PATHOGEN UPDATE

Partnering with regions and countries to identify priority pathogens for vaccines

Immunization Agenda 2030 Monitoring and Evaluation – March 2024

I. Context

WHO is partnering with regions and countries to identify **priority pathogens for new vaccine research and development** (R&D) under Immunization Agenda 2030 (IA2030). The pathogen scope includes **endemic pathogens** that are important to human health, with vaccine candidates in the pipeline, and where any existing vaccines do not address public health needs for all regions. This approach is using multi-criteria decision analysis (MCDA) to identify context-specific priorities, followed by regional consultations to deliberate on the results and finalize priorities. The *MCDA Survey Preparation and*

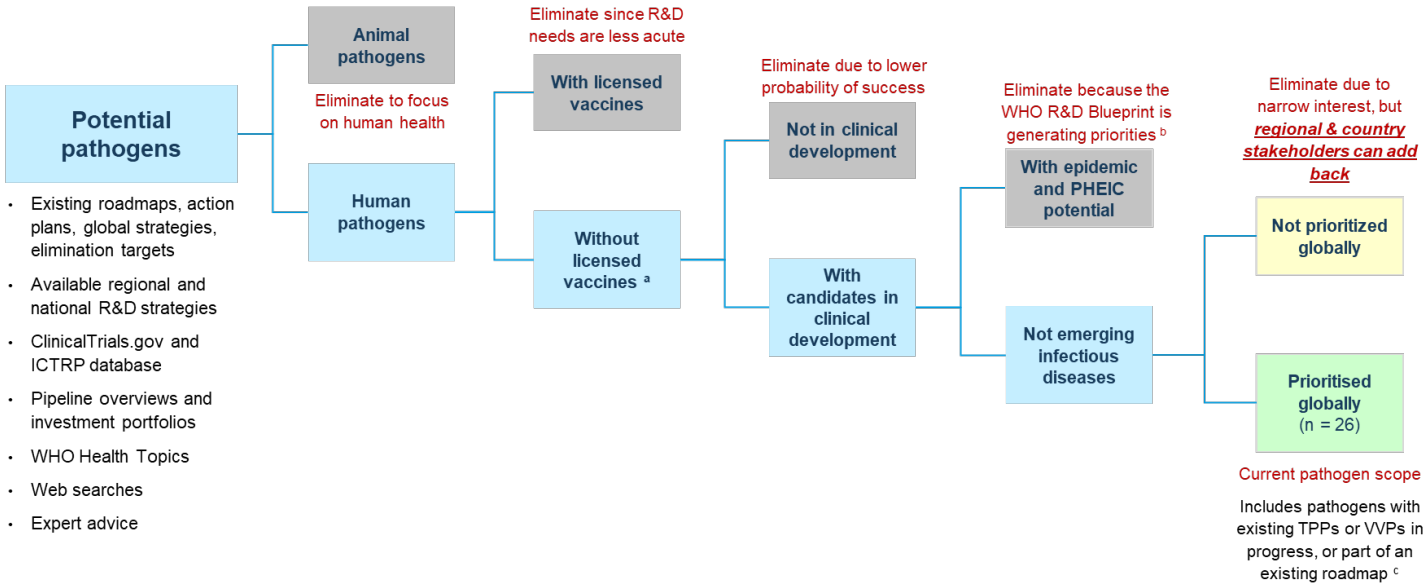
Launch Report (November 2022)[a] gives a detailed description of the MCDA approach, including scope, criteria definitions, and pathogen scoring.

The initial scope included 24 pathogens. This report describes changes to the scope of pathogens and pathogen scores as of March 2024.

II. Rationale for updates

The initial list of pathogens was compiled from a landscape of existing priorities identified in the published and grey literature. These included pathogens prioritized for vaccine R&D, or for research or surveillance at the global, regional or national level. Additional pathogens were identified by searching for vaccine trials on ClinicalTrials.gov[b] and the International Clinical Trials Registry Platform,[c] and from Health Topics on the WHO website,[1] an analysis of investments in global health research,[2] and Wikipedia.[3] A series of screening questions (or "filters") were applied to the pathogen list to reduce it to a more manageable number as shown in Figure 1.

Figure 1 Pathogen screening questions



a Pathogens where vaccines for new indications are needed were included.
b. PHEIC: Public health emergency of international concern. [4]
c. Roadmaps include *Vaccines to tackle drug resistant infections*, and *Roadmap for NTDs* [5,6]
Abbreviations: ICTRP – International Clinical Trials Registry Platform. NTD – neglected tropical disease. TPP – target product profile. VVP – Vaccine Value proposition

One strength of the MCDA approach is the ability to update pathogen data as new information emerges and based on advice from regional stakeholders. As a result, the priority list can be a "living document". This is consistent with IA2030 guidance and with the rapid pace of change in vaccine R&D. Accordingly, the following updates have been made to the pathogen scope and scoring:

[a] https://www.technet-21.org/en/resources/document/vaccine-r-d-priorities-survey-preparation-and-launch-for-pdvac-input
[b] Search conducted on June 6, 2022 using the keyword "vaccine", and limited to phase 1, 2, and 3 trials. 7343 trials found.
[c] Search conducted on June 8, 2022 using the keyword "vaccine", and limited to phase 1, 2, and 3 trials. 6718 trials found.

A. Chlamydia trachomatis and Hepatitis C virus: add to scope

The final screening question takes regional stakeholder perspectives into consideration. Based on advice from regional stakeholders, 2 pathogens were added in March 2023: ***Chlamydia trachomatis*** and **Hepatitis C virus**.

B. Dengue virus: add to scope

Dengue vaccines are available from two manufacturers, Sanofi and Takeda. WHO recommends that the Sanofi vaccine be used in combination with pre-vaccination screening, or only in areas with documented seroprevalence rates of at least 80% by age 9 years. [7] In October 2023, WHO's Strategic Advisory Group of Experts on Immunization (SAGE) recommended that the Takeda vaccine be "considered for introduction in settings with high dengue disease burden and high transmission intensity to maximize the public health impact and minimize any potential risk in seronegative persons". [8] Based on these recommendations, dengue vaccines for dengue-naïve individuals remain an unmet need, and dengue virus should be considered in the scope of this project.

C. *Pseudomonas aeruginosa*: remove from scope

As of October 2023, the *P aeruginosa* vaccine R&D pipeline appears to be inactive. The most recent vaccine trial was a Phase 2/3 efficacy study evaluating IC43 in a high-risk intensive care unit population. This trial found that IC43 was immunogenic and well tolerated, but observed no clinical benefit compared to placebo treatment. [9] This study was completed in 2015 and more recent trials were not found either in recent reviews [10,11] or through searches on clinicaltrials.gov (condition: pseudomonas, other terms: vaccine) or the ICTRP search portal (terms: pseudomonas, vaccine). Therefore, *P aeruginosa* does not meet the screening criterion of "with candidates in clinical development" and can be dropped from the scope of this exercise.

D. Respiratory syncytial virus: update scoring

Multiple new approaches to RSV prevention have been licensed in 2022 and 2023. They include RSV vaccines for the elderly, an RSV vaccine to prevent infant RSV disease through maternal immunization, and a monoclonal antibody to prevent RSV disease in infants and toddlers. Based on this progress, scores for RSV were reviewed and updated starting in October 2023.

