The following information resources have been selected by the National Health Library and Knowledge Service Evidence Virtual Team in response to your question. The resources are listed in our estimated order of relevance to practicing healthcare professionals confronted with this scenario in an Irish context. In respect of the evolving global situation and rapidly changing evidence base, it is advised to use hyperlinked sources in this document to ensure that the information you are disseminating to the public or applying in clinical practice is the most current, valid and accurate.

## YOUR QUESTION

What technologies are being used to enhance COVID-19 response?

## IN A NUTSHELL

A wide range of technologies are being developed and deployed in response to the COVID-19 pandemic. The material presented here is a selection of available resources in the following categories:



# GENERAL ICT RESOURCES

## INTERNATIONAL LITERATURE

### Ting et al. (2020). Digital technology and COVID-19[1]

The past decade has allowed the development of a multitude of digital tools. Now they can be used to remediate the COVID-19 outbreak.
The year 2020 should have been the start of an exciting decade in medicine and science, with the development and maturation of several digital technologies that can be applied to tackle major clinical problems and diseases. These digital technologies include the Internet of Things (IoT) with next-generation telecommunication networks [eg 5G]; big-data analytics; artificial intelligence (AI) that uses deep learning and blockchain technology. These technologies are highly interrelated: the proliferation of the IoT in

devices and instruments in hospitals and clinics facilitates the establishment of a highly interconnected digital ecosystem, enabling real-time data collection at scale, which could then be used by AI and deep learning systems to understand healthcare trends, model risk associations and predict outcomes. This is enhanced by blockchain technology, a back-linked database with cryptographic protocols and a network of distributed computers in different organizations, integrating peer-to-peer networks to ensure that data are copied in multiple physical locations, with modified algorithms to ensure data are secured but traceable.

**Reeves et al. (2020). Rapid Response to COVID-19: Health Informatics Support for Outbreak Management in an Academic Health System[2]**

Our [San Diego, CA] health system has confirmed prior and current cases of COVID-19. An Incident Command Center was established early in the crisis and helped identify electronic health record (EHR) based tools to support clinical care. We outline the design and implementation of EHR based rapid screening processes, laboratory testing, clinical decision support, reporting tools, and patient-facing technology related to COVID-19. The EHR is a useful tool to enable rapid deployment of standardized processes. UC San Diego Health built multiple COVID-19-specific tools to support outbreak management, including scripted triaging, electronic check-in, standard ordering and documentation, secure messaging, real-time data analytics, and telemedicine capabilities. Challenges included the need to frequently adjust build to meet rapidly evolving requirements, communication and adoption, and coordinating the needs of multiple stakeholders while maintaining high-quality, pre-pandemic medical care.
Conclusion: The EHR is an essential tool in supporting the clinical needs of a health system managing the COVID-19 pandemic.

**Jahanbin et al. (2020). Using Twitter and web news mining to predict COVID-19 outbreak[3]**

Discusses web news mining of social networks such as Twitter to track and monitor the spread of the disease.

## OTHER

### World Economic Forum (2020). How digital infrastructure can help us through the COVID-19 crisis[4]

Our digital infrastructure needs strengthening to deal with the impact of COVID-19 and future public health crises:

- better integration of artificial intelligence into the public health response should be a priority
- analysis of big data relating to citizens' movement, disease transmission patterns and health monitoring could be used to aid prevention measures

### MobiHealthNews (2020) [News Article]. Tech's role in tracking, testing, treating COVID-19[5]

With the incidence of new COVID-19 cases growing by the day, healthcare stakeholders are continuing to search for tools and medications to help stem the tide. We have seen the digital health community release new tools aiming to monitor the spread of the disease and facilitate better treatment. And it sounds as if there's still more to come, as just this morning CNBC reported that tech giants Facebook, Amazon and Google were sitting down with the World Health Organization to talk about their role in combating the spread of disease as well as misinformation.
In terms of COVID-19, we are seeing another rise in digital epidemiology tools, chatbot helpers, EHR guidance tools and rapid-response test kits.
This article lists how health organizations, governments and digital health vendors are using technology to tackle the COVID-19 crisis.

### Asia Times (2020) [News Article]. South Korea turns to tech to take on COVID-19[6]

This article discusses a range of innovative technologies including: diagnostic apps; telecommuting solutions; an interactive Coronoavirus map; CCTV data mining and mobile phone location information; apps for home quarantine, self-diagnosing and contact with monitoring staff; apps for immigrants to communicate their health status on a daily basis. A commercial company Seegene uses an artificial intelligence-powered automated production system to produce tests with a 6-hour turnaround, supplying Italy and Germany. Two other biotech start-ups produce a

portable, battery-powered scan device that can detect COVID-19 infection in 30 minutes.

