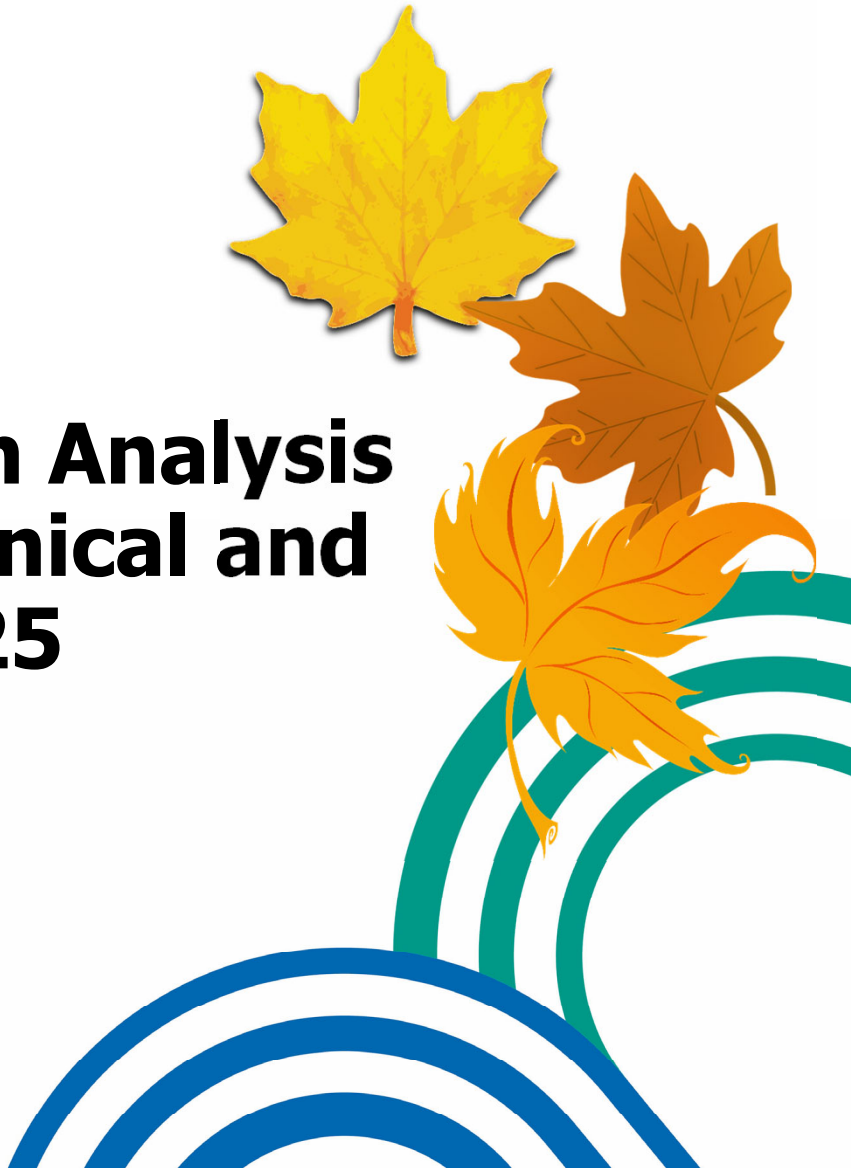
Folkhälsomyndigheten

Global antibiotic resistance surveillance report 2025 och Analysis of antibacterial agents in clinical and preclinical development 2025

Stephan Stenmark



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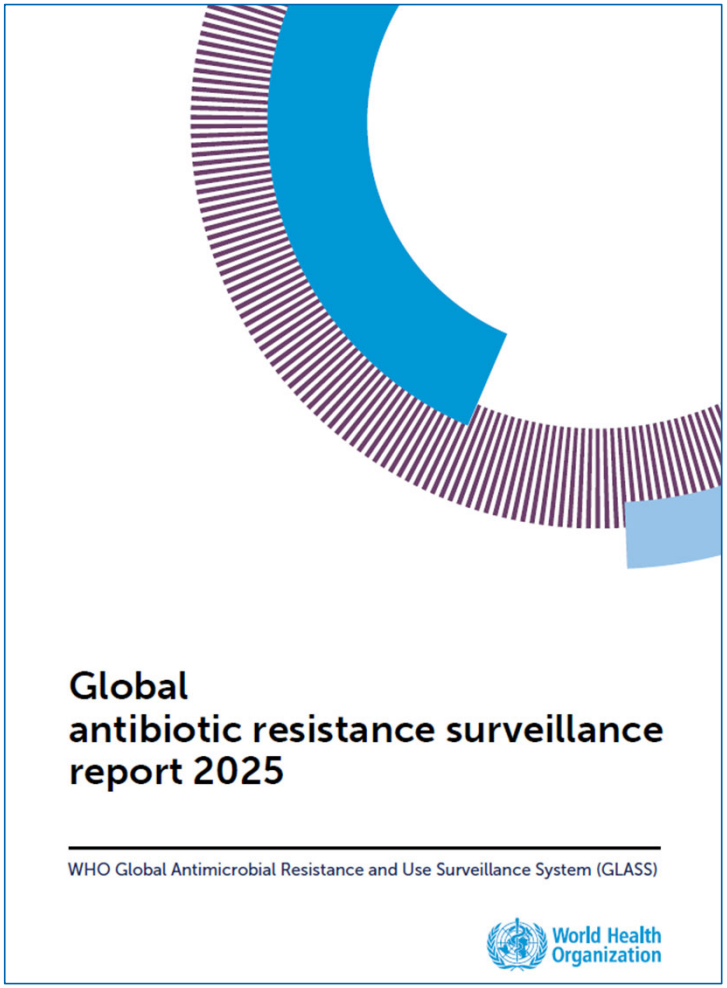

WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS)

- Lanserat 2015
- Vid slutet av 2024 deltog 127 länder och 3 territorier
- Regionala och globala uppskattningar för 93 Infektion-patogen-antibiotika kombinationer
- Redovisar data fram till 2023
- För första gången, nationella skattningar av prevalens och regionala och globala resistenstrender för några av dessa kombinationer
- Stödjer målet från FN mötet 2024 att minska AMR relaterade dödsfall med 10% till 2030 och att >70% av antibiotika till människor ska tillhöra Access i AWaRe

