WHONET Introduction

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CAPTURA
Capturing data on Antimicrobial resistance Patterns and Trends in Use in Regions of Asia

MOTT MACDONALD

UKaid
from the British people

The Fleming Fund
Regional Grants

Objectives - WHONET

- Describe WHONET concept and purpose
- Describe and locate available WHONET resources
- Create a WHONET lab configuration and enter AMR data manually
- Conduct AMR data analysis (Part 1: %RIS Statistics, isolate filters, isolate listings, summary statistics, cumulative antibiograms, annual trends)
- Conduct AMR data Analysis (Part 2: Macros, Enhanced CA, Scatterplot analysis, resistance profiles, MDR/XDR/PDR, isolate alerts, cluster alerts/outbreak detection, automated reports)

Objectives - Cumulative Antibiograms (CA)

- Describe basics and pitfalls of cumulative antibiograms (CA)
- Generate routine and enhanced CAs with WHONET

Objectives - BacLink

- Describe BacLink concept and purpose
- Practice AMR data export/import of VITEK-2 files and import of Excel files

Vision

Surveillance of antimicrobial resistance and microbial populations

Clinical, public health, and research microbiology laboratories generate a richly-detailed window into evolving microbial populations in real-time. Yet this resource remains largely untapped and underutilized.

The use of a common software supports local, national, regional, and global collaboration and analyses to support:

- recognition, tracking, and containment of emerging threats (including outbreaks) in real-time
- cost-effective patient care through antimicrobial stewardship, including locally-relevant standard treatment guidelines
- public health awareness, policy, interventions, and assessment of interventions
- Local and national capacity for quality laboratory testing
- Basic science and operational research

