Stopping the spread of the Covid-19 epidemic is possible if cases are identified fast and efficiently using a mobile phone app.

BDI Pathogen Dynamics Group
Oxford University

www.coronavirus-fraser-group.org
There is one truth in epidemiology:

If every infected person infects on average less than one other person \((R<1)\), the epidemic will eventually die out.

According to our calculations, individuals with Covid-19 currently infect on average two other persons \((\text{reproductive number } R = 2)\)

How can we reduce this number to less than 1?
How can we reduce R to less than 1?

The best way to stop every epidemic from spreading is a vaccine, but a Covid-19 vaccine will not be ready in time for the first wave.

We therefore have to resort to old methods of containment:

- Isolating patients
- Tracing their contacts and quarantining them
- Social distancing
Unchecked, the epidemic could grow to 100,000 cases in a little over a month.

We estimate a doubling time of 5 days.

460 confirmed cases on 12 March
Transmissions during the long pre-symptomatic period of Covid-19 make contact tracing a challenge.

46% of infections are estimated to be transmitted from pre-symptomatic individuals.

\[ R_0 = 2.0: \]

- \( R_p = 0.9 \) from pre-symptomatic
- \( R_s = 0.7 \) from symptomatic
- \( R_e = 0.2 \) from environmental
- \( R_a = 0.1 \) from asymptomatic
However, epidemic spread can be contained if cases are found fast and in sufficient numbers.
Isolating cases and quarantining contacts quickly is critical

Average delay between index case diagnosis and start of contact quarantine

Epidemic growth rate

Interactive version: see https://bdi-pathogens.shinyapps.io/covid-19-transmission-routes
Isolating cases and quarantining contacts quickly is critical
Classical contact tracing is slow, but a mobile app can trace contacts instantaneous, efficiently, and at scale.
The app records which other phones have been close and immediately alerts all contacts of diagnosed cases.
User uptake and testing capacity need to be high for the concept to work.

- Good user buy-in
- Efficient contact tracing
- Continuous investment in testing

Ideally 60+ % Opt-out automatic installation?

1000 cases, 20 contacts = 20,000 test per day
User uptake and testing capacity need to be high for the concept to work

Whilst testing capacity is limited, it is feasible to use empirical diagnosis, though that will result in false positives. But still not a lockdown.

Ideally 60+ % Opt-out automatic installation?

1000 cases, 20 contacts = 20,000 test per day

Good user buy-in  Efficient contact tracing  Continuous investment in testing
The app is a way to avert large number of deaths and substantial economic damage.

Keogh-Brown et al (2010) estimate the cost of 10 days of quarantine of the whole UK workforce to be 0.9% of GDP.
The app will be crucial, regardless of whether there is a general lockdown or not.

<table>
<thead>
<tr>
<th>No lockdown</th>
<th>Partial lockdown</th>
<th>General lockdown</th>
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<tr>
<td>Given high enough uptake, epidemic can be stopped with little economic damage</td>
<td>E.g. access to public transport, etc. only with app and “all clear” message.</td>
<td>E.g. app with “all clear” message can be used to leave the lockdowned areas</td>
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<td>Reduces the economic effects of a general lockdown</td>
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After the end of the general epidemic, the app helps to quickly trace newly imported cases and stop local outbreaks
The app enables evidence-based decision making

Policy makers

Use for implementation of relevant policies

Mobile app

Produces real-time data for evidence-based decision-making
Continuous ethical oversight is required as the app evolves during the epidemic.
Networked Apps have revolutionised every sector of service and delivery sector. Why not public health?

Google maps provides real-time route optimisation by analysing networked phones.

Amazon: revolutionised delivery through networked apps.

Uber: revolutionised taxi industry.

Slack: revolutionised how teams are organised.

The networked COVID app we propose applies similar thinking

The current strategy seems to be to use modelling and information to optimise the deployment of 20th century public health measures.

We propose considering networked approaches that can significantly enhance prevention: the idea of a networked App approach having large impact is plausible (see recent scientific paper, Ferretti & Wymant et al)
Networked data-driven systems will facilitate any policy option. They increase the feasibility of controlling the epidemic.