E. Chikungunya virus: defer scoring update

In November 2023, the US Food and Drug Administration (US FDA) approved the first chikungunya vaccine, IXCHIQ®. US FDA approval was based on immunogenicity and *in-vitro* neutralizing antibody titres, and confirmatory studies to verify and describe clinical benefit are required for continued approval.[a] As of February 2024, this vaccine is under review by the European Medicines Agency, Health Canada, and Anvisa (Brazil).[b] Its manufacturer, Valneva, is planning to launch

[a] https://www.fda.gov/media/174693/download?attachment

[b] https://valneva.com/wp-content/uploads/2024/02/Valneva_Company-Presentation_February_2024a-v2.pdf

the vaccine in 2024, targeting travellers and military from non-endemic regions. Endemic regions would be served through a manufacturing partnership with Instituto Butantan. [a]

- In light of this progress, we considered whether to update the scoring for Chikungunya virus, particularly for Criteria 8, Unmet needs for prevention and treatment. (Table 1Table 3) In our view, this is not yet a material change in "the effectiveness and suitability of alternative measures" because:The effectiveness and suitability of IXCHIQ are not yet known, since the vaccine was licensed based on its immunogenicity.
- Licensure remains provisional, pending acceptable completion of confirmatory studies.
- Availability in endemic regions will require completion of technology transfer to Instituto Butantan and licensure of Butantan-manufactured vaccines.

We will continue to monitor progress in chikungunya vaccine R&D and will review the scoring for this pathogen when warranted.

III. Scoring method

Pathogens were scored using the approach described in the *MCDA Survey Preparation and Launch Report (November 2022).*[b] Briefly, pathogens were scored for each of the 8 criteria for prioritization (Table 1) on a region-by-region basis and from a global perspective.

The quantitative criteria (1 – 3) were scored using burden estimates for 2019 from Global Burden of Diseases Project (GBD).[c] Region-specific thresholds between levels were set based on the highest burden in each region caused by a pathogen in the scope of this exercise, as described in the *MCDA Survey Preparation and Launch report (November 2022).*[g] are shown in Table 2.

Table 1 Criteria for prioritization

Criteria	Description	Scoring
1. Annual deaths in children under 5	Deaths attributable to the pathogen in both sexes, < 5 years old	Quantitative
2. Annual deaths in people 5 and older	Deaths attributable to the pathogen in both sexes, ≥ 5 years old	Quantitative
3. Years lived with disability (all ages)	Years of healthy life lost each year due to disability or ill-health caused by the pathogen	Quantitative

[a] https://valneva.com/wp-content/uploads/2024/02/Valneva_Company-Presentation_February_2024a-v2.pdf

[b] https://www.technet-21.org/en/resources/document/vaccine-r-d-priorities-survey-preparation-and-launch-for-pdvac-input

[c] https://vizhub.healthdata.org/gbd-results/ and https://ghdx.healthdata.org/record/ihme-data/global-bacterial-antimicrobial-resistance-burden-estimates-2019

Criteria	Description	Scoring
4. Social and economic burden per case	Reflects individual social and economic impact such as impact on education, stigma, and the costs of prevention, health care, and lost productivity. To avoid "double-counting" disease prevalence, this criterion is considered on a ***per case basis***	Qualitative
5. Disruption due to outbreaks	Reflects societal impact due to outbreaks, including social disruption, impact on healthcare, trade and tourism, and the cost of containment measures	Qualitative
6. Contribution to inequity	Reflects disproportionate impact on socially and economically disadvantaged groups, including women	Qualitative
7. Contribution to antimicrobial resistance (AMR)	Reflects the threat of resistance, based on current levels of resistance, contribution to antimicrobial use, and designation as an AMR priority	Qualitative
8. Unmet needs for prevention and treatment	Reflects the effectiveness and suitability of alternative measures. Considers whether current measures are "deliverable" to those who need them, but does not consider current levels of access	Qualitative

Table 2 Quantitative thresholds

WHO Region	Criteria	Thresholds				
		Very low	Low	Medium	High	Very high
African	1 Annual deaths in children under 5	<22,000	22,000-44,000	44,000-66,000	66,000-88,000	>88,000
	2 Annual deaths in people 5 and older	<20,000	20,000-41,000	41,000-61,000	61,000-81,000	>81,000
	3 Annual years lived with disability (all ages)	<190,000	190,000-390,000	390,000-580,000	580,000-780,000	>780,000
Americas	1 Annual deaths in children under 5	<1,500	1,500-3,000	3,000-4,500	4,500-6,100	>6,100
	2 Annual deaths in people 5 and older	<37,000	37,000-74,000	74,000-110,000	110,000-150,000	>150,000
	3 Annual years lived with disability (all ages)	<59,000	59,000-120,000	120,000-180,000	180,000-230,000	>230,000
E. Med.	1 Annual deaths in children under 5	<6,700	6,700-13,000	13,000-20,000	20,000-27,000	>27,000
	2 Annual deaths in people 5 and older	<15,000	15,000-29,000	29,000-44,000	44,000-58,000	>58,000
	3 Annual years lived with disability (all ages)	<54,000	54,000-110,000	110,000-160,000	160,000-220,000	>220,000
European	1 Annual deaths in children under 5	<680	680-1,400	1,400-2,000	2,000-2,700	>2,700
	2 Annual deaths in people 5 and older	<40,000	40,000-82,000	82,000-120,000	120,000-160,000	>160,000
	3 Annual years lived with disability (all ages)	<25,000	25,000-50,000	50,000-75,000	75,000-100,000	>100,000
SE Asian	1 Annual deaths in children under 5	<8,600	8,600-17,000	17,000-26,000	26,000-35,000	>35,000
	2 Annual deaths in people 5 and older	<37,000	37,000-74,000	74,000-110,000	110,000-150,000	>150,000

WHO Region	Criteria	Thresholds				
		Very low	Low	Medium	High	Very high
	3 Annual years lived with disability (all ages)	<130,000	130,000-260,000	260,000-390,000	390,000-520,000	>520,000
W. Pacific	1 Annual deaths in children under 5	<1,500	1,500-3,100	3,100-4,600	4,600-6,100	>6,100
	2 Annual deaths in people 5 and older	<49,000	49,000-99,000	99,000-150,000	150,000-200,000	>200,000
	3 Annual years lived with disability (all ages)	<83,000	83,000-170,000	170,000-250,000	250,000-330,000	>330,000
Global	1 Annual deaths in children under 5	<41,000	41,000-82,000	82,000-120,000	120,000-160,000	>160,000
	2 Annual deaths in people 5 and older	<190,000	190,000-380,000	380,000-570,000	570,000-760,000	>760,000
	3 Annual years lived with disability (all ages)	<450,000	450,000-910,000	910,000-1,400,000	1,400,000-1,800,000	>1,800,000

The qualitative criteria (4 – 8) were scored based on data from PubMed queries and internet searches in English. To give a balanced picture, PubMed queries focused on systematic reviews. Using the definitions in Table 3, multiple analysts[a] independently scored the pathogens on a region-by-region basis and from a global perspective. Differences between their scores were discussed to arrive at consensus scores. For transparency, scores were coded to indicate the level of data available as shown in Table 4.

Table 3 Qualitative Levels

Criteria / *Sub-criteria*	**Very low**	**Low**	**Medium**	**High**	**Very high**
4 Social and economic burden per case	Very low burden for each case	Low burden for each case	Moderate burden for each case	High burden for each case	Very high burden for each case
4.1 Economic burden per case	*Rarely leads to hospitalization* *Little or no losses of productivity*	*Seldom requires hospitalization* *Minor losses of productivity*	*Sometimes requires hospitalization* *Some losses of productivity*	*Often requires hospitalization* *Moderate losses of productivity*	*Typically requires hospitalization* *Serious losses of productivity*
4.2 Social burden per case	*Little or no impact on education or social well-being (e.g due to stigma)*	*Minor impact on education or social well-being (e.g due to stigma)*	*Some impact on education or social well-being (e.g due to stigma)*	*Moderate impact on education or social well-being (e.g due to stigma)*	*Serious impact on education or social well-being (e.g due to stigma)*

[a] Analysts were: *C trachomatis* and hepatitis C virus - Angela Hwang, Anastasia Pantelias, and Ísis Umbelino of Bridges to Development; Dengue virus - AH, AP, and Maria Dreher of Bridges to Development; and RSV - AH and Erin Sparrow of WHO.