WHO Consultation on Surveillance of Antimicrobial Resistance

WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTE

BVI/PHA/ANT/82.2

ENGLISH ONLY

drug resistance, Microbial - comp

SURVEILLANCE OF ANTIMICROBIAL RESISTANCE REPORT OF A CONSULTATION

antibiotics

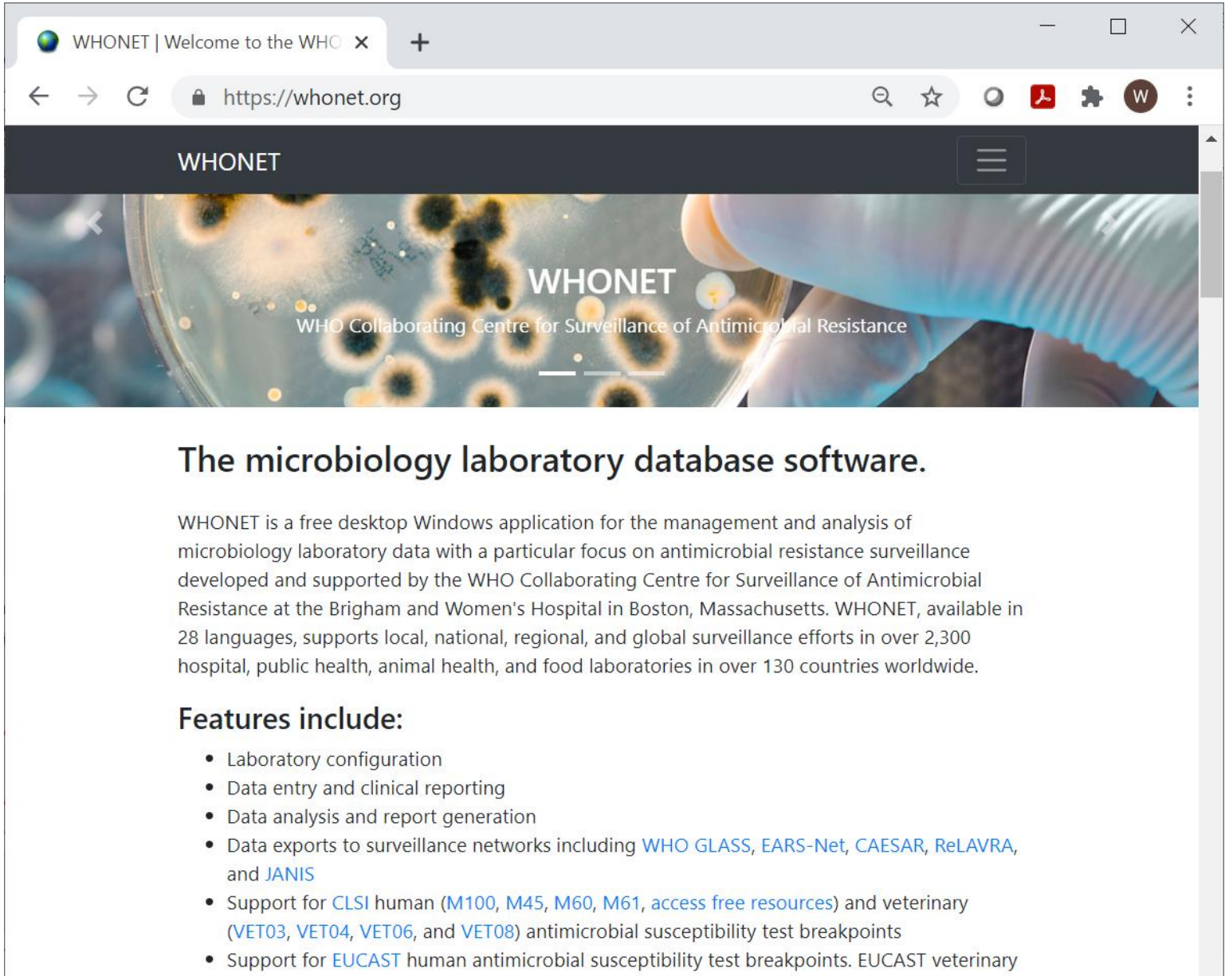
Geneva, 22-26 November 1982

CONTENTS

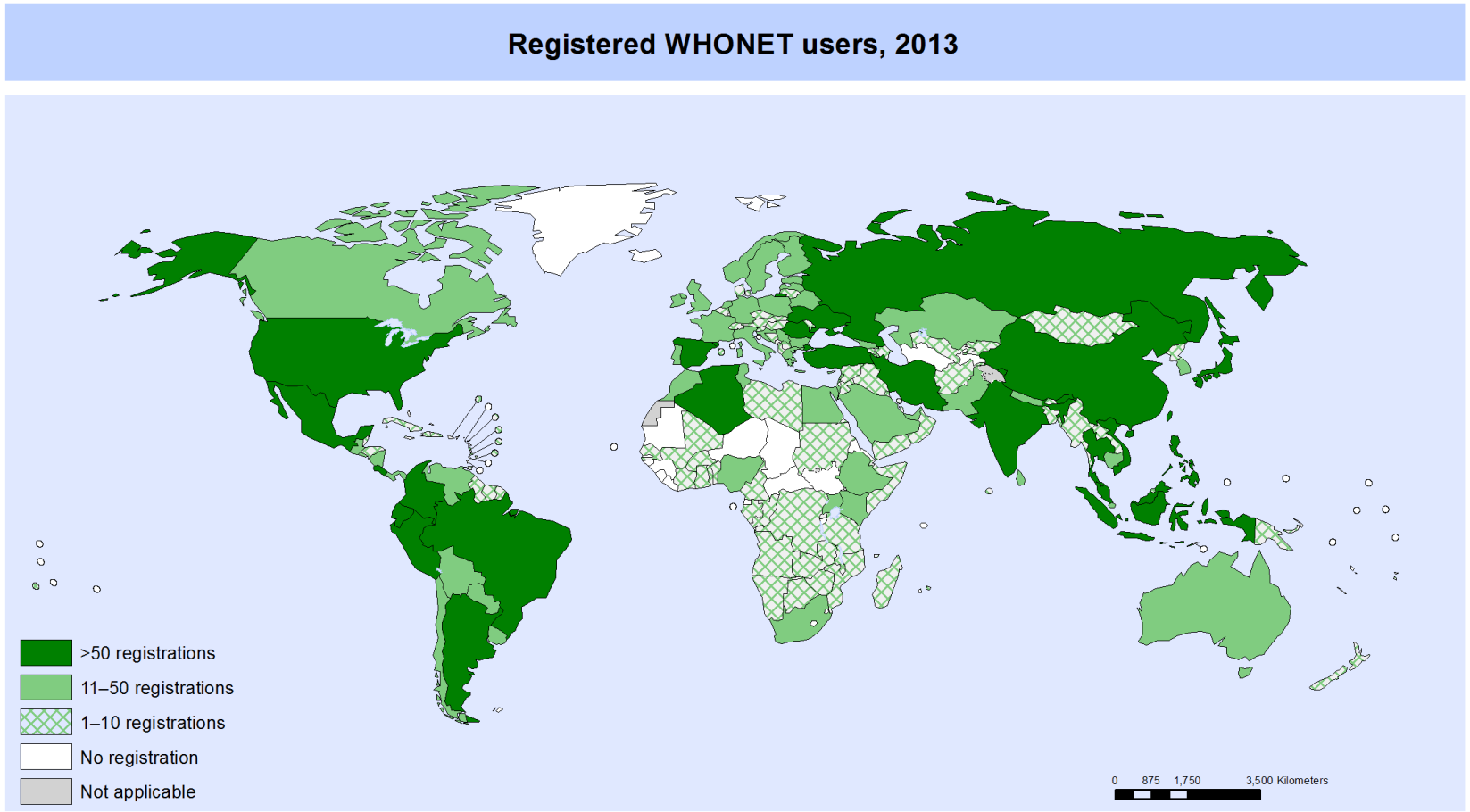
LEVEL	OBSERVATION	USE
LOCAL	Frequency of resistance to each antibiotic	Aid selection of antibiotics for individual patients.
	Frequency of resistance to each combination of antibiotics	Identify cross-infecting strains, locally endemic resistance plasmids
	Local trends in resistance	Aid reevaluation of local antibiotic usage and infection control practices
NATIONAL	More resistance to one antibiotic than usual in other countries.	Decrease use of the antibiotic, introduce alternative agents.
	Variation in antibiotic resistance in different regions of the country.	Seek regional differences in usage, vehicles of resistance spread, e.g. food or water, hygienic practices.
Regional	General level and trend of national resistance overall in comparison with other countries	Review, revise national antibiotic usage strategy to increase its effectiveness, reduce costs and resistance.
GLOBAL	Global trends in resistance to various antibiotics, prevalence of different bacterial genera.	Guide development, use of new antibiotics, ways of preserving efficacy of older ones. Compare practices in different countries.
	Early detection of new resistance to an antibiotic in a particular strain in a particular area.	Global warning to detect, contain treat the emerging strain, examine circumstances preceeding its emergence.
	Global trends in prevalence of distinctive combinations of resistance or resistance genes	Detection, prevention of international spread of particular resistance plasmids or resistant strains.

WHO Consultation on Surveillance of Antimicrobial Resistance – 1982
-- Emphasis on the local, national, and global needs for surveillance and for action

WHONET Website



WHONET Registrations around the world



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.

