Antimicrobial Resistance Surveillance: WHONET and DHIS2 Integration in Bangladesh

Fleming Fund CAPTURA
Fleming Fund RADAAR

The Fleming Fund
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Antimicrobial resistance

Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi.

AMR occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death. As a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others.

Antimicrobials - including antibiotics, antivirals, antifungals and antiparasitics - are medicines used to prevent and treat infections in humans, animals and plants. Microorganisms that develop antimicrobial resistance are sometimes referred to as "superbugs".

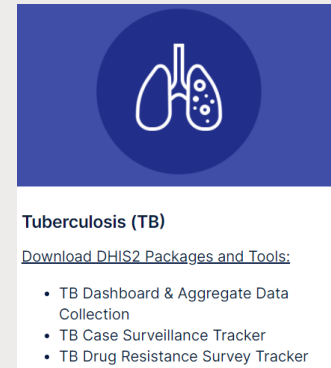https://www.who.int/health-topics/antimicrobial-resistance

Some leading AMR surveillance initiatives

- Global level: FAO/OIE/WHO Tripartite
  - United Nations Interagency Coordination Group on AMR and Global Leaders Group on AMR
  - WHO Global Antimicrobial Resistance Surveillance (WHO GLASS)
  - Food and Agriculture Organization (FAO)
  - World Organisation for Animal Health (OIE)
  - In coordination with the UN Environment Programme (UNEP) and the UN Development Programme (UNDP)

- Regional AMR surveillance networks
  - European Antimicrobial Resistance Surveillance System (EARS-Net)
  - Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR)
  - Latin American Network for Surveillance of Antimicrobial Resistance (ReLAVRA)

- Fleming Fund from the UK Department of Health & Social Care
  - Country Grants
  - Fellowship Grants
  - Regional Grants
    - CAPTURA: "Capturing data on AMR patters and trends in use in regions of Asia" led by the International Vaccine Institute
    - RADAAR: "Regional Antimicrobial resistance Data Analysis for Advocacy, Response and policy" led by the International Vaccine Institute
    - MAAP: "Mapping Antimicrobial Resistance and Antimicrobial Use Partnership " led by the African Society for Laboratory Medicine
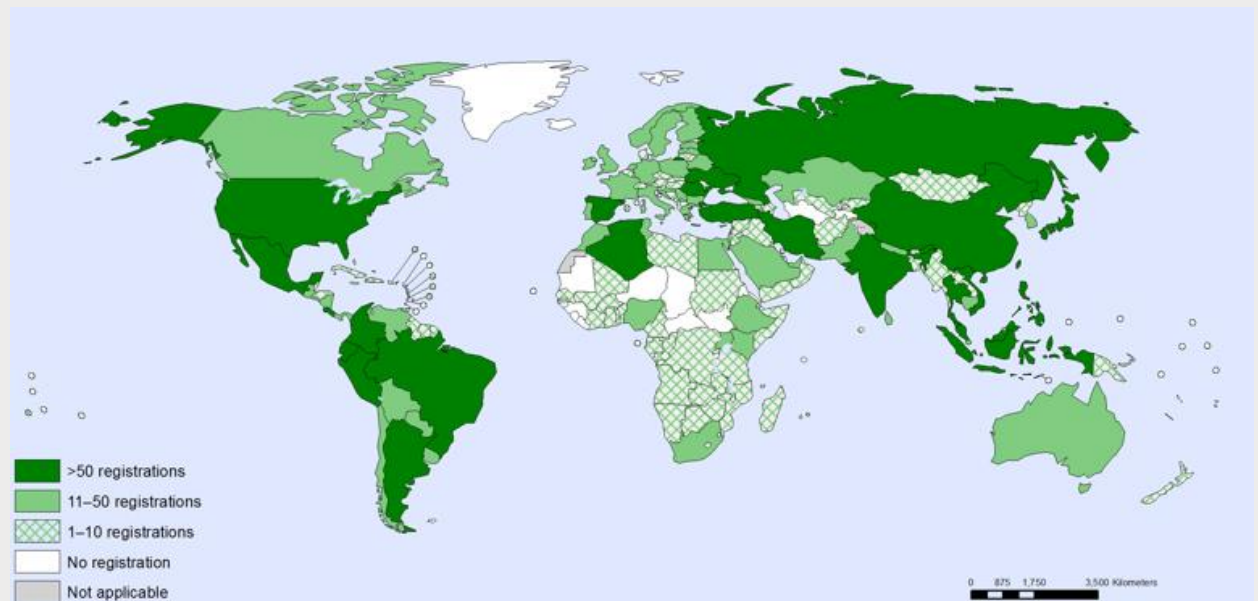
DHIS2 and AMR data management initiatives

