Genomic Surveillance of Antimicrobial Resistance: One Health Approach

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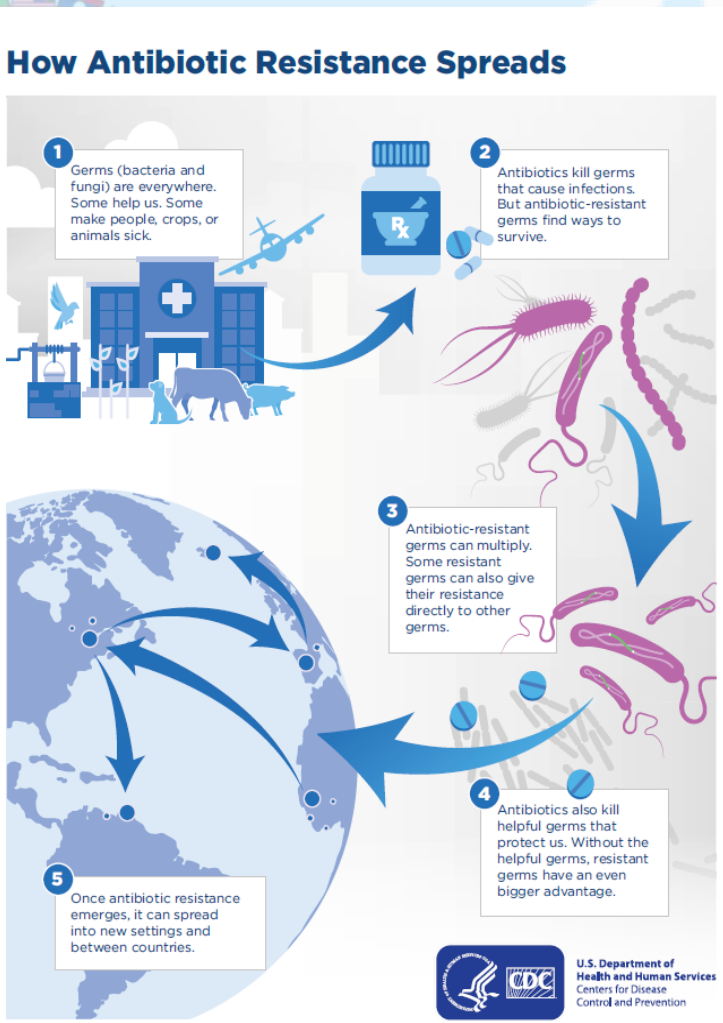

- Antimicrobial Resistance (AMR) **is a pressing global health issue, rendering common antibiotics ineffective against widespread bacterial infections**

- **The 2022 Global Antimicrobial Resistance and Use Surveillance System (GLASS) report highlighted median reported rates in 76 countries of 42% for third-generation cephalosporin-resistant *E. coli* and 35% for methicillin-resistant *Staphylococcus aureus*, which are major concerns**

GLASS Whole-genome sequencing for surveillance of antimicrobial resistance : https://www.who.int/publications/i/item/9789240011007

RESEARCH ARTICLE

Excess mortality attributable to antimicrobial-resistant bacterial bloodstream infection at a tertiary-care hospital in Indonesia

..”We used routine databases of the microbiology laboratory and hospital admission at Dr. Wahidin Sudirohusodo Hospital, a tertiary-care hospital in South Sulawesi from 2015 to 2018. Of 77,752 hospitalized patients, 8,341 (10.7%) had at least one blood culture taken..”

Pathogens	Total	Community origin	Hospital origin	P value
Escherichia coli				
3rd generation cephalosporin-resistant	78% (81/104)	50% (6/12)	82% (75/92)	0.01
3rd generation cephalosporin-resistant plus carbapenem resistant	4% (4/104)	0% (0/12)	4% (4/92)	0.46
Klebsiella pneumonia				
3rd generation cephalosporin-resistant	56% (96/171)	56% (18/32)	56% (78/139)	0.99
3rd generation cephalosporin-resistant plus carbapenem resistant	25% (43/171)	25% (8/32)	25% (35/139)	0.98
Staphylococcus aureus				
Methicillin-resistant	51% (124/245)	61% (30/49)	48% (94/196)	0.10
Acinetobacter spp.				
Carbapenem-resistant	48% (82/171)	13% (1/8)	50% (81/163)	0.04
Pseudomonas aeruginosa				
Carbapenem-resistant	19% (13/68)	33% (2/6)	18% (11/62)	0.35

Tauran PM, Djaharuddin I, Bahrun U, Nurulita A, Katu S, Muchtar F, et al. (2022) Excess mortality attributable to antimicrobial-resistant bacterial bloodstream infection at a tertiary-care hospital in Indonesia. PLOS Glob Public Health 2(7): e0000830. https://doi.org/10.1371/journal.pgph.0000830

Original Article

Nasopharyngeal carriage rate, serotype distribution, and antimicrobial susceptibility profile of *Streptococcus pneumoniae* isolated from children under five years old in Kotabaru, South Kalimantan, Indonesia

Korrie Salsabila [a], Wisiva Tofriska Paramaiswari [a], Hafsah Amalia [a], Akhmad Ruyani [b], Wisnu Tafroji [a], Yayah Winarti [a], Miftahuddin Majid Khoeri [a], Dodi Safari [a,*]

Table 3 Antibiotic profile for 34 multidrug resistant *S. pneumoniae* isolates from children under five years old in Kotabaru, South Kalimantan, Indonesia.

