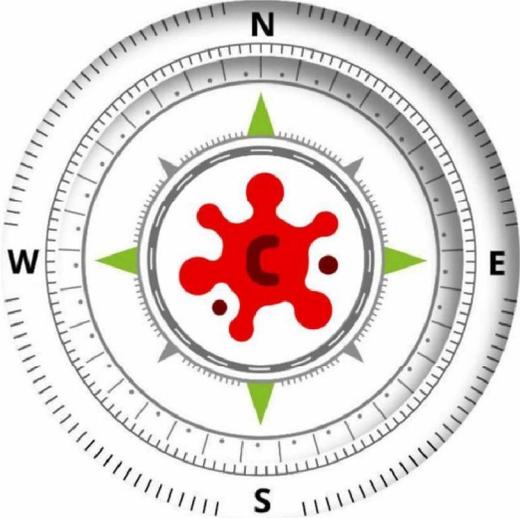




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**Navigating the COVID-19 crisis with technology**

April 17, 2020

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## Introduction

Whilst pandemics have impacted human lives before, we have never been on one hand as exposed to COVID-19 and on the other as well equipped to fight it as today

### Exposure

Compared to black death, smallpox, the Spanish flu, but also more recently SARS, globalization has increased our exposure, hence viruses can spread across the globe faster than ever before.



Source: <https://time.com/5803225/yuval-noah-harari-coronavirus-humanity-leadership/>

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### Equipped

*"Despite horrendous outbreaks such as AIDS and Ebola, in the twenty-first century epidemics kill a far smaller proportion of humans than in any previous time since the Stone Age"*<sup>1</sup>

This is due to 3 levers:

#### Science

*"During the last century, scientists, doctors and nurses throughout the world pooled information and together managed to understand both the mechanism behind epidemics and the means of countering"*<sup>1</sup>

#### Healthcare (& hygiene)

Strong healthcare system with emergency capacity being scaled up, e.g. shortage of respiratory equipment countered through production by companies like Dyson, Ford and even F1 teams

#### Technology

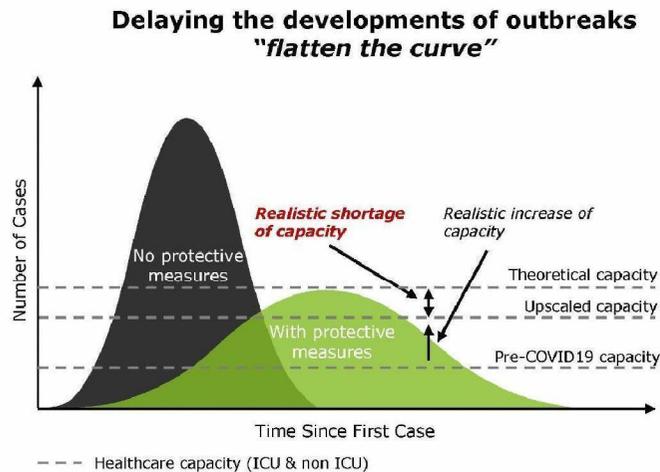
The whole world has been digitalized and everyone is traceable through their (smart)phones. We're more than ever able to trace spreading patterns, advice and (if wanted) even control citizens in their mobility & health.

**The question is: How can we leverage these technologies?**

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## “Flatten the curve”

Current measures are focused on ensuring the healthcare system is able to cope with the demand. Technology can support by providing information, advice and control



## Technology support

Technology’s contribution to ensure the healthcare system is able to cope with the demand by providing:

### Information

Extracting information from (large) amounts of data and distribute this information to all relevant stakeholders to enable better decision making

### Advice

Advising citizens and other stakeholders how to best adapt their behaviour to the current (and changing) situation

### Control

Stricter enforcements to make sure citizens and other stakeholders adhere to current (and future) measures

**The aim is to be as effective as possible taken into account the appropriate level of intrusiveness**

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## Deloitte research March-April 2020

A taskforce from Deloitte gathered and assessed technological solutions based on effectiveness, intrusiveness, citizen behaviour and economic impact

### What have we done to start leveraging technology?



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## Solution space

We distinguish five categories of technology solutions which countries use to fight COVID-19. Three are focused on location information and two on medical support

Category	Goal	Typical solution	Country examples
<b>A. Tracking groups of people</b>	<ul style="list-style-type: none"> <li>Understanding and (potentially) preventing spreading patterns by tracking and tracing movement patterns of people</li> </ul>	<ul style="list-style-type: none"> <li>Telcos sharing (anonymized) location data of mobile phones</li> <li>Tech companies (Facebook, Google) sharing (anonymized) location data</li> </ul>	<ul style="list-style-type: none"> <li>Austria, Belgium, China, Germany, Israel, Italy, South Korea, Netherlands, Russia, Taiwan, UK, US, global initiatives</li> </ul>
<b>B. Location control of individuals</b>	<ul style="list-style-type: none"> <li>Control the movement patterns of infected people (comply with quarantine)</li> <li>Control the movement patterns of healthy people (permit)</li> </ul>	<ul style="list-style-type: none"> <li>Mobile application to be installed by citizens with control mechanisms (mandatory)</li> </ul>	<ul style="list-style-type: none"> <li>Austria, Switzerland, China, Germany, Israel, Italy, South Korea, Netherlands, Poland, global initiatives</li> </ul>
<b>C. Location tracking &amp; advice to individuals</b>	<ul style="list-style-type: none"> <li>Inform citizens what locations to avoid due to high risk of infection</li> <li>Warn citizens on potential contact with infected person</li> </ul>	<ul style="list-style-type: none"> <li>Mobile application installed on voluntary basis</li> <li>Overlay in existing application, e.g. Google Maps, Baidu</li> </ul>	<ul style="list-style-type: none"> <li>China, Israel, Singapore, UK, US</li> </ul>
<b>D. Medical / Health advice to individuals</b>	<ul style="list-style-type: none"> <li>Share medical information and help citizens identify/diagnose their symptoms</li> <li>Help or prevent people falling ill through health advice</li> </ul>	<ul style="list-style-type: none"> <li>Mobile application installed on voluntary basis</li> </ul>	<ul style="list-style-type: none"> <li>China, Denmark, Indonesia, Israel, South Korea, Netherlands, UK, US, global initiatives</li> </ul>
<b>E. Professional medical support</b>	<ul style="list-style-type: none"> <li>Support medical institutions &amp; professionals in treatment, containment and management of suspects and patients</li> </ul>	<ul style="list-style-type: none"> <li>Platform solution to enhance insights through AI learning or connect resources to for additional medical support</li> </ul>	<ul style="list-style-type: none"> <li>China, South Korea, Netherlands, Norway, New Zealand, global initiatives</li> </ul>