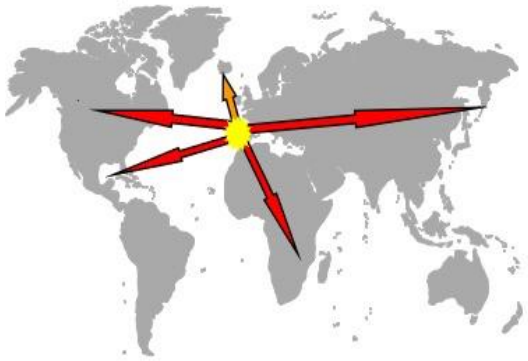
Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
World Health Organization

World Health Organization

AMR Surverillance and One Health

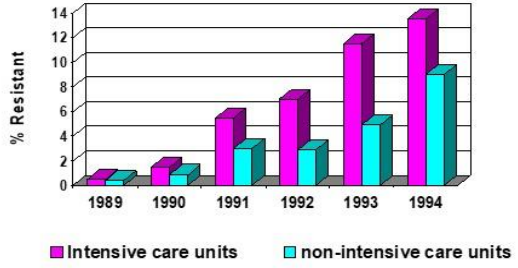
Appearance

Dissemination

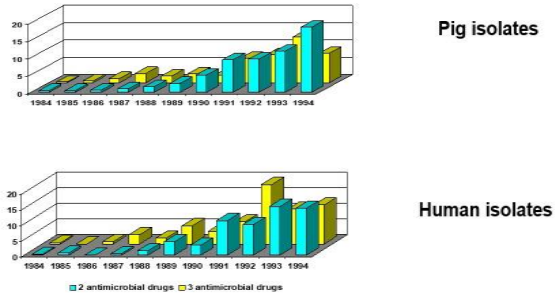


EMERGENCE OF ANTIMICROBIAL RESISTANCE

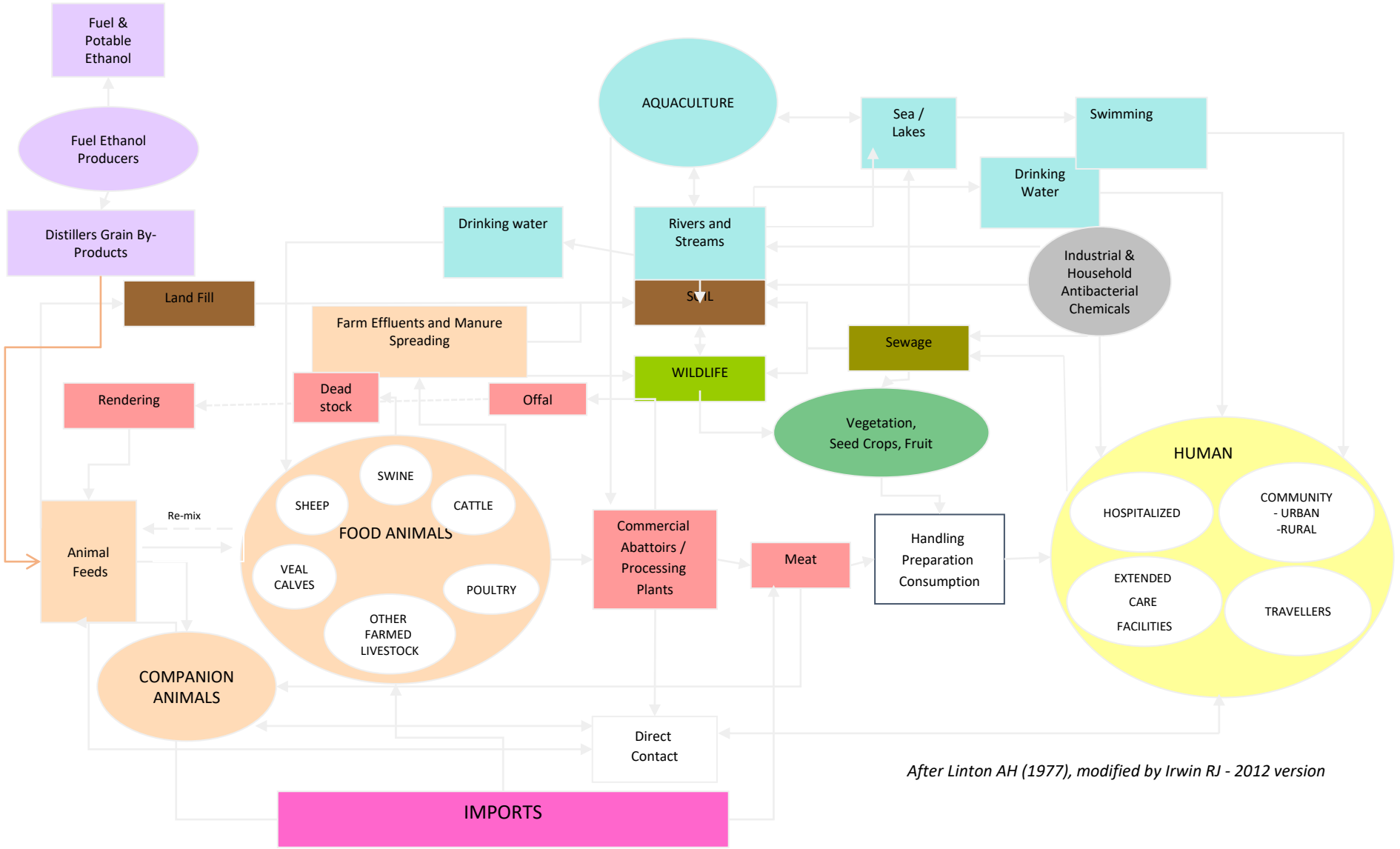
Establishment



Transfer between sectors



One Health view of antimicrobials and resistance



After Linton AH (1977), modified by Irwin RJ - 2012 version

AMR Surveillance objectives

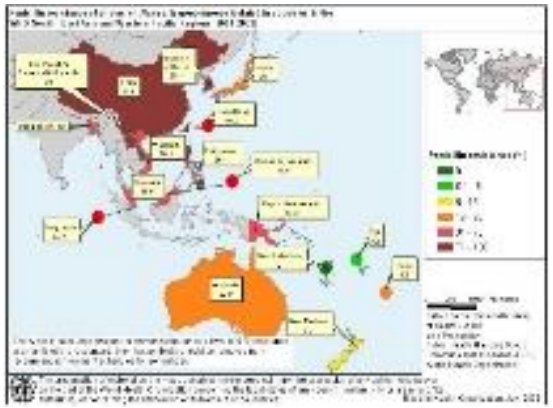
Objectives	Local	National	Regional	Global
Policy and advocacy				
Priority setting and funding	X	X	X	X
Awareness and education	X	X	X	X
Legislation and regulation			X	X
Epidemiology of resistant microbes				
Pathogen and resistance trends	X	X	X	X
Recognition of emerging threats	X	X	X	X
Disease burden	X	X	X	X
Benchmarking		X	X	X
Resistance containment				
Treatment guidelines	X	X		
Response to emerging threats	X	X	X	X
Assessment of interventions	X	X	X	X
New diagnostics and therapeutics			X	X
Capacity-building				
Laborotory capacity	X	X	X	X
Epidemiological capaciy	X	X	X	X