Criteria / *Sub-criteria*	**Very low**	**Low**	**Medium**	**High**	**Very high**
5 Disruption due to outbreaks	Little or no social disruption or impact on healthcare, trade or tourism	Slight social disruption or impact on healthcare, trade or tourism	Moderate social disruption or impact on healthcare, trade or tourism	High social disruption or impact on healthcare, trade or tourism, including due to preventive measures	Very high social disruption or impact on healthcare, trade and tourism, including due to preventive measures
6 Contribution to inequity	Affects all communities equally	Burden falls on socially and economically disadvantaged groups, including women, **slightly** more than other groups	Burden falls on socially and economically disadvantaged groups, including women, **moderately** more than other groups	Burden falls on socially and economically disadvantaged groups, including women, **much** more than other groups	Burden falls on socially and economically disadvantaged groups, including women, all or most of the time
7 Contribution to antimicrobial resistance (AMR)	Not resistant to first-line drugs and not associated with antimicrobial use	Little resistance to first-line drugs and little association with antimicrobial use	Some resistance to first-line drugs, associated with high antimicrobial use	Significant resistance to first-line drugs, associated with high antimicrobial use	A global resistance threat due to widespread resistance and association with high antimicrobial use
7.1 AMR Priority	*The pathogen has not been highlighted as a priority for AMR*	*The pathogen has not been highlighted as a priority for AMR*	*The pathogen has been highlighted as a country priority for AMR*	*The pathogen has been highlighted as a regional priority for AMR*	*The pathogen has been highlighted as a critical or high global priority for AMR*
7.2 Frequency of resistance	*Very few isolates are resistant to first-line antimicrobial drugs*	*A low proportion of isolates is resistant to first-line antimicrobial drugs*	*A moderate proportion of isolates is resistant to first-line antimicrobial drugs*	*A high proportion of isolates is resistant to first-line antimicrobial drugs*	*A high proportion of global isolates is resistant to first-line antimicrobial drugs*
7.3 Antimicrobial use	*Low antimicrobial use is associated with infection by the pathogen*	*Moderate or low antimicrobial use is associated with infection by the pathogen*	*High antimicrobial use is associated with infection by the pathogen*	*High antimicrobial use is associated with infection by the pathogen*	*High antimicrobial use is associated with infection by the pathogen*
8 Unmet needs for prevention and treatment	The alternatives for prevention or treatment meet the needs of most people	The alternatives for prevention or treatment meet the needs of many people	The alternatives for prevention or treatment meet the needs of some people	The alternatives for prevention or treatment meet the needs of few people	There are no effective alternatives for prevention or treatment

Table 4 Coding for data availability

Quantitative scoring	Qualitative scoring
A: Burden data from GBD 2019 or AMR dataset	A: Based on data from regional sources
B: Burden calculated by other studies	B: Score inferred based on sources from other regions or pathogens
C: Data not available, will test a range of scores	

Scores were reviewed first by at least expert per pathogen, then by at least 1 regional expert as shown in Table 5. Regional reviewers were asked to consider whether the scores reflect their understanding of the pathogens in the context of their region. To enable consistency in scoring, their review packets included the scoring and supporting information for all the pathogens in scope. Reviews were conducted in 2 rounds, the first focused on *C trachomatis* and hepatitis C, and the second focused on dengue virus and RSV.

Table 5 Reviewers

Review Perspective	Round 1	Round 2
Pathogen Experts	*C trachomatis*: Carolyn Deal, Sami Gottlieb	Dengue virus: Annelies Wilder-Smith
	Hepatitis C: Diana Faini, Nickal Luhmann	RSV: Ruth Karron
African Region	Michelle Groome	KP Asante
Region of the Americas	Cristiana Toscano	Cristiana Toscano, Gonazolo Vazquez-Prokopec
E. Mediterranean Region	Ahmed Deemas Al Suwaidi	
European Region	Sophie Biernaux, Mariagrazia Pizza	
South-East Asian Region	Kawser Choudhury	Kathryn Anderson Jacqueline Deen
Western Pacific Region	David Durrheim	
Global	Martin Friede	

Scores were finalized based on reviewer feedback and incorporated in MCDA calculations as of March 2024.

IV. Results

A. Scores by Region

1. African Region

See Table 4 for A, B, C coding for data availability.

Table 6 African Region Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (B)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Very low (A)	Medium (C)	Medium (A)	Medium (C)	Medium (C)	High (A)
Hepatitis C virus	Very low (A)	Medium (A)	Very low (A)	Very high (A)	Low (B)	Very high (A)	Low (B)	High (A)
RSV	High (A)	Low (A)	Very low (A)	Medium (B)	High (A)	Medium (B)	High (B)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	Medium (A)	Medium (A)	Very Low (A)	Very high (A)
Cytomegalovirus	Very low (C)	Low (C)	Medium (C)	High (B)	Very low (B)	Medium (A)	Very low (B)	Very high (B)
Extra-intestinal pathogenic *E coli*	Medium (A)	High (A)	Very low (A)	Medium (B)	Low (B)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus	Very low (A)	Low (A)	Medium (A)	High (A)	Very low (B)	High (B)	High (B)	High (A)
Group B streptococcus	High (A)	Low (A)	Very low (A)	High (A)	Low (B)	Medium (A)	Low (A)	Very high (A)
Herpes simplex types 1 and 2	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (B)	Very high (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Medium (A)	Low (A)	Very low (B)	Very high (A)	Low (A)	Low (A)
HIV-1	Low (A)	Very high (A)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Very low (A)	Low (A)	Very low (A)	Low (B)	Very high (A)	Medium (B)	Medium (B)	High (A)
Intestinal pathogenic *E. coli*	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (A)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	Very high (A)	Very low (A)	High (B)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very low (A)	Very high (B)	High (A)	Very high (A)	Medium (A)	Medium (A)
Mycobacterium leprae	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (B)	Low (A)	High (A)
M. tuberculosis (TB)	Low (B)	Very high (B)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (B)	Low (B)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	High (A)	Low (A)	Very low (A)	High (A)	Medium (B)	Very high (A)	High (A)	High (A)
Norovirus	Low (A)	Low (A)	Very low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
P. falciparum (malaria)	Very high (C)	Very high (C)	Very high (C)	High (A)	High (A)	Very high (A)	High (A)	High (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (A)	High (B)	Low (B)	Medium (B)
Schistosomes	Very low (A)	Very low (A)	Very high (A)	Medium (A)	Low (A)	Very high (A)	Low (A)	High (A)
Shigella	High (A)	Low (A)	Low (A)	High (A)	Medium (A)	High (B)	High (B)	High (A)
Staphylococcus aureus	High (A)	Very high (A)	Very low (A)	High (B)	Low (B)	Medium (B)	Very high (A)	High (A)

2. Region of the Americas

See Table 4 for A, B, C coding for data availability.