## Effectiveness vs Intrusiveness

Effectiveness and intrusiveness are considered the most important factors in order to assess solutions

### Effectiveness

"The degree to which a solution decreases the speed at which the coronavirus spreads" driven by 2 factors:

- Reach
  - The **number of people** that are targeted to change their behavior by the solution, based on phase in the citizen journey (healthy population → suspected population → infected population → immune population)
- Behavioral impact
  - The **likelihood** of a person changing behavior based on relevance and enforcement of the solution
  - How **drastically** a person is expected to **change behavior** based on the solution
  - The degree to which the solution may **relieve the pressure** on the healthcare system

### Intrusiveness

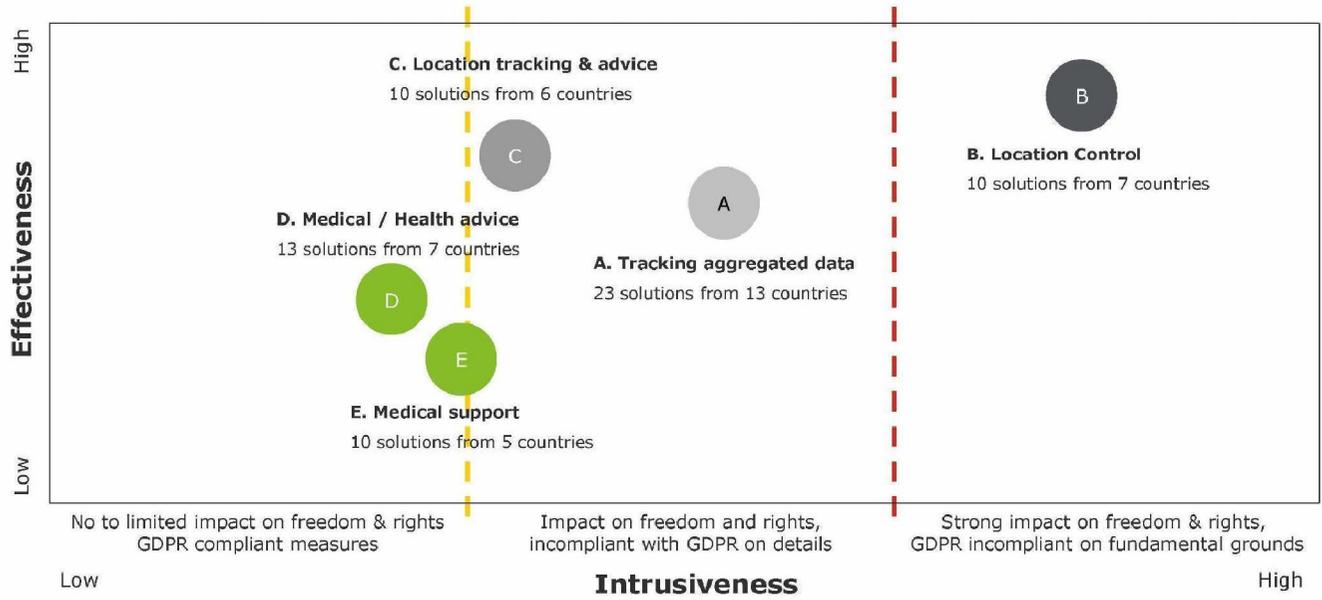
"The degree to which a solution negatively impacts the rights and freedom of its citizens" driven by 3 factors:

- Impact on liberty
  - The degree to which a solution **affects** (positively or negatively) a citizen's **liberty** (mandatory solutions infringe more than voluntary solutions)
- Impact on privacy
  - The degree to which a solution **affects** a citizen's right to **privacy** (solutions that require personal/medical data infringe more than solutions that don't)
- Emotional impact
  - The degree to which a solution **affects** (positively or negatively) a citizen's **emotional state** (based on their emotional state in the citizen journey)

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### Category ranking

Aggregated assessment view per category shows high effectiveness is linked to high intrusion (category B). Location Control to be both most effective and most intrusive