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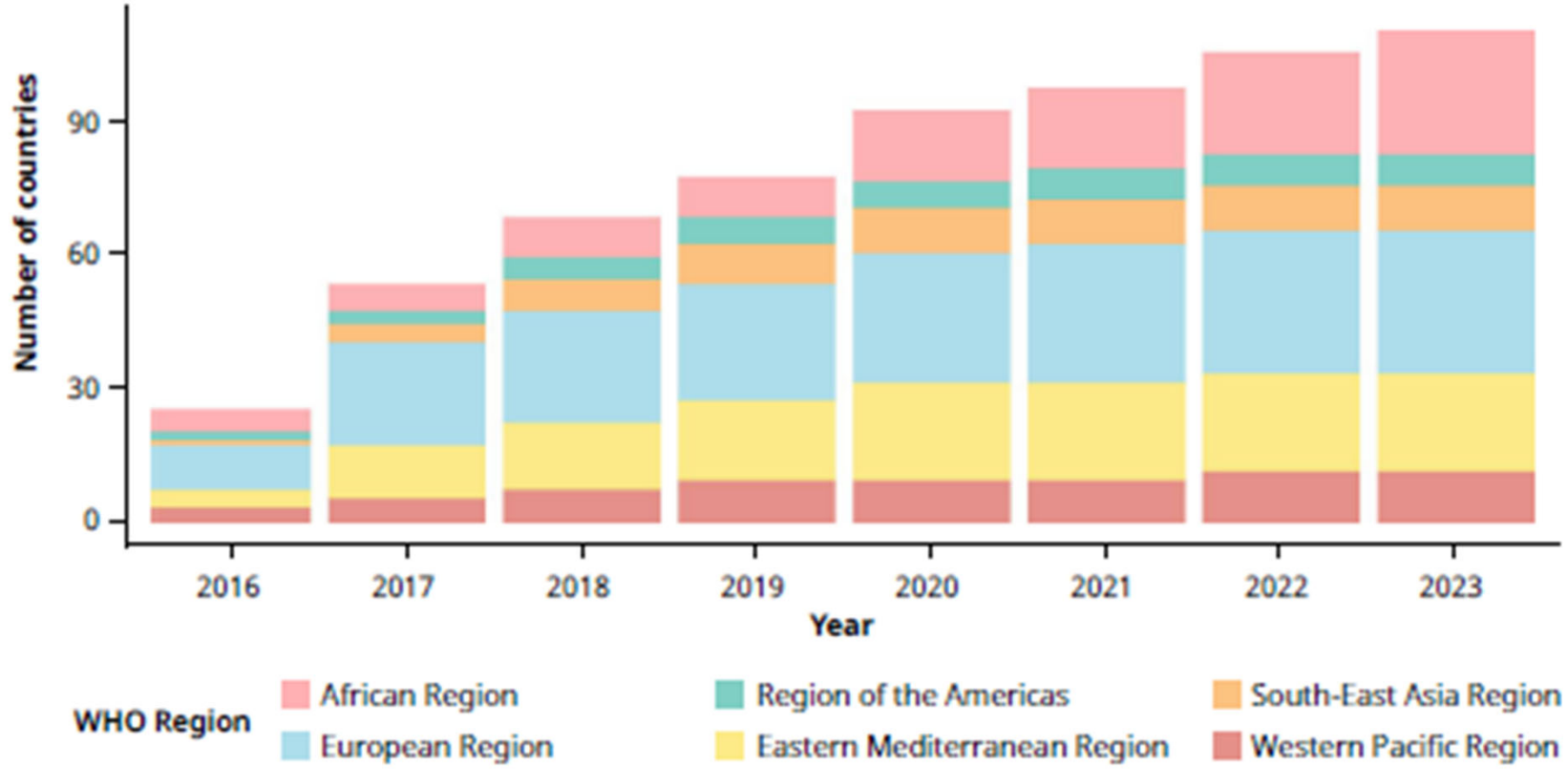
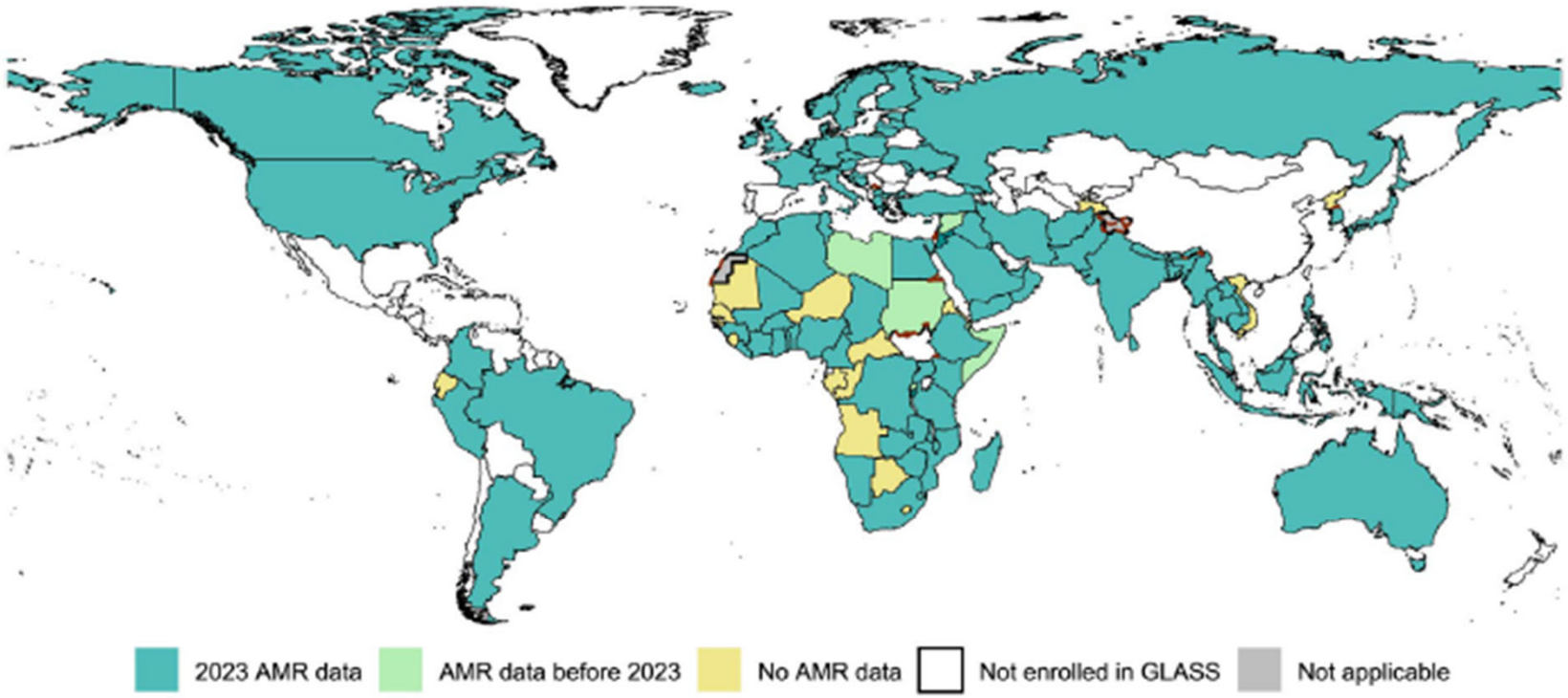
Figure 1. Numbers of countries that reported AMR data to GLASS, by WHO region, 2016–2023[1]



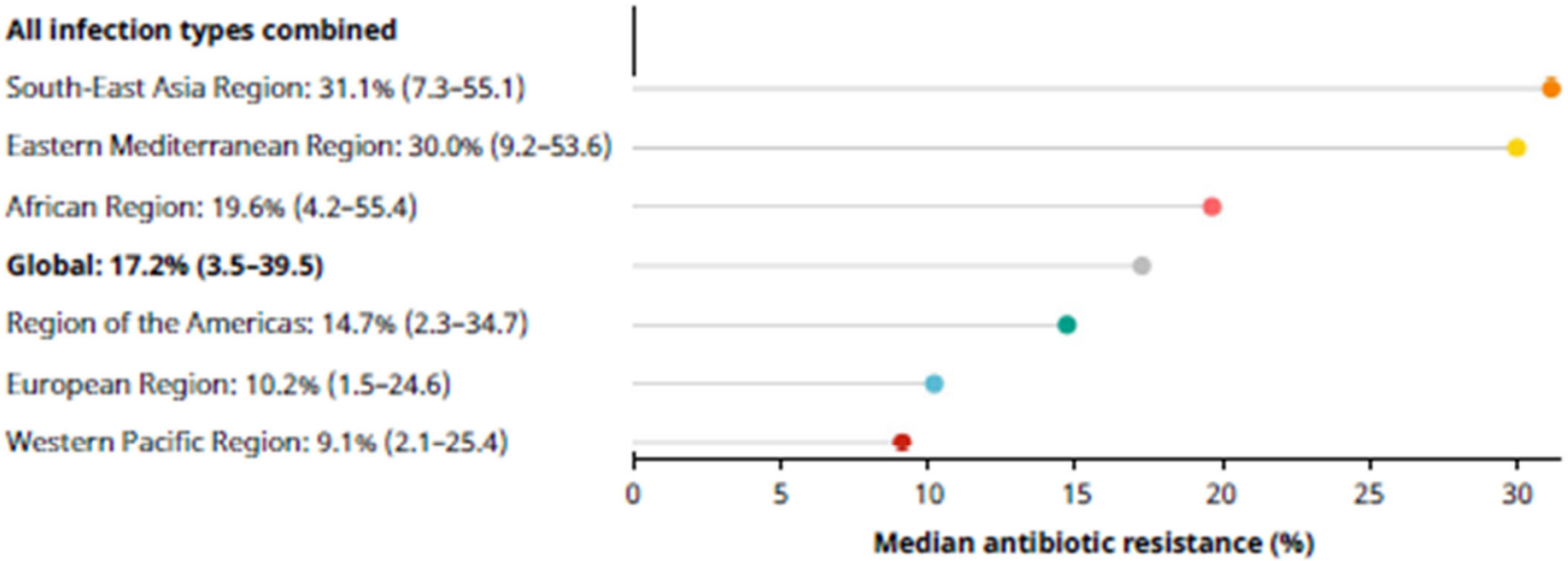
Numbers of countries include three territories and areas

