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(C190060)

This submission is relevant to items 1 and 5 of the inquiry terms of reference. Further explanation and information can be provided if required.

I strongly recommend the Science and Technology Committee consider greater involvement of engineering expertise in future plans for emergency preparedness and response, including those for infectious disease outbreaks; appropriate areas of this expertise should significantly contribute to practical solutions, as discussed in other submissions [including C190010 & C1900042].

The following recommendations are based on my personal learning as a chartered engineer and retired subject matter expert who was involved in post – Fukushima improvements to UK nuclear emergency preparedness and response. I believe aspects of this learning are relevant to the control of infectious diseases. I was asked to lead UK industry / defence / agencies response to recommendation FR-6 of the Fukushima report by ONR (Office for Nuclear Regulation). This required a review of available techniques and research to test the practicability of providing authorities real-time information about radioactive releases to the environment. I subsequently led preparation of guidance for the UK nuclear industry on this topic.

The contribution of research and development in understanding, modelling and predicting the nature and spread of the virus.

The R&D requires clarity, transparency and **strong governance** of:

- Objectives and requirements management for specific research projects.
- Identification, responsibility and accountability of those with requirements specification, funding and research key roles.
- Assessment of competence of those who hold key roles.
- Effective resource management.
- Comprehensive stakeholder engagement plans.
- Routine review of the risk register, research needs, progress and conclusions.

Potential research to combat the virus involves a wide range of organisations and stakeholders. The sustainability and effectiveness of research to mitigate COVID-19 and other risks in the national risk register should be enhanced by visibility and understanding of all related research needs, together with their relative importance, value and funding.

The ranking of FR-6 research objectives was agreed with stakeholders and based on cost and schedule for implementation of expected improvement in the quality of, and reduction of time to provide, key information to the emergency management organisation and authorities. In this context, quality was primarily increased confidence in information. The ranking required awareness and agreement of the impact of all data and modelling uncertainties on confidence in that key information. This or an alternative, more appropriate approach to prioritising research for modelling and predicating the spread of the virus should be clear to interested parties.

Potential risks arising from key stakeholder (including those within regulator and responsible government departments) staff changes, work load and gaps in areas of their specialist knowledge should be considered in COVID-19 R&D governance arrangements regarding impact on requirements definition and oversight to ensure effective implementation of improvements.

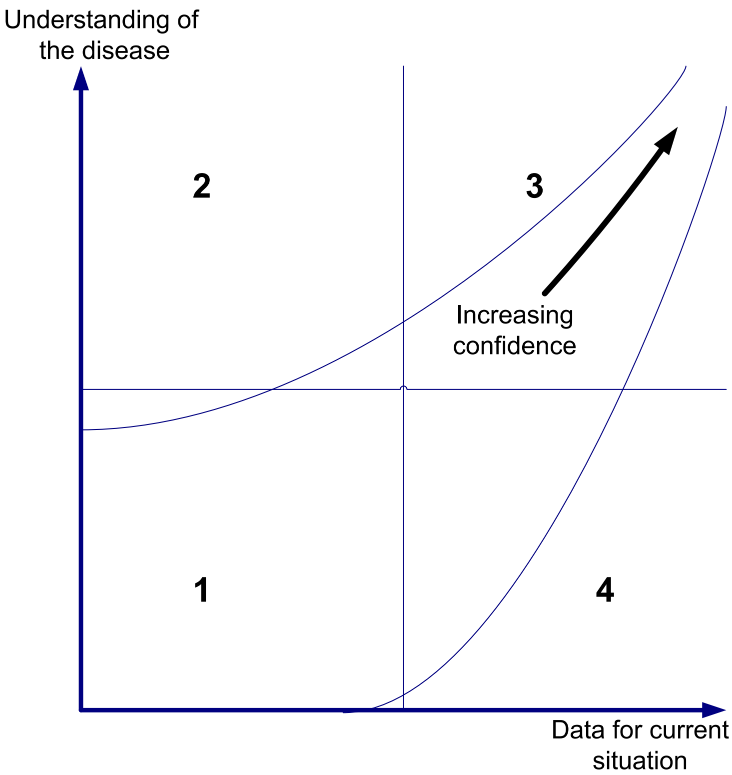
Key tools to model and predict the nature and spread of infectious diseases should be developed, substantiated and maintained to ensure their high integrity in accordance with methodology similar to IEC 61508; this includes the requirement to ensure competence of those involved throughout the lifecycle. Models should be subject to thorough verification, validation and subsequent impact assessment of changes to underpinning assumptions and data. Government policy or strategy for response should not be based on results from a single research group or model [see C190038].