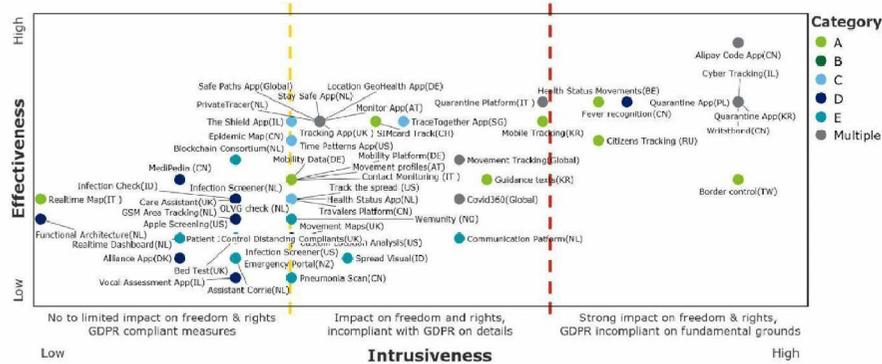


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### Solution areas

Assessment of individual solutions shows same effectiveness-intrusiveness relation. To facilitate a choice, clustering into mutually exclusive solution areas is required

#### Plot individual solutions



- Higher **intrusiveness** can lead to higher **effectiveness**, but **returns diminish**
- Many solutions **overlap** because they are **nearly identical** solutions implemented by **different countries**
- Within each **category**, **choices** can be made around level effectiveness and intrusiveness

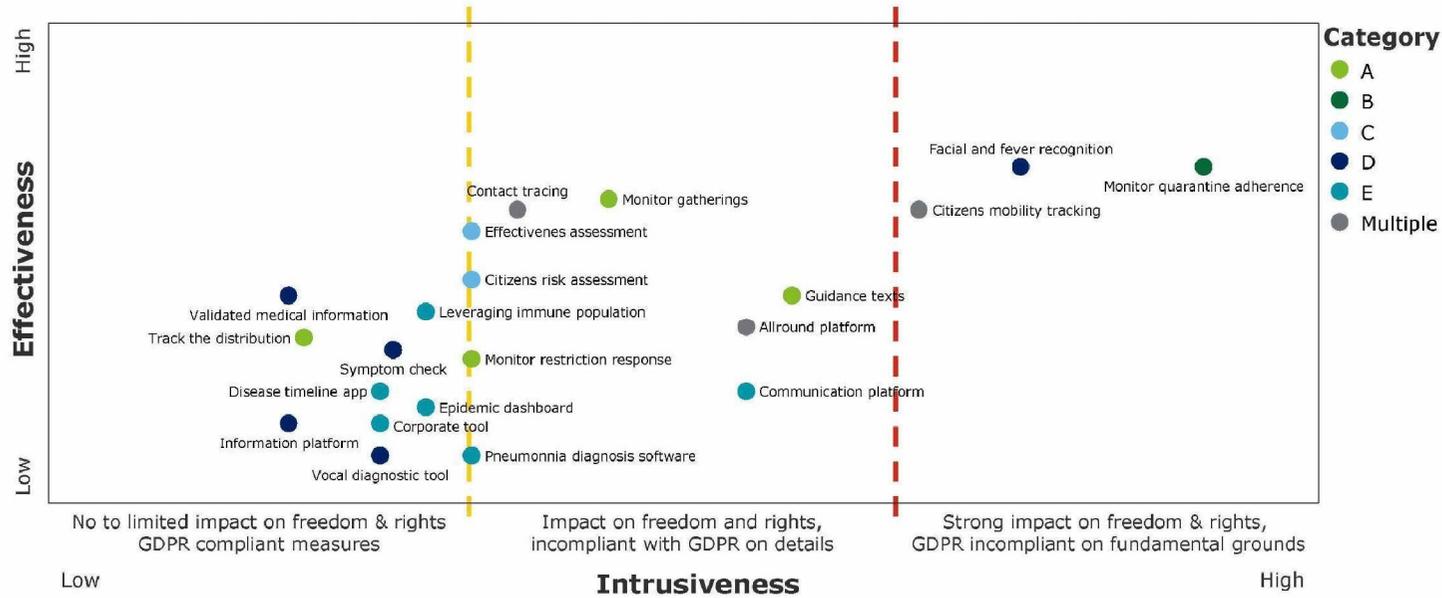
#### Solutions areas per category

Cat.	Solution area
A	Guidance texts
	Monitor gatherings
	Monitor restriction response
B	Track the distribution
	Monitor quarantine adherence
C	Citizens risk assessment
	Effectiveness assessment
D	Facial and fever recognition
	Information platform
	Symptom check
	Validated medical information
	Vocal diagnostic tool
E	Communication platform
	Corporate tool
	Disease timeline app
	Epidemic dashboard
	Leveraging immune population
Multiple	Pneumonia diagnosis software
	Allround platform
	Citizens mobility tracking
	Contact tracing

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### Ranking of solution areas

Assessment of all 21 identified solution areas show a trade-off between effectiveness and intrusiveness when choosing for a specific solution area





## Future scenarios vs citizen behaviour

Possible societal & economic scenarios and citizen's behaviour need to be taken into account in the assessment of appropriate technology

### Future scenarios

A first projection on how the situation may look like in the (near) future, based on the virus spread, government and healthcare responses. These assist in understanding which technology is most suited to apply.

- Covid-19 spread
  - Vaccine development, infection rate
- Government response
  - Social distancing measures
- Healthcare implications
  - Deployment at maximum capacity
- State of the economy
  - Duration of recession

Based on the variables above we have created 3 scenarios (worst, base and best case)

### Citizen's behaviour

Taking into account how citizens may respond to the public measures and the influence of their behaviour on the application of technology.