Figure 2.1. Countries reporting AMR data to WHO GLASS for at least one calendar year, 2016–2023



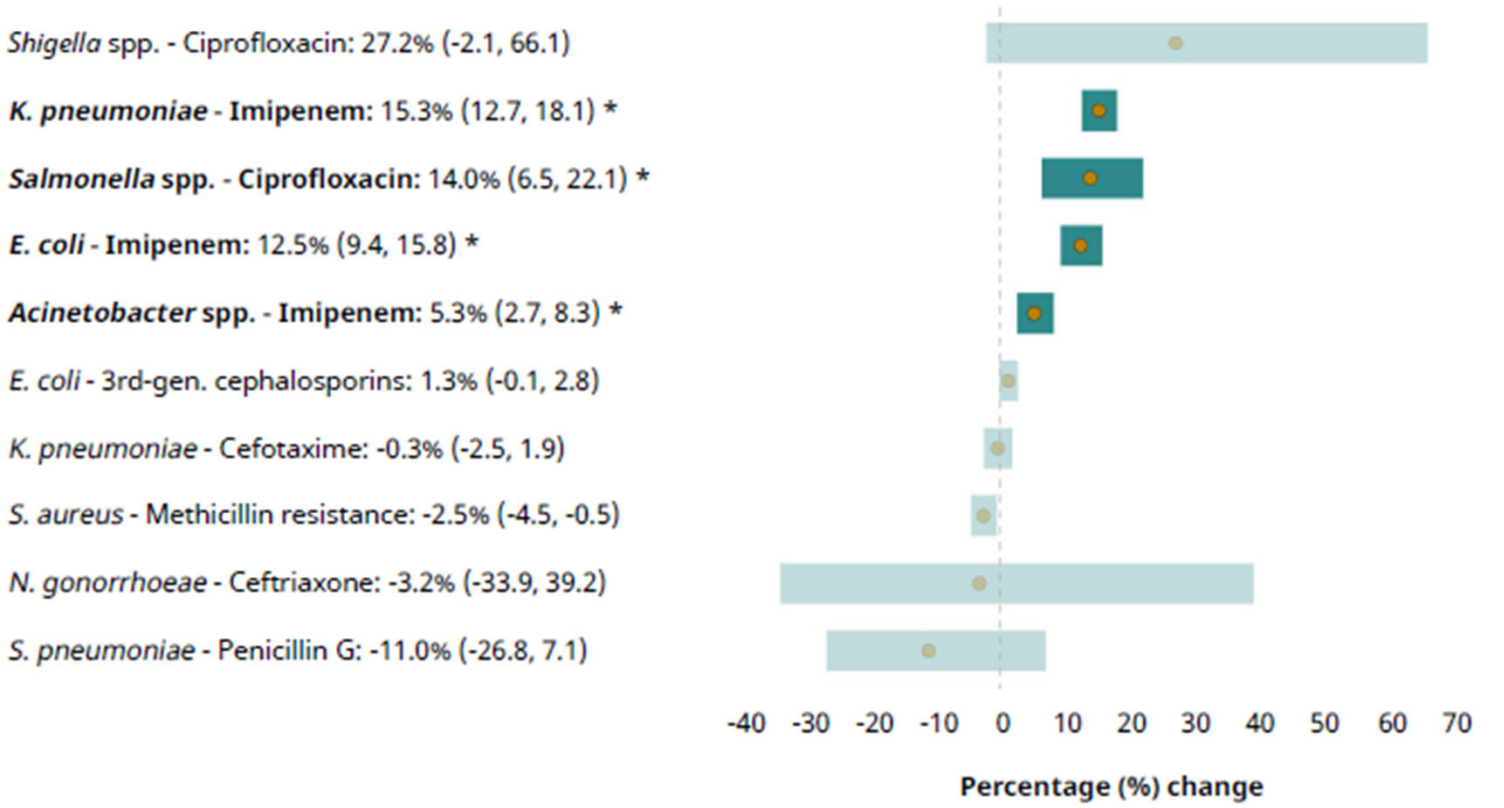
A country is considered to have reported AMR data if it has submitted AST results for at least one surveillance-defined infection type, pathogen and antibiotic combination under surveillance for at least one calendar year.

Figure 2. Median AMR in 93 infection type–bacterial pathogen–antibiotic combinations, by WHO region, 2023



The median and interquartile ranges are useful summaries for comparing the percentage of resistance among regions, but they do not reflect the full variation in resistance in specific infection–pathogen–antibiotic combinations. For example, for urogenital gonorrhoea, the level of global resistance to four of the six commonly used antibiotics, including ceftriaxone (0.3%), is low (< 1.0%), but it is much higher to azithromycin (12.6%) and ciprofloxacin (75.0%).

Figure 3. Trends of AMR: median annual change in percentage, 2018–2023



Population-weighted median annual percentage change in AMR between 2018 and 2023, represented by a dot, with 95% CrI. An asterisk (*) indicates a statistically meaningful trend. When trends were available for several infection types, only that with the highest annual percentage change is shown in the figure.

Figure 5. Median national percentage of AMR in bloodstream infections (2023), by income classification and universal health coverage (UHC) service coverage index