Knowledge Management of all government funded research should be improved. Accessibility was a barrier, beyond that related to information security, to FR-6 work. An example of learning from the nuclear sector which may be useful but unknown to COVID-19 R&D projects:
Dispersion of radioactive contamination (including particulate <5μm which behaves like a gas) in enclosed areas was studied, based on CFD (computational fluid dynamics) modelling of typical environments and scenarios. Improved guidelines for appropriate protective measures were based on this work.

The capturing during the crisis of data of the quantity and quality needed to inform decisions.

The challenge to urgently provide accurate predictions with sufficient confidence to support decisions by the authorities to protect the public is similar for nuclear, pandemic and many other types of emergency. Evidence form Prof. Ferguson [C190038] explains the challenge of uncertainty during an emerging infectious disease outbreak together with the types and benefits of different approaches to modelling. Both nuclear and pandemic emergencies require reliable data at the earliest opportunity to analyse an event. Prompt radiometric measurements of the environment provide key data for use with developed models to predict the impact of a nuclear emergency. The initial development of models to predict progression of an infectious disease presents additional challenge. A means to confirm and track infection together with sufficient data from multiple sources is required to develop validated models before their use to confidently predict outcomes for specific scenarios.
Fig 1 illustrates the uncertainty in modelling and data, low confidence in predications and need for a precautionary approach to urgent decisions in the early phases of a pandemic.

FIG 1: Confidence in prediction of emerging infectious disease progression for defined scenarios and control measures



KEY

(1) Limited understanding of the disease and limited types and quantity of data*.

- Validated models unavailable.
- Largest uncertainty / lowest confidence in prediction.
- **Precautionary approach is essential.**

(2) Good understanding of the disease but limited types and quantity of data*.

- Validated models available.
- Large uncertainty / low confidence in prediction.

(3) Good understanding of the disease and extensive, multiple types of data*

- Validated models available.
- Lowest uncertainty / highest confidence in prediction.

(4) Extensive, multiple types of data* but limited understanding of the disease.

- Validated models unavailable.
- Large uncertainty / low confidence in prediction.
- High reliance on consensus of expert judgement

**Data relevant to the defined scenario and control measures of interest.*

I support the points raised by Dr Schofield [C190012] regarding independent assessment of advice to SAGE and also application of "cautionary" and "so far as is reasonably practicable" principles applied to high hazard industries including nuclear.

Other areas of potential learning from arrangements for nuclear emergencies include:

- Use of standard templates for data collection appropriate for different phases and tailored to support timely decision making.
  (*I strongly support recommendation 5ii) in evidence from Dr Cole [C190002].*)
- Defined control measures, and conditions for their initiation, to protect the public.
- Communication to those members of the public who may be affected by an emergency and their awareness of potential instructions and required actions.
  (*The 2011 Pandemic Influenza Preparedness Team report, "Principles of effective communication" identifies the need to communicate complex issues before an emergency*).
- A high degree of local control of emergencies, e.g. providing immediate countermeasure advice to the public.
  (*Increased local government responsibility for response to the pandemic was only announced on 17th July. However, local government officials have not had access to the required test and infection data. Experience suggests devolved responsibility from the outset, as in Germany, may be more responsive and effective*.)
- Comprehensive training and frequent emergency exercises.
- Close regulation of industry emergency preparedness and capabilities including stores of critical equipment.
- International oversight of nuclear operators (*IAEA and WANO*).
- Agreements for mutual support between nuclear sites.
- The high integrity and security requirements for systems to collect analyse and communicate information and data.

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