Table 7 Region of the Americas Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (A)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Very high (A)	Medium (A)	Medium (C)	High (A)
Hepatitis C virus	Very low (A)	Medium (A)	Very low (A)	Very high (A)	Low (A)	Very high (A)	Low (A)	High (A)
Respiratory syncytial virus	Medium (A)	Low (A)	Very low (A)	Medium (A)	High (A)	Medium (A)	Medium (A)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Low (B)	Medium (A)	High (A)	Medium (A)	Very low (B)	Very high (A)
Cytomegalovirus	Low (C)	Low (C)	Medium (C)	High (A)	Very low (B)	Medium (A)	Very low (B)	Very high (B)
Extra-intestinal pathogenic *E. coli* (ExPEC)	High (A)	High (A)	Very low (A)	Medium (A)	Low (A)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Low (A)	Low (A)	Very high (A)	Medium (A)	Very low (A)	Medium (A)	High (B)	Medium (A)
Group B streptococcus (*S agalactiae*)	Medium (A)	Very low (A)	Very low (A)	High (A)	Low (A)	Medium (A)	Low (A)	High (A)
Herpes simplex types 1 and 2	Low (C)	Very low (C)	Very low (A)	High (A)	Very low (B)	High (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Very low (A)	Low (A)	Very low (B)	Very high (A)	Low (B)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Low (A)	Low (A)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Low (A)	Low (A)	Very low (A)	Low (A)	Very high (A)	Medium (A)	Medium (A)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (B)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	Medium (A)	Very low (A)	High (A)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Medium (A)	Very high (A)	Medium (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (A)	Medium (A)	High (A)
Mycobacterium tuberculosis (TB)	Very low (B)	Very low (B)	Low (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Low (A)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (A)	High (B)	High (A)	Medium (A)
Norovirus	Very low (A)	Very low (A)	Low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Very low (C)	Very low (C)	Very low (C)	High (A)	Medium (A)	Very high (A)	High (A)	Medium (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (A)	High (B)	Low (B)	Low (B)
Schistosomes	Very low (A)	Very low (A)	Low (A)	Low (A)	Low (A)	High (A)	Low (B)	Medium (A)
Shigella	Very low (A)	Very low (A)	Low (A)	High (A)	Medium (A)	High (A)	High (A)	High (A)
Staphylococcus aureus	Very high (A)	Very high (A)	Very low (A)	High (A)	Low (A)	Medium (B)	Very high (A)	High (A)

3. Eastern Mediterranean Region

See Table 4 for A, B, C coding for data availability.

Table 8 Eastern Mediterranean Region Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (B)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (A)	Medium (A)	Medium (C)	High (A)
Hepatitis C virus	Very low (A)	Very high (A)	Very low (A)	Very high (A)	Low (B)	Very high (A)	Low (B)	High (A)
Respiratory syncytial virus	Low (A)	Very low (A)	Very low (A)	Medium (A)	High (A)	Medium (B)	Low (B)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	Low (A)	Medium (A)	Very low (B)	Very high (A)
Cytomegalovirus	Very low (C)	Low (C)	Medium (C)	High (B)	Very low (B)	Medium (A)	Very low (B)	Very high (B)
Extra-intestinal pathogenic *E. coli* (ExPEC)	High (A)	High (A)	Very low (A)	Medium (A)	Low (B)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Very low (A)	Medium (A)	Very high (A)	Medium (A)	Very low (B)	Medium (B)	High (B)	Medium (A)
Group B streptococcus (*S agalactiae*)	High (A)	Very low (A)	Very low (A)	High (B)	Low (B)	Medium (B)	Very low (B)	High (A)
Herpes simplex types 1 and 2	Very low (C)	Very low (C)	Very low (A)	Medium (B)	Very low (B)	Medium (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Low (A)	Low (B)	Very low (B)	Very high (A)	Low (B)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Very low (A)	Low (A)	Very low (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Very low (A)	Very low (A)	Very low (A)	Low (B)	Very high (A)	Medium (B)	Medium (B)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (B)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	Medium (A)	Very low (A)	High (B)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very high (A)	Very high (A)	High (A)	Very high (A)	Medium (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (B)	Very low (A)	Very high (B)	Low (A)	High (A)
Mycobacterium tuberculosis (TB)	Low (B)	Very high (B)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (B)	Low (B)	High (B)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (B)	High (B)	High (B)	Medium (A)
Norovirus	Low (A)	Very low (A)	Low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Very low (C)	Very low (C)	Low (C)	High (A)	Low (A)	High (B)	Medium (A)	Medium (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (A)	Low (A)	High (B)	High (A)	Medium (A)
Schistosomes	Very low (A)	Very low (A)	Low (A)	Low (A)	Low (B)	High (A)	Low (A)	Medium (A)
Shigella	Low (A)	Very low (A)	Medium (A)	Medium (A)	Medium (B)	High (B)	High (B)	High (A)
Staphylococcus aureus	High (A)	High (A)	Very low (A)	High (B)	Low (A)	Medium (B)	Very high (A)	High (A)

4. European Region

See Table 4 for A, B, C coding for data availability.

Table 9 European Region Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (A)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Very low (A)	Very low (C)	Low (A)	Medium (C)	Very low (C)	Medium (A)
Hepatitis C virus	Very low (A)	Low (A)	Low (A)	Very high (A)	Very low (A)	Very high (A)	Low (A)	High (A)
Respiratory syncytial virus	Very high (A)	Very low (A)	Very low (A)	Medium (A)	High (A)	Medium (B)	Medium (A)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	Medium (A)	Medium (A)	Very low (B)	Very high (A)
Cytomegalovirus	Medium (C)	Low (C)	Medium (C)	High (A)	Very low (B)	Medium (A)	Very low (B)	Very high (A)
Extra-intestinal pathogenic *E coli*	Medium (A)	Very high (A)	Low (A)	Medium (A)	Low (B)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Low (A)	Low (A)	Very high (A)	Medium (A)	Very low (A)	Medium (B)	High (B)	Medium (A)
Group B streptococcus (*S agalactiae*)	Low (A)	Very low (A)	Very low (A)	High (A)	Low (B)	Medium (A)	Low (A)	High (A)
Herpes simplex types 1 and 2	Very low (C)	Very low (C)	Low (A)	Medium (A)	Very low (B)	Medium (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Very low (A)	Low (B)	Very low (B)	Very high (A)	Low (B)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Very low (A)	Very low (A)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Low (A)	Very low (A)	Very low (A)	Low (A)	Very high (A)	Medium (B)	Medium (B)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (B)	Very high (A)	Medium (A)
Klebsiella pneumoniae	High (A)	Medium (A)	Very low (A)	High (B)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (B)	High (A)	Very low (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (A)	Very low (B)	High (A)
Mycobacterium tuberculosis (TB)	Low (B)	Very low (B)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (B)	Low (B)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (B)	High (B)	High (B)	Medium (A)
Norovirus	Very low (A)	Very low (A)	High (A)	Low (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Very low (C)	Very low (C)	Very low (C)	Low (B)	Very low (A)	Very Low (B)	Very low (A)	Very low (B)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (A)	High (B)	Low (B)	Low (B)
Schistosomes	Very low (A)	Very low (A)	Very low (A)	Very low (B)	Low (A)	Very low (B)	Very low (B)	Very low (A)
Shigella	Very low (A)	Very low (A)	Low (A)	Medium (A)	Medium (A)	High (B)	High (B)	High (A)
Staphylococcus aureus	Very high (A)	Very high (A)	Very low (A)	High (A)	Low (A)	Medium (B)	Very high (A)	High (A)

5. South-East Asian Region

See Table 4 for A, B, C coding for data availability.