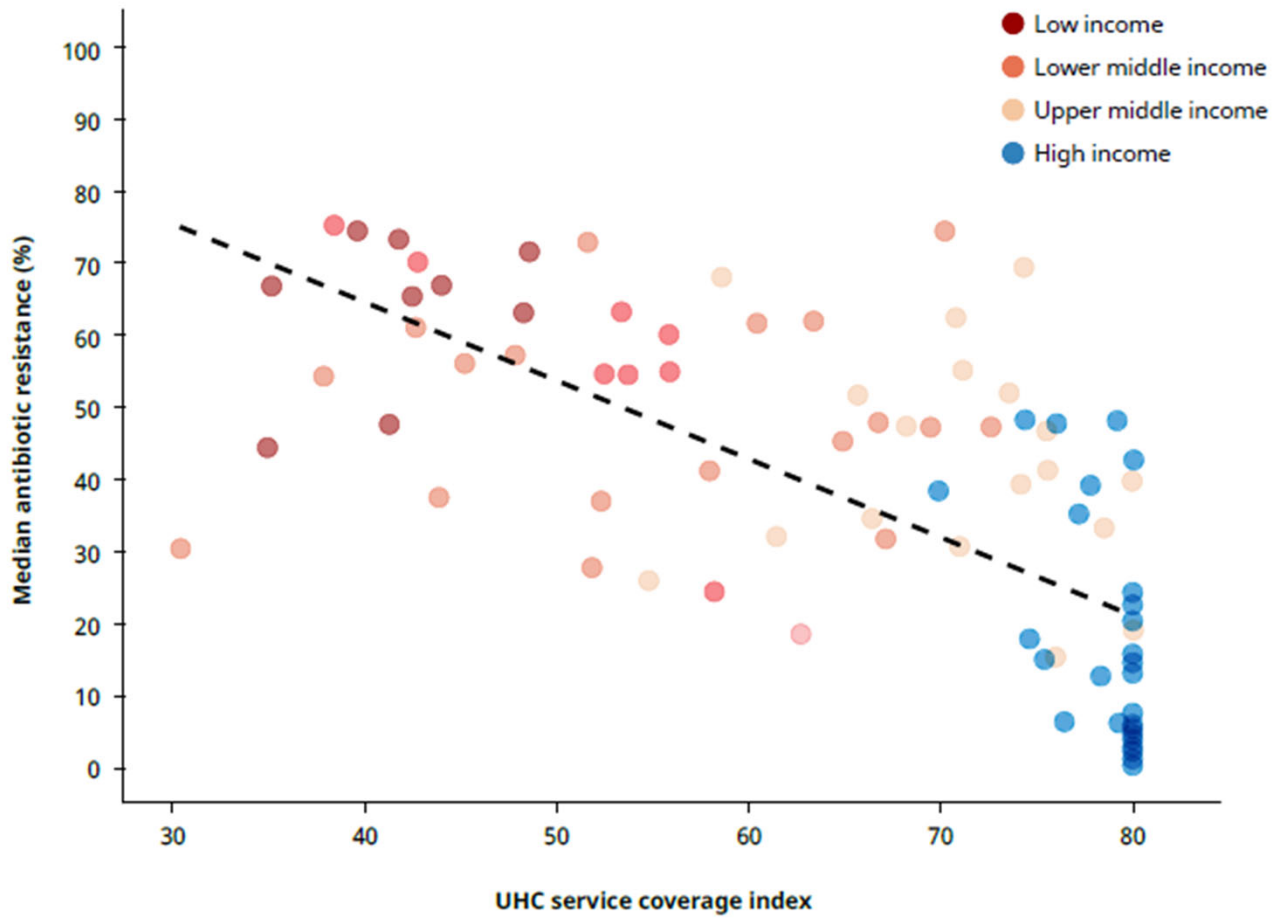
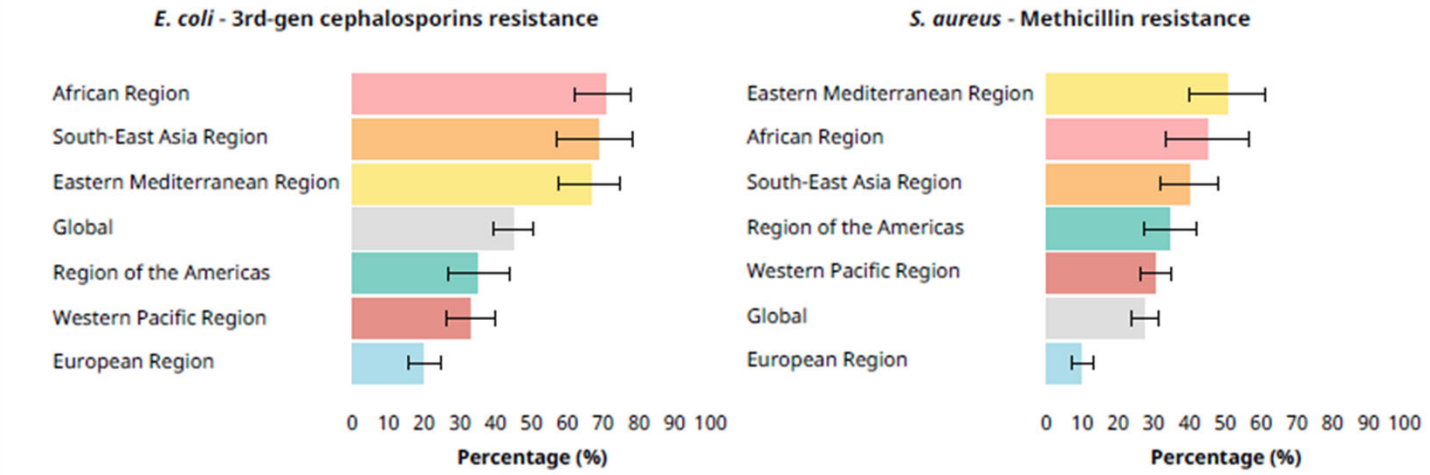
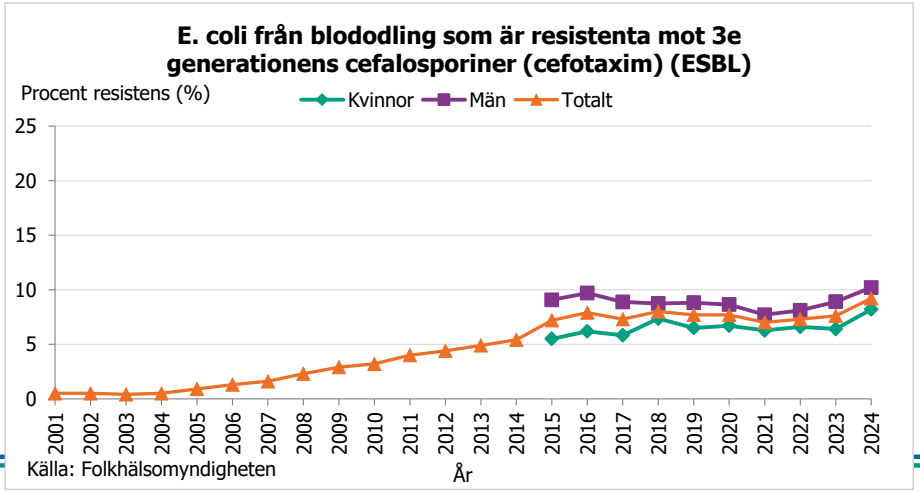


Figure 3.2. Percentage resistance to third-generation cephalosporins in *E. coli* and MRSA: global and regional estimates, 2023