- University of Oslo and HISP-India: Tracker module

- FIND: "Event" program and WHO GLASS export

- PATH AMR Surveillance in Senegal: Tracker for clinical reporting

- DHIS2 WHO Tuberculosis Package, including AMR

Tuberculosis (TB)

Download DHIS2 Packages and Tools:

- TB Dashboard & Aggregate Data Collection
- TB Case Surveillance Tracker
- TB Drug Resistance Survey Tracker

- Viet Nam
  - For two years, explored the use of a "Event" programs for national AMR surveillance, but stopped because of limitations in the approach

WHONET

- WHONET is a free desktop software developed and supported by the WHO Collaborating Centre for Surveillance of Antimicrobial Resistance in Boston, United States

- WHO currently supports surveillance of antimicrobial resistance (AMR) in over 3,000 hospital, food, and animal health laboratories in over 130 countries. The software is available in 29 languages

- WHONET modules include:
  - Laboratory configuration
  - Data entry
    - Manual data entry
    - Data import with BacLink
  - Data analysis
  - Data exports

>50 registrations
11–50 registrations
1–10 registrations
No registration
Not applicable

WHONET-DHIS2 Integration strategy

- WHONET supports three DHIS2 export types
  - WHONET analysis results to DHIS2 "Data Sets" CSV files
  - WHONET isolate records to "Event Program" CSV files
  - Data Set and Event Program Metadata XML files

WHONET Standard reports

WHONET Standard report	User-defined	DHIS2

Report name

1. DHIS2 - Isolate listing summary - Laboratory + Country by Week
2. DHIS2 - Isolate listing summary - Laboratory + Organism by Month
3A. DHIS2 - Susceptibility summary - Gram negative Organism + Laboratory by Month
3A. DHIS2 - Susceptibility summary - Gram positive Organism + Laboratory by Month

WHO GLASS Export

Save as type: WHO GLASS-AMR

Data year: 2020

Data set: Data set 1

☑ Use a date filter   ☑ Export to DHIS2

Interactive WHONET analysis exports
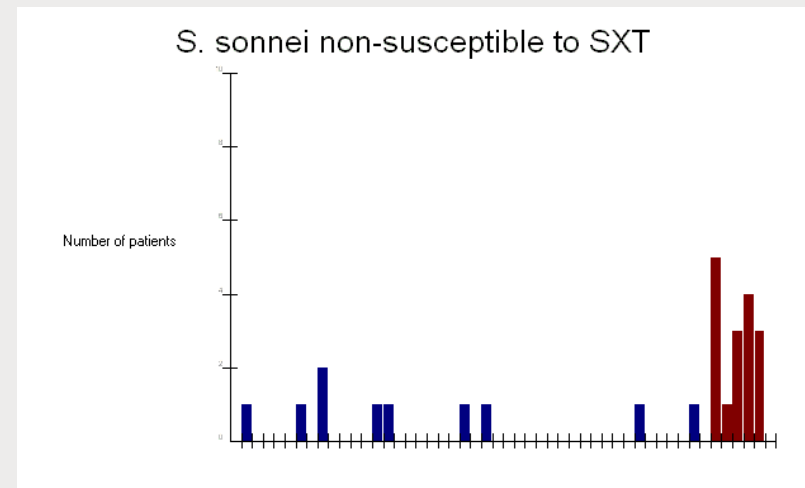
Output   DHIS2

Configure output files

In the future

- JSON data transfers
- University of Oslo and HISP-India Tracker module integration
- Automated synchronization of WHONET and DHIS2 backends

