Research questions for COVID-19

These questions are designed to be a guide only to the requirements of the call. UKRI will consider proposals that answer research and innovation priorities, related to the impact of COVID-19, outside of this list.

If you have a research and innovation proposal that addresses the health impacts of COVID-19 it is expected that you will submit this to the joint UKRI and Department for Health and Social Care rolling call. Exceptions to this could include where applicants are bringing beyond biomedical expertise to bear or where applicants are looking at non-acute health conditions that will manifest over longer than a 12-month period and whose study needs to commence within the pandemic context e.g. for data and sample collection. The MRC would only exceptionally expect to see submissions made to it as Lead Council via the UKRI rolling call.

Data availability and use

What data exists nationally and internationally, what new data should we collect and how?

How can we best capture high quality data without burdening front line health and care and other key worker staff?

Provision of Trusted Research Environments. How do we share data across health and care, academia, government and industry to facilitate research and innovation in a timely way (including real-time data), while ensuring security and privacy?

How do we ensure quality of data and support data wrangling to bring data into standard formats?

How do we prioritise data science research and allocate research questions to appropriate teams?

How do we link health, social, economic and environmental data with appropriate privacy and security protections to inform policy?

How can we deploy the predictive capabilities of AI to target interventions more effectively and at individuals?

How do we ensure that big data algorithms generated for use during this time minimise the risks of bias, including gender and race/ethnic biases?

Modelling and prediction

How do we improve pandemic and epidemiological models, ensuring their validity and predictive accuracy?

How do we incorporate new data-driven algorithms in vaccine and drug discovery?

How do we build digital twins of healthcare systems to enable real-time management of resources and treatment strategies?

How do we build digital twins of population behaviour and urban environments to inform policies to ease the lockdown?

How do we build data-driven predictive models of business and the economy to inform government policy?

How can data science help rapid evaluation of clinical information and trial data in real time?
How can spatial mapping help contain outbreaks and manage the longer-term control of the epidemic?

**Accelerated use of AI and automation**

In what ways can AI and automation help rebuild the economy and what technologies can be rapidly deployed?

How will remote and on-line working develop and which areas will be transformed?

What opportunities for innovation will be created by increased availability of digital data?

How can government and public services most rapidly adopt data-driven systems to deliver their new responsibilities more efficiently?

**National security and geopolitics**

How can we identify and respond to misinformation and fake news?

What new national security and cybersecurity risks are being created?

How will different countries emerge from the pandemic, and how will the geopolitical balance change?

What are the implications for climate change and responses to it?

**Engineering**

How can engineering help reconfigure clinical spaces to reduce nosocomial spread?

How can health/bio screening of passengers and luggage for flying (or public transport generally) be improved by engineering?

Minimising air-borne transmission within the engineered environment i.e. buildings, aircraft etc.?

Transforming manufacturing production processes through digital technologies that balance the need for physical presence in the workplace with social distancing?

Enabling people to work productively in different ways using creative digital research?

How can social distancing and maintenance of good hygiene be enabled with the right diagnostics and analytics deployed where needed?

Designing and manufacturing infection control devices at speed so that common/public spaces be sanitised rapidly?

Accelerating and adapting site modular manufacture and remote informatics to promote social distancing in construction?

How can deep cleaning technologies and methodologies be developed in a way that is compatible with the UK’s environmental sustainability goals?

What new materials, design and manufacturing approaches should we start to consider in preparation for pandemics e.g. reusable PPE to replace single use?

How can engineering research help the UK to retain some of the air-quality and wider climate-related gains made during the lockdown?
What would support the expansion of clean energy and technology options to enable the UK to accelerate towards achieving net-zero?

Can we increase resilience and agility of UK manufacturing, including through research in the digitalisation and reconfigurability of future manufacturing capability?

What role can engineering play in ensuring the future resilience of national infrastructure?

What role can predictive modelling play in understanding the risks posed by the potential convergence of multiple local, national or global events e.g. summer fires, autumn floods, in pandemics?

**Inequalities**

What is the impact of the crisis on economic, social and health inequalities? How can the increasing inequalities best be addressed?

What explains the differentials in infection and mortality rates between groups?

How significant is the digital divide especially in terms of access to education & work?