### Coronavirus Tech Handbook[7]

The Coronavirus Tech Handbook is a crowd-sourced library for technologists, civic organizations, private institutions, researchers and specialists working on [technological] responses to the pandemic. It is a rapidly evolving resource with thousands of expert contributors.

## DASHBOARDS AND SITUATIONAL AWARENESS

### World Health Organization Health Emergency Dashboard[8]

The World Health Organization (WHO) Health Emergency Dashboard is a platform which aims to share information about public health events and emergencies. The data on the dashboard is refreshed every 15 minutes and data is accurate as at time of refreshing. The WHO Health Emergency Dashboard is not a comprehensive representation of all the events and emergencies; the events displayed are a subset of those reported through official channels as mandated by the International Health Regulations. The size of the pie charts corresponds to the number of events in a given country or territory; the size does not indicate the severity or risk associated with the events.

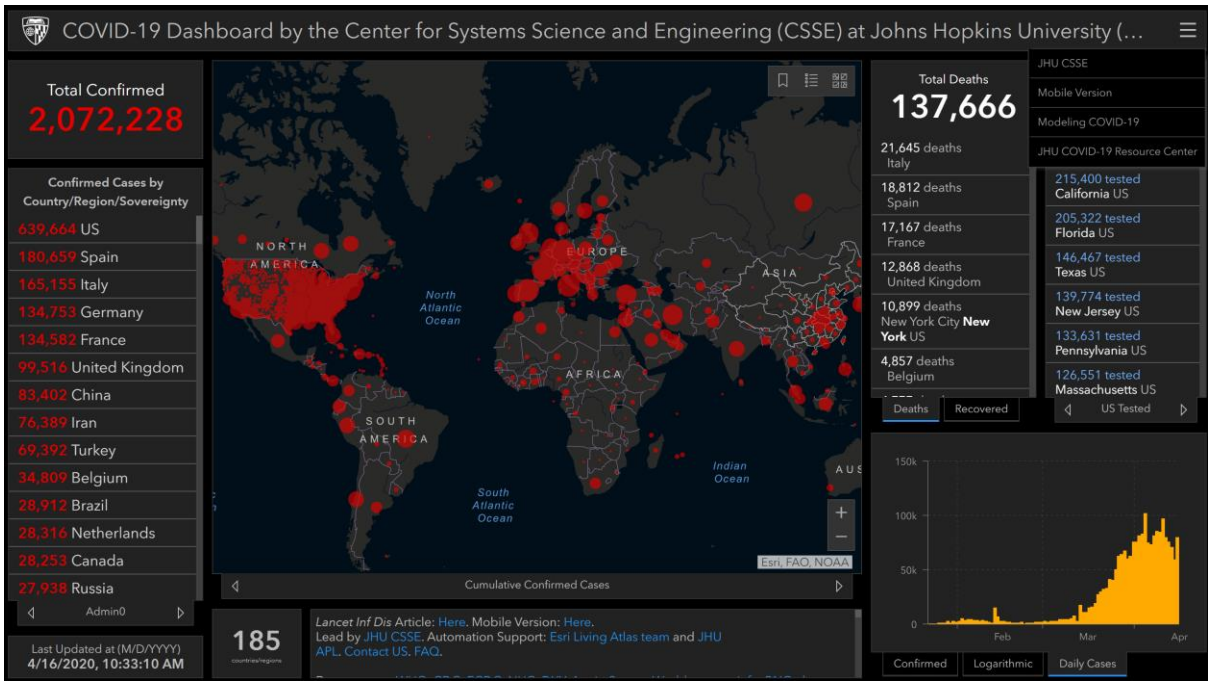
### Health System Response Monitor (HSRM)[9]

The Health System Response Monitor (HSRM) has been designed in response to the COVID-19 outbreak to collect and organize up-to-date information on how countries in the WHO European Region are responding to the crisis. It focuses primarily on the responses of health systems but also captures wider public health initiatives. This is a joint undertaking of the WHO Regional Office for Europe, the European Commission and the European Observatory on Health Systems and Policies.