- 1,5m distance in public
- Working from home
- Prohibition of social gatherings
- Closing of contact employments

Based on adherence to the measures above we have created 3 behaviour scenarios (full adherence, moderate compliance and negligence)

# Future scenarios

We see 3 scenarios unfolding in the coming year

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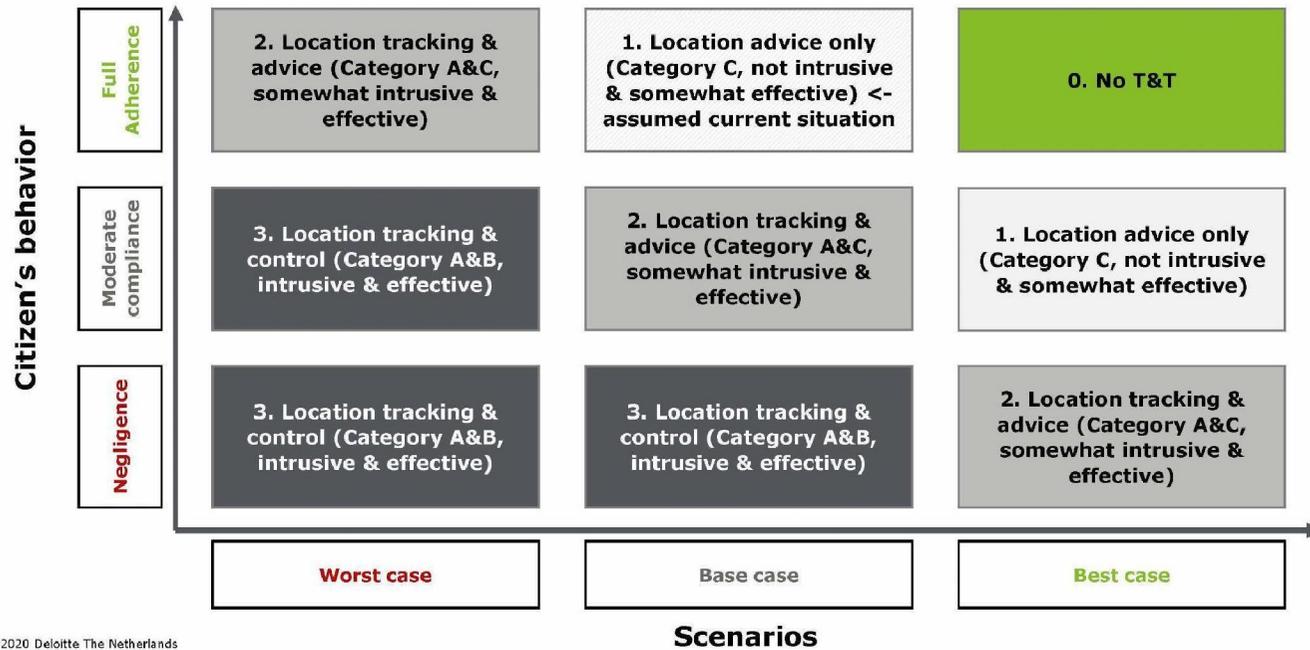
	<b>1</b>	<b>2</b>	<b>3</b>
	<b>Worst case scenario</b>	<b>Base case scenario</b>	<b>Best case scenario</b>
<b>Macro factors</b>			
<b>Virus spread</b>	<ul style="list-style-type: none"> <li>Virus continues to contaminate people in large amount and continuous to be highly contagious <b>into 2021</b></li> <li>Vaccination is available beginning of 2022</li> <li>Infection rate is &gt;2 and is unstable</li> </ul>	<ul style="list-style-type: none"> <li>Virus continues to contaminate people with several small shocks until <b>end of 2020 – beginning 2021</b></li> <li>Vaccination is available summer/autumn 2021</li> <li>Infection rate is &gt;1 and is relatively unstable</li> </ul>	<ul style="list-style-type: none"> <li>Intense short period of spread that flattens towards <b>autumn 2020</b></li> <li>Vaccination is available beginning of 2021</li> <li>Infection rate is &lt;1 and continues to be stable</li> </ul>
<b>Government response</b>	<ul style="list-style-type: none"> <li>Duration of social distancing measures continues for <b>12+ months</b></li> </ul>	<ul style="list-style-type: none"> <li>Duration of social distancing measures stops after <b>6 months</b></li> </ul>	<ul style="list-style-type: none"> <li>Duration of social distancing measures become less severe after <b>3 months</b></li> </ul>
<b>Healthcare response</b>	<ul style="list-style-type: none"> <li>Healthcare system continues to be overwhelmed into 2021</li> <li>Collateral damage into other healthcare disciplines, bordering countries and society as a whole</li> <li>Availability of tests insufficient</li> </ul>	<ul style="list-style-type: none"> <li>Additional COVID-19 healthcare system deployed on max. capacity until beginning of 2021</li> <li>Availability of tests operates at max. capacity</li> </ul>	<ul style="list-style-type: none"> <li>Additional COVID-19 healthcare capacity deployed on max. capacity until autumn 2020</li> <li>Tests ready to use</li> </ul>
<b>Economic impact<sup>1</sup></b>	<ul style="list-style-type: none"> <li>Recession takes 6 quarters (at least) recovery in 2021 unlikely</li> <li>BBP 2020: -7.3%; 2021: -2.7%</li> <li>Unemployment rate 2021: 9.4%</li> </ul>	<ul style="list-style-type: none"> <li>Recession in 2020 followed by strong recovery 2021</li> <li>BBP 2020: - 5%; 2021: +3.8%</li> <li>Unemployment rate 2021: 5.3~8.4%</li> </ul>	<ul style="list-style-type: none"> <li>Recession in first half 2020 followed by strong recovery</li> <li>BBP 2020: -1.2%; 2021: +3.5%</li> <li>Unemployment rate 2021: 4.5%</li> </ul>
<b>Overall recovery trend</b>			