Table 10 South-East Asian Region Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (B)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Medium (A)	Medium (A)	Very high (A)	Medium (A)	Medium (A)	High (A)
Hepatitis C virus	Very low (A)	High (A)	Very low (A)	Very high (A)	Low (B)	Very high (A)	Low (A)	High (A)
Respiratory syncytial virus	High (A)	Low (A)	Very low (A)	Medium (A)	High (A)	Medium (B)	High (B)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	High (A)	Medium (A)	Very low (B)	Very high (A)
Cytomegalovirus	Very low (C)	Low (C)	Medium (C)	High (B)	Very low (B)	Medium (A)	Very low (B)	Very high (B)
Extra-intestinal pathogenic *E coli*	High (A)	Very high (A)	Very low (A)	Medium (B)	Low (B)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Very low (A)	Very high (A)	Very high (A)	High (A)	Very low (A)	High (B)	High (B)	High (A)
Group B streptococcus (*S agalactiae*)	High (A)	Low (A)	Very low (A)	High (B)	Low (B)	Medium (B)	Very low (A)	Very high (A)
Herpes simplex types 1 and 2	Very low (C)	Very low (C)	Very low (A)	High (A)	Very low (B)	High (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Low (A)	Low (A)	Very low (B)	Very high (A)	Low (B)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Very low (A)	Low (A)	High (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Very low (A)	Low (A)	Very low (A)	Low (A)	Very high (A)	Medium (B)	High (B)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (B)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	Very high (A)	Very low (A)	High (A)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very low (A)	Very high (A)	High (A)	Very high (A)	Medium (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (A)	Medium (A)	High (A)
Mycobacterium tuberculosis (TB)	Very high (B)	Very high (B)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (B)	Low (B)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Very low (A)	Very low (A)	Very low (A)	Low (B)	Very low (A)	High (B)	High (B)	Medium (A)
Norovirus	Very low (A)	Low (A)	Very low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Low (C)	Very low (C)	Low (C)	High (A)	Medium (A)	High (B)	High (A)	Medium (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (A)	Low (A)	High (A)	High (A)	Medium (A)
Schistosomes	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (B)	High (A)	Low (B)	Medium (A)
Shigella	Very low (A)	Very low (A)	Low (A)	High (A)	Medium (A)	High (B)	Very high (A)	High (A)
Staphylococcus aureus	High (A)	Very high (A)	Very low (A)	High (B)	Very low (A)	Medium (B)	Very high (A)	High (A)

6. Western Pacific Region

See Table 4 for A, B, C coding for data availability.

Table 11 Western Pacific Region Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Very low (B)	Medium (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Low (A)	Medium (A)	Very high (A)	Medium (A)	Medium (C)	High (A)
Hepatitis C virus	Very low (A)	Medium (A)	Very low (A)	Very high (A)	Low (A)	Very high (A)	Low (A)	High (A)
Respiratory syncytial virus	Very high (A)	Very low (A)	Very low (A)	Medium (A)	High (A)	Medium (B)	High (A)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	High (A)	Medium (A)	Very low (B)	High (A)
Cytomegalovirus	Medium (C)	Low (C)	Medium (C)	High (A)	Very low (B)	Medium (A)	Very low (B)	Very high (B)
Extra-intestinal pathogenic *E. coli* (ExPEC)	High (A)	Medium (A)	Very low (A)	Medium (B)	Low (A)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Low (A)	Medium (A)	Very high (A)	High (A)	Very low (A)	High (A)	High (B)	High (A)
Group B streptococcus (*S agalactiae*)	High (A)	Very low (A)	Very low (A)	High (B)	Low (B)	Medium (B)	Low (A)	High (A)
Herpes simplex types 1 and 2	Low (C)	Very low (C)	Very low (A)	High (A)	Very low (B)	High (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Low (A)	Low (A)	Very low (B)	Very high (A)	Low (B)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Low (A)	Very low (A)	Medium (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Medium (A)	Low (A)	Very low (A)	Low (A)	Very high (A)	Medium (B)	High (B)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (B)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	Medium (A)	Very low (A)	High (A)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (B)	Very low (B)	Very low (A)	Very high (A)	Very low (B)	High (A)	Very low (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (B)	Medium (A)	High (A)
Mycobacterium tuberculosis (TB)	Very high (B)	Medium (B)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (B)	Low (A)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (B)	High (B)	High (B)	Medium (A)
Norovirus	Very low (A)	Very low (A)	Low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Very low (C)	Very low (C)	Very low (C)	High (A)	Low (A)	High (B)	Medium (A)	Medium (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (A)	High (A)	Medium (A)	Low (B)
Schistosomes	Very low (A)	Very low (A)	Very low (A)	Low (B)	Low (B)	High (A)	Low (A)	Medium (A)
Shigella	Very low (A)	Very low (A)	Very low (A)	High (A)	Medium (B)	High (B)	High (B)	High (A)
Staphylococcus aureus	Very high (A)	Very high (A)	Very low (A)	High (A)	Low (A)	High (A)	Very high (A)	High (A)

7. Global

See Table 4 for A, B, C coding for data availability.

Table 12 Global Scores

Pathogen	1 Annual deaths in children under 5	2 Annual deaths in people 5 and older	3 Annual years lived with disability (all ages)	4 Social and economic burden per case	5 Disruption due to outbreaks	6 Contribution to inequity	7 Contribution to antimicrobial resistance	8 Unmet needs for prevention & treatment
Chlamydia trachomatis	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Very low (A)	High (A)	Low (A)	High (A)
Dengue virus	Very low (A)	Very low (A)	Low (A)	Medium (A)	High (A)	Medium (A)	Medium (A)	High (A)
Hepatitis C virus	Very low (A)	Medium (A)	Very low (A)	Very high (A)	Low (A)	Very high (A)	Low (A)	High (A)
Respiratory syncytial virus	High (A)	Low (A)	Very low (A)	Medium (A)	High (A)	Medium (A)	Medium (A)	Medium (A)
Not updated, see the MCDA Survey Preparation and Launch Report (November 2022) for supporting data								
Chikungunya virus	Very low (B)	Very low (B)	Very low (B)	Medium (A)	High (A)	Medium (A)	Very low (A)	Very high (A)
Cytomegalovirus	Very low (C)	Low (C)	Medium (C)	High (B)	Very low (B)	Medium (A)	Very low (B)	Very high (A)
Extra-intestinal pathogenic *E. coli* (ExPEC)	High (A)	Very high (A)	Very low (A)	Medium (A)	Low (A)	Medium (A)	Very high (A)	Medium (A)
Group A streptococcus (*S pyogenes*)	Very low (A)	Medium (A)	Very high (A)	High (A)	Very low (A)	High (A)	High (A)	High (A)
Group B streptococcus (*S agalactiae*)	High (A)	Very low (A)	Very low (A)	High (A)	Low (A)	Medium (A)	Low (A)	High (A)
Herpes simplex types 1 and 2	Very low (C)	Very low (C)	Very low (A)	High (A)	Very low (B)	High (A)	Low (A)	High (A)
Hookworm	Very low (C)	Very low (C)	Medium (A)	Low (A)	Very low (B)	Very high (A)	Low (A)	Low (A)
Human immunodeficiency virus 1 (HIV-1)	Low (A)	Very high (A)	Very high (A)	Very high (A)	High (A)	Very high (A)	Very high (A)	High (A)
Influenza	Very low (A)	Low (A)	Very low (A)	Low (A)	Very high (A)	Medium (A)	Medium (A)	High (A)
Intestinal pathogenic *E. coli* (InPEC)	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Medium (B)	Medium (A)	Very high (A)	Medium (A)
Klebsiella pneumoniae	Very high (A)	High (A)	Very low (A)	High (A)	Low (A)	Low (B)	Very high (A)	High (A)
Leishmania	Very low (A)	Very low (A)	Very low (A)	Very high (A)	Medium (A)	High (A)	Medium (A)	Medium (A)
Mycobacterium leprae (leprosy)	Very low (C)	Very low (C)	Very low (A)	Very high (A)	Very low (A)	Very high (A)	Medium (A)	High (A)
Mycobacterium tuberculosis (TB)	High (B)	Very high (B)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	High (A)
Neisseria gonorrhoeae	Very low (A)	Very low (A)	Very low (A)	Medium (A)	Low (A)	High (A)	Very high (A)	Medium (A)
Non-typhoidal *Salmonella*	Medium (A)	Very low (A)	Very low (A)	Medium (A)	Medium (A)	High (A)	High (A)	Medium (A)
Norovirus	Low (A)	Very low (A)	Low (A)	Medium (A)	High (A)	Medium (A)	Low (B)	High (A)
Plasmodium falciparum (malaria)	Very high (C)	Low (C)	Very high (C)	High (A)	Medium (A)	High (A)	High (A)	High (A)
Salmonella Paratyphi	Very low (A)	Very low (A)	Very low (A)	Low (A)	Low (A)	High (A)	High (A)	Medium (A)
Schistosomes	Very low (A)	Very low (A)	Medium (A)	Low (A)	Low (A)	High (A)	Low (A)	Medium (A)
Shigella	Medium (A)	Very low (A)	Low (A)	High (A)	Medium (A)	High (A)	High (A)	High (A)
Staphylococcus aureus	High (A)	Very high (A)	Very low (A)	High (A)	Low (A)	Medium (A)	Very high (A)	High (A)

B. Scores by Pathogen

1. Chlamydia trachomatis

See Table 4 for A, B, C coding for data availability.