## INTERNATIONAL LITERATURE

### Dong et al. (2020). An interactive web-based dashboard to track COVID-19 in real time[10]

In response to this ongoing public health emergency, we developed an online interactive dashboard, hosted by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, Baltimore, MD, USA, to visualise and track reported cases of coronavirus disease 2019 (COVID-19) in real time. The dashboard, first shared publicly on Jan 22, illustrates the location and number of confirmed COVID-19 cases, deaths, and recoveries for all affected countries. It was developed to provide researchers, public health authorities, and the general public with a user-friendly tool to track the outbreak as it unfolds. All data collected and displayed are made freely available, initially through Google Sheets and now through a GitHub repository, along with the feature layers of the dashboard which are now included in the ESRI Living Atlas.




The dashboard reports cases at the province level in China; at the city level in the USA, Australia, and Canada; and at the country level otherwise. During Jan 22–31, all data collection and processing were done manually, and updates were typically done twice a day, morning and night. As the outbreak evolved, the manual reporting process became unsustainable; therefore, on

Feb 1, we adopted a semi-automated living data stream strategy. Our primary data source is DXY, an online platform run by members of the Chinese medical community, which aggregates local media and government reports to provide cumulative totals of COVID-19 cases in near real time at the province level in China and at the country level otherwise. Every 15 min, the cumulative case counts are updated from DXY for all provinces in China and for other affected countries and regions. For countries and regions outside mainland China, we found DXY cumulative case counts to frequently lag behind other sources; we therefore manually update these case numbers throughout the day when new cases are identified. To identify new cases, we monitor various Twitter feeds, online news services and direct communication sent through the dashboard. Before manually updating the dashboard, we confirm the case numbers with [national], regional and local health departments. All manual updates for countries and regions outside mainland China are coordinated by a team at Johns Hopkins University.

## CONTACT TRACING

### INTERNATIONAL LITERATURE

**Cho et al. (2020). Contact tracing mobile apps for COVID-19: Privacy considerations and related trade-offs**[11]

Contact tracing is an essential tool for public health officials and local communities to fight the spread of novel diseases such as the COVID-19 pandemic. The Singaporean government just released a mobile phone app that is designed to assist health officials in tracking down exposures after an infected individual is identified. However, there are important privacy implications of the existence of such tracking apps. This paper analyzes some of those implications and discuss ways of ameliorating the privacy concerns without decreasing usefulness to public health.

### Yasaka et al. (2020). Peer-to-Peer Contact Tracing: A Privacy-Preserving Smartphone Application[12]

Contact tracing using smartphone technology is a powerful tool which may be employed to limit disease transmission during an epidemic or pandemic, yet contact tracing applications present with significant privacy concerns regarding the collection of personal data such as location. This study looks at how to provide an effective contact tracing smartphone application that respects user privacy by not collecting location information or other personal data.

### Ferretti et al. (2020). Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing[13]

The newly emergent human virus SARS-CoV-2 is resulting in high fatality rates and incapacitated health systems. Preventing further transmission is a priority. This paper analyses the key parameters of epidemic spread to estimate the contribution of different transmission routes and determine requirements for case isolation and contact-tracing needed to stop the epidemic. It concludes that viral spread is too fast to be contained by manual contact tracing, but could be controlled if this process was faster, more efficient and happened at scale. A contact-tracing app which builds a memory of proximity contacts and immediately notifies contacts of positive cases can achieve epidemic control if used by enough people. By targeting recommendations to only those at risk, epidemics could be contained without need for mass quarantines ['lock-downs'] that are harmful to society. The ethical requirements for such an intervention are discussed.

### Ienca et al. (2020). On the responsible use of digital data to tackle the COVID-19 pandemic[14]

Large-scale collection of data could help curb the COVID-19 pandemic, but it should not neglect privacy and public trust. Best practices should be identified to maintain responsible data-collection and data-processing standards at a global scale.

### Raskar et al. (2020). Apps Gone Rogue: Maintaining Personal Privacy in an Epidemic[15]

Containment, the key strategy in quickly halting an epidemic, requires rapid identification and quarantine of the infected individuals, determination of whom they have had close contact with in the previous days and weeks, and decontamination of locations the infected individual has visited. Achieving

containment demands accurate and timely collection of the infected individual's location and contact history. Traditionally, this process is labour intensive, susceptible to memory errors, and fraught with privacy concerns. With the availability of smart phones, many people carry a tool which can be utilized to quickly identify an infected individual's contacts during an epidemic, such as the current 2019 novel Coronavirus crisis. Unfortunately, the very same first-generation contact tracing tools have been used to expand mass surveillance, limit individual freedoms and expose the most private details about individuals. This paper outlines the different technological approaches to mobile-phone based contact tracing to date and elaborates on the opportunities and the risks that these technologies pose to individuals and societies. Advanced security enhancing approaches that can mitigate these risks are described as is trade-offs that must be made when developing and deploying any mass contact tracing technology. The aim of this paper is to continue to grow the conversation regarding contact tracing for epidemic and pandemic containment and discuss opportunities to advance this.