<sup>1</sup>Source: Centraal Planbureau (March 2020)

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### Assessment future scenarios vs citizen behaviour

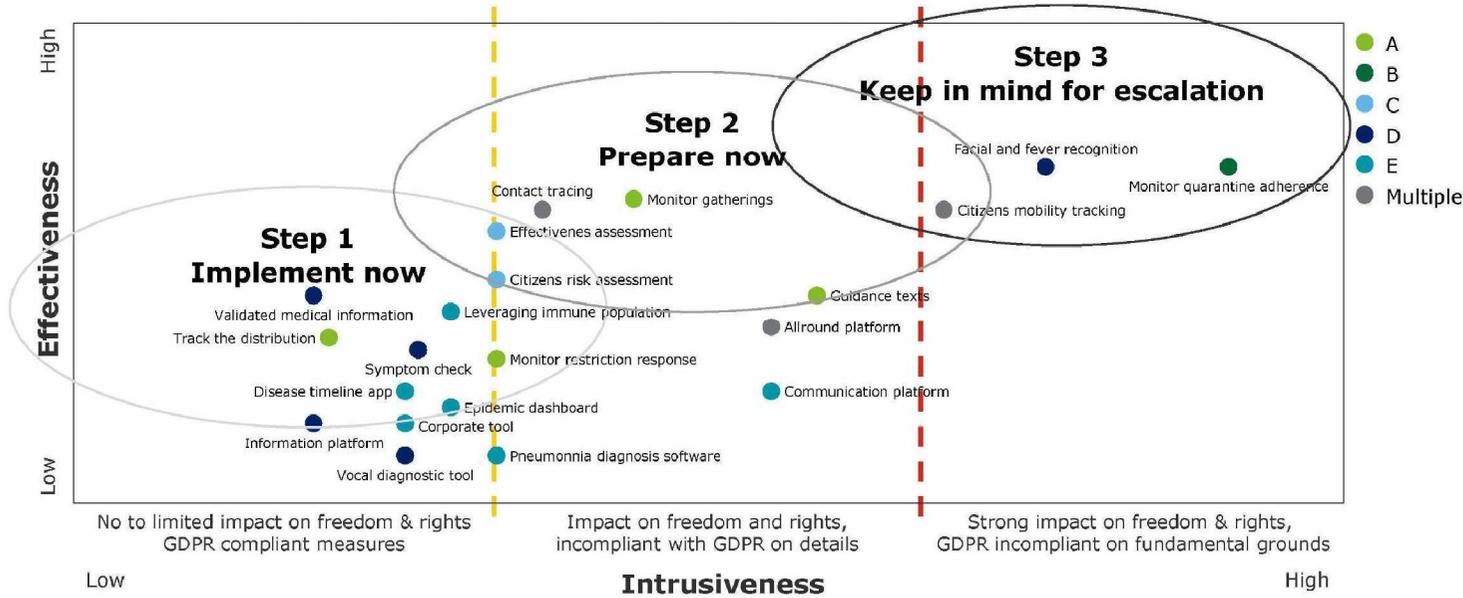
We see nine possible situations appear based on scenarios and citizen's behaviour, of which location tracking is most apparent



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### Preliminary advice

Our advice is to prepare for a 3 step approach

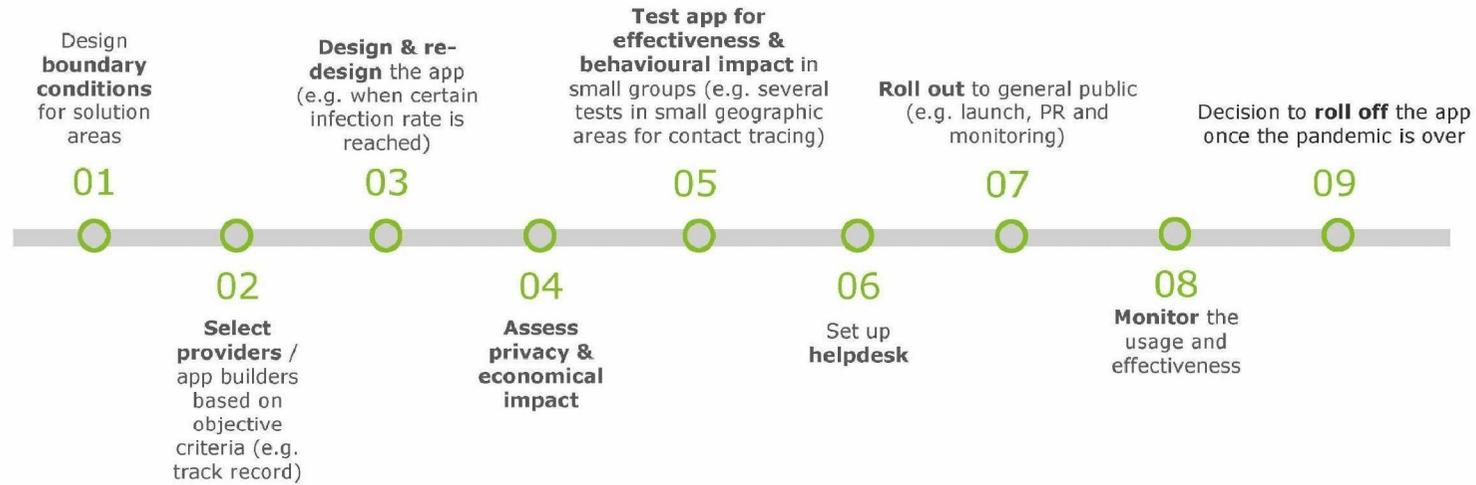


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## Next steps\*

Several steps are advised in order to design, implement and re-design the apps needed to curb the COVID-19 pandemic

