

Priority areas

Modelling, AI, digital and data approaches to understanding of the COVID-19 pandemic and mitigating its effects

- Data: preparation of data sets to defined quality standards for research; trusted research environments to make data widely available and enable data linkage for research with appropriate levels of privacy, security and transparent acknowledgment of representativeness; development of highly efficient data storage and transfer systems for rapid joint analysis of large data sets.
- Machine learning, deep learning and AI: to make actionable predictions from data and understand and mitigate against further waves of infection. Examples could include trust, data privacy and other ethical issues related to contact tracing, virus testing, workplace and wider societal monitoring, or predicting human behaviour.
- Modelling - new models for bio-molecular simulations, epidemiology, transmission in different environments, and effectiveness of barriers to infection; model validation, reproducibility and uncertainty quantification.

Engineering and physical sciences approaches for national recovery and transformation

- Technology development and adaptation to aid national recovery and new ways of working, including within industry and new working environments (e.g. home working).
- Understanding the effects of the pandemic on the energy transition towards net zero and how the UK will meet its energy demand and production requirements.
- Adaptable and reconfigurable manufacturing, to allow scale-up of COVID-19 related products quickly, efficiently and at volume.

Understanding, monitoring and controlling COVID-19 transmission

- Understanding, monitoring and controlling COVID-19 transmission in health and social care settings and systems: projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions
- Understanding and monitoring how viral transmission occurs: particularly indoors and within transport systems; projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions.
- Controlling transmission through better design and manufacturing of PPE or other protective materials (including recyclable and reusable), new anti-viral surfaces or cleaning methodologies; managing air and people flows and adapting urban environments.

COVID-19 in the environment

- What are the environmental factors (both natural and anthropogenic) which have a detectable effect on the transmission of the virus? Examples include air quality and weather. Projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions.
- How does the virus move through and persist in the environment (biotic, abiotic and built) to help understand and detect the potential for re-emergence? Projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions.
- Which environmental factors exacerbate or diminish the impact of the virus and the severity of the disease? Projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions.

COVID-19 Human - Animal interface

- Research on preventing transmission between animals and humans including future spill-over events through: surveillance and characterisation of SARS-CoV-2 in animal reservoirs and identifying the potential for reverse zoonoses; understanding virus maintenance and prevalence in animal reservoirs / intermediate animal hosts; understanding modalities of transmission between animals, and from animals (including companion animals) to humans, and how the virus may survive on various surfaces, including animal fur. Projects should include information on the effectiveness of current interventions and suggest the optimum raft of interventions
- Developing a One Health approach for future risk reduction strategies at the animal-human-environment interface including biosafety in food production systems and farms, and understanding the socio-geographic origins of zoonotic viruses.

Greening the recovery

- How can we quantify the impacts of the epidemic induced restrictions on the environment? Providing a baseline against which the environmental effects of economic and social recovery may be measured.
- How do we protect and build on the improvements made in the environment prior to the pandemic (e.g. pollution, greenhouse emissions) as the economy starts to grow again, and ensure future investment including in infrastructure embodies environmental ambitions?
- 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? For example, travel to work, use of green spaces? What are these impacts/benefits at local, national and global scales, and how can benefits be retained?

Policy and behavioural change

- What behavioural responses are most effective – singly and in combination – at reducing infection?
- Which behavioural responses are most effective in different risk environments at work, at home, during transport, etc (work in this area should include consideration of the viral load)?

Economic impacts and micro-, macro- and fiscal economic policy

- We continue to need more work on identifying those policies which will be effective in restarting the economy and encouraging recovery and long term renewal (including macroeconomic policies).
- How can we limit the ‘scarring’ effects of the pandemic, and its damage to human, natural, physical and social capital (including to vulnerable groups and across the regions and nations of the UK), and how can economic analysis and policy ensure improved future outcomes?
- What impact has the pandemic already had upon different parts of the UK, different organisations and sectors, work patterns, the make-up of the workforce, inter-sectoral flows and supply chains, and current and future demand for jobs, skills, and economic assets (such as office space and transport infrastructure)? What future impacts are anticipated, and what are the appropriate policy responses?