Table 13 ***Chlamydia trachomatis***

Criteria	African	Americas	E. Med.	European	SE Asian	W. Pacific	Global
1 Annual deaths in children under 5	0 Very low (A)	0 Very low (A)	0 Very low (A)	0 Very low (A)	0 Very low (A)	0 Very low0 (A)	0 Very low (A)
2 Annual deaths in people 5 and older	173 Very low (A)	111 Very low (A)	55 Very low (A)	85 Very low (A)	442 Very low (A)	105 Very low (A)	972 Very low (A)
3 Annual years lived with disability (all ages)	22,542 Very low (A)	12,664 Very low (A)	12,712 Very low (A)	9,784 Very low (A)	31,802 Very low (A)	34,580 Very low (A)	124,428 Very low (A)
4 Social and economic burden per case	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Medium (A)	Very high (A)
5 Disruption due to outbreaks	Very low (B)	Very low (A)	Very low (B)	Very low (A)	Very low (B)	Very low (B)	Very low (A)
6 Contribution to inequity	High (A)	High (A)	High (A)	High (A)	High (A)	Medium (A)	High (A)
7 Contribution to antimicrobial resistance	Low (A)	Low (A)	Low (A)	Low (A)	Low (A)	Low (A)	Low (A)
8 Unmet needs for prevention & treatment	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)

Notes and selected citations

1-3 Annual deaths in children under 5, Annual deaths in people 5 and older, Annual years lived with disability

- Source: GBD Results [Internet]. Institute for Health Metrics and Evaluation. [cited 2022 Oct 5]. Available from: https://vizhub.healthdata.org/gbd-results

4 Social and economic burden per case

- "STIs have a direct impact on sexual and reproductive health through stigmatization, infertility, cancers and pregnancy complications and can increase the risk of HIV". (https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis)
- "While it is often an asymptomatic infection in women, *C. trachomatis* is also an important cause of cervicitis, urethritis, and pelvic inflammatory disease (PID), which is an ascending infection of the uterus, fallopian tubes, or neighboring pelvic structures that can vary in presentation as asymptomatic endometritis, salpingitis, tuboovarian abscess, pelvic peritonitis, perihepatitis, or periappendicitis." (PMID 27144177)
- Ascending infection by *C. trachomatis* can lead to long-term scarring of the female upper genital tract, resulting in infertility, ectopic pregnancy, and chronic pelvic pain. *Chlamydia* infections are one of the most important preventable causes of infertility in women. (PMID 20470050)
- *Chlamydia* is also associated with adverse pregnancy outcomes such as miscarriage, stillbirth, ectopic pregnancy, preterm delivery and low birth weight. (PMID 27144177) In addition, prospective studies show that chlamydial conjunctivitis and pneumonia occur in 18-44% and 3-16%, respectively, of infants born to those with chlamydia. (https://www.cdc.gov/std/chlamydia/stdfact-chlamydia-detailed.htm)
- Infections in the eye cause trachoma, the leading infectious cause of blindness. (https://www.who.int/publications/i/item/9789240010352) That said, trachoma burden and mass drug administration did not strongly influence this scoring because ocular disease is unlikely to be a vaccination target.

5 Disruption due to outbreaks

- Very few reports of outbreaks of *Chlamydia* infections. (https://www.ecdc.europa.eu/en/chlamydia/facts)

6 Contribution to inequity

- Women are disproportionately affected by the disease sequelae of chlamydial infection. (PMID 20470050)
- Infection rates are extremely high among indigenous communities in the Brazilian Amazon (PMID 34067165) Prevalence in Australian Aboriginal populations are also high. (PMID 31766703)
- Disparities among racial groups: in the US, chlamydia rates among Blacks were 6-fold higher than among Whites. (https://www.cdc.gov/std/chlamydia/stdfact-chlamydia-detailed.htm)

7 Contribution to antimicrobial resistance

- *C. trachomatis* infections are easily treated with first line antimicrobials and AMR has not been a major issue; however, there is some concern that AMR could potentially develop. Prevalence and mechanisms of AMR in *Chlamydia* are poorly understood. (PMID 36421278, 26392647, 34479551, 27218014, 28930567; https://doi.org/10.1016/j.mpmed.2022.02.006)
- There is some evidence of resistance associated with mass antibiotic treatment to prevent trachoma. (PMID 31554017)

8 Unmet needs for prevention and treatment

- Treatment regimens are single-dose azithromycin or a 1-week course of doxycycline, depending on presentation. (PMID 27559553)
- Treatment failures due to poor compliance and reinfection remain concerns. (PMID 36421278)
- Screening programs have been implemented in the general population in several HICs and in high-risk populations in many settings. (PMID 33879251, 30520712, many others) but vary in impact and cost-effectiveness. "Despite implementing a range of interventions to control chlamydia, there is no practice-based evidence that population prevalence can be reduced by screening programmes or widespread opportunistic testing." (PMID 34045364)

2. *Dengue virus*

See Table 4 for A, B, C coding for data availability.

Table 14 Dengue Virus

Criteria	African	Americas	E. Med.	European	SE Asian	W. Pacific	Global
1 Annual deaths in children under 5	33 Very low (A)	214 Very low (A)	321 Very low (A)	0 Very low (A)	5,232 Very low (A)	847 Very low (A)	6,655 Very low (A)
2 Annual deaths in people 5 and older	16 Very low (A)	1,136 Very low (A)	1,069 Very low (A)	0 Very low (A)	25,252 Very low (A)	1907 Very low (A)	29,400 Very low (A)
3 Annual years lived with disability (all ages)	47,532 Very low (A)	48,421 Very low (A)	22,954 Very low (A)	0 Very low (A)	327,359 Medium (A)	105,267 Low (A)	552,498 Low (A)
4 Social and economic burden per case	Medium (C)	Medium (A)	Medium (A)	Very low (C)	Medium (A)	Medium (A)	Medium (A)
5 Disruption due to outbreaks & emergencies	Medium (A)	Very high (A)	Medium (A)	Low (A)	Very high (A)	Very high (A)	High (A)
6 Contribution to inequity	Medium (C)	Medium (A)	Medium (A)	Medium (C)	Medium (A)	Medium (A)	Medium (A)
7 Contribution to antimicrobial resistance	Medium (C)	Medium (C)	Medium (C)	Very low (C)	Medium (A)	Medium (C)	Medium (A)
8 Unmet needs for prevention & treatment	High (A)	High (A)	High (A)	Medium (A)	High (A)	High (A)	High (A)

Notes and selected citations

- **Annual deaths and YLDs**: Institute for Health Metrics and Evaluation, Global Burden of Diseases 2019. https://vizhub.healthdata.org/gbd-results/ Because the global burden of dengue virus has been increasing, GBD 2019 is likely to under-estimate the dengue burden.[13] Updated regional estimates of dengue burden are in preparation, and will be incorporated in this scoring when available from WHO.
- **Social and economic burden per case**. Costs and burden include healthcare costs and lost productivity. [14]