Antibiotics	Sussceptible	Intermediate	Resistant	Range MICs
	n(%)	n(%)	n(%)	
Penicillin[a]	19 (56)	9 (26)	6 (18)	0.12 - >4
Amoxicilin/Clavulanic Acid 2:1	13 (38)	10 (29)	11 (32)	≤2/1–8/4
Cefepime[a]	18 (53)	16 (47)	0 (0)	≤0.5–2
Cefotaxime[a]	23 (68)	11 (32)	0 (0)	≤0.12–2
Ceftriaxone[a]	20 (59)	13 (38)	1 (3)	≤0.12 - >2
Cefuroxime	5 (15)	0 (0)	29 (85)	≤0.5 - >4
Moxifloxacin	34 (100)	0 (0)	0 (0)	≤1
Levofloxacin	28 (82)	0 (0)	6 (18)	1–2
Meropenem	5 (15)	18 (53)	11 (32)	≤0.25–1
Ertapenem	33 (97)	1 (3)	0 (0)	≤0.5–2
Vancomycin	34 (100)	0 (0)	0 (0)	≤0.5–1
Azithromycin	5 (15)	0 (0)	29 (85)	≤0.25 - >2
Erythromycin	5 (15)	0 (0)	29 (85)	≤0.25 - >2
Tetracycline	3 (9)	0 (0)	31 (91)	≤1 - >8
Trimethoprim/Sulfamethoxazole	0 (0)	4 (12)	30 (88)	1/19 - >4/76
Linezolid	34 (100)	0 (0)	0 (0)	0.5–1
Clindamycin	19 (56)	0 (0)	15 (44)	≤0.12 - >1
Chloramphenicol	33 (97)	0 (0)	1 (3)	2–16

[a] Penicillin, ceftriaxone, cefotaxime, and cefepime using CLSI 2019 non-meningitis breakpoints. For penicillin 4 μg/mL was intermediate and ≥8 μg/mL was resistant. While for Cefepime, Cefotaxime, Ceftriaxone, 2 μg/mL was intermediate and ≥4 μg/mL was resistant.

Global Antimicrobial Resistance and Use Surveillance System (GLASS) priority pathogens

Penicillins
Sulfonamides and trimethoprim
Extended-spectrum cephalosporins

Streptococcus pneumoniae

Sulfonamides ,
trimethoprim
Fluoroquinolones
Extended-spectrum
cephalosporins
Carbapenems
Polymyxins
Penicillins

Escherichia coli

Fluoroquinolones
Extended-spectrum cephalosporins Carbapenems

Salmonella spp.

Sulfonamides and trimethoprim
Fluoroquinolones
Extended-spectrum cephalosporins
Carbapenems
Polymyxins
Penicillins

Klebsiella pneumoniae

Penicillinase-stable β-lactams

Staphylococcus aureus

Fluoroquinolones
Extended-spectrum cephalosporins
Macrolides

Shigella spp.

Tetracyclines
Aminoglycosides
Carbapenems
Polymyxins

Acinetobacter spp.

Extended-spectrum cephalosporins
Macrolides
Aminocyclitols
Fluoroquinolones
Aminoglycosides

Neisseria gonorrhoeae

Triazole antifungals
Amphotericin B
Echinocandin antifungals

Candida spp.*

Extended-spectrum cephalosporins
Aminocyclitols
Quinolones
Polymyxins

Pseudomonas aeruginosa*

Annex 2. Global Antimicrobial Resistance and Use Surveillance System priority pathogens and associated antimicrobial resistance

Whole-Genome Sequencing in Genomic Surveillance

- **Disease surveillance and outbreak investigation**
  - Identification of Pathogens
  - Outbreak Tracing
- **Antimicrobial Resistance Monitoring:**
  - Identification of Resistance Genes
  - Surveillance of Resistance Patterns
- **Vaccine Development and Monitoring:**
  - Strain Variation
  - Vaccine Target Identification
- **Public Health Response:**
  - Real-Time Monitoring
  - Targeted Intervention

Whole-Genome Sequencing in Genomic Surveillance

- **Genomic Epidemiology:**

  - Population Dynamics
  - Contact Tracing

- **One Health Approach:**

  - Interconnectedness: WGS supports one health approach by integrating genomic data from humans, animals, and the environment

Aim of study: To characterize analysis the bacterial pathogens both phenotypic and genomic data from community, health facilities (hospital), food production animal and environment and antimicrobial use (AMU) in hospital, community, veterinary and agricultural.

Topic: **Infectious disease and immunology (Health)**

Project timeline:

1st year :

- Sample collection from different hospitals (WHO priority pathogen isolates such as ESBL, Carbapenem resistant organisms, MRSA, *S. pneumonia*-penicillin resistant, from any clinical specimens)
- Sample collection and isolation of WHO priority pathogen from community
- Data collection of antimicrobial use in hospital is using AMU PPS method adopted from WHO.

2nd year

- Sample collection and isolation of WHO priority pathogen from animal (chicken), food product (meat, shrimp) and environment (water and sediment)
- History of antimicrobial use in community, animal is using questionnaires.
- Extraction of bacterial DNA from all samples

3rd year

- Library preparation for whole genome sequencing (WGS)
- Bioinformatic analysis of WGS result, to characterize of AMR bacteria, mechanism of resistance,

transmission of antimicrobial gene (ARG) between human, animal and environment.

Thank you