

Dynamic Dashboard - List of Infectious Agents with a relevant AMR issue

Section A: Categories applicable to all sectors

Bacteria / gram variable

This category includes the bacteria that are considered:

- gram variable, meaning they may stain either negative or positive
- Atypical, meaning they do not colour with Gram staining but rather remain colourless, or it is difficult to see the Gram reaction
- Acid fast

Bacteria / Other gram negative

The category includes any gram negative bacteria considered to have a drug resistance issue that are not listed individually (see section B and C). This will also include projects that are specifically conducting R&D on gram negative bacteria without specifying which bacterium.

Bacteria / Other gram positive

The category includes any gram positive bacteria considered to have a drug resistance issue that are not listed individually (see section B and C). This will also include projects that are specifically conducting R&D on gram positive bacteria without specifying which bacterium.

Bacteria / Not specified

Includes projects conducting R&D relevant to AMR that do not specify which bacterium or Gram reaction.

Bacteria / Other

This is an old field that is currently being replaced with the subcategories above.

Section B: Human Bacterial Pathogens

Categorization and inclusion methodology for human bacterial pathogens

The World Health Organization's (WHO) Global Priority List of Antibiotic-Resistant Bacteria [1], the United States of America's Centers for Disease Control and Prevention (CDC) Antibiotic Resistant Threats in the United States 2019 [2] and the bacteria included in the European Centre for Disease Prevention and Control's (ECDC) European Antimicrobial Resistance Surveillance Network (EARS-Net) [3] were used to develop a combined list of priority bacteria with a drug-resistance issue. It was considered that all research into these bacteria, irrespective of the drug-resistance profile, would be relevant to advance efforts to address antimicrobial resistance.

For the categorization process, only the bacterial genus level (noting the family *Enterobacteriaceae* was also included) was used and will be displayed. Table 1 list the genus included in categorization and the rules applied for inclusion based on the aforementioned priority lists.

When projects included bacteria other than those listed in Table 1 an individual assessment was performed by the Secretariat to determine if there is a known drug-resistance issue. This assessment included searching the literature and reaching a consensus within the Secretariat if the bacteria has a known drug-resistance issue or not. Where consensus was not reached or there was ambiguity in the literature bacteria were parked and further investigation was conducted.

The list of additional bacteria and the outcomes from the assessment are provided in Table 2 and 3. Please note that these lists will be continually updated.

Table 1 - Genus of priority bacteria and inclusion criteria for the Dynamic Dashboard

Priority [^]	Bacterial genus	Inclusion criteria for the Dynamic Dashboard
Critical	<i>Acinetobacter</i>	All <i>Acinetobacter</i> included.
	<i>Clostridioides</i>	<i>Clostridioides</i> (or <i>Clostridium</i>) <i>difficile</i> was included. Any other <i>Clostridioides</i> and <i>Clostridium</i> were individually assessed for inclusion.
	<i>Enterobacter</i>	All <i>Enterobacter</i> included.
	<i>Enterobacteriaceae</i>	<i>Enterobacter</i> spp., <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Proteus</i> spp. <i>Providencia</i> spp. and <i>Serratia</i> spp. were included. In addition, projects that just mentioned <i>Enterobacteriaceae</i> , without further specification, were included. Any other bacteria in the <i>Enterobacteriaceae</i> family were individually assessed for inclusion.
	<i>Escherichia</i>	<i>Escherichia coli</i> was included. Any other <i>Escherichia</i> were individually assessed for inclusion.
	<i>Klebsiella</i>	<i>Klebsiella pneumoniae</i> was included. Any other <i>Klebsiella</i> were individually assessed for inclusion.
	<i>Morganella</i>	All <i>Morganella</i> included.
	<i>Proteus</i>	All <i>Proteus</i> included.
	<i>Providencia</i>	All <i>Providencia</i> included.
	<i>Pseudomonas</i>	<i>Pseudomonas aeruginosa</i> was included. Any other <i>Pseudomonas</i> were individually assessed for inclusion.
	<i>Serratia</i>	All <i>Serratia</i> included.
High	<i>Campylobacter</i>	All <i>Campylobacter</i> included.
	<i>Enterococcus</i>	<i>Enterococcus faecium</i> and <i>Enterococcus faecalis</i> were included. Any other <i>Enterococcus</i> were individually assessed for inclusion.
	<i>Helicobacter</i>	<i>Helicobacter pylori</i> was included. Any other <i>Helicobacter</i> were individually assessed for inclusion.
	<i>Mycobacterium</i>	<i>Mycobacterium tuberculosis</i> was included. Any other <i>Mycobacterium</i> were individually assessed for inclusion.
	<i>Neisseria</i>	<i>Neisseria gonorrhoeae</i> was included. Any other <i>Neisseria</i> were individually assessed for inclusion.
	<i>Salmonella</i>	All <i>Salmonella</i> included.
	<i>Staphylococcus</i>	<i>Staphylococcus aureus</i> was included. Any other <i>Staphylococcus</i> were individually assessed for inclusion.
Medium	<i>Streptococcus</i>	<i>Streptococcus pneumoniae</i> , group A <i>Streptococcus</i> (<i>S. pyogenes</i> and group B <i>Streptococcus</i> (<i>S. agalactiae</i>)) were included. Any other <i>Streptococcus</i> were individually assessed for inclusion.
	<i>Haemophilus</i>	<i>Haemophilus influenzae</i> was included. Any other <i>Haemophilus</i> were individually assessed for inclusion.
	<i>Shigella</i>	All <i>Shigella</i> included.
Watch	<i>Bordetella</i>	<i>Bordetella pertussis</i> was included. All other <i>Bordetella</i> were checked to see if there was a published resistance issue

