UK Health Security Agency

Priority pathogen families research and development (R&D) tool

A reference tool to help guide England-based funders of research and development

Content

Background

The availability of medical countermeasures (accurate and scalable diagnostics, and safe and effective therapeutics and vaccines or DTVs) for infectious diseases with pandemic and epidemic potential has always been of vital global health importance. Recent experiences (for example with COVID-19 and mpox) have demonstrated the need for active DTV research and development pipelines across a range of pathogens.

Within the UK, the national Biological Security Strategy published in 2023 provides a vision, mission and plan to protect the country from significant biological risks. It contains a number of commitments to detect, prevent and respond to such threats, including the discovery and development of therapeutics and vaccines within 100 days.

As the government agency responsible for securing and protecting the public's health, the UK Health Security Agency (UKHSA) was asked to support the delivery of this Biological Security Strategy by developing a list of 'priority pathogens'. In response, UKHSA has developed this priority pathogen family research and development reference tool.

Note: This tool has been developed through the collective knowledge and opinions of subject matter experts within UKHSA, and may not reflect the views of wider UK government or devolved administrations. It does **not** constitute a commitment from the UK government or others to fund research and development into DTVs for the pathogen families included, or to fund production or purchase of DTVs that arise from such research.

About the tool

The purpose of this tool is to describe important pathogen families where investment into DTV research and development is most needed in the interests of biosecurity. We think this tool will be of most interest to academic institutions and England-based funders of health research.

Importantly, the tool aims to support all aspects of the UK Biological Security Strategy and is therefore not just focused on preparedness for pandemics. The pathogen families include global threats that have the potential to impact the UK through importation, as well as established endemic pathogens.

For illustration within the tool, one or two notable pathogens have been described for each family. Some of these pathogens have been suggested elsewhere in the scientific literature as so-called 'prototype pathogens' or their use advocated as pathfinders for the development of DTVs that may be used for an entire pathogen family. UKHSA has not done its own assessment of the use of these pathogens for this purpose.

It is important to note that:

1. The tool is **not** a detailed threat assessment. How the tool has been developed is described below.
2. The focus is on viral and bacterial families. Fungi were **not** explicitly considered in this iteration.
3. The list of families included in this tool is **not** exhaustive and they are not ranked. It is recognised that threats to heath could arise from other pathogen families. It should be noted that work is needed in other families outside those listed, and the tool is intended to guide future research and development activity to strengthen biosecurity, rather than be prescriptive.
4. Priorities and risks will change, based on changes in epidemiology and progress towards developing diagnostics and countermeasures. The tool **must** be used with other information as appropriate, and represents a snapshot at one point in time.

How this tool was created

This tool has primarily been developed through the collective knowledge and opinions of subject matter experts within UKHSA. In addition, the content of the tool was developed through:

- consideration of parallel lists and prioritisation attempts from global partners
- an accumulation of expert epidemiological and clinical insights from within the agency
- application of published evidence from various sources

The pathogen families were agreed for inclusion through pragmatic consensus of UKHSA experts. That consensus was reached broadly through consideration of a pathogen family's pandemic and epidemic potential (as demonstrated by existing pathogens within those families), burden of disease, and existing DVT pipelines. For each family, one or two notable pathogens were then agreed for inclusion, to act as the focus of additional reference information as described in tables A and B below.

Note: The consensus views of UKHSA expressed in the tool, and other content included such as DTV pipelines, are accurate to the best of UKHSA's knowledge at time of drafting, but are subject to change.

Table A. Information within the priority pathogen families research and development tool: Categories for viral families

Category	Description
Overall family pandemic potential	**High**, **Medium** or **Low** Based on subject matter experts within UKHSA who have considered severity of disease, routes of transmission and previous pandemics amongst known pathogens in this family. Importantly, these ratings do not represent a detailed threat assessment of this pathogen family. The ratings are intended as a guide only, and should not be used in isolation for decision making. The rating is intended to apply to the family **as a whole**, and may not apply to individual pathogens within that family.
Overall family epidemic potential	**High**, **Medium** or **Low** Based on subject matter experts within UKHSA who have considered severity of disease, routes of transmission and previous epidemics amongst known pathogens in this family. Importantly, these ratings do not represent a detailed threat assessment of this pathogen family. The ratings are intended as a guide only, and should not be used in isolation for decision making. The rating is intended to apply to the family **as a whole**, and may not apply to individual pathogens within that family.