## GEOGRAPHIC INFORMATION SYSTEMS

### INTERNATIONAL LITERATURE

**Kamel Boulos et al. (2020). Geographical tracking and mapping of coronavirus disease COVID-19 [and] severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) epidemic and associated events around the world: how 21st century GIS technologies are supporting the global fight against outbreaks and epidemics[16]**

In December 2019, a new virus emerged in Wuhan, Hubei Province, China, and rapidly spread to other parts of China and other countries around the world. As with the original SARS-CoV epidemic of 2002/2003 and with seasonal influenza, geographic information systems and methods including among other application possibilities online real-time mapping of disease cases and of social media reactions to disease spread, predictive risk mapping using population travel data and tracing and mapping super-spreader trajectories and contacts across space and time are proving indispensable for timely and effective epidemic monitoring and response. This paper describes a range of practical online and mobile GIS and mapping dashboards and applications

for tracking the 2019 coronavirus epidemic and associated events as they unfold globally.

**Kastner et al. (2020). Viewing the Progression of COVID-19 with NewsStand**[17]
With the continuing spread of COVID-19, it is clearly important to be able to track the progress of the virus over time to be better prepared to anticipate its emergence in new regions. Officially released numbers of cases will likely be the most accurate means by which to track this, but they will not necessarily paint a complete picture. The authors have developed an application that is usable on desktop and mobile devices that allows users to explore geographic spread in discussion about the virus through analysis of keyword prevalence in geo-tagged news articles.

**Zhou et al. (2020). COVID-19: Challenges to GIS with big data**[18]

- GIS with big data provides geospatial information to fight COVID-19.
- Big data showed power on epidemic transmission analysis and prevention decision making support.
- Challenges still continue in data aggregation, knowledge discovery, and dynamic expression.

## OTHER

**ESRI [Commercial Company] (2020). Geographic Information Systems for Coronavirus Planning and Response**[19]
ESRI is an American company that supplies GIS. This paper gives an overview of how GIS capabilities can be used for a health-oriented response to pandemic influenza.

SYMPTOM MONITORING

## INTERNATIONAL LITERATURE

**Udugama et al. (2020). Diagnosing COVID-19: The Disease and Tools for Detection[20]**

COVID-19 has spread globally since its discovery in Hubei province, China, in December 2019. A combination of computed tomography imaging, whole genome sequencing and electron microscopy were initially used to screen and identify SARS-CoV-2, the viral etiology of COVID-19. The aim of this review article is to inform the audience of diagnostic and surveillance technologies for SARS-CoV-2 and their performance characteristics. We describe point-of-care diagnostics that are on the horizon and encourage academics to advance their technologies beyond conception. Developing plug-and-play diagnostics to manage the SARS-CoV-2 outbreak would also be useful in preventing future epidemics.

**Pan (2020). Application of personal-oriented digital technology in preventing transmission of COVID-19, China[21]**

We reported several personal-oriented and mobile phone-based information technologies which were recently developed and widely used during the outbreak of COVID-19 in China. These technologies help reduce the transmission of COVID-19 and maintain normal social order.

## OTHER

**Lovell (2020) [News Article]. Ireland's health service uses patientMpower remote monitoring solution for COVID-19 patients[22]**

Dublin-based digital health firm patientMpower has developed a remote monitoring solution for COVID-19 on behalf of the Irish Health Service Executive (HSE). This enables monitoring of otherwise healthy patients with mild to moderate symptoms who are in self-isolation.

**Lovet (2020). [News Article]. A-list tech engineers team up with Boston Children's Hospital on coronavirus tracking tool[23]**

Looking to better track the spread of the novel coronavirus, a team of engineers from some of Silicon Valley's most notable companies has joined

forces with Boston Children's Hospital's Chief Innovation Officer John Brownstein on a new tool dubbed covidnearyou.org. The platform aims to gather data from people at home and report it back to public health organizations such as the CDC.