- **Disruption due to outbreaks and emergencies.** In dengue-endemic countries, there is a significant economic burden due to costs of vector control programs and health care system costs during outbreaks, which are highly disruptive to the health care system. Some countries suffer economic costs due to impacts on tourism during an outbreak. [14–16] In Europe, locally acquired cases are increasing and the likelihood of local transmission in areas where the vectors are present is deemed "moderate". [12]
- **Contribution to inequity**. Because the vector is highly domesticated, dengue transmission is associated with urbanization and outbreaks can affect all socio-economic classes. [16–18] Poorer populations may be more affected due to environmental factors and lack of access to interventions that can prevent human/mosquito contact, such as quality housing and insect screens.
- **Contribution to AMR**. Presumptive antibiotic treatment for acute febrile illness, such as caused by dengue, is common in many settings. [19,20]
- **Unmet needs for prevention and treatment**. Vector control is costly, difficult to implement, and hard to sustain. Treatment consists of case management and there is no specific antiviral for dengue illness. [7,21] Sanofi's CYD-TDV dengue vaccine is safe and efficacious in seropositive individuals but carries an increased risk of severe dengue in seronegative individuals. Therefore, it is recommended only for those with prior infection. [7] In October 2023, WHO's Strategic Advisory Group of Experts on Immunization (SAGE) recommended that Takeda's new QDENGA vaccine be "considered for introduction in settings with high dengue disease burden and high transmission intensity to maximize the public health impact and minimize any potential risk in seronegative persons". [8] Thus, safe, effective, and affordable dengue vaccines for use irrespective of serostatus remain an unmet need.
- **Context for prioritization**. Dengue is under-recognized in Africa, where dengue outbreaks may often be masked by other febrile illnesses. [22] Very high priority in the geographies that suffer from outbreaks, Americas, SE Asia, and Western Pacific. AMR and WPR have had dengue-specific strategic plans. [23,24] EUR and SEAR have ongoing or recent dengue-related activities. [12,25] At the global level, dengue is included in the Global Strategy for Dengue Prevention and Control, the Global Integrated Arbovirus Initiative, and the Road map for neglected tropical diseases 2021–2030. [6,26,27]
- **Americas context**. The nature of dengue transmission leads to high social, political and economic burdens in the Americas. Only this year Dengue Outbreaks in Peru and Paraguay led to the removal of the country health ministers. Additionally, many locations with tourism see major declines during dengue periods, which increase indirect costs by a lot. (Gonzalo Vazquez Prokopec, review comment)
- **Eastern Mediterranean context.** Dengue virus outbreaks are increasing and almost 7 out of the 22 countries in the region are endemic with dengue virus with the highest burden in Pakistan and Yemen. Unfortunately, the epidemiology of dengue virus remains poorly characterized due to several reasons including inadequate human

and vector surveillance, non-reporting of illness syndromes, and poor diagnostic capacity in many countries in the region. (Ahmed Alsuwaidi, review comment)

3. Hepatitis C virus (HCV)

See Table 4 for A, B, C coding for data availability.

Table 15 Hepatitis C virus (HCV)

Criteria	African	Americas	E. Med.	European	SE Asian	W. Pacific	Global
1 Annual deaths in children under 5	136 Very low (A)	9 Very low (A)	125 Very low (A)	6 Very low (A)	397 Very low (A)	7 Very low (A)	681 Very low (A)
2 Annual deaths in people 5 and older	47,646 Medium (A)	82,391 Medium (A)	72,793 Very high (A)	66,918 Low (A)	128,553 High (A)	142,165 Medium (A)	541,635 Medium (A)
3 Annual years lived with disability (all ages)	17,083 Very low (A)	25,514 Very low (A)	23,742 Very low (A)	27,366 Low (A)	43,396 Very low (A)	64,374 Very low (A)	201,949 Very low (A)
4 Social and economic burden per case	Very High (A)	Very High (A)	Very High (A)	Very High (A)	Very High (A)	Very High (A)	Very High (A)
5 Disruption due to outbreaks	Low (B)	Low (A)	Low (B)	Very low (A)	Low (B)	Low (A)	Low (A)
6 Contribution to inequity	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)	Very high (A)
7 Contribution to antimicrobial resistance	Low (B)	Low (A)	Low (B)	Low (A)	Low (A)	Low (A)	Low (A)
8 Unmet needs for prevention & treatment	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)

Notes and selected citations

1-3 Annual deaths in children under 5, Annual deaths in people 5 and older, Annual years lived with disability

- Source: GBD Results [Internet]. Institute for Health Metrics and Evaluation. [cited 2022 Oct 5]. Available from: https://vizhub.healthdata.org/gbd-results. Data for "Total burden related to Hepatitis C" were used.

- A regional reviewer noted that HCV burden is increasing globally and in the Americas.

4 Social and economic burden per case

- 70% (55–85%) of persons will develop chronic HCV infection. Of those with chronic HCV infection, the risk of cirrhosis ranges from 15% to 30% within 20 years. https://www.who.int/news-room/fact-sheets/detail/hepatitis-c
- "HCV has emerged as an important trigger of lymphoproliferative disorders, owing to its lymphotropism, and of a wide spectrum of extra-hepatic manifestations (HCV-EHMs) affecting different organ systems. … In addition, neuropsychiatric disorders and neurocognitive dysfunction are reported in nearly 50% of patients with chronic HCV infection, which are independent of the severity of liver disease or HCV replication rates." (PMID 26576086)
- Associations have been observed between HCV infection and Hepatobiliary tract cancer (PMID33780211) and incident esophageal cancer (PMID33780211); Kidney disease (https://www.sciencedirect.com/science/article/pii/S166526811930451X?via%3Dihub); Osteoporotic fracture (PMID 29322660); Neuropsychiatric symptoms and cognitive impairment (PMID 26576086, 30610739, 31405320, 35220648); Schizophrenia (PMID 8565883); Metabolic diseases (https://pubmed.ncbi.nlm.nih.gov/31746482/); and Coronary atherosclerosis (PMID 27207725)
- HCV infection might increase the risk of other conditions, such as Diabetes mellitus and hepatocellular carcinoma (PMID 35103624); HIV and kidney disease (PMID 26271205, 26147631). HCV treatment can "reactivate" HBV infections (PMID 36556178)
- HCV can be transmitted vertically from mother to infant (PMID 36066543, https://www.wjgnet.com/1007-9327/full/v21/i38/10783.htm). HIV-infected pregnant women are more likely to transmit the virus to their infants. (PMID 36066543) "Despite being "asymptomatic" on routine medical history, children with early acquired HCV have significantly poorer health status than community controls." (https://onlinelibrary.wiley.com/doi/10.1111/j.1440-1746.2007.04859.x)
- Due to association with injection drug use, Hep C is seen as a stigmatizing disease (PMID 35993427)
- "Pan-genotypic DAAs remain expensive in many high- and upper-middle-income countries. However, prices have dropped dramatically in many countries (primarily low-income and lower-middle-income countries) due to the introduction of generic versions of these medicines. … In many low and middle income countries the curative treatment course is available for less than $50." (https://www.who.int/news-room/fact-sheets/detail/hepatitis-c)
- In Egypt, the estimated cost of identifying a patient with active HCV infection was US$85, and the cost per cure was $130. https://www.nature.com/articles/s41575-020-00392-3

5 Disruption due to outbreaks

- Outbreaks in healthcare settings have been reported and attributed to inadequate infection control practices (PMID 36463162, 32155208, 26449566)

6 Contribution to inequity

- HCV infections occur at higher rates in socially and economically disadvantaged groups, including Ethnic minorities (PMID 32323289); "Waste pickers" and others with low socio-economic status (PMID 32529235); HIV-infected persons (PMID 36267256, 35639675, 35732463, 36267256); Lesbian, gay, bisexual and transgender populations (PMID 35346371); Prisoners (PMID 36177400); People who inject drugs (PMID 35799203); Persons with malaria or schistosomes (PMID 35388763)
- Disadvantaged groups are less likely to have access to safe medical procedures and infection control. As a result, "Unsafe injections, body piercing, unsafe dental procedure, unsafe shaving, and tattooing were identified as major risk factors for reported by HCV population participants." (PMID 36340297, 35758763) Other studies have identified risks of Dialysis (PMID 36195804, 36383211, 35013390) and Tattoos (PMID 35085358)
- Many with HCV face barriers in accessing care. (https://www.hhs.gov/sites/default/files/Viral-Hepatitis-National-Strategic-Plan-2021-2025.pdf)