Table B. Information within the priority pathogen families research and development tool: Categories for notable pathogens

Category	Description
Domestic transmission	**Not official statistics:** to be used as a guide only **Nil**: no transmission within England **Low**: rare or occasional transmission or detection within the community **Moderate**: frequent transmission or detection within the community, and/or especially within high risk groups **High**: very common transmission or detection in the community
Climate sensitive risk	**Yes**: evidence exists that distribution and/or transmission of this pathogen has been affected by climate change **Likely**: no clear evidence exists but given the very limited evidence available, or the transmission dynamics of this pathogen, it is likely that climate change has or will impact the spread of this pathogen globally **Unknown**: no current evidence exists Guided by experts from UKHSA's Centre for Climate and Health Security based on a rapid review of the evidence as of July 2024.

Category	Description
Antimicrobial resistance (AMR) concern	**Critical**, **High**, **Medium**, or **No major concern** as defined by WHO's Bacterial Priority Pathogen assessment of antimicrobial resistance. Guided by experts from UKHSA's AMR and Healthcare-Associated Infection division.
HCID	As per the UKHSA definition of high consequence infectious disease.
Vaccine availability	Guided by experts in UKHSA's Vaccine Development and Evaluation Centre, based on best understanding as of December 2024. Other products may exist, and no efficacy or clinical suitability is implied.
Diagnostics availability	Guided by experts in UKHSA's Diagnostics Accelerator, primarily based on a market search conducted between May and August 2024 and verification with UKHSA experts, and focused on diagnostics **specific** to the notable pathogens listed. Other products may exist, and no fitness for purpose is implied.
Therapeutics availability	As suggested in the IPPS 100 Days Mission Scorecard (January 2025), or based on the best understanding of UKHSA experts. Other products may exist, and no efficacy or clinical suitability is implied.

How this tool compares with other efforts to prioritise pathogens

There have been significant efforts, especially since the COVID-19 pandemic, by a number of organisations to 'prioritise pathogens' for various different reasons. To give 3 important examples:

1. In June 2024, the WHO R&D Blueprint published its approach to pathogen prioritisation, within its framework for epidemic and pandemic preparedness. Over 200 experts contributed to the work, which suggests prioritisation of 28 viral families and a small group of bacteria. As with the UKHSA tool, the framework advocates for a focus on families, and UKHSA is working with WHO in its global efforts.
2. The UK Vaccines Network is a standing group of academics, industry representatives and funding bodies which is tasked with advising DHSC how to use committed Official Development Assistance (ODA) funding for vaccine development. The basis of the UKVN pathogen prioritisation activities reflect the distinct focus on low- and middle- income settings.
3. The Coalition for Epidemic Preparedness Innovations (CEPI) is a global partnership of public, private and philanthropic organisations. It exists to support rapid creation of vaccines against emerging threats and maintains its own short list of priority pathogens, which influences the portfolio of work it invests in.

UKHSA has considered the parallel initiatives of other organisations when developing this tool; the UKHSA tool does not supersede these other lists, but was created for a different purpose. Where the UKHSA tool differs, is the inclusion of some pathogen families which are already established in England (endemic diseases), making this approach particularly relevant for funders of DTV research and development based in this country.

Next steps

This tool has been created to support further implementation of the UK Biological Security Strategy. The tool may be of use to industry organisations, academic institutions, funders of research and development into DTVs, and other parts of the UK government to guide where funding is prioritised.

UKHSA will use the proposed priority pathogen families to guide its own work, including through its Vaccine Development and Evaluation Centre and Diagnostics Accelerator.

The content of this tool is subject to change and is accurate to the best of UKHSA's knowledge as of January 2025, or as stated in Tables A and B above. UKHSA will consider annual updates to this tool.

The priority pathogen family R&D tool

Note: The consensus views of UKHSA expressed in the tool, and other content included such as diagnostic, therapeutic and vaccine (DTV) pipelines, are accurate to the best of UKHSA's knowledge at time of drafting, but are subject to change. This tool has been developed through the collective knowledge and opinions of subject matter experts within UKHSA, and may **not** reflect the views of wider UK government or devolved administrations. It does **not** constitute a commitment from the UK government or others to fund research and development into DTVs for the pathogen families included, or to fund production or purchase of DTVs that arise from such research.

