Google-Apple consortium

Great care has gone into developing a system that preserves confidentiality and privacy

A nearly-identical app is in wide use elsewhere, notably Germany, where its adoption is rapidly increasing and users with positive tests are reporting to the system

- Germany is having remarkable success in reducing the number of serious cases and deaths, perhaps due in part to use of the app

Its greatest success in slowing the spread of the virus is highly dependent on widespread adoption (~50%), although even lesser degrees of use are likely of some value

I recommend that you give high priority to downloading and using this app, and encouraging everyone you know to do so as well

SlowCOVIDNC Information

Official web site for NC DHHS app

- <https://covid19.ncdhhs.gov/slowcovidnc>

Frequently Asked Questions (FAQ)

- Very informative

Questions or comments for me

- Edwin 'Ed' Cox, MD - ebcox@yahoo.com