



What is Antimicrobial Resistance (AMR)?

Medicines for treating infections lose effect because the microbes change;

1. mutate
2. acquire genetic information from other microbes to develop resistance

Types of AMR

1. **Antibacterial resistance** (e.g. to antibiotics and other antibacterial drugs)
2. **Antiviral resistance** (e.g. to anti-HIV medicines)
3. **Antiparasitic resistance** (e.g. to anti-malaria medicines)
4. **Antifungal resistance** (e.g. to medicines used to treat *Candidiasis*)



AMR is a natural phenomenon accelerated by use of antimicrobial medicines. Resistant strains survive and aggregate.

Antimicrobial Resistance Global Report on Surveillance 2014 (I)

- Focuses on antibacterial resistance (ABR)
- Information gathered include:

Surveillance of ABR
according to WHO
regions



National and published
data on 7 bacteria



Systematic reviews of
evidence of health and
economic burden in
5 bacteria/ resistance
combinations



Identification of gaps



Antimicrobial Resistance Global Report on Surveillance 2014 (II)

Summaries of surveillance and current resistance situation:

Disease-specific programs

- Tuberculosis
- Malaria
- HIV
- Influenza

Other related areas

- ABR in food-producing animals and food chain
- Antifungal resistance

WHO tools facilitating surveillance of ABR



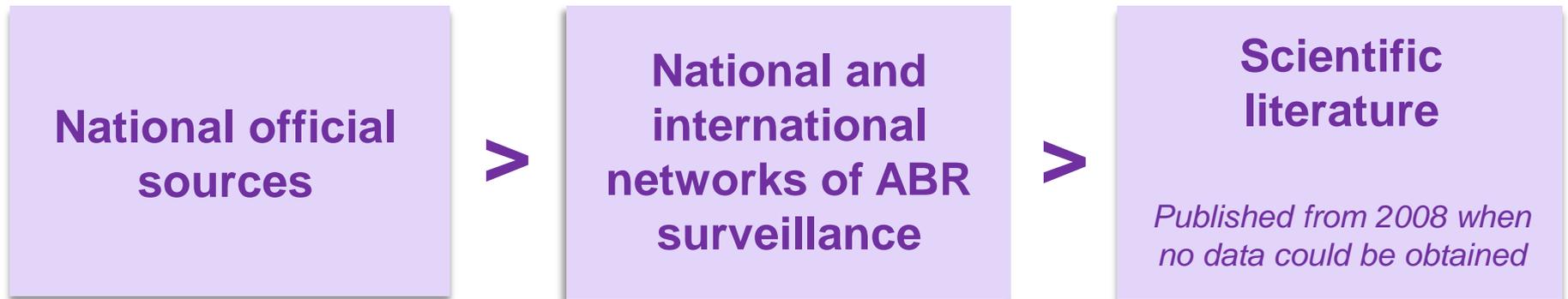
Selected Bacteria/Resistance Combinations

Bacterium	Resistance/ decreased susceptibility to:
<i>Escherichia coli</i>	3 rd generation cephalosporins, fluoroquinolones
<i>Klebsiella pneumoniae</i>	3 rd generation cephalosporins, carbapenems
<i>Staphylococcus aureus</i>	Methicillin (beta-lactam antibiotics) i.e. MRSA
<i>Streptococcus pneumoniae</i>	Penicillin
Nontyphoidal <i>Salmonella</i> (NTS)	Fluoroquinolones
<i>Shigella</i> species	Fluoroquinolones
<i>Neisseria gonorrhoeae</i>	3 rd generation cephalosporins