Category definitions and important caveats are as described in Tables A and B, above. Human-to-human transmission is categorised as Respiratory, Contact (with bodily fluids, including sexual and blood-borne), Food or water, or Vector borne.

For diagnostics availability, this relates to tests **specific** for the notable pathogen listed. P = PCR, S = serology, L = LFD, HT = high throughput, LT = low throughput, LDT = laboratory developed test, RUO = research use only, ADT = academic developed test, Ag = antigen, Ag RUO = antigen research use only, Ab = antibody, Ab RUO = antibody research use only, POC = point of care.

1. Priority viral families

Viral family	Overall pandemic potential	Overall epidemic potential	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Adenoviridae	Medium	High	**Human adenovirus (B, C, E, F)**	Adenovirus infection	Food or water Respiratory Contact	N	Unknown	N	High	Worldwide	Y Limited use only	**LABORATORY** P: HT, LT, LDT S: RUO **NEAR PATIENT** P: POC; L: Ag	Nil specific Supportive only
Arenaviridae	Low	Medium	**Lassa virus**	Lassa fever	Contact	Y	Likely	Y	Nil. Rare imported cases	Endemic in sub-Saharan Africa	N Candidates in (phase 1 + 2) trials	**LABORATORY** P: LT, LDT S: LDT, RUO **NEAR PATIENT** L: Ag RUO	Nil specific Supportive only Candidates in phase 2 trials
Caliciviridae	Medium	High	**Norovirus**	Norovirus infection	Food or water	N	Y	N	High	Worldwide	N Candidate in (phase 3) trial	**LABORATORY** P: HT, LT, LDT S: ADT **NEAR PATIENT** P: POC; L: Ag	Nil specific Supportive only
Coronaviridae	High	High	**MERS-CoV**	MERS	Respiratory (uncommon; typically zoonotic)	Y	Likely	Y	Nil. Rare imported cases	Middle East, notably Saudi Arabia.	N Several candidates in (phase 1) trials	**LABORATORY** P: LT, LDT S: RUO **NEAR PATIENT** P: POC	Nil specific Supportive only Candidates in phase 2 trials

Viral family	Overall pandemic potential	Overall epidemic potential	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Filoviridae	Low	High	**Ebola virus (EBOV)**	Ebola virus disease	Contact	Y	Unknown	Y	Nil	Outbreaks in sub-Saharan Africa.	Y Ervebo and Zabdeno/Mvabea	**LABORATORY** P: HT, LT, LDT S: RUO **NEAR PATIENT** L: Ag	Y WHO-recommended mAbs
			Sudan virus (SUDV)	Sudan virus disease	Contact	Y	Unknown	Y	Nil	Outbreaks in sub-Saharan Africa.	N Candidates in clinical trials	**LABORATORY** P: LDT, RUO S: RUO **NEAR PATIENT** None	Nil specific Supportive only Candidates in trials
			Marburg virus	Marburg virus disease	Contact	Y	Likely	Y	Nil	Outbreaks in sub-Saharan Africa.	N Candidates in clinical trials	**LABORATORY** P: LT, LDT S: RUO **NEAR PATIENT** L: Ag RUO	Nil specific Supportive only Candidate in phase 1 trials
Flaviviridae	Low	High	**Dengue virus**	Dengue	VBD	N	Y	N	Nil Multiple imported cases each year	Common globally. Increasing in Europe.	Y Qdenga licenced in UK	**LABORATORY** P: LT, LDT S: LT, LDT, RUO **NEAR PATIENT** P: POC; L: Ag, Ab	Nil specific Supportive only Candidates in phase 2 trials
			Zika virus	Zika	VBD Contact	Y	Y	N	Nil Sporadic imported cases	Americas, Pacific islands, Africa, and Asia	N Candidates in (phase 2) trials	**LABORATORY** P: LT, LDT S: HT, LT, LDT, RUO **NEAR PATIENT** P: POC; L: Ag, Ab	Nil specific Supportive only Candidate in phase 1 trial
			Hepatitis C virus	Hepatitis C	Contact	N	Unknown	N	Moderate	Worldwide	N	**LABORATORY** P: HT, LT, LDT S: HT, LT, LDT, RUO **NEAR PATIENT** P: POC; L:Ag RUO, Ab	Y Direct acting antivirals +/- interferon