WHONET analysis, alert, and report features
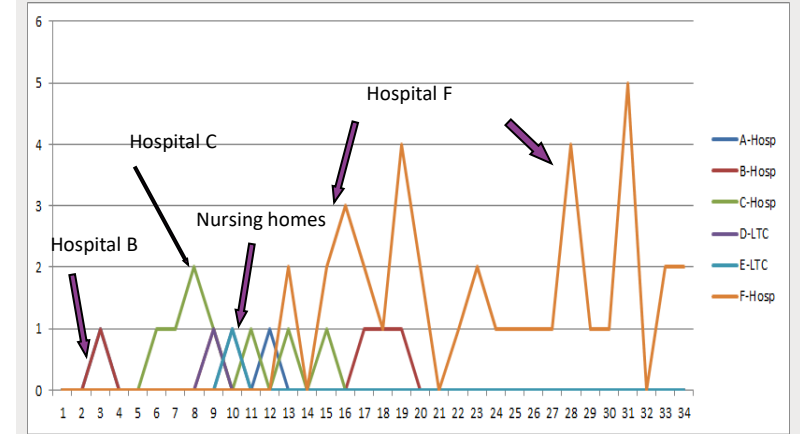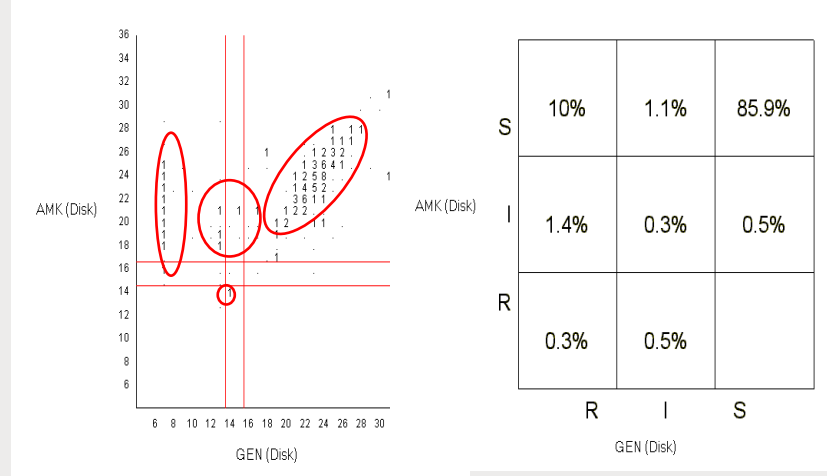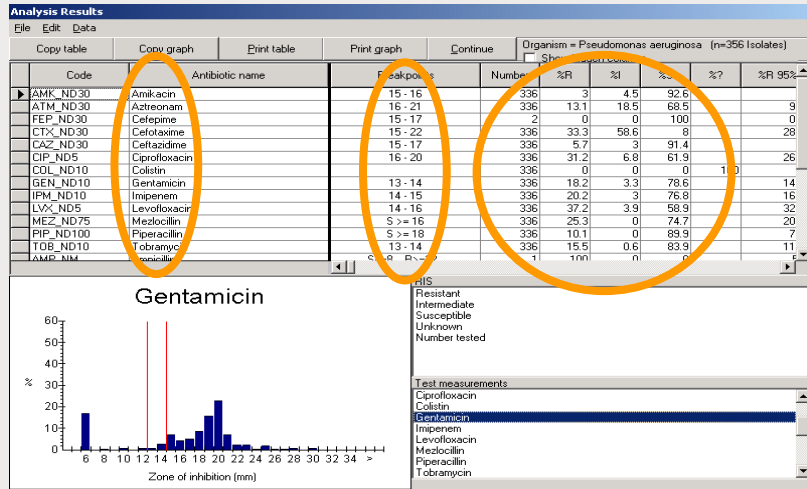
Limitations of DHIS2 core functionality with AMR data

- Incorrect counting of "patient" and "isolate" results, both with "Data Sets" and "Events"

- Errors in antimicrobial susceptibility test result interpretations and difficult maintenance
  - Complex and hierarchical rules for multiple test methodologies that must be updated annually
  - Human and animal clinical breakpoints and epidemiological cutoff values

- Simple descriptive statistics, not higher-level analyses such as the below
  - Hierarchical microbiology alerts for quality control, public health, and clinical importance
  - Interactive definition of multidrug resistance and resistance profile tracking
  - SaTScan-driven statistical outbreak detection

- File sizes, number of records, and performance
  - WHONET teaching database includes one month of data from a small community hospital with 622 "positive" samples. File size = 140KB with 622 records.
  - The DHIS2 export file is 6.5 MB (46 times larger) with 42,000+ records (67 times larger)

Some – but not all – of the limitations in DHIS2 core functionality can be mitigated with DHIS2 app development

AMR Surveillance in Bangladesh

- As part of the Fleming Fund CAPTURA project in coordination with the Bangladesh Directorate General of Health Services
  - Over 140 microbiologists, clinicians, IT staff, and national AMR policymakers have been trained
  - WHONET has been installed in 31 laboratories thus far
  - Three years of historical laboratory data from 41 governmental and private hospitals in eight divisions are being collected
  - With a successful pilot, this will be sustained with prospective data collection and use and automation of data file processing
- WHONET-DHIS2 Integration pilot
  - We have a DHIS2 pilot instance hosted in Amazon Web Services for nonconfidential data
  - With a successful pilot, DGHS will establish an AMR-dedicated DHIS2 server for both confidential and nonconfidential data with automated file transfers and synchronization of WHONET and DHIS2 backend databases