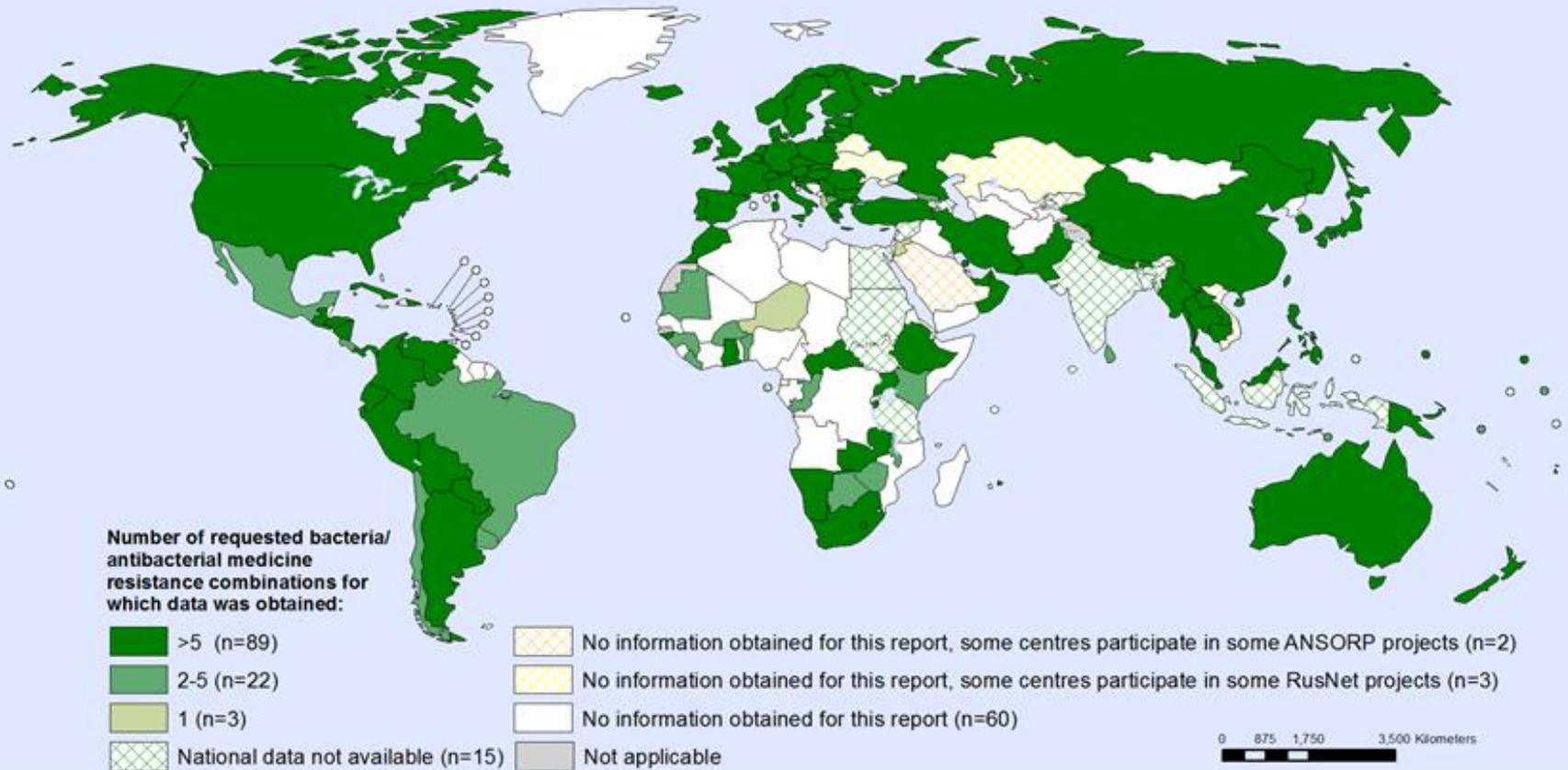


Data Collection

Resistance Proportions and Surveillance



Available National Data* on Resistance for Nine Selected Bacteria/Antibacterial Drug Combinations, 2013



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
 Map Production: Health Statistics and Information Systems (HSI)
 World Health Organization



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*National data means data obtained from official sources, but not that data necessarily are representative for the population or country as a whole