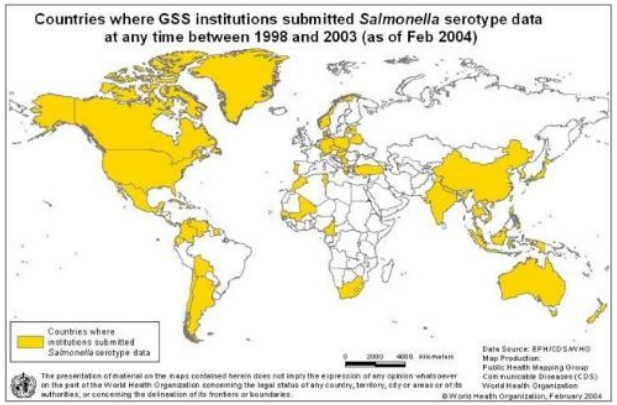
United Nations

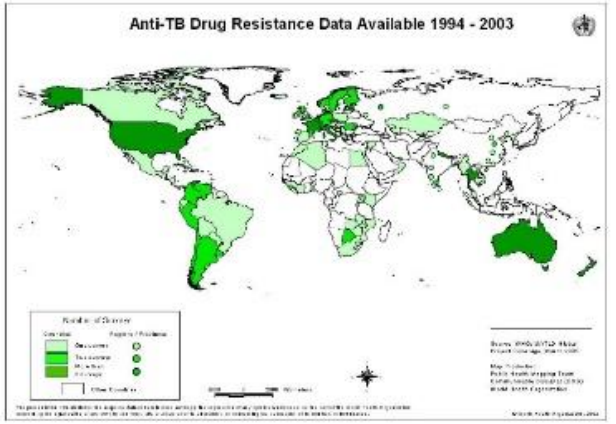
- High-Level Meeting on AMR - 2016
- Inter-Agency Collaborative Group on AMR (IACG)
- One Health Global Leaders Group on AMR (GLG)
- Sustainable Development Goals
  - New indicators for MRSA and ESBL *E. coli* in blood

World Health Organization

- WHO GLASS modules
  - Core AMR surveillance
  - Core AMC surveillance
  - EAR – Emerging Antimicrobial Resistance
  - EGASP – AMR in *Neisseria gonorrhoeae*
  - AMR in Candidemia
  - Attributable mortality in bacteremia
  - Hospital Antimicrobial Use Point Prevalence Study
  - ESBL *E. coli* TriCycle
- Pathogen- or subject-specific programs
  - AGISAR (Advisory Group for Integrated Surveillance of Antimicrobial Resistance)
  - Global Foodborne Infections Network (GFN)
  - WHO/IUTLD TB
  - HIVResNet
  - Malaria



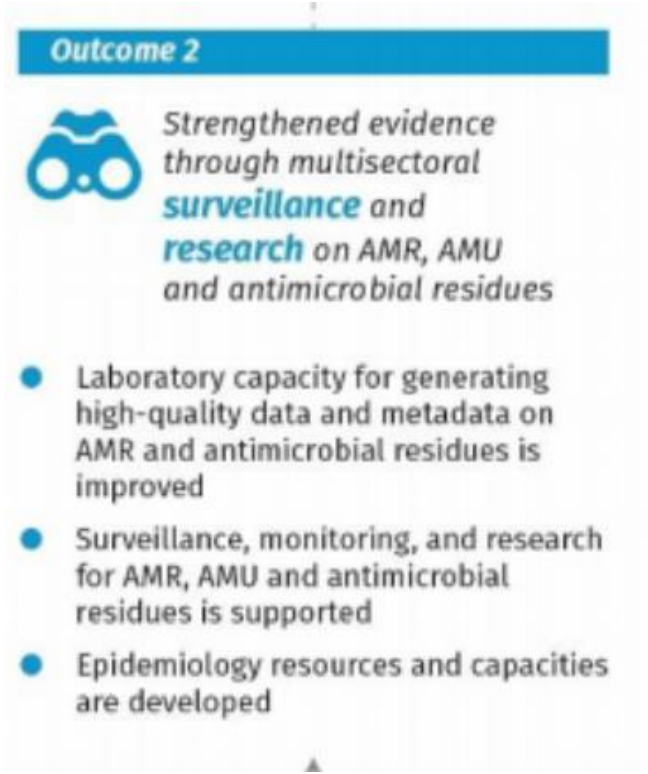




Food and Agriculture Organization of the UN

The FAO Action Plan on AMR 2016-2020

Draft proposal for the Action Plan on AMR 2021-2025



- FAO AMR Surveillance guidelines
  - Published: AMR in healthy animals
  - Advanced draft: AMR in diseased animals and in aquiculture
  - In development: AMR in animal environment and Antimicrobial use
- FAO-ATLASS: FAO Assessment Tool for Laboratories and AMR Surveillance Systems
- FAO-PMP-AMR: FAO Progressive Management Pathway for AMR
- FAO Technical Working Group on AMR Data Management