Importing WHONET results to DHIS2

Metadata, Data Set, and Event import

Metadata automatically available within Maintenance

Display of Data Set and Events – WHO GLASS Example

Dashboard display

Map edited for confidentiality

DGHS AMR Data Visualization Proposed Architecture
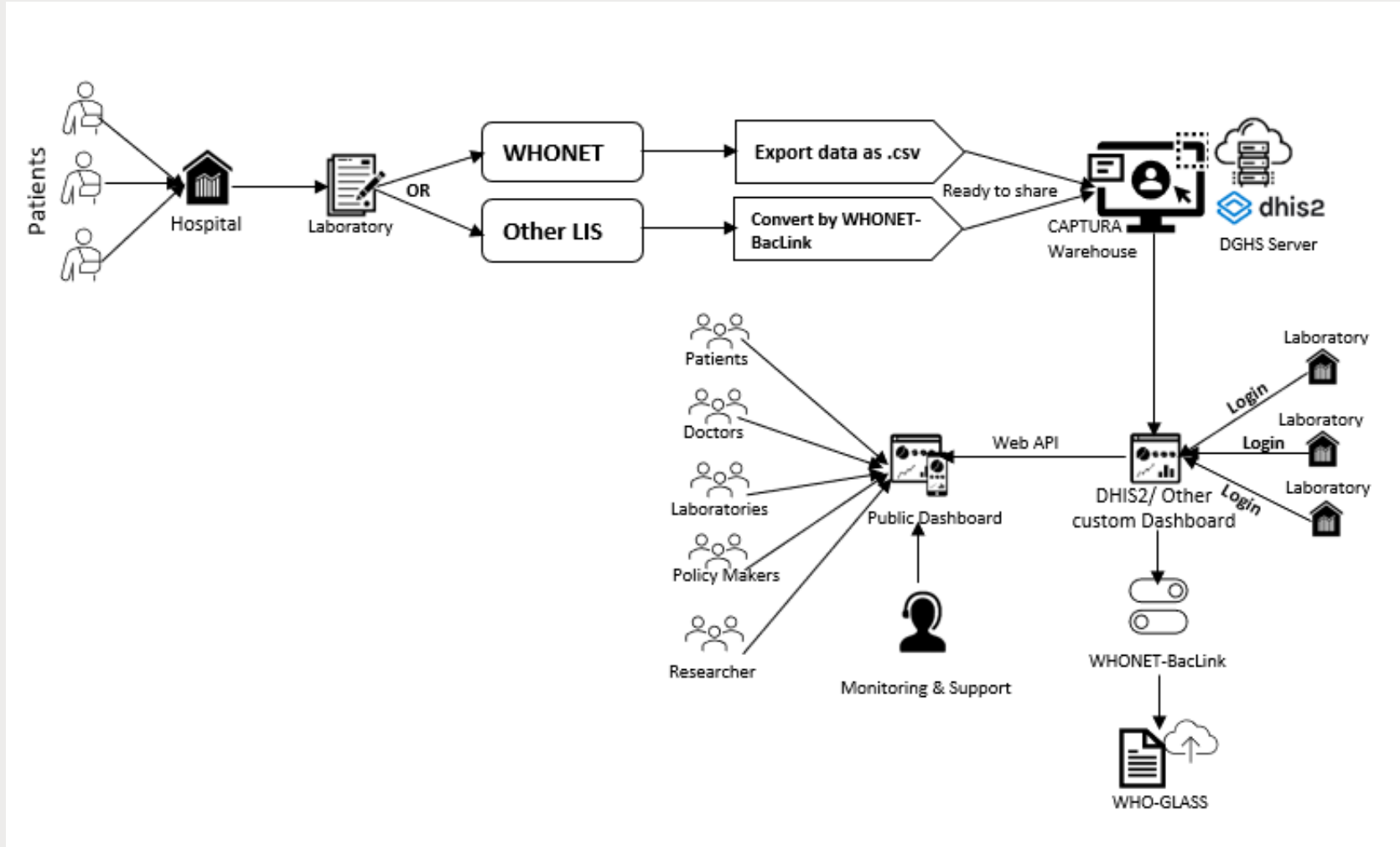
Conclusions

- WHONET is widely used worldwide to support local, national, regional, and global AMR surveillance initiatives; however, it has no web presence at the present time

- DHIS2 is widely used by national authorities for surveillance and programming monitoring initiatives. However, there are few production examples where DHIS2 is currently used to support AMR reporting or surveillance efforts

- Through the WHONET-DHIS2 interoperability features described, it is possible to leverage the strengths of both systems
  - WHONET's advanced data import, analysis, reporting, and alert features for microbiology laboratory data and AMR test results
  - Bangladesh DHIS2 platform for web-based visualization for communicable disease reporting, program monitoring, and policymaking

- This integration should support the development, implementation, monitoring, and impact evaluation in near real-time of national AMR containment strategies

Thank you

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