Bacteria Commonly Causing Infections in Hospitals and Communities

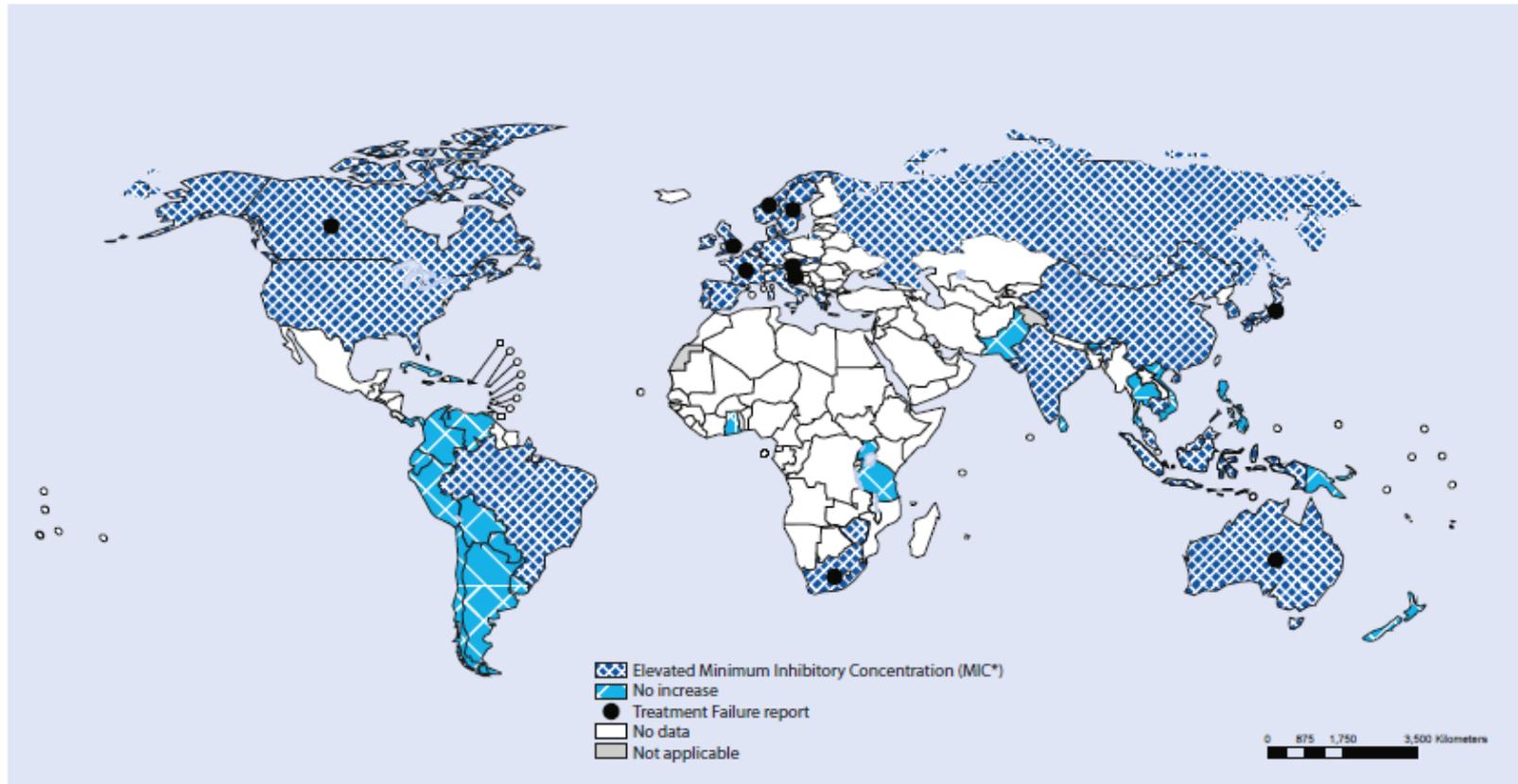
Name of bacterium/ resistance	Examples of typical diseases	No. of 194 MS providing national data	No. of WHO regions with national reports of 50 % resistance or more	Range of reported proportion of resistance
<i>Escherichia coli</i>	Urinary tract infections, blood stream infections			
-vs 3 rd gen. cephalosporins		84	5/6	0-82
-vs fluoroquinolones		90	5/6	3-96
<i>Klebsiella pneumoniae</i>	Pneumonia, blood stream infections, urinary tract infections			
-vs 3 rd gen. cephalosporins		85	6/6	2-82
-vs carbapenems		69	2/6	0-68
<i>Staphylococcus aureus</i>	Wound infections, blood stream infections			
-vs methicillin "MRSA"		83	5/6	0.3-90

Bacteria Mainly Causing Infections in the Community

Name of bacterium/ resistance	Examples of typical diseases	No. of 194 MS providing national data	No. of WHO regions with national reports of 25 % resistance or more	Range of reported proportion of resistance
<i>Streptococcus pneumoniae</i>	Pneumonia, meningitis, otitis			
-non-susceptible to penicillin		66	6/6	0-73
Nontyphoidal <i>Salmonella</i>	Foodborne diarrhoea, blood stream infections			
-vs fluoroquinolones		66	3/6	0-96
<i>Shigella</i> species	Diarrhoea ("bacillary dysentery")			
- vs fluoroquinolones		34	2/6	0-47
<i>Neisseria gonorrhoeae</i>	Gonorrhoea			
-vs 3 rd gen. cephalosporins		42	3/6	0-36

Neisseria Gonorrhoeae

Detection of decreased susceptibility to 3rd generation cephalosporin and treatment failures up to 2010



* Note: cefixime >0.25µg/L or ceftriaxone >0.125µg/L. The definition of decreased susceptibility to third-generation cephalosporins differs across AMR testing methods. Countries are shaded where there has been any report of decreased susceptibility within their jurisdiction.