Social impact upon vulnerable groups and regions

- Research on the uneven epidemiological, economic, psychological and social impacts of the pandemic across society, with a particular focus on identifying those most at risk and how policy

making can best support them. Particular gaps are noted in relation to BAME communities and children and young people.

- Research on communities and how they help support vulnerable people, families and groups. This includes research to understand how civil society, the voluntary sector and faith groups have acted and how their actions have influenced community resilience.

Impacts of COVID-19 on cultural and creative sector

- The 'digital turn' in cultural consumption: opportunities and limitations.
- Impacts of creative/cultural sector on mental health and well-being under lockdown and during emergence from lockdown.
- Role of cultural and creative sector in emergence from COVID/post-COVID recovery.

Ethical, Regulatory and Human Rights issues in responses to COVID-19

- Ethics of prioritization of COVID-related healthcare decisions and interventions
- Data and AI ethics in relation to COVID-19 public health measures e.g. tracing apps
- Ethical dimensions of (un)equal impacts of COVID-related decision-making
- Ethical dimensions of pandemic response and policing activities
- Tensions between collective actions/obligations and individual and human rights

Communication and Public Health during the pandemic

- Design and the effective communication of official health guidance
- Identifying and creating trusted public health information sources
- Communicating a diversity of COVID-19 experiences

Mechanistic studies of the disease and its sequela

- Identification of key biomarkers of infection severity and immune protection; better understanding the immune response of asymptomatic disease carriers; identifying the effects of age, gender, ethnicity, health status and the influence of co-infecting respiratory pathogens on the immune response to primary infection. Projects should suggest the optimum raft of interventions.
- Virology, Immunity and Pathophysiology: research focused on defining critical biological/pathological parameters necessary for the prioritisation of preventative, supportive and/or therapeutic interventions. This includes understanding viral genotype/phenotype relationships, the immunology and immunopathology of the disease, the immunity generated post-severe, -mild and -asymptomatic infection and the persistence of that immunity. Studies should ensure they include relevant links to epidemiology or clinical expertise and where appropriate the established large-scale studies and consortia in this area.
- Mental Health and Neurological Consequences- Studies understanding the biological contributors of the disease, its management and/or isolation on mental health, mental illnesses, and neurological consequences, including assessment of the presence and pathology of the virus in the brain. Development of interventions to better manage mental health and neurological consequences.

Epidemiology

- Transmission - Research that will enable better understanding of the nature of transmission of and exposure to the virus, including quantifying the infectious dose, understanding the relationship between viral RNA and the amount of infectious virus, duration of viral shedding,



transmission from asymptomatic cases and children, and understanding the role of aerosols, surfaces, buildings and their features.

- Settings: community epidemiology in non-health or social care settings, for example homes, workplaces, schools, universities, prisons and homeless hostels.
- Disease Susceptibility and Severity: understanding susceptibility of different populations (age, sex, ethnicity, demographics, occupation etc.), including vulnerable and marginalised groups such as the homeless and drug users. Characterization of the spectrum of clinical manifestations, both acute and longer term, and disease severity of SARS-CoV2 infections, including potential contribution of viral load, kinetics and genotype, sites of infection and associated immunopathology, variability in immune responses, collateral tissue damage, and associated factors (demographics, etc.).
- Control and Mitigation: research to understand social distancing measures that are most effective at preventing or reducing spread of SARS-CoV2, and how such distancing, shielding and isolation measures may be most effectively relaxed.

Intervention development and early evaluation, including experimental medicine studies

- Diagnostics: rapid point-of-care diagnostics for use at the community level in different settings and in the context of seasonal respiratory viral infection. Proposals will need to justify their added value robustly, in the context of significant existing activity, and to provide strong evidence in terms of deliverability and route to commercialisation, at scale and speed.
- Primary, Adjunctive and Supportive Therapies: development and evaluation, including experimental medicine studies, of the effect of primary, adjunctive and supportive interventions and therapies, including immune modulators. Proposals will need to be placed in the context of work already underway in this area, including as listed in the WHO directory of clinical trials.
- Vaccines: development and evaluation of investigational vaccines and passive immunological approaches, improved collaboration and comparison across different studies. Proposals will need to justify their case robustly for funding, against the significant existing international activity in this area.