What role do social networks (family, friends, peers, social media groups) play in supporting/maintaining/mobilising individual and collective resilience during this crisis? How are social networks being mobilised and what are the inequalities in these? How inclusive are new forms of social connection and which social groups are being excluded and why? Can they be made more inclusive?

What is the impact of social isolation and how does it differ across groups, particularly vulnerable groups (including those with low levels of digital skills)? What has happened to the ‘loneliness epidemic’ during lockdown?

What kinds of online teaching have proven effective? For what subjects, age groups? How should the government address inequalities of educational provision when more teaching & learning may have to occur online or on TV? What is the impact of the crisis on educational outcomes? And how does that differ across groups, and interventions, particularly for the most vulnerable young people?

How has the influence of the epidemic and responses differed by gender and race? For example, do caring responsibilities lead to differences in labour market participation (entry and exit) etc?

What is the impact on vulnerable people and families (financially vulnerable, domestic abuse, parental conflict, children in care, family breakdown and neglect). What is the impact on offending, homelessness, drug & alcohol abuse?

**Behavioural Insights**

What interventions are most effective at delivering short, medium and longer term behavioural change, and how does this differ across groups?

How can we best help people adhere to, and monitor adherence to, advice about behavioural advice about COVID-19, considering regional and demographic variation?

What will be the short-, medium- and long-term impact of the wider social changes required on, for example, crime, the legal system and education?
Updated: 11/05/2020 JD

How can social distancing and social cohesion be maintained if the distancing measures need to be extended? What are the unintended consequences of releasing data and how does it influence behaviour?

How has (and will) the public respond to changes in policy as we come out of the lock-down?

Have the various COVID-19 apps that allow ongoing surveillance / tracing of contacts, locations, biomarkers, affected the public’s attitudes to privacy, confidentiality and other ethical concerns in relation to personal data collection (including non-Covid-related personal data) via smartphone and other devices?

How has the COVID-19 crisis affected people’s willingness to provide biological material for research for the public good? What has been learned about how best to motivate this type of altruistic behaviour?

What has been learned from the COVID-19 response about how to best (efficiency, response rate, usable samples, ethics, public trust) conduct community-wide, public biological sampling in a Western democracy?

National Recovery and Transformation

What lessons can be learned from other countries’ experiences?

What information should inform decision-making about emerging from lock-down?

What are the potential ‘scarring’ impacts on work and lifetime earning prospects of young people finishing education & entering the workforce?

What lessons are there from the rapid changes in practices in health and education for delivery and productivity of public services?

What happens when a large number of charities fail? What services will either vanish or fall to the public sector to pick up?

What are the impacts of policy on different institutions (schools, universities, workplaces) and across space (cities v rural areas) and how will that influence their ability to recover?

How will society and the economy differ after the epidemic and how can policy change the economy and society in positive ways?

What lessons can be learned to help develop pandemic preparedness in the future?

Societal resilience

How well-equipped is the third sector in terms of resources, capacity and know-how to respond quickly to emergency community needs (i.e. civil resilience work). How quickly could it be mobilised to support emergency needs and what would they require to do so?

What is the impact of COVID-19 on offending, homelessness, drug & alcohol abuse?

How inclusive are new forms of social connection following Covid-19?
What is the impact of the crisis on educational outcomes? And how does that differ across groups, and interventions, particularly for the most vulnerable young people?

What needs to be done now to help equip future societies for health emergencies?

**Macroeconomic and fiscal situation**

What lessons can be learned from other countries’ experiences?

What economic and epidemiological information should inform decision-making about emerging from lock-down? Integration of the two modelling approaches.

How badly is trade collapsing and what are the UK’s supply chain fragilities?

Business impacts – sector impacts, SME closures; how will different sectors, business models and supply chains respond?

Regional/spatial impacts of economic recession – devolved nations, city regions; how does the economic impact of the epidemic and the prospect for recovery differ across places and social characteristics such as gender, ethnicity, age, skill-levels, local government-support etc?

How effective has the social safety net been as unemployment increases?

**Employment and work**

Is it feasible to stagger travel to work and deploy a common building occupancy? What will its impact be?

How do employment practices influence patterns of infection?

How have Government support measures influenced the behaviour of different types of firms (i.e. by size and sector) and what new measures might be needed?

What types of jobs are being lost, and what is the impact on different people? How will the crisis influence different peoples’ ability to find work and transition into new occupations? Will older workers return to the labour market?