[^]Priority level used for visualisations on the Dynamic Dashboard

Table 2 - Other bacteria with a drug resistance issue included in the Dynamic Dashboard

Genus	Species	Key reference
<i>Actinomyces</i>	<i>Actinomyces</i> spp.	[4]
<i>Burkholderia</i>	<i>B. cenocepacia</i>	[5]
	<i>B. cepacia</i>	[5]
	<i>B. mallei</i>	[5]
	<i>B. multivorans</i>	[5]
	<i>B. pseudomallei</i>	[5]
	<i>B. vietnamiensis</i>	[5]
<i>Chlamydia</i>	<i>C. trachomatis</i>	[6, 7]
<i>Clostridium</i>	<i>C. botulinum</i>	[8, 9]
	<i>C. perfringens</i>	[10, 11]
<i>Coxiella</i>	<i>C. burnetti</i>	[12]
<i>Chronobacter</i>	<i>Chronobacter</i> spp., formerly <i>Enterobacter sakazakii</i>	[13]
<i>Corynebacterium</i>	<i>C. diphtheriae</i>	[14]
<i>Enterococcus</i>	<i>E. hirae</i>	[15]
<i>Helicobacter</i>	<i>H. cinaedi</i>	[16]
<i>Listeria</i>	<i>L. monocytogenes</i>	[17]
<i>Moraxella</i>	<i>M. catarrhalis</i>	[18, 19]
<i>Mycobacterium</i>	Non tuberculosis mycobacterium (NTM) as a group	[20]
	<i>M. abscessus</i>	[21]
	<i>M. africanum</i>	[22]
	<i>M. avium</i>	[20]
	<i>M. kyorinense</i>	[23]
	<i>M. leprae</i>	[24]
	<i>M. ulcerans</i>	[25]
<i>Mycoplasma</i>	<i>M. genitalium</i>	[26]
	<i>M. pneumoniae</i>	[27]
<i>Porphyromonas</i>	<i>P. gingivalis</i>	[28]
<i>Staphylococcus</i>	<i>S. epidermidis</i>	[29]
<i>Streptococcus</i>	<i>S. mitis</i>	[30]
<i>Treponema</i>	<i>T. pallidum</i>	[31, 32]
<i>Ureaplasma</i>	<i>Ureaplasma</i> spp.	[33]
<i>Vibrio</i>	<i>V. alginolyticus</i>	[34]
	<i>V. cholerae</i>	[35]
	<i>V. vulnificus</i>	[36]

Table 3 - Bacteria with low drug resistance excluded from the Dynamic Dashboard

Genus	Species	Key reference
<i>Francisella</i>	<i>F. tularensis</i>	[37]
<i>Neisseria</i>	<i>N. meningitidis</i>	[38]

Section C: List of Infectious Agents relevant for AMR R&D in Animals

Categorization and inclusion methodology for animal pathogens relevant to AMR

A pathogen list relevant to AMR R&D for animals was created based on OIEs guidance documents resulting from consultation of two ad hoc Groups on 'Prioritization of Disease for which Vaccines could reduce Antimicrobial Use in Animals'.

- Pigs, poultry and fish (April 2015) [AHG AMUR Vaccines 2015](#) and
- Cattle, sheep and goats (May 2018) [AHG AMUR Vaccines Ruminants 2018](#)

In addition, relevant animal pathogens with an unmet need for AMR were included per input from the experts consulted by the Secretariat for the development of the animal-specific categorization fields of the Dynamic Dashboard.

For the categorization process, only pathogen genus or family level were used and are displayed in the Dynamic Dashboard. All species within the listed genus or family were included and some representative species are listed in the tables. When projects included species that are not listed in the tables below and with a relevance for AMR, they were categorized as virus-other, fungus-other and parasite-other, respectively. In the case of bacterial infections, they were categorized as other and according to gram staining (other-gram positive, other-gram negative and other-gram variable).