### Simplified timeline



\*As formulated on April 17, 2020



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# APPENDIX



## Assessment lens | People

For the implementation of the apps, we advice to create personas, map the citizen journey and expand it into a full service blueprint

### 1. Create personas

A persona is an archetype developed to **represent a shared interest group or segment**. It is an amalgamation of attributes derived from actual stakeholder research, and embodies peoples' real-world perceptions, likes, dislikes, wants, needs, desires.

As most citizens of the Netherlands may become users of these services, there will be multiple personas.

#### Goals

- Understand who our users are and how they feel and think
- Understand how our users interact with technology
- Serving as the base for the design of the products and as a reminder of continuous user perspective

### 2. Map the citizen journey

Mapping the journey brings understanding of what people are doing, thinking and feeling at any given point in time, **when interacting with the app(s)**.

All the apps (e.g. contact tracking & medical help app) will be taken into account in the citizen journey, as well as the different personas and their various experiences.

#### Goals

- Understand the interaction pattern of the user/citizen with the new services
- Understand which phases are most important or need more attention (e.g. extensive user manual to explain service)
- Serves as a basis to map the full service blueprint

### 3. Expand the journey into a service blueprint\*

A Service Blueprint describes the service inside-out: how does it work in detail?

In one overview, it shows the citizen journey and experience, including all the **touchpoints and backstage processes, stakeholders and technology involved**.

In this case, that includes contact with GGD, RIVM, hospitals/GP offices, technology partners etc.

#### Goals

- Obtain a systematic view of the services and one blueprint to rely on
- Alignment of all touchpoints, stakeholders, and backstage processes to the user experience

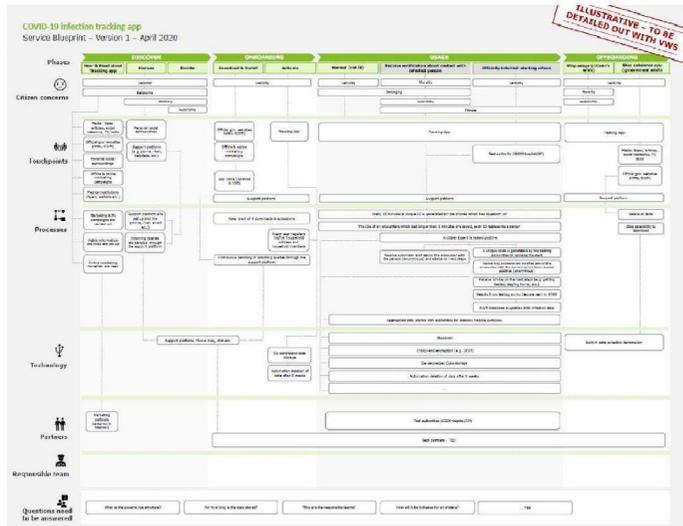
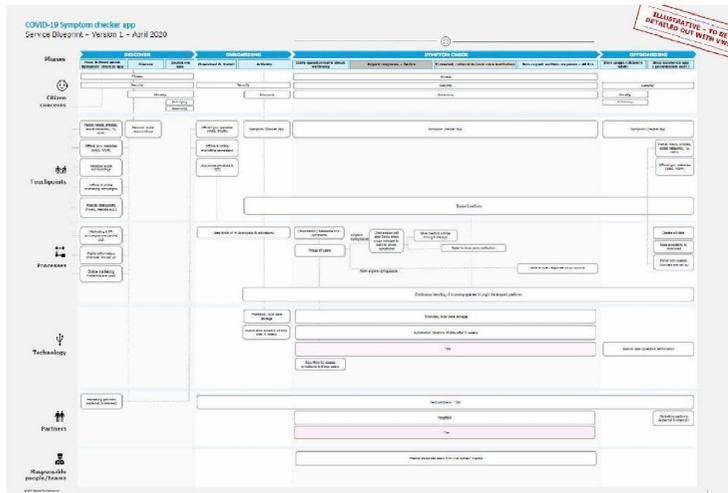
*\*An example for both the Tracking app as the Symptom monitoring app have been made*

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# Assessment lens | People

An example for both the Tracking app as the Symptom monitoring app have been made

We have created first examples of how a service blueprint for the apps could look like, focusing on the backstage processes and showing which capabilities are needed when implementing the apps.



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## Assessment lens | People

The choice and implications of technology should be adjusted to the needs and worries of the citizen for which personas are used

A persona is an archetype developed to represent a shared interest group or segment. It is an amalgamation of attributes derived from actual stakeholder research, and embodies peoples' real-world perceptions, likes, dislikes, wants, needs, desires. Until now, 5 citizens were interviewed.