WHONET Features

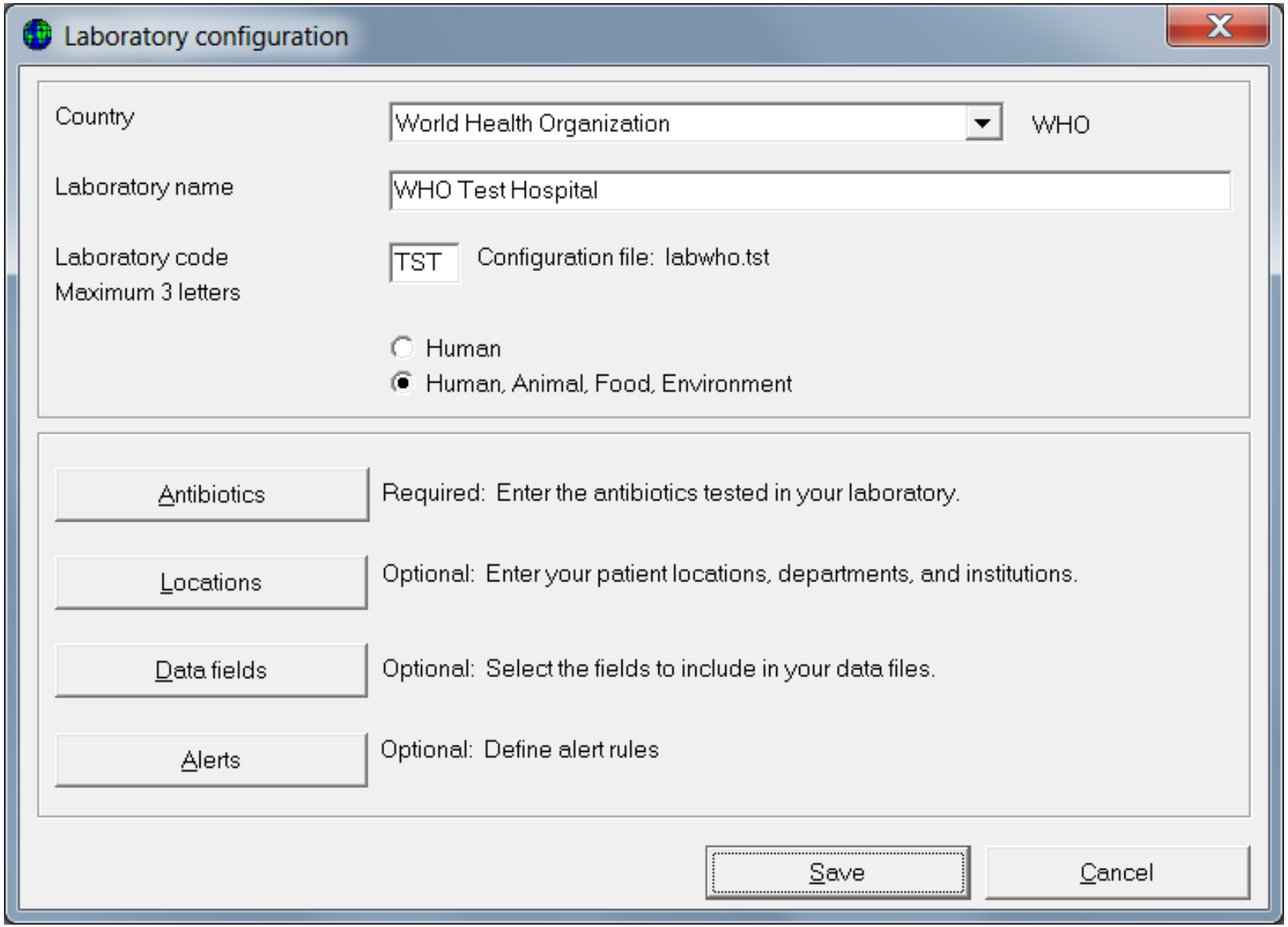
WHONET 2022

- AMR data entry, data analysis, and sharing
- 26 languages, incl. Arabic
- Supports CLSI 2022 breakpoints (M100, M45, M60, M61)
- Supports EUCAST 2022 breakpoints

BacLink

- For the capture and standardization of data from existing systems
  - Simple data files: Text-, MS Excel-, MS Access-data files
  - Laboratory instruments: e.g. Vitek™, BD Phoenix™, MicroScan™, ..
  - Laboratory information systems (LIS): Commercial, or locally developed
- Included as part of the WHONET package