Table 4 – Animal Bacterial Pathogens

Bacterial Genus	Species include, but not limited to
<i>Actinobacillus</i>	<i>Actinobacillus pleuropneumoniae</i>
<i>Aeromonas</i>	<i>Aeromonas hydrophila</i>
<i>Anaplasma</i>	<i>Anaplasma marginale</i>
<i>Bacillus</i>	<i>Bacillus anthracis</i>
<i>Bibersteinia</i>	<i>Bibersteinia trehalosi</i>
<i>Bordetella</i>*	<i>Bordetella bronchiseptica</i>
<i>Brachyspira</i>	All <i>Brachyspira</i> included
<i>Brucella</i>	<i>Brucella suis</i> , <i>Brucella abortus</i> , <i>Brucella ovis</i> , <i>Brucella melitensis</i>
<i>Campylobacter</i>*	All <i>Campylobacter</i> included
<i>Chlamydiaceae</i>	All <i>Chlamydia</i> included
<i>Clostridioides</i>*	<i>Clostridium perfringens</i>
<i>Corynebacterium</i>	All <i>Corynebacterium</i> included
<i>Dermatophilus</i>	<i>Dermatophilus congolensis</i>
<i>Dichelobacter</i>	<i>Dichelobacter nodosus</i>
<i>Edwardsiella</i>	<i>Edwardsiella ictaluri</i>
<i>Ehrlichia</i>	<i>Ehrlichia ruminantium</i>
<i>Escherichia</i>*	All <i>Escherichia</i> included
<i>Flavobacterium</i>	<i>Flavobacterium columnare</i>
<i>Fusobacterium</i>	<i>Fusobacterium necrophorum</i>
<i>Haemophilus</i>*	<i>Haemophilus parasuis</i>
<i>Histophilus</i>	<i>Histophilus somni</i>
<i>Lawsonia</i>	<i>Lawsonia intracellularis</i>
<i>Leptospira</i>	All <i>Leptospira</i> included
<i>Mannheimia</i>	<i>Mannheimia capricolum</i> , <i>Manheimia haemolytica</i>
<i>Mycobacterium</i>*	<i>Mycobacterium bovis</i> , <i>Mycobacterium avium</i> (paratuberculosis)
<i>Mycoplasma</i>	<i>Mycoplasma agalactiae</i> , <i>Mycoplasma hyopneumoniae</i>
<i>Pasteurella</i>	<i>Pasteurella multocida</i>
<i>Photobacterium</i>	All <i>Photobacterium</i> included
<i>Piscirickettsia</i>	<i>Piscirickettsia salmonis</i>

<i>Pseudomonas</i> *	All <i>Pseudomonas</i> included
<i>Salmonella</i> *	All <i>Salmonella</i> included
<i>Staphylococcus</i> *	<i>Staphylococcus aureus</i> , <i>Staphylococcus hyicus</i> , <i>Staphylococcus aureus mastitis</i> , <i>Staphylococcus pseudintermedius</i>
<i>Streptococcus</i> *	<i>Streptococcus agalactiae</i> , <i>Streptococcus suis</i> , <i>Streptococcus uberis</i>
<i>Trueperella</i>	<i>Trueperella pyogenes</i>
<i>Vibrio</i>	All <i>Vibrio</i> included
<i>Yersinia</i>	<i>Yersinia ruckerii</i>

*Any bacteria with relevance for AMR but not included in bacteria genus names highlighted in bold indicate a human priority pathogen as described above.

Table 5 – Animal Viral Pathogens

Virus Family	
<i>Arteriviridae</i>	Porcine Reproductive and Respiratory Syndrome virus (PPRS)
<i>Birnaviridae</i>	Infectious Bursal Disease virus (IBDV)
<i>Coronaviridae</i>	Bovine coronavirus (BCoV), Avian coronavirus/Infectious bronchitis virus (IBV)
<i>Orthomyxoviridae</i>	All influenza viruses included
<i>Paramyxoviridae</i>	Peste des petits ruminants virus (PPRV), Bovine Respiratory Syncytial Virus (BRSV)
<i>Pestivirus</i>	Bovine Virus Diarrhoea Virus (BVDV)
<i>Poxviridae</i>	Goatpox Virus, Sheeppox Virus
<i>Reoviridae</i>	Bluetongue virus, Rotavirus

Table 6 – Animal Fungal Pathogens

Fungus Genus	
<i>Aspergillus</i>	All <i>Aspergillus</i> included
<i>Candida</i>	All <i>Candida</i> included
<i>Cryptococcus</i>	All <i>Cryptococcus</i> included
<i>Mucorales</i>	All <i>Mucorales</i> included

Table 7 – Animal Parasitic Pathogens

For the categorization process, parasites were grouped into protozoa, helminths and ectoparasites.

Parasites	
Protozoa- <i>Babesia</i>	All <i>Babesia</i> included
Protozoa- <i>Cryptosporidium</i>	<i>Cryptosporidium parvum</i>
Protozoa- <i>Eimeria</i>	All <i>Eimeria</i> included
Protozoa- <i>Theileria</i>	<i>Theileria annulata</i> , <i>Theileria parva</i>
Protozoa- <i>Trypanosoma</i>	All <i>Trypanosoma</i> included
Helminths- <i>Nematodes</i>	Mostly families: <i>Trichostrongylidae</i> , <i>Molineidae</i> , <i>Ancylostomatidae</i> , <i>Chabertiidae</i>
Helminths-Other	For example trematoda such as <i>Fasciola hepatica</i>
Ectoparasites	All ectoparasites are included

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