			
 <b>Fit Fien</b>		 <b>Vulnerable Vera</b>	
 <b>Health</b> <ul style="list-style-type: none"> <li>None/minor prior physical health issues</li> <li>May have had COVID-19 already, without feeling (very) ill</li> </ul>	 <b>Smartphone savviness</b> <p>Medium - High</p>	 <b>Health</b> <ul style="list-style-type: none"> <li>Immunocompromised because of age and chronic illness (diabetes type 2)</li> <li>More likely to fall ill and be hospitalized</li> </ul>	 <b>Smartphone savviness</b> <p>Medium</p>
 <b>Main needs</b> <ul style="list-style-type: none"> <li>Clarity through tests to know who has COVID-19 and who is already immune, to know with whom I can interact</li> <li>Clarity in all the measurements &amp; communication in terms of safety</li> </ul>	 <b>Main worry</b> <ul style="list-style-type: none"> <li>My loved ones or other vulnerable people falling (very) ill</li> </ul>	 <b>Main needs</b> <ul style="list-style-type: none"> <li>Understanding how COVID-19 may affect my health</li> <li>Clarity through tests to know who actually has COVID-19 and who is already immune, to know with whom I can interact</li> </ul>	 <b>Main worry</b> <ul style="list-style-type: none"> <li>The insecurity of not knowing how ill I – or my loved ones – may become when catching COVID-19</li> </ul>
 <p><i>I'm not so afraid of getting COVID-19, I will be fine. I am just worried about the vulnerable people around me and in the Netherlands</i></p>		 <p><i>My current range of action is already so small, what more can I do? But I feel insecure about what happens when I get ill, or my loves ones.</i></p>	

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## Assessment lens | Legal

The various solution categories suggest different levels of legal risk

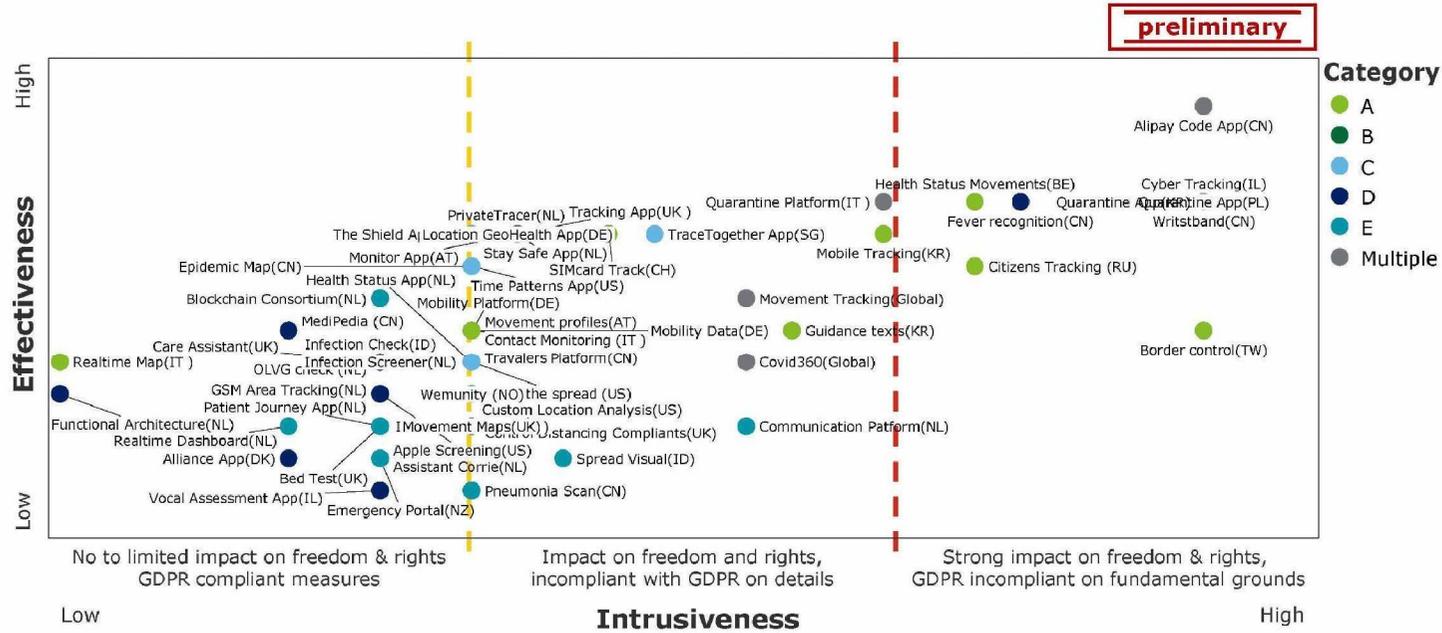
Solution	Implications (focus on privacy/data protection)
A. Tracking aggregated data	<ul style="list-style-type: none"> <li>Processing personal data of citizens must be lawful*.</li> <li>The GDPR does not apply to anonymous data, however, the threshold to anonymize data is very high.</li> <li>In some cases, aggregated data, including meta data, is still traceable to an individual.</li> <li>The value of anonymous (or aggregated) data for data analysis is much lower than personal data.</li> </ul>
B. Location control - Control the movement patterns of infected people (comply with quarantine) - Control the movement patterns of healthy people (permit)	<ul style="list-style-type: none"> <li>Location data will be combined with medical data. Therefore, a strict regime applies.</li> <li>Processing personal data of citizens must be lawful*.</li> <li>According to the EDPB (a European advisory body), location data can only be used when made anonymous or with the consent of individuals.</li> <li>A major risk with the use of location data is 'function creep', the fact that based on the availability of a new type of data, new purposes are being developed that were not anticipated at the time of the original collection of the data.</li> <li>Technically, the monitoring can be done secretly, without informing the owner. Monitoring can also be done semi-secretively, when people 'forget' or are not properly informed that location services are switched 'on', or when the accessibility settings of location data are changed from 'private' to 'public'.</li> <li>Liability risk in case of providing false information (and/or failing to provide correct information).</li> </ul>
C. Location tracking & advice - Inform citizens what locations to avoid due to high risk of infection - Warn citizens on potential contact with infected person	<ul style="list-style-type: none"> <li>Processing personal data of citizens must be lawful*.</li> <li>In order to bring a medical device to market, it must be CE marked in accordance with Dutch and European medical device legislation.</li> <li>Software provider may qualify as healthcare provider. In this case the user will have additional rights.</li> </ul>
D. Medical / Health advice - Share medical information and help citizens identify/diagnose their symptoms - Help or prevent people falling ill through health advice	<ul style="list-style-type: none"> <li>Processing personal data of citizens must be lawful*.</li> <li>Consent could be an appropriate lawful basis, but not in the relationship employer/employee.</li> <li>There are certain conditions to be met to work in the Dutch healthcare sector. E.g. only BIG-registered staff is allowed to perform 'reserved procedures', such as surgical and obstetric procedures, injections and administering anesthetics.</li> </ul>
E. Medical support	<ul style="list-style-type: none"> <li>Processing personal data of citizens must be lawful*.</li> <li>Consent could be an appropriate lawful basis, but not in the relationship employer/employee.</li> <li>There are certain conditions to be met to work in the Dutch healthcare sector. E.g. only BIG-registered staff is allowed to perform 'reserved procedures', such as surgical and obstetric procedures, injections and administering anesthetics.</li> </ul>
<p>* In order to qualify a processing as 'lawful' it must comply with the GDPR, including the requirements of proportionality, transparency, security, data minimization, there must be a lawful basis to process, it must be compliant "by design" and "by default", there must be a data processing agreement between the controller and processor, the controller must comply with data subject rights (e.g. right to erasure) and a personal data breach policy must be in place.</p>	