Laboratory configuration



Data entry – Manual

Sample origin
Human/animal/ food/environment

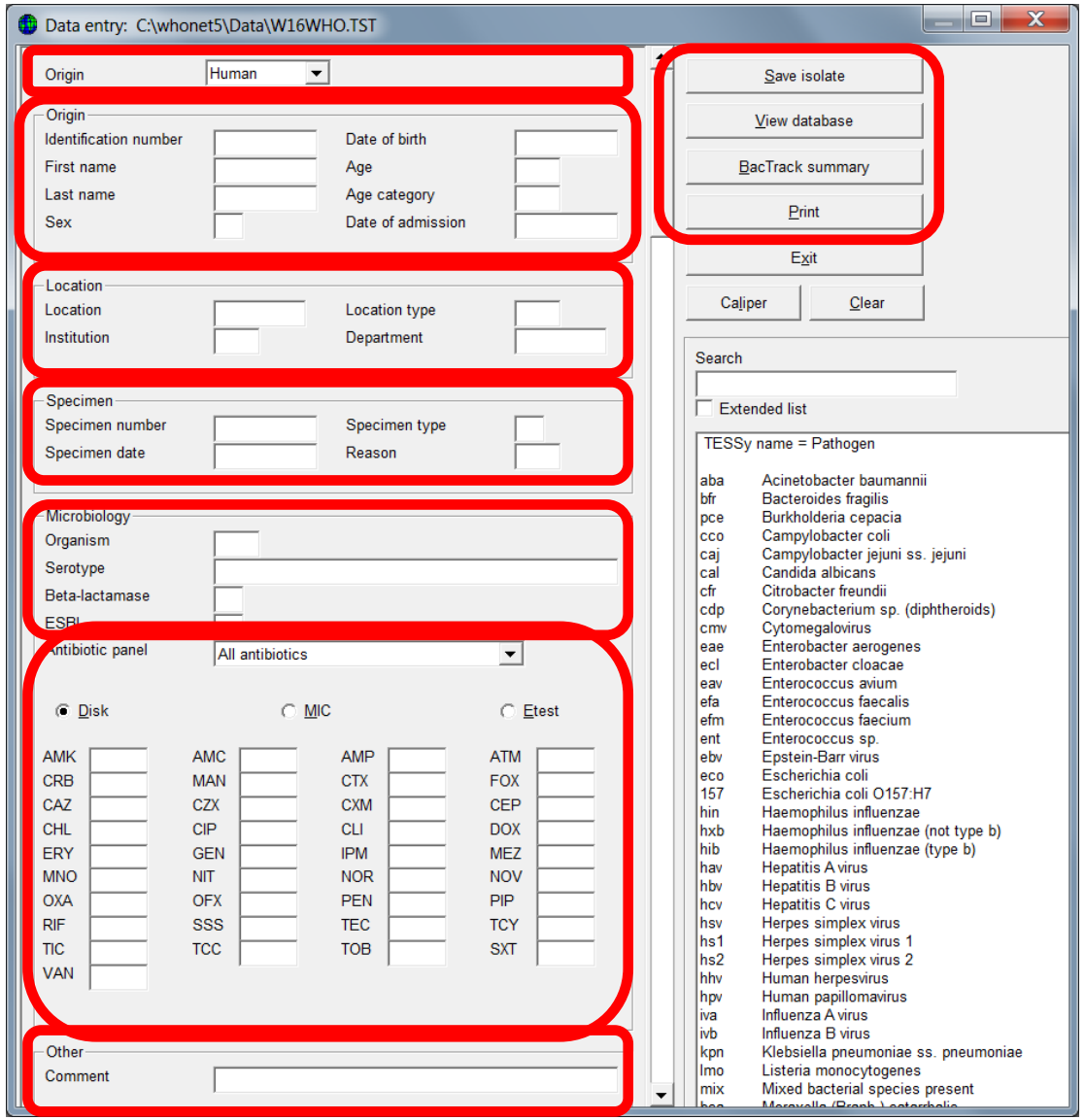
Location

Specimen

Organism

Antibiotics
Disk, MIC, Etest

Other



Data entry – Import with BacLink

Most laboratories in the medium- and high-resource world already have computer systems for managing their microbiology data… and also many in low-resource settings.

- Simple desktop systems: Excel, Access,…
- Laboratory instruments: Vitek, Microscan, BD Phoenix, etc.
- Laboratory information systems: Commercial or in-house

This is an obstacle because they are not directly compatible.

But it is also an opportunity! The electronic data have been stored.

The goal of BacLink is converting data from existing incompatible systems into common WHONET files.