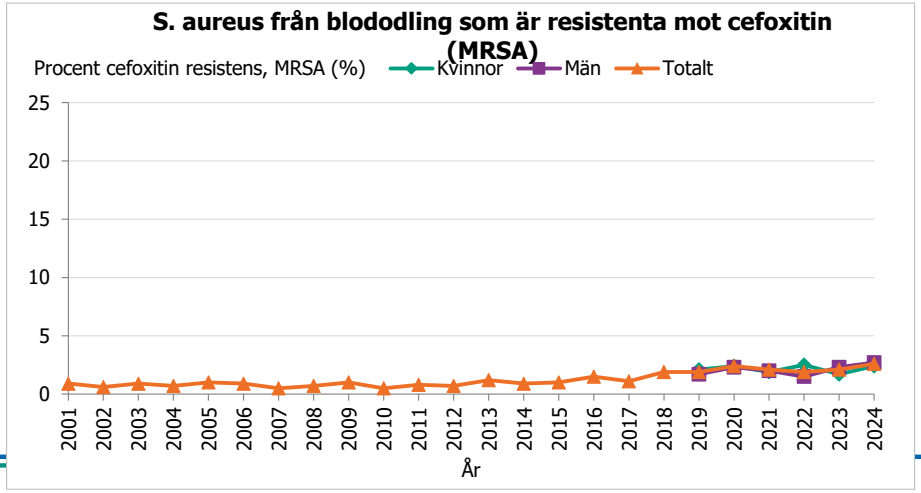
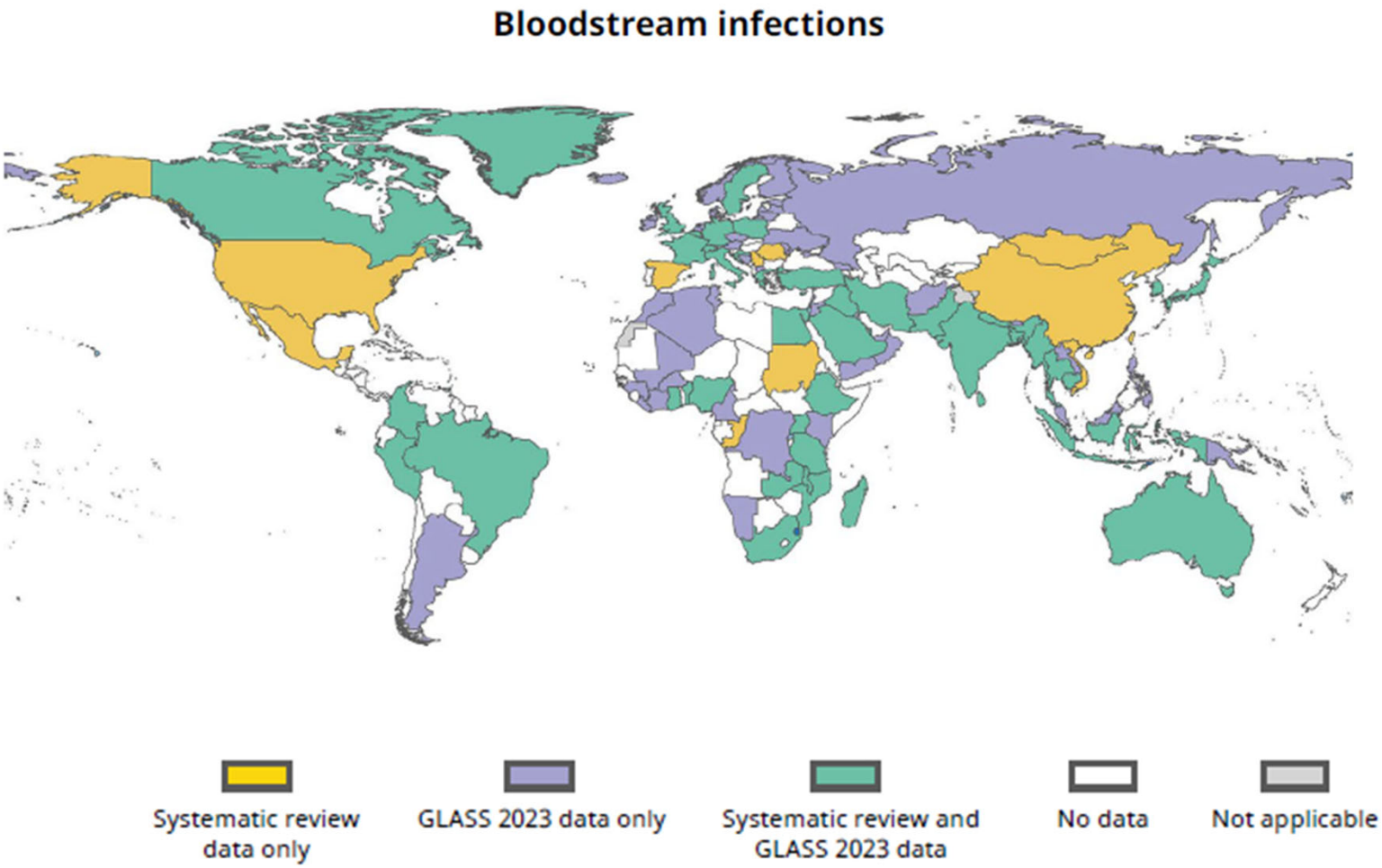


Table 3.1. Global trends in percentage AMR by infection type: median annual change (2018–2023) and 2023 percentage resistance estimates

Infection type	Antibiotic	Trend	Annual % change[a]	Resistance in 2023 (%)[b]	No. of countries[c]
Bloodstream					
Acinetobacter spp.	Imipenem	Increasing	5.3 (2.7, 8.3)	54.3 (49.3, 59.2)	64
E. coli	Cefotaxime	Stable	1.4 (–0.1, 2.9)	39.0 (33.5, 44.8)	64
	3rd-gen. cephalosporins	Stable	1.3 (–0.1, 2.8)	44.8 (39.3, 50.4)	83
	Imipenem	Increasing	12.5 (9.4, 15.8)	2.4 (1.8, 3.3)	74
K. pneumoniae	Cefotaxime	Stable	–0.3 (–2.5, 1.9)	55.2 (48.5, 61.7)	60
	Imipenem	Increasing	15.3 (12.7, 18.1)	16.7 (13.9, 19.9)	73
Salmonella spp.	Ciprofloxacin	Increasing	9.4 (3.9, 15.3)	18.0 (13.9, 22.9)	65
S. aureus	Methicillin resistance	Stable	–2.5 (–4.5, –0.5)	27.1 (23.5, 31.0)	84
S. pneumoniae	Penicillin G	Stable	–11.0 (–26.8, 7.1)	5.2 (3.6, 7.6)	44
Gastrointestinal					
Salmonella spp.	Ciprofloxacin	Increasing	14.0 (6.5, 22.1)	16.3 (13.8, 19.1)	46
Shigella spp.	Ciprofloxacin	Stable	27.2 (–2.1, 66.1)	29.7 (22.9, 37.5)	19
Urinary tract					
E. coli	Cefotaxime	Stable	–0.3 (–1.5, 1.0)	39.8 (33.9, 46.0)	53
	Imipenem	Increasing	8.5 (6.1, 11.0)	2.6 (2.0, 3.5)	55
K. pneumoniae	Cefotaxime	Stable	–0.4 (–2.3, 1.4)	45.5 (38.6, 52.5)	45
	Imipenem	Increasing	12.9 (10.6, 15.1)	10.9 (8.7, 13.6)	51
Urogenital					
N. gonorrhoeae	Ceftriaxone	Stable	–3.2 (–33.9, 39.2)	0.3 (0.1, 0.6)	38

Figure 4.1. Data availability from the systematic review and GLASS, by infection type