Viral family	Overall pandemic potential	Overall epidemic potential	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Hantaviridae	Low	Low	**Hantaan virus**	Haemorrhagic fever with renal syndrome (HFRS)	Respiratory (rare; typically zoonotic)	Y	Y	Y	Nil	Asia and Northern and Western Europe	Y Limited approvals, new candidates in trials	**LABORATORY** P: LT, LDT, RUO S: LT, LDT, RUO **NEAR PATIENT** L: Ab RUO	Nil specific Supportive only Candidate in phase 1 trial
Nairoviridae	Low	Medium	**CCHF virus**	Crimean-Congo Haemorrhagic fever	VBD Contact	Y	Y	Y	Nil Rare imported cases	Endemic in all of Africa, the Middle East and in Asia	N Candidates in (phase 1) trials	**LABORATORY** P: LT, LDT S: LDT, RUO **NEAR PATIENT** None	Nil specific Supportive only Candidate in phase 2 trial
Orthomyxoviridae	High	High	**Non-seasonal influenza**	Flu	Respiratory	Y	Likely	Avian	Low Significant potential for increase	Worldwide	Y Partial coverage only	**LABORATORY** P: LT, LDT S: LDT, RUO **NEAR PATIENT** L: Ag	Y Antivirals
Paramyxoviridae	High	High	**Nipah virus**	Nipah virus infection	Contact	Y	Likely	Y	Nil	Asia (incl Malaysia, Bangladesh, India)	N Candidates in clinical trials	**LABORATORY** P: LT, LDT, RUO S: ADT **NEAR PATIENT** P: POC	Nil specific Supportive only Candidates in phase 1 trials
Peribunyaviridae	Low	Medium	**Oropouche virus**	Oropouche fever	VBD	Y	Unknown	N	Nil	Caribbean and Latin America	N	**LABORATORY** P: LDT, RUO S: ADT **NEAR PATIENT** None	Nil specific Supportive only

Viral family	Overall pandemic potential	Overall epidemic potential	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Phenuiviridae	Low	Medium	**Rift Valley fever virus**	Rift Valley fever	VBD Contact	Y	Y	N	Nil	Mostly occurs in Africa	N Candidate in (phase 2) trial	**LABORATORY** P: LT, LDT S: LDT, RUO **NEAR PATIENT** None	Nil specific Supportive only
			SFTS virus	Severe fever with thrombo-cytopenia virus syndrome	VBD Contact	N	Unknown	Y	Nil	Sporadic cases in Asia	N	**LABORATORY** P: LDT, RUO S: ADT **NEAR PATIENT** None	Nil specific Supportive only Candidates in trials
Picornaviridae	High	High	**Enterovirus D68, A71**	Acute flaccid myelitis	Food and water Respiratory	N	Unknown	N	Low	Worldwide	N Candidate in (phase 1) trial	**LABORATORY** P: LT, LDT S: RUO **NEAR PATIENT** P: POC; L: Ag	Nil specific Supportive only Candidates need further study
Pneumoviridae	Medium	High	**Human metapneumo-virus**	hMPV infection	Respiratory Contact	N	Likely	N	High	Worldwide	N Candidate in (phase 1) trial	**LABORATORY** P: HT, LT, LDT **NEAR PATIENT** P: POC; L: Ag	Nil specific Supportive only
Poxviridae	Medium	High	**Monkeypox virus (clade I)**	Mpox	Contact	Y	Unknown	N	Nil Sporadic imported cases	Central Africa with sporadic cases elsewhere	Y Additional candidates in trials	**LABORATORY** P: LT, LDT, ADT **NEAR PATIENT** None	Antivirals with unclear efficacy Candidates in phase 2 trials
Togaviridae	Low	Medium	**Chikungunya virus**	Chikungunya	VBD	N	Y	N	Nil Multiple imported cases each year	Outbreaks in Africa, Asia and the Americas	Y Valneva vaccine	**LABORATORY** P: LT, LDT S: LT, LDT, RUO **NEAR PATIENT** P: POC; L: Ab	Nil specific Supportive only Candidate in phase 3 trial