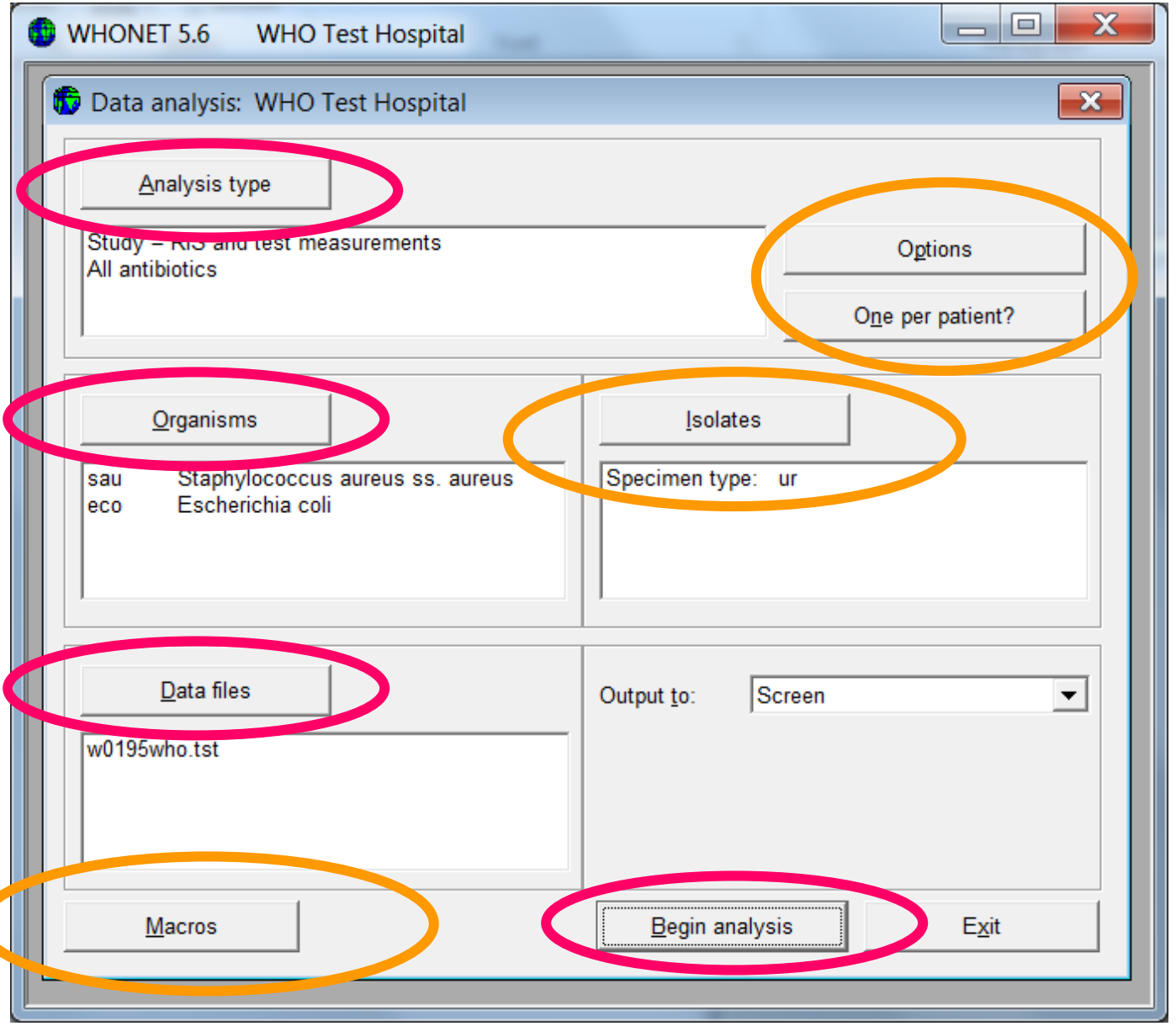
Incompatible Local systems

BacLink

WHONET

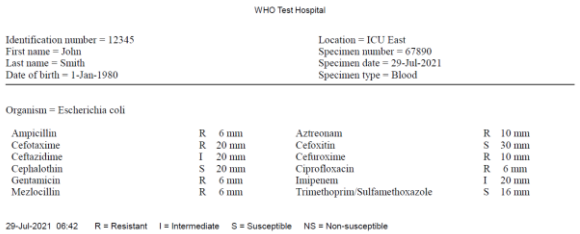
Standard WHONET files

Data analysis



Data analysis, alert, and report features

Clinical reports



WHO Test Hospital

Identification number = 12345
First name = John
Last name = Smith
Date of birth = 1-Jan-1980

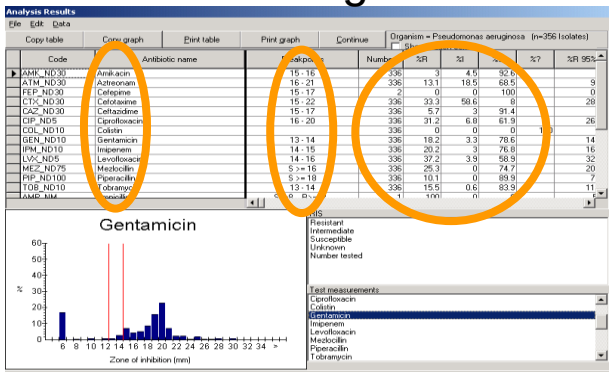
Location = ICU East
Specimen number = 67890
Specimen date = 29-Jul-2021
Specimen type = Blood

Organism = Escherichia coli

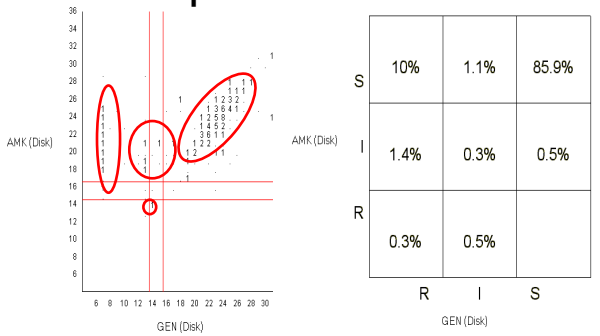
Ampicillin	R	6 mm	Aztreonam	R	10 mm
Cefotaxime	R	20 mm	Cefoxitin	S	30 mm
Ceftazidime	I	20 mm	Cefuroxime	R	10 mm
Cephalothin	S	20 mm	Ciprofloxacin	R	6 mm
Gentamicin	R	6 mm	Imipenem	I	20 mm
Mezlocillin	R	6 mm	Trimethoprim/Sulfamethoxazole	S	16 mm

29-Jul-2021 06:42 R = Resistant I = Intermediate S = Susceptible NS = Non-susceptible

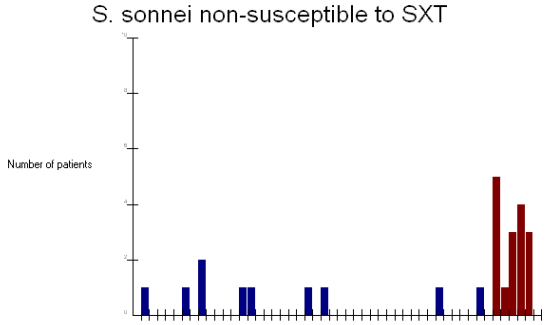
%RIS and histograms



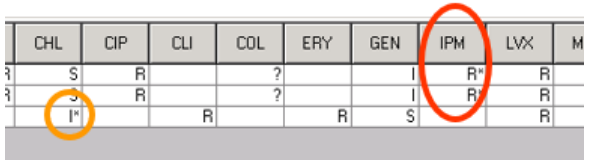
Scatterplot



Outbreak detection



Microbiology alerts

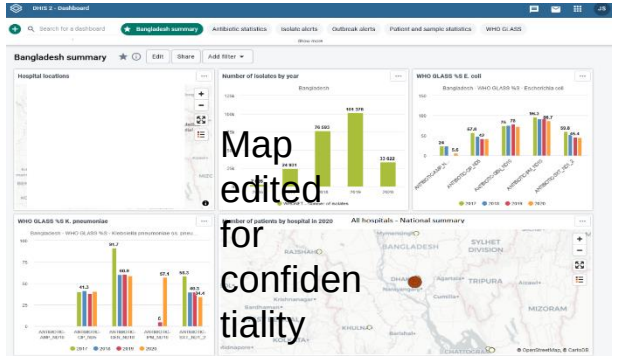


	CHL	CIP	CLI	COL	ERY	GEN	IPM	LVX	M
R	S	R		?		I	R*	R	
R	S	R		?		I	R*	R	
	I*		R		R	S		R	

WHO GLASS

GLASS
Global AMR Surveillance System

DHIS2



MicroReact

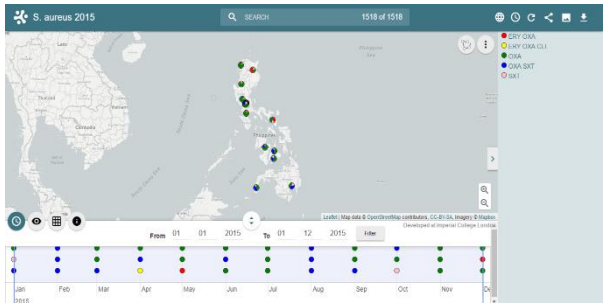


Figure 4: Screenshot of Microreact File for S. aureus 2015

Conclusion

WHONET is for the surveillance of evolving microbial populations
One focus is on annual surveillance of priority resistance trends – trends, treatment guidelines, advocacy
But there are many other applications of greater value in real-time to support the recognition and containment of emerging threats including novel resistant strains and possible outbreaks
to improve laboratory capacity and data quality

What’s new in WHONET 2023?