	No. of bloodstream infections reported in 2023 (% of total)						
WHO region and country[a]	Total	*Acinetobacter* spp.	*E. coli*	*K. pneumoniae*	*Salmonella* spp.	*S. aureus*	*S. pneumoniae*
France	919	0 (0.0)	0 (0.0)	0 (0.0)	56 (6.1)	0 (0.0)	863 (93.9)
Georgia	898	101 (11.2)	225 (25.1)	183 (20.4)	2 (0.2)	355 (39.5)	32 (3.6)
Greece	6464	1523 (23.6)	1837 (28.4)	2093 (32.4)	23 (0.4)	922 (14.3)	66 (1.0)
Croatia	2826	258 (9.1)	1299 (46.0)	562 (19.9)	13 (0.5)	606 (21.4)	88 (3.1)
Ireland	4946	56 (1.1)	3049 (61.6)	555 (11.2)	0 (0.0)	947 (19.1)	339 (6.9)
Iceland*	466	1 (0.2)	258 (55.4)	44 (9.4)	0 (0.0)	128 (27.5)	35 (7.5)
Italy	53 987	2651 (4.9)	24 841 (46.0)	11 836 (21.9)	123 (0.2)	13 404 (24.8)	1132 (2.1)
Lithuania	3099	120 (3.9)	454 (46.9)	532 (17.2)	6 (0.2)	810 (26.1)	177 (5.7)
Luxembourg	621	7 (1.1)	461 (74.2)	83 (13.4)	3 (0.5)	5 (0.8)	62 (10.0)
Latvia	807	55 (6.8)	329 (40.8)	143 (17.7)	1 (0.1)	235 (29.1)	44 (5.5)
Republic of Moldova	406	62 (15.3)	68 (16.7)	190 (46.8)	3 (0.7)	79 (19.5)	4 (1.0)
North Macedonia	283	32 (11.3)	52 (18.4)	95 (33.6)	0 (0.0)	99 (35.0)	5 (1.8)
Malta	859	24 (2.8)	498 (58.0)	168 (19.6)	7 (0.8)	134 (15.6)	28 (3.3)
Netherlands (Kingdom of the)	11 748	139 (1.2)	7255 (61.8)	1387 (11.8)	152 (1.3)	2034 (17.3)	781 (6.6)
Norway	6015	33 (0.5)	3949 (65.7)	779 (13.0)	86 (1.4)	792 (13.2)	376 (6.3)
Poland	7277	425 (5.8)	3031 (41.7)	1562 (21.5)	96 (1.3)	1796 (24.7)	367 (5.0)
Russian Federation	9671	1443 (14.9)	1627 (16.8)	3980 (41.2)	57 (0.6)	2378 (24.6)	186 (1.9)
Sweden	21 978	125 (0.6)	10 717 (48.8)	2165 (9.9)	0 (0.0)	7915 (36.0)	1056 (4.8)
Türkiye	19 875	3048 (15.3)	6 000 (30.2)	6218 (31.3)	99 (0.5)	4256 (21.4)	254 (1.3)
Ukraine	1897	271 (14.3)	212 (11.2)	711 (37.5)	11 (0.6)	618 (32.6)	74 (3.9)
Kosovo[c]	164	29 (17.7)	24 (14.6)	63 (38.4)	2 (1.2)	36 (22.0)	10 (6.1)
Eastern Mediterranean Region	39 836	6362 (16.0)	11 266 (28.3)	9701 (24.4)	693 (1.8)	10 620 (26.7)	1194 (3.1)
Afghanistan	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
United Arab Emirates	3959	167 (4.2)	1499 (37.9)	1000 (25.3)	124 (3.1)	908 (22.9)	261 (6.6)
Bahrain	964	106 (11.0)	267 (27.7)	249 (25.8)	25 (2.6)	294 (30.5)	23 (2.4)
Egypt	919	115 (12.5)	187 (20.3)	327 (35.6)	1 (0.1)	289 (31.4)	0 (0.0)
Iran (Islamic Republic of)	2925	688 (23.5)	826 (28.2)	621 (21.2)	14 (0.5)	723 (24.7)	53 (1.8)
Iraq	2164	565 (26.1)	492 (22.7)	366 (16.9)	113 (5.2)	606 (28.0)	22 (1.0)
Jordan	3 297	391 (11.9)	659 (20.0)	482 (14.6)	17 (0.5)	1675 (50.8)	73 (2.2)

Table 1. Population and hospitals contributing data: coverage, representativeness and blood culture rate, EU/EEA, 2023

Country	Estimated population coverage[a] (%)	Geographical representativeness[b]	Hospital representativeness[c]	Isolate representativeness[d]	Blood culture rate (blood culture sets/ 1 000 patient-days)[e]
Austria	90	High	High	High	ND
Belgium	42[f]	High	Medium	High	115.7[f]
Bulgaria	45	Medium	Medium	Medium	12.8
Croatia	90	High	High	High	29.0
Cyprus	82	High	High	High	69.4
Czechia	70	High	High	High	18.2
Denmark	100	High	High	High	261.7
Estonia	100	High	High	High	40.2
Finland	84	High	High	High	195.8
France	0[f]	Low [f]	Low [f]	Low [f]	ND
Germany	40	High	Medium	High	ND
Greece	68	High	High	High	ND
Hungary	90	High	High	High	19.5
Iceland	100	High	High	High	72.0
Ireland	92	High	High	High	56.5
Italy	66	High	High	High	61.2
Latvia	90	High	High	Medium	24.8
Liechtenstein	40	Medium	Medium	Medium	2.1
Lithuania	100	High	High	High	8.8
Luxembourg	100	High	High	High	42.5
Malta	95	High	High	High	32.8
Netherlands	76	High	High	High	ND
Norway	94	High	High	High	80.9
Poland	21	Medium	Medium	High	55.1
Portugal	98	High	High	High	323.6
Romania	13	Low	Low	Low	39.7
Slovakia	54	High	High	High	30.6
Slovenia	99	High	High	High	44.7
Spain	28	Medium	High	High	606.6
Sweden	89	High	High	High	112.4

World Health Organization

About the GLASS dashboard | Global AMU data | Global AMR data | Country, territory or area profiles

GLASS dashboard

The GLASS dashboard presents global antimicrobial use (AMU) and resistance (AMR) data for countries, territories, and areas (CTAs) that were enrolled in GLASS by the end of 2024, by means of interactive visualisations. CTA profiles for AMR and AMU are also provided. Dashboards are optimised for use in Google Chrome.

All figures and underlying data are downloadable.

Further information about GLASS can be found in the link below. The link also provides access to comprehensive pdf GLASS reports for previous years.

Last updated on 25 September 2025, with 2016- 2023 data (submitted by end of 2024)

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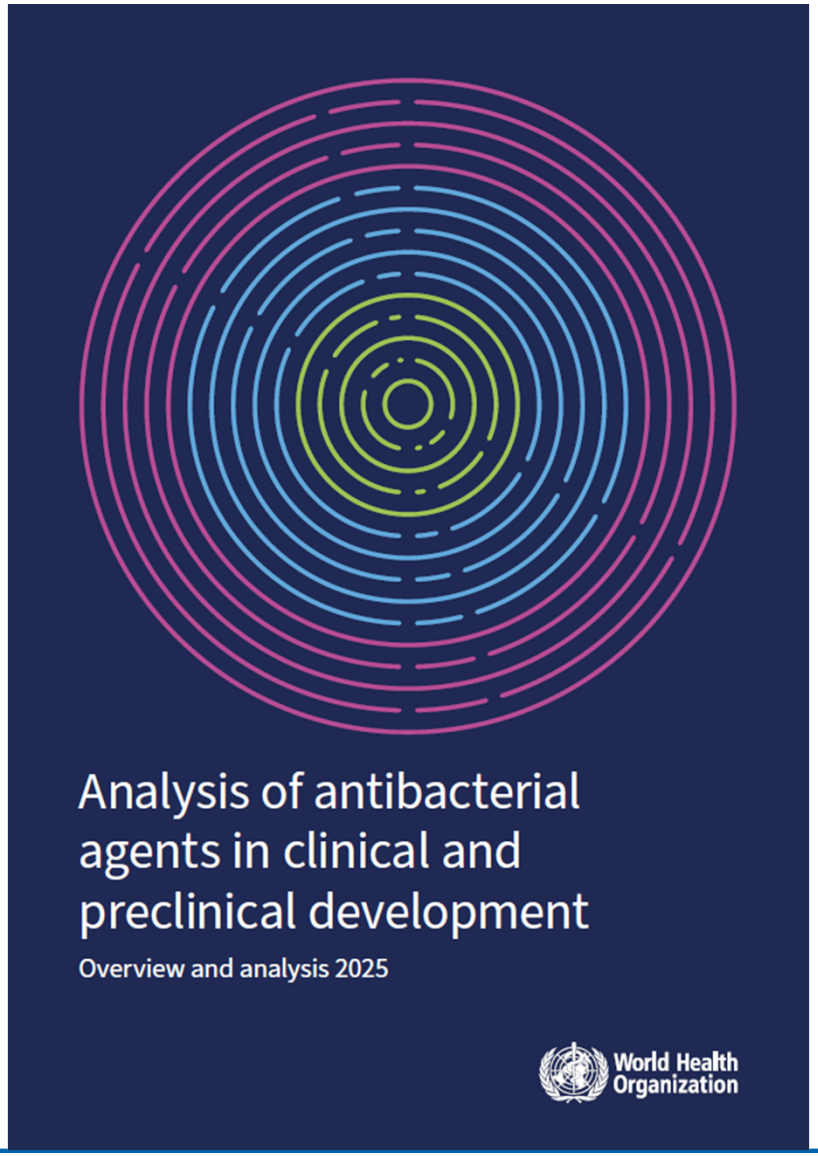