2. Priority bacterial families

Bacterial family	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	AMR concern	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Bacillaceae	***Bacillus anthracis***	Anthrax	Contact Respiratory	Y	Y	No major concern	N	Nil	Worldwide	Y	**LAB** P: LDT, RUO S: RUO **NEAR PT** P: POC RUO L: Ag RUO	Y
Coxiellaceae	***Coxiella burnetii***	Q-fever	VBD	Y	Unknown	No major concern	N	Low	Worldwide (exception of New Zealand)	Y QVax, only licensed in Australia	**LAB** P: LT, LDT S: LT, LDT, RUO **NEAR PT** None	Y
Enterobacteriaceae	***Klebsiella pneumoniae***	Pneumonia, Bloodstream and wound infections	Contact	N	Unknown	Critical	N	Medium	Worldwide	N	**LAB** P: HT, LT, LDT S: RUO **NEAR PT** P: POC	Y
	***Escherichia coli* (ETEC, STEC, EPEC)**	Gastro-intestinal disease, HUS	Food or water	Y	Y	Critical	N	High	Worldwide	N	**LAB** P: HT, LT, LDT S: LDT, RUO **NEAR PT** P: POC; L: Ag	Y
	***Escherichia coli* (UPEC)**	Cystitis, Pyelonephritis	Food or water Contact	Y	Y	Critical	N	High	Worldwide	N	**LAB** P: ADT **NEAR PT** None	Y
	Yersinia pestis	Plague	VBD Respiratory	Y	Unknown	No major concern	Y	Nil	USA, South America, Africa and Asia	N Candidates in trials	**LAB** P: LDT, RUO S: RUO **NEAR PT** None	Y

Bacterial family	Notable pathogen	Disease	Human-to-human transmission	Zoonosis	Climate-sensitive risk	AMR concern	HCID	Domestic burden	Geographical spread	Vaccine availability	Diagnostics availability	Therapeutics availability
Francisellacae	***Francisella tularensis***	Tularaemia	VBD Food or water	Y	Unknown	No major concern	N	Nil	Northern hemisphere	N Unlicensed LVS vaccine	**LAB** P: LT, LDT, RUO S: LT **NEAR PT** P: POC L: Ab	Y
Moraxellaceae	***Acinetobacter baumannii***	Pneumonia, Bloodstream infections, UTI	Contact	N	Likely	Critical	N	Low	Worldwide	N	**LAB** P: HT, LT, LDT S: RUO **NEAR PT** P: POC	Y
Neisseriaceae	***Neisseria gonorrhoeae***	Gonorrhoea	Contact	N	Unknown	High	N	High	Worldwide	N Candidate in trials	**LAB** P: HT, LT, LDT **NEAR PT** P: POC L: Ag	Y
Staphylococcaceae	***Staphylococcus aureus***	Cellulitis, Endocarditis, Pneumonia	Contact	N	Unknown	High	N	High	Worldwide	N	**LAB** P: HT, LT, LDT S: RUO **NEAR PT** P: POC	Y
Streptococcaceae	**Group A Strep**	Pharyngitis, Impetigo, Scarlet fever, Septicaemia	Respiratory Contact	N	Likely	Medium	N	High	Worldwide	N Candidates in trials	**LAB** P: HT, LT, LDT S: LDT, RUO **NEAR PT.** P: POC; L: Ag	Y
	Group B Strep	Chorioamnionitis, Pneumonia, Meningitis, Septicaemia	Contact Intra-partum	N (typically)	Unknown	Medium	N	Medium	Worldwide	N Candidates in trials	**LAB** P: HT, LT S: LDT, RUO **NEAR PT.** P: POC; L: Ag	Y
	Streptococcus pneumoniae	Pneumonia, Meningitis	Respiratory	N	Unknown	Medium	N	High	Worldwide	Y Not all serotypes	**LAB** P: LT, LDT S: LDT, RUO **NEAR PT** P: POC; L: Ag	Y

About the UK Health Security Agency

UK Health Security Agency (UKHSA) prevents, prepares for and responds to infectious diseases, and environmental hazards, to keep all our communities safe, save lives and protect livelihoods. We provide scientific and operational leadership, working with local, national and international partners to protect the public's health and build the nation's health security capability.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

Published: March 2025
Publishing reference: GOV-18351

UKHSA supports the Sustainable Development Goals