Systemic Reviews: Evidence of the Burden of Antibacterial Resistance

Is there any difference in outcome from infections caused by resistant vs sensitive bacteria?



Risk of Death is Higher in Patients Infected with Resistant Strains

		Deaths (%)		
	Outcome (number of studies included)	Resistant	Not resistant	RR (95% CI)
<i>Escherichia coli</i> resistant to:				
<i>3rd gen. cephalosporins</i>	Bacterium attributable mortality (n=4)	23.6	12.6	2.02 (1.41 to 2.90)
<i>Fluoroquinolones</i>	Bacterium attributable mortality (n=1)	0	0	
<i>Klebsiella pneumoniae</i> resistant to:				
<i>3rd gen. cephalosporins</i>	Bacterium attributable mortality (n=4)	20	10.1	1.93 (1.13 to 3.31)
<i>Carbapenems</i>	Bacterium attributable mortality (n=1)	27	13.6	1.98 (0.61 to 6.43)
<i>Staphylococcus aureus</i> resistant to:				
<i>Methicillin (MRSA)</i>	Bacterium attributable mortality (n=46)	26.3	16.9	1.64 (1.43 to 1.87)

Does Published Literature Indicate Additional Costs Due to ABR?

Antibacterial resistance	Studies included in SR (n)	Studies reporting cost data (n)	Excess cost (n = studies reporting costs)			
			Hospitalization	Antibacterial therapy	Medical care	Additional cost variables
<i>Escherichia coli</i> resistant to:						
<i>3rd gen. cephalosporins</i>	25	2	Yes (n=2)	Yes (n=1)	Yes (n=1)	Yes (n=1)
<i>Fluoroquinolones</i>	12	0	-	-	-	-
<i>Klebsiella pneumoniae</i> resistant to:						
<i>3rd gen. cephalosporins</i>	24	0	-	-	-	-
<i>Carbapenems</i>	13	0	-	-	-	-
<i>Staphylococcus aureus</i> resistant to:						
<i>Methicillin</i>	147	19	-	Yes (n=6)	Yes (n=6)	Yes (n=9)

Estimates of Burden of Antibacterial Resistance

European Union *population 500m*

25,000 deaths per year

2.5m extra hospital days

Overall societal costs
(€ 900 million, hosp. days)
Approx. €1.5 billion per year



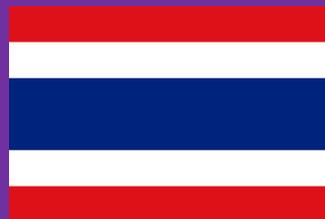
Source: ECDC 2007

Thailand *population 70m*

>38,000 deaths

>3.2m hospital days

Overall societal costs
US\$ 84.6–202.8 mill. direct
>US\$1.3 billion indirect



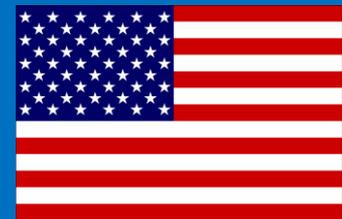
Source: Pumart et al 2012

United States *population 300m*

>23,000 deaths

>2.0m illnesses

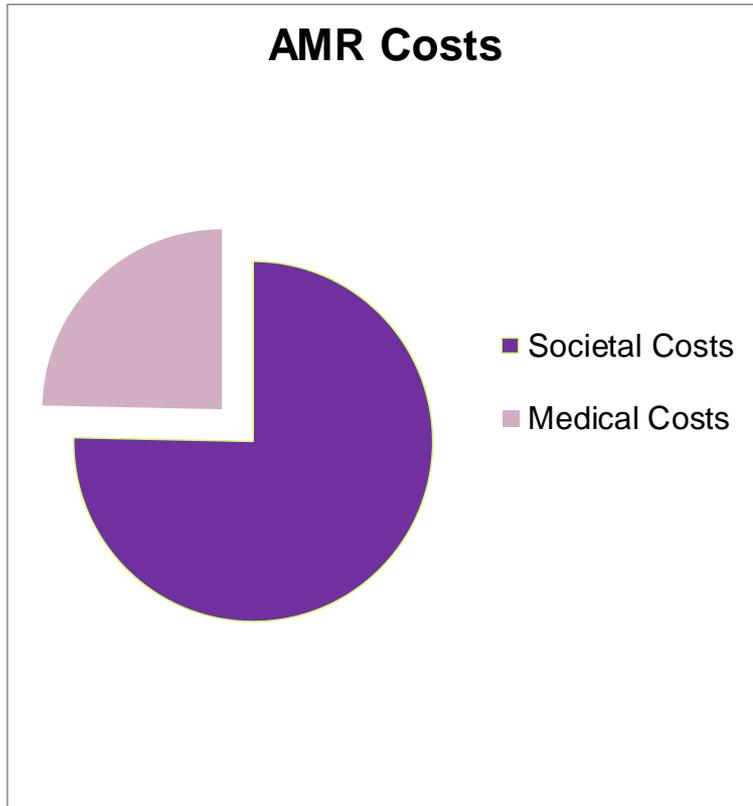
Overall societal costs
Up to \$20 billion direct
Up to \$35 billion indirect