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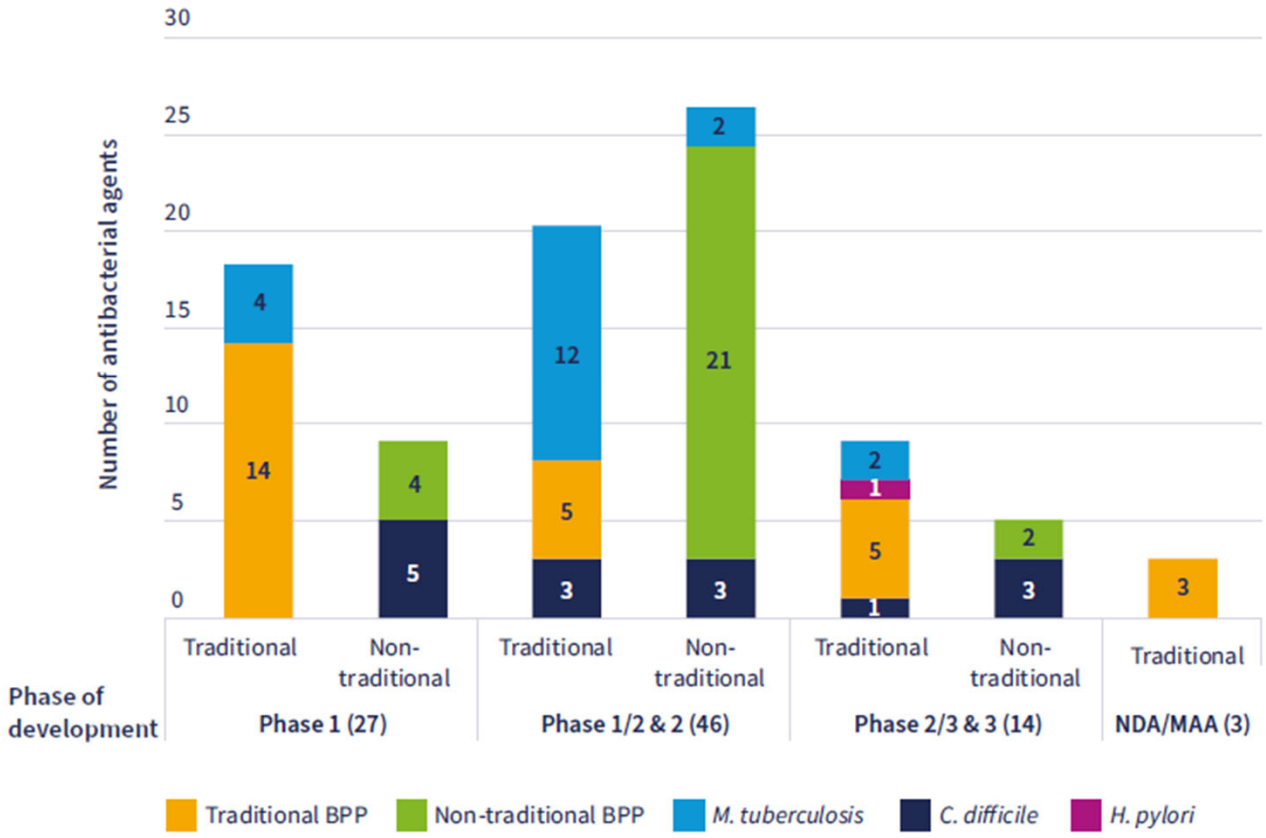
Fig. 1. Number of traditional and non-traditional antibacterials by clinical development phase (Phases 1–3 and NDAs/MAAs)



BPP: bacterial priority pathogen; NDA: new drug application; MAA: marketing authorization application.

As of 15 February 2025, there are:

- 90 antibacterials and/or combinations that include at least one new therapeutic entity targeting the WHO bacterial priority pathogens, or *Clostridioides difficile* and *Helicobacter pylori*, in the clinical pipeline from Phase 1
  - 50 are traditional antibacterial
    - 45 (90%) target WHO BPPs, including 18 (40%) focused on drug-resistant *M. tuberculosis*.
  - 40 are non-traditional agents

Table 3. The activity of different β-lactams and β-lactam/BLI combinations approved since 2017 or currently in development against the most clinically relevant β-lactamases, including carbapenemases

		CRE				CRAB	
		A	A	D	B		
		ESBL	KPC	OXA	MBL		
Reference	β-lactams and β-lactam/BLI combination	(CTX-M)	(KPC-2,-3)	(OXA-48)	(NDM)	OXA	CRPA
Approved	Vaborbactam + Meropenem	●	●	●	X	X	X
Approved	Relebactam + Imipenem + Cilastatin	●	●	●	X	X	?
Approved	Cefiderocol	●	●	●	●	●	●
Approved	Sulbactam+ Durlobactam (ETX-2514)	X	X	X	X	●	X
Approved	Cefepime + Enmetazobactam (AAI-101)	●	?	X	X	X	X
NCT05584657	Sulopenem	●	X	X	X	X	X
NCT03840148	Cefepime+ Taniborbactam (VNRX-5133)	●	●	●	? [a]	-	●
NCT04505683	Benapenem	X	X	X	X	X	X
NCT04979806	Cefepime + Zidebactam	●	●	●	?	? [b]	?
NCT05072444	Xeruborbactam (QPX7728) + beta-lactam (S-649228)	●	●	●	●	●	●
NCT05204368	Funobactam (XNW4107) + Imipenem + Cilastatin	●	●	?	X	?	X
NCT05488678	Ceftibuten + Ledaborbactam (VNRX-7145)	●	●	● [d]	X	X	X
NCT05645757	Ertapenem + Zidebactam	●	●	● [e]	● [e]	X	?
NCT05887908	Cefepime+ Nacubactam (OP0595)	●	●	X	?	X	?
NCT05887908	Aztreonam + Nacubactam (OP0595)	●	●	●	●	X	X
NCT05905913	Meropenem + ANT3310	●	●	●	/	●	X
NCT05226923	Meropenem + KSP-1007(MEROPEN)	●	●	?	?	?	?

Pathogen activity: ● active; ? possibly active; X not active; / not tested.

CRAB: carbapenem-resistant *A. baumannii*; CRPA: carbapenem-resistant *P. aeruginosa*; CTX-M: CTX-M-type β-lactamase; ESBL: extended-spectrum β-lactamase; KPC: *K. pneumoniae* carbapenemase; MBL: metallo-β-lactamase; NDM: New Delhi metallo-β- lactamase; OXA: oxacillinase.

Grey shading: Market authorized as of July 2017.