What are the prospects for young people entering work – what risks of long-term ‘scarring’?

Which new behaviours and working practices will remain and which should we encourage (i.e. working from home, less travel, etc.) for greater environmental sustainability?

What can managers and workers do to maintain positive psychological states? How can suffering be acknowledged and managed?

**Environment**

What are the environmental factors (both natural and anthropogenic) which have a detectable effect on the spread of the epidemic? Examples include air quality and weather.
How can we quantify the impacts of the epidemic induced restrictions on the environment while they are still detectable? Providing a baseline against which the environmental effects of economic and social recovery may be measured.

How do we protect and maintain the improvements made, prior to this pandemic, in the environment (e.g. pollution, greenhouse emissions) as the economy starts to grow again?

What are the environmental impacts/benefits of behaviour change due to the epidemic (e.g. greenhouse gas emissions; particulates and other pollutants) including any potential changes during recovery? What are these impacts/benefits at local, national and global scales?

What other organisms can the virus infect and are there potential wildlife reservoirs? Are there closely-related coronaviruses circulating in other natural environment host species? How may the virus move through and reside in the environment (natural and built) to help understand the potential for re-emergence?

What is the potential for environmental virology, including animal reservoirs, to develop different measures of community-level virus prevalence, such as analysis of waste water? How can such techniques be used to measure the temporal and spatial spread of the virus?

Has the chemical loading to the environment (e.g. disinfectant, pharmacological) changed as a result of the pandemic? If so, is there impact on ecosystem function and services, and is there a solution for recovery?

Do environmental factors exacerbate or diminish the impact of the virus and the severity of the disease?

How has social distancing and changed people’s perception of the environment and their relationship with the environment following the epidemic?

**Security & Justice**

What narratives are being promoted by foreign states and violent extremist groups? Are they being used to exploit the crisis to harm the UK or malignly influence our politics?

What can be done to increase the influence of accurate information and reduce the harm of misinformation?

What is the impact of the crisis on different kinds of crime and crime rates? For example, its impact on domestic abuse, gang-related crime, fraud or online cybercrime?

How has home-working changed security culture, compliance and risk? What improves home-working cybersecurity?

What is the impact on the legal system of changes in employment, welfare benefits, family breakdown or housing disputes?

How has the epidemic changed how people access justice (and their enforcement of rights)?
What communications methods and media are most effective to communicate about rights to legal support and access to justice?

How have new powers in the UK and internationally influenced civil liberties? Are safeguards working and what are the likely longer-term impacts?

What have been the impacts on prisons, probation and the courts?

HEALTH AND CARE

Epidemiology

What is required to use serology to understand (i) the proportion of population who have had disease (ii) how long immunity lasts and who gets it (iii) the proportion of disease that is asymptomatic and how do they contribute to transmission?

What data flows are required to manage the epidemic longer term?

What is required across case testing, contact testing and well-planned sampling to get national coverage and accurate figures on spread?

What would be the most effective ‘early warning system’ for the detection of new epidemics?

Immunology

What role does the immune system play in determining variation in susceptibility to primary infection, how does this vary across the lifecourse and what are the key biomarkers?

How is protective immunity generated, what are its characteristics and duration, and how effectively is protective immunity boosted upon re-exposure to infection?

Does the host immune response to contribute to pathology and thus what is the role of immunomodulatory therapies in COVID-19?

Is there immunological cross reactivity to other coronaviruses and, if so, is it protective or does it contribute to pathology?

What, if any, are the immune evasion strategies of SARS-COVID-2?

Virology

Where else does the virus go in the body and what effects does that have?

Is there any evidence of entry into the central nervous system? And is the route of entry neuronal or vascular?

What are the neurotropic effects of COVID-19 infection? To what extent does entry into the CNS contribute to the medical distress of COVID-19?

If any, are there longer term post illness neurotoxic effects caused by COVID-19?

Are there any associated post-infection fatigue or distress syndromes?

Does this virus have any animal reservoirs, e.g. domestic animals, and can this infect humans?

How important is gastrointestinal tract involvement?
Is there important myocardial involvement?

What are the host-virus interactions at a molecular level, including in key components of transmission such as replication and shedding?

Is mutation going to cause a problem with either enhanced pathogenicity or immune escape (genomics, clinical science, immunology)?