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### Ranking of solutions

Assessment of all 57 identified solution show a trade-off between effectiveness and intrusiveness when choosing for a specific solution area



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## Contact tracing app

Contact tracing apps that allow voluntary contact tracing are being introduced by governments around the world

Description						
Country	Name	Provider	Live	Strategic choices	Effectiveness	Intrusiveness
SG	TraceTogether App	GovTech and Health Ministry	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Bluetooth (relative signal strength indication)</li> </ul>	Medium	Medium
AT	Monitor App	Government	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Bluetooth</li> </ul>	Medium	Medium
Global	Safe Paths App	Massachusetts Institute of Tech.	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>GPS</li> </ul>	Low / Medium	Low/Medium
IT	Contact Monitoring	Ministry of innovation & University of Pavia	Yes	<ul style="list-style-type: none"> <li>Semi-voluntary</li> <li>Aggregated telco data</li> </ul>	Low	Low
IL	The Shield App	Health ministry	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Aggregated telco data</li> </ul>	Low	Low
DE	Location GeoHealth App	Geohealth	Not yet	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Bluetooth, GPS, WiFi</li> </ul>	Medium	Low/Medium
UK	Tracking App	UK government & University of Oxford	Not yet	<ul style="list-style-type: none"> <li>Voluntary</li> <li>GPS</li> </ul>	Low / Medium	Medium
NL	Stay Safe App	ENKO group BV	Not yet	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Bluetooth, GPS, WiFi</li> </ul>	Medium	Low/Medium
	PrivateTracer	PrivateTracer	Not yet	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Bluetooth, GPS</li> </ul>	Medium	Medium

Source: desk research; Deloitte analyses

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## Symptom check app

Symptom check apps that allow infection assessment are introduced by governments and private companies around the world

Description						
<ul style="list-style-type: none"> <li>The symptom check app automates <b>testing triage</b></li> <li>The app requests input around <b>symptoms</b> and <b>travel history</b> to determine a person's <b>risk of infection</b></li> <li>When a person's <b>risk of infection</b> is deemed <b>high enough</b> the person is <b>contacted</b> by <b>medical staff</b> or is advised to take a COVID-19 <b>test</b></li> </ul>						
Country	Name	Provider	Live	Strategic choices	Effectiveness	Intrusiveness
UK	Care Assistant	Babylon	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons contact by medical staff</li> </ul>	Medium	Low
DK	The Alliance	7Peaks	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons can contact medical panel</li> </ul>	Medium	Low
ID	Infection Check	Gojek & startup Halodoc	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons advised to take COVID-19 test</li> </ul>	Low/Medium	Low
US	Apple Screening	Apple	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons advised to take COVID-19 test</li> </ul>	Low/Medium	Low
	Infection Screener	Verily, by Google	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons advised to take COVID-19 test</li> </ul>	Low/Medium	Low
NL	OLVG check	OLVG Hospital	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons contact by medical staff</li> </ul>	Medium	Low
	Infection Screener	Philips	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>High risk persons contact by medical staff</li> </ul>	Medium	Low
	COVID Radar	LUMC	Yes	<ul style="list-style-type: none"> <li>Voluntary</li> <li>Information is used to track the spread of COVID-19</li> </ul>	Low	Low

Source: desk research; Deloitte analyses