## VIRTUAL COLLABORATION AND TELEHEALTH

Please note that a separate summary of evidence on telehealth as it relates to the COVID-19 pandemic is also available.

### INTERNATIONAL LITERATURE

**Smith et al. (2020). Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19)[24]**

The current coronavirus (COVID-19) pandemic is again reminding us of the importance of using telehealth to deliver care, especially as means of reducing the risk of cross-contamination caused by close contact. For telehealth to be effective as part of an emergency response it first needs to become a routinely used part of our health system. Hence, it is time to step back and ask why telehealth is not mainstreamed. In this article, we highlight key requirements for this to occur. Strategies to ensure that telehealth is used regularly in acute, post-acute and emergency situations, alongside conventional service delivery methods, include flexible funding arrangements, training and accrediting our health workforce. Telehealth uptake also requires a significant change in management effort and the redesign of existing models of care. Implementing telehealth proactively rather than reactively is more likely to generate greater benefits in the long-term and help with the everyday and emergency challenges in healthcare.

**Greenhalgh et al. (2020). Video consultations for covid-19[25]**

The rapid spread of covid-19 and the fact that healthcare facilities could be sources of contagion has focused attention on new models of care that avoid face-to-face contact between clinician and patient. There has been particular interest in video consultations, which are already being rolled out in many countries as part of national digital health strategies. How appropriate are video consultations for dealing with the coronavirus crisis and what are the challenges of scaling up this model at speed?

## OTHER [VIRTUAL COLLABORATION]

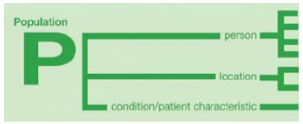
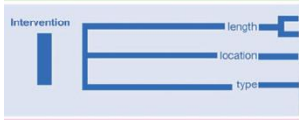
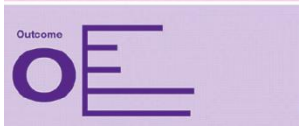
There are many different tools that can be used for virtual collaboration and remote working. With any commercially-available software, it is recommended to research the software, the company and to be aware of their procedures regarding data security, data storage and recoverability.

Among the popular tools in use currently are:

- Asana
- Google Suite
- Microsoft Teams
- Slack
- Trello
- Zoom/Zoom Video Communications

Produced by the members of the National Health Library and Knowledge Service Evidence Team.† Current as at 08 APRL 2020.This evidence summary collates the best available evidence at the time of writing and **does not replace clinical judgement or guidance**. Emerging literature or subsequent developments in respect of COVID-19 may require amendment to the information or sources listed in the document. Although all reasonable care has been taken in the compilation of content, the National Health Library and Knowledge Service Evidence Team makes no representations or warranties expressed or implied as to the accuracy or suitability of the information or sources listed in the document. This evidence summary is the property of the National Health Library and Knowledge Service and subsequent re-use or distribution in whole or in part should include acknowledgement of the service.

The following PICO(T) was used as a basis for the evidence summary:

| | |
|---|---|
|  | COVID-19 PANDEMY |
|  | INFORMATION TECHNOLOGY |
|  | |
|  | COVID-19 RESPONSE |

The following search strategy was used:

MESH TERMS : MH PANDEMICS MH "CORONAVIRUS+"
FREE KEYWORDS "PANDEMICS" "COVID-19" OR CORONAVIRUS OR "WUHAN VIRUS" OR "2019-NCOV" OR "SEVERE ACUTE RESPIRATORY SYNDROME CORONAVIRUS 2" OR "2019 NOVEL CORONAVIRUS" OR "2019 NEW CORONAVIRUS"
**AND**
MESH TERMS FOR "GEOGRAPHIC INFORMATION SYSTEMS" "TECHNOLOGY" "COMMUNICATION" "BIOMEDICAL TECHNOLOGY" "CONTACT TRACING"
FREE KEYWORDS GIS, "GEOGRAPHIC INFORMATION SYSTEMS", "CONTACT TRACING", "CONTACT TRACKING" "SITUATION AWARENESS" "COMMUNICATION" "REMOTE" "VIRTUAL" "HEALTH TECHNOLOGY ASSESSMENT" "SYSTEMS" "SUPPORT" "COLLABORATION" "TEAM" "MEETING" "SYMPTOMS TRACKING" "SYMPTOMS TRACKER" "SYMPTOMS MONITORING" "AWARENESS"

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