How important is viral load in determining the outcome in individuals?

What do we know about susceptibilities in the virus itself?

What more do we need to know about virus persistence outside of the host and conditions associated with increased transmission?

**Mental Health, resilience and wellbeing**

What effect has COVID-19 and social isolation had on the prevalence of anxiety, depression and engagement with harmful behaviours (e.g. self-harm and suicide)?

What is the optimal structure for a mentally healthy life in the wake of COVID-19 and social or physical distancing?

What are the mental health consequences of the COVID-19 lockdown and social isolation for vulnerable groups, and how can these be mitigated under pandemic conditions?

What is the effect of repeated media consumption about COVID-19 in traditional and social media on mental health, and how can wellbeing be promoted?

How can we make better decisions when dealing with uncertainty and dynamic complexity, particularly when under pressure?

What can managers and workers do to maintain positive psychological states? How can suffering be acknowledged and managed?

What unique sources of individual and collective resilience have emerged during the crisis? How can these be harnessed to help bring about closure, reflection, healing as part of the recovery process? How can these sources of resilience be supported/enhanced so as to protect against the next epidemic?

What are the predictors of psychological responses to the crisis and to interventions? How do these consequences track over time, personal and demographic characteristics, health history and so forth?

What are the unique challenges that key workers, their families and others involved in the response will experience, and how to mitigate the impact of these?

What is the influence of different policies and social, geographic and institutional contexts have on social connectivity and the parameters of models used to inform decision-making about future impacts?
What is the role of digital access to culture in promoting well-being during the emergency, how does this compare to the role played by non-digital access, and what long-term lessons are there to be learned here?

What role do the arts and humanities play in supporting/maintaining/mobilising individual and collective resilience during and after this crisis? How can the arts and humanities be mobilised and engaged to support individual and collective resilience?

**Contact-tracing apps**

What are the technology choices and how effective are they?

How do we implement data protection, privacy and security by design?

What should be the scope of data collection?

What are the ethical issues and how can they be managed to acquire and maintain public trust?

**Clinical/healthcare management**

What can we learn from unusual presentations of severe disease (e.g., in younger patients or otherwise healthy people)?

What is the role of comorbidities and interactions with drugs used to treat those comorbidities?

Can genomics help to predict outcomes, progression to severe disease and treatment options?

What do we know about pregnancy and vertical transmission risks?

How important is nosocomial and other healthcare acquired infection and how can it best be managed?

What are the clinical markers of severe disease/at risk/ICU patients’ need and how can these be used in practice (clinical science, genomics)?

Do healthcare spaces need to be reconfigured to stop the spread of COVID-19?

What is the role of robotics in healthcare management?

What are the overall health impacts (mental and physical) of the measures imposed to reduce the epidemic in the UK?

What approach to patient prioritisation should be taken when early effective treatments appear; for example, compassionate use or expanded patient access? Who should take responsibility for prioritisation (e.g. an ethics committee; drug manufacturers; government bodies; an interdisciplinary group). Should the approach be harmonised across national territories? Can it be harmonised?

How do prior public attitudes to death, suffering and disease impact public expectations of government and NHS responses to the COVID-19 emergency (and public attitudes to ‘what success looks like’ in assessing government/NHS responses)?

How will government/health service responses to COVID-19 shape future public expectations of the NHS?
**Treatments and preventative measures**

What analysis is required to understand the mode of spread, including an engineering assessment of droplet trajectories?

How can we set up manufacturing capability to produce large quantities of testing devices once a virus has been identified? What would it take to repurpose existing manufacturing lines quickly for other medical diagnostics?

What treatment technologies should we have ready in large quantities in preparation for the next pandemics? What other equipment should be stockpiled in strategic reserves?

What do we know about the virus and its susceptibilities?

Can we identify targets for drug treatments?

Which existing drugs might have an effect and how should they be used in clinical trials?

Which vaccines can be fast tracked through to clinical testing and how can we make that happen (regulation, science funding, manufacturing, trial design, ethics scrutiny)?

What other treatment options should be explored (e.g., neutralising antibodies, immune serum, siRNA, experimental approaches with live virus) and what funding calls and links to companies will be needed?

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What treatments are required for pathologies associated with this virus including V/Q mismatch and shunting, inflammation and co-agulopathy?