7 Contribution to antimicrobial resistance

- Not apparently associated with antibiotic use
- Direct-acting antivirals are relatively new. Treatment failures have been observed and associated mutations are now being characterized. (PMID 31943236, 32904849, https://aasldpubs.onlinelibrary.wiley.com/doi/10.1002/hep.27934)

8 Unmet needs for prevention and treatment

- There is currently no effective vaccine against hepatitis C so prevention depends on reducing the risk of exposure to the virus in health care settings and in higher risk populations. (https://www.who.int/news-room/fact-sheets/detail/hepatitis-c) Coverage of evidence-based harm-reduction services for HCV prevention among people who inject drugs remains poor. (PMID 29074410)
- In one systematic review, HCV infection was the disease most commonly transmitted by needlestick injuries (PMID 35394056, 35692264)
- Multiple diagnostic tools, including point-of-care testing methods. (PMID 35150578, 35626411, 36537787)
- Because of the lack of symptoms, it is important for medical providers to screen for viral hepatitis before liver damage occurs. (https://www.hhs.gov/sites/default/files/Viral-Hepatitis-National-Strategic-Plan-2021-2025.pdf) Globally, only 21% of people living with chronic hepatitis C infection know their status. (https://www.who.int/publications/i/item/9789240027077) Screening strategies and their cost-effectiveness vary by location and epidemiological situation. (PMID 34870793)
- Existing antiviral treatments are safe, effective, and cost-effective (PMID 35357774, 35646774). They may not prevent all long-term sequelae of HCV infection (PMID 35525392).
- Treatment challenges include adherence to the 12 – 14 week course of treatment (https://www.who.int/news-room/fact-sheets/detail/hepatitis-c) and integrating treatment with counseling, harm reduction, and other services. (PMID 35013390, 35273933, 35303490, 35812487, 35883158)
- Reinfection after successful therapy can occur, including among people living with HIV (PMID 35659336, 35968434) For persons who inject drugs, a reinfection incidence of at least 1.0 per 100 PY has been calculated (PMID 32659974, 31125496, 26787172) For prisoners who inject drugs, a reinfection incidence of 12.5 per 100 PY has been observed. (PMID 35362522)

4. Respiratory syncytial virus

See Table 4 for A, B, C coding for data availability.

Table 16 Respiratory syncytial virus (RSV)

Criteria	African	Americas	E. Med.	European	SE Asian	W. Pacific	Global
1 Annual deaths in children under 5	72,040 High (A)	4,077 Medium (A)	10,052 Low (A)	3,404 Very high (A)	27,492 High (A)	6,588 Very high (A)	123,790 High (A)
2 Annual deaths in people 5 and older	30,023 Low (A)	39,269 Low (A)	6,401 Very low (A)	36,190 Very low (A)	63,633 Low (A)	38,477 Very low (A)	214,704 Low (A)
3 Annual years lived with disability (all ages)	8,926 Very low (A)	5,354 Very low (A)	3,034 Very low (A)	4,249 Very low (A)	23,838 Very low (A)	4,922 Very low (A)	50,426 Very low (A)
4 Social and economic burden per case	Medium (B)	Medium (A)	Medium (A)	Medium (A)	Medium (A)	Medium (A)	Medium (A)
5 Disruption due to outbreaks	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)	High (A)
6 Contribution to inequity	Medium (B)	Medium (A)	Medium (B)	Medium (B)	Medium (B)	Medium (B)	Medium (A)
7 Contribution to antimicrobial resistance	High (B)	Medium (A)	Low (B)	Medium (A)	High (B)	High (A)	Medium (A)
8 Unmet needs for prevention & treatment	Medium (A) *Formerly High*	Medium (A) *Formerly High*	Medium (A) *Formerly High*	Medium (A) *Formerly High*	Medium (A) *Formerly High*	Medium (A) *Formerly High*	Medium (A) *Formerly High*

Notes and selected citations

1-3 Annual deaths in children under 5, Annual deaths in people 5 and older, Annual years lived with disability

- Source: GBD Results [Internet]. Institute for Health Metrics and Evaluation. [cited 2022 Oct 5]. Available from: https://vizhub.healthdata.org/gbd-results

4 Social and economic burden per case

- RSV imposed a substantial economic burden on health systems, governments, and the society.[28]

5 Disruption due to outbreaks

- Seasonal epidemics occur every year in the general population in most locations globally. RSV outbreaks reported in older adults in long-term care facilities. [29,30]

6 Contribution to inequity

- While males are more likely to have RSV ALRI than females, the difference is slight. [31]
- Higher RSV incidence observed in socioeconomically disadvantaged areas. [32]

7 Contribution to antimicrobial resistance

- Antibiotics are administered quite frequently for RSV in children; however, the type of antibiotic used (penicillin derivative or other), would make a difference as penicillin-derived antibiotics are unlikely to contribute to AMR. Improved evidence regarding the type of antibiotic used is needed to have confidence in the assessment.
- Use of POC tests can significantly reduce antibiotic prescription for RSV bronchiolitis. [33]
- Due to the high rate of RSV infections in young children and consistent picture across US, Finland, and China, scored as Medium. [34–37]

8 Unmet needs for prevention and treatment

Note: scoring for this criterion considers the effectiveness and suitability (including deliverability) of alternatives for prevention and treatment and does not factor in current levels of access. Current access is reflected in criteria 1-3, which consider the current burden of disease.

- Prevention for infants and toddlers
    - An RSV vaccine was licensed in 2023 for maternal immunization to protect RSV in infants. [38] Due to safety signals relating to preterm birth, SAGE is likely to require additional studies before issuing global recommendations for use.
    - Monoclonal antibodies
        - Palivizumab, a monoclonal antibody, has proven effectiveness for preventing laboratory-confirmed cases and hospitalization in high-risk children <2 y of age. Palivizumab is recommended only for the highest risk infants in most high-income settings. [39] Its high cost and dosing regimen make it unsustainable and difficult to deliver in low-resource settings.
        - Nirsevimab, a new monoclonal antibody to prevent RSV lower respiratory tract disease in neonates and infants, has been approved starting in 2022. [40] Administered as a single dose in advance of the RSV season, nirsevimab is more deliverable than palivizumab and has been recommended for widespread use in the US. [41] However, it remains too costly for use in most lower-income settings.
    - Pediatric vaccines are in development, but none have been licensed as of October 2023.
- Prevention for older adults. Two vaccines to prevent RSV disease in older adults were licensed in 2023. [42,43]
- There is no antiviral treatment for RSV. https://pubmed.ncbi.nlm.nih.gov/31541233/
- In view of the new vaccines and monoclonal antibodies available to prevent RSV disease, we proposed to shift the score for this criterion from **High** (The alternatives for prevention or treatment meet the needs of ***few*** people) to **Medium** (The alternatives for prevention or treatment meet the needs of ***some*** people).

Current context for prioritization

- WHO has defined Preferred Product Characteristics for RSV vaccines and monoclonal antibodies and a Vaccine Value Profile is in preparation. https://www.who.int/publications/i/item/WHO-IVB-17.11, https://www.who.int/publications/i/item/9789240021853
- Numerous professional societies have identified RSV prevention as a global unmet need, and are advocating for development of safe, effective, and affordable preventive interventions. In LICs, RSV disease remains largely

unrecognized.
https://media.path.org/documents/Advancing_RSV_Maternal_Immunization__A_Gap_Analysis_Report.pdf.

- Countries in every WHO region are participating in a RSV surveillance network.
https://cdn.who.int/media/docs/default-source/influenza/who-rsv-surveillance-strategy-phase-26mar2021.pdf

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