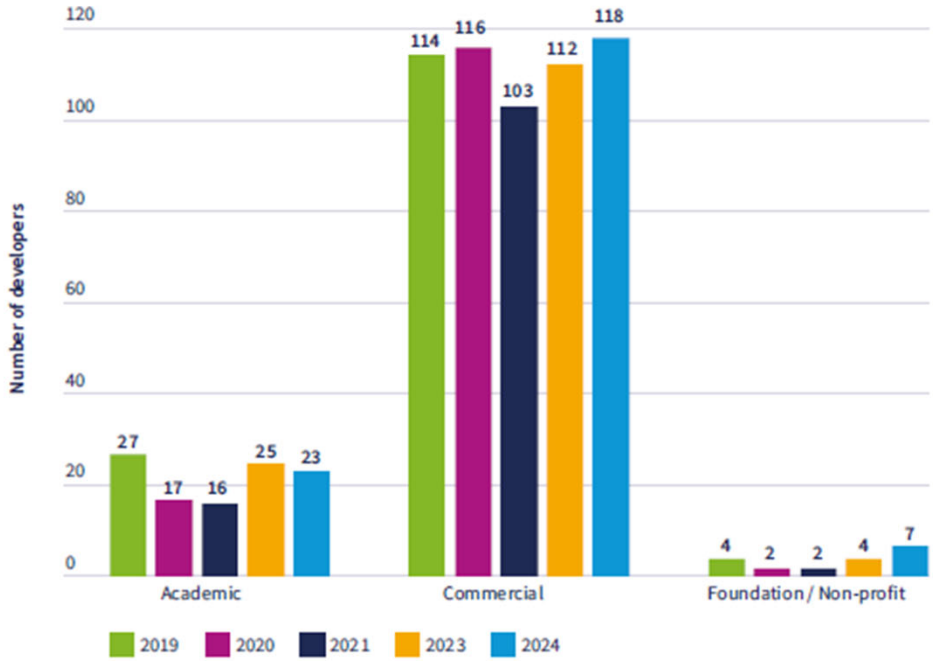
[a] Heteroresistance described (15).
[b] MICs for CRAB isolates (16) expressing OXA23,24 and 58 clustered around 8–16 mg/L, compared with 64 mg/L for cefepime alone and >128 mg/L for zidebactam alone (16).
[c] Not active in vivo against IMP6 producing-KP. See product profile for details.
[d] Loss of activity if co-production of class C and class D (OXA48-like) SBL (17).
[e] Active against MBL-producing *E. coli*, but not *K. pneumoniae*; not active against Enterobacterales with the combination of MBL+OXA48 (18).

Xeruborbactam (QPX7728) + β-lactam (S-649228)

- bicyclic boronate BLI (new class) under development with a still undisclosed β-lactam.
- The preclinical development included testing in combination with several β-lactams.
  - Phase 1 clinical studies are testing the combination with cefiderocol.
  - QPX7831 is the oral prodrug of xeruborbactam (QPX7728) *(33–35)* undergoing clinical testing in phase 1 studies with ceftibuten.
  - is being studied as treatment in carbapenem-resistant *Acinetobacter*, *Pseudomonas* and Enterobacterales infections.
  - The oral formulation in combination with ceftibuten is intended as treatment of CRE.

Preclinical pipeline

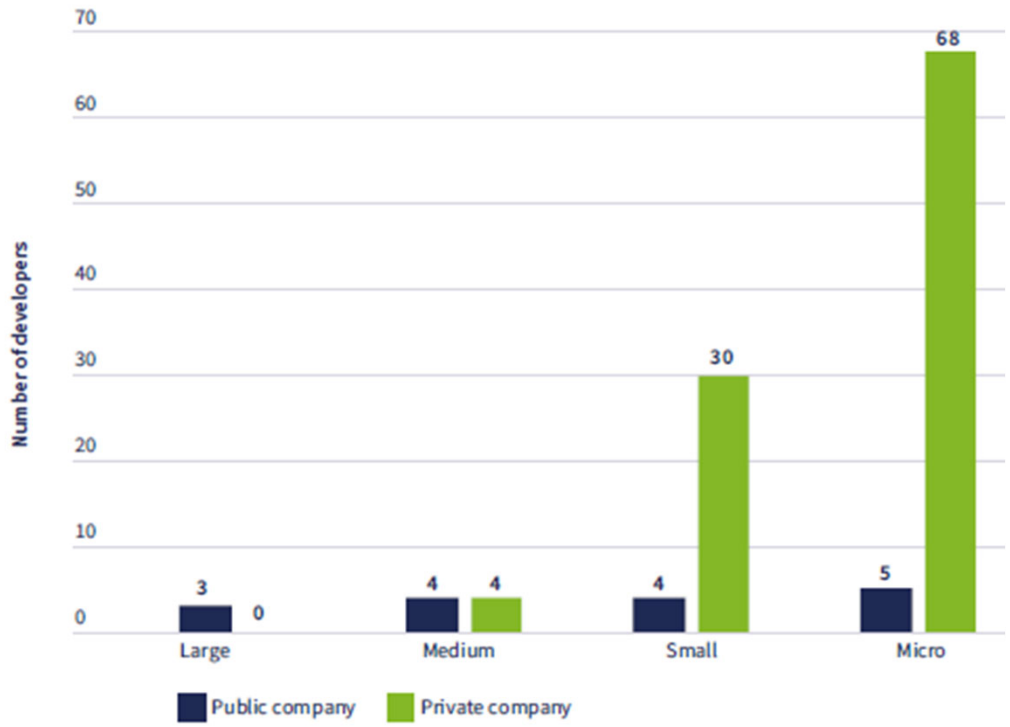
Fig. 4. Categorization of groups with preclinical pipeline programmes by type



- 148 individual groups are progressing 232 programmes worldwide.
- The European Region and the Region of the Americas host the majority of groups (45.3% and 41.2% respectively).
- Only 75 agents (32.3%) target a single pathogen, continuing a downward trend in this area.
- 92 products (39.7%) are classified as non-traditional, including phages, virulence inhibitors, immunomodulatory compounds and potentiator agents, among others.

Preclinical pipeline

Fig. 5. Categorization of companies with preclinical pipeline programmes by ownership and size



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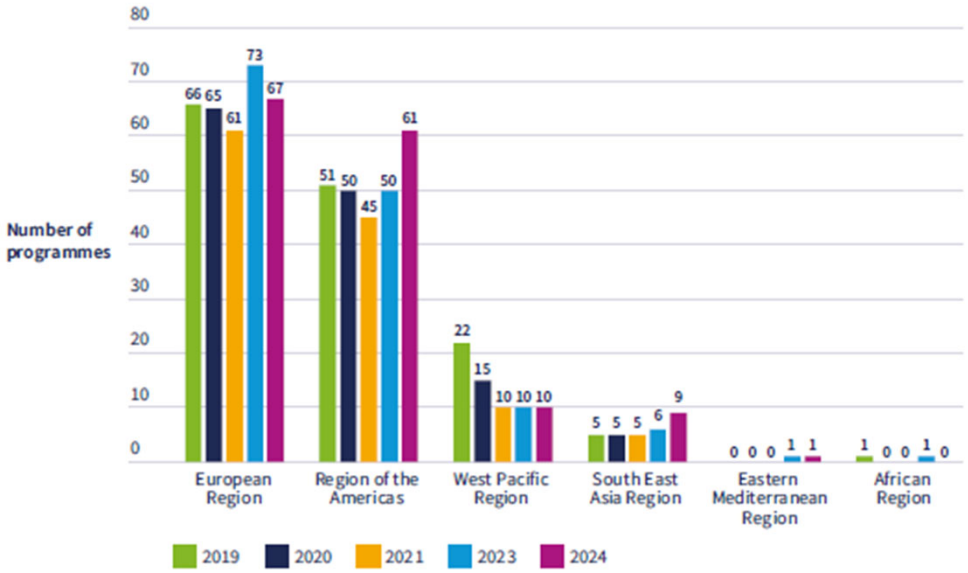
Preclinical pipeline

Fig. 10. Geographical distribution of the 148 institutions with preclinical pipeline projects across the 2019–2024 analysis shown by WHO geographical regions (panel A)



[a] This refers to the number of developers.

Fig. 10. Geographical distribution of the 148 institutions with preclinical pipeline projects across the 2019–2024 analysis shown by country (panel B).