Source: US CDC 2013

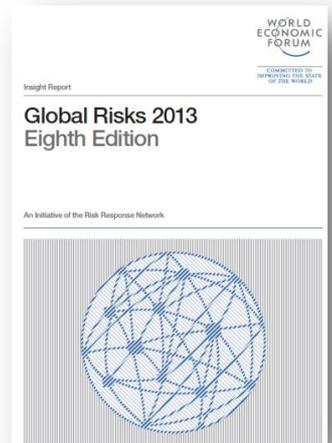
Global information is insufficient to show complete disease burden impact and costs

Overall Economic Impact Much Higher



- Reduced consumer income, employment, savings
- Increased national investment, spending, healthcare delivery
- Reduced gross domestic product (GDP): 1.4% to 1.6%

Source: Roberts et al CID 2009; 49:1147-84.



Summary:

Antibacterial Resistance

1. High proportions of resistance were reported in all regions to common treatments for bacteria causing infections in both healthcare settings and in the community
2. Antibacterial resistance has a negative effect on patient outcomes and health expenditures
3. Treatment options for common infections are running out
4. Despite limitations, the report demonstrates worldwide magnitude of ABR and surveillance gaps



Summary:

Surveillance of Antibacterial Resistance

1. Gaps are largest where health systems are weak
2. There is no agreement on surveillance standards:
 - What samples and information to collect
 - How to analyse samples
 - How to compile and share data
3. Obtained national data was usually based on proportions of resistant bacteria rather than proportions of resistant bacteria causing specific diseases or affecting defined populations
4. The report provides a benchmark for future surveillance progress



AMR in Disease-Specific Programs (Tuberculosis, Malaria, HIV and Influenza)

Epidemiologically sound surveillance systems were established to monitor resistance and disease impact.

This has taken many years to build and is dependant on external funding.

Available information verifies that AMR is increasing:

Example of mycobacterium:

Tuberculosis

Increased morbidity
and mortality,
increased costs,
threatened disease
control

Example of parasite:

Malaria

Threatened disease
control

Example of viruses:

HIV and influenza

Threatened disease
control

AMR in Food-Producing Animals and Food Chain

1. Major gaps exist in surveillance and data sharing
2. Integrated surveillance systems would enable data comparison from food-producing animals, food products and humans
3. Surveillance is hampered by lack of implemented global standards
4. WHO is pursuing a multi-sectoral approach by collaborating with the Food and Agriculture Organization (FAO), the World Organisation for Animal Health (OIE) and other stakeholders



Antifungal Drug Resistance: Invasive *Candidiasis*

Antifungal resistance in *Candidiasis* poses a burden on patients and healthcare systems



Resistance to fluconazole varies widely by country/species

Gaps exist in information



Resistance to newest class of antifungals (*echinocandins*) is emerging



Surveillance of Antimicrobial Resistance: Needs and Next Steps

Vision

“To achieve a monitoring capacity that will capture the global situation of antimicrobial resistance, and inform decision-making.”

http://apps.who.int/iris/bitstream/10665/90975/1/WHO_HSE_PED_2013.10358_eng.pdf

Towards integrated surveillance of AMR

In humans and animals
and in disease specific programs

Immediate steps will focus on ABR

Standards for global surveillance
Collaborative platform for surveillance



Antimicrobial Resistance in a Wider Context

A global problem requiring a global solution

Commitment from
stakeholders in all
sectors



Comprehensive
national plans



**Surveillance is key to inform
public health actions and strategies**

World Health Assembly May 2014

In January 2014, the Executive Board approved a draft resolution co-sponsored by several Member States:

“Combating antimicrobial resistance, including antibiotic resistance”

http://apps.who.int/gb/ebwha/pdf_files/EB134/B134_R13-en.pdf