Migration from WHONET 5.6 with Microsoft Visual Basic 6 (1998) to WHONET 2017+ with Microsoft Visual Studio 2022 .NET 4

- Some advantages of Visual Studio
  - Modern, compatible, comprehensive set of programming tools
  - Multi-threading to support faster and multiuser performance
  - Expanded debugging details (partially implemented)

Data management

- Migration from DBF files to SQLite – but both are supported
- SQLite is more modern, faster, smaller, fewer restrictions, more secure (and suitable for web platforms), support multiple users

Automatic language translations (but requiring validation)

- If there is any need, these options exist in Google Translate. Bengali, Gujarati, Kannada, Malayalam, Marathi, Nepali, Oriya, Punjabi, Sindhi, Sinha, Tamil, Urdu

Adaptations for non-human health sectors

Introduced in 2002, gradual improvements over time in collaboration with FAO, OIE, US FDA and USDA

Expanded WHONET data field and code lists

- Animal species, production type, food type, etc.
- Pathogens, antimicrobials, specimen types, etc.
- AGISAR and TriCyle *E. coli* ESBL projects
- Integration with SILABFA and DHIS2

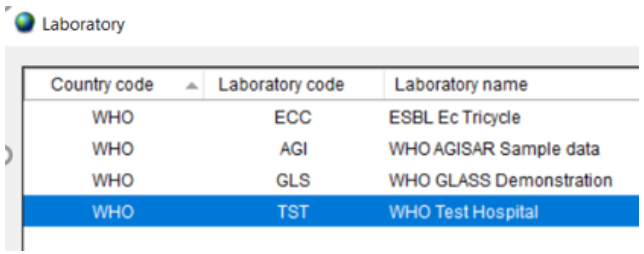
Breakpoints

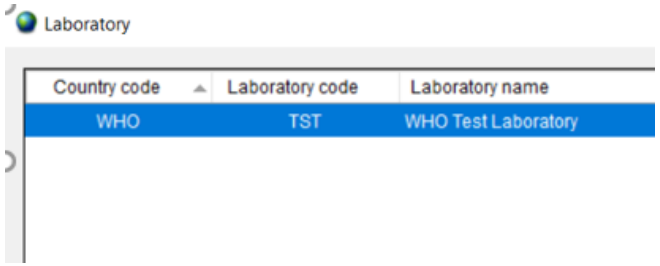
- CLSI: Human (M100, M45, M60, M61) and Veterinary (VET01, VET06, VET03, VET04) clinical breakpoints
- EUCAST: Human clinical breakpoints and Epidemiological Cutoff Values (ECOFFs/ECVs). Veterinary breakpoints are in development
- Integration of WHONET with ECOFFinder

One Health Sample data

- 100 human, 100 animal, 100 food, and 100 environmental isolates

Installation and configuration





- Increasing number of pre-defined laboratory configuration templates
- Merged together 4 configurations into 1
- Merged 4 sample data files into two
  - One month of human health hospital data
  - One Health data set with human, animal, food, and environmental results (100 isolates of each)
- Expanded support for breakpoints and epidemiological cutoff values (more details later)
- Resistance profile auto-configuration feature

Data Entry

New “View database” feature for SQLite files including more advanced searching, “find and replace”, result paging (valuable for large data files)

Initial steps towards a “Patient lookup” record across multiple files

Modest improvements in clinical reports (but more to come)

Data analysis

- Reorganized “Analysis options”
- More WHONET-SaTScan features for cluster detection
- Dynamic and configurable breakpoint selection
- Quick analysis
  - Standard reports for Excel
  - Standard reports for Word
- Publications in PubMed
  - https://pubmed.ncbi.nlm.nih.gov/?term=stelling+antimicrobial+resistance
  - https://pubmed.ncbi.nlm.nih.gov/?term=stelling+satscan
  - https://pubmed.ncbi.nlm.nih.gov/?term=stelling+resistance+genotype

Data exports

WHO GLASS

- WHO GLASS-AMR
- WHO GLASS-Candidemia
- WHO GLASS-Individual
- WHO EGASP (in development)

DHIS2

New AST Interpretation engine

Converting “zone diameters” and “MIC values” to R, I, S (and other) categories is complex to implement, tedious to maintain over time, and often done incorrectly.

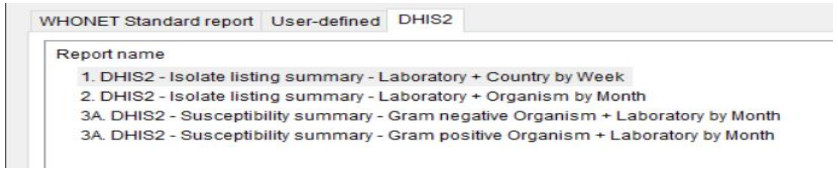
- Disease-specific (meningitis, nonmeningitis, UTI, etc.)
- Animal specific (human, horse, dogs, fish, etc.)
- Expert rules (MRSA, inducible clindamycin resistance, ESBL, BLNAR), intrinsic resistance rules, epidemiological cutoff values
- Because of these complexities, many LIMS only record RIS categories without test measurements
- There are also valuable public health alerts like “important species” and ”importance resistance” and laboratory “data quality alerts”

Based on prior WHONET work and with support from MSF in 2021, we have developed a “table-driven” approach for linking all of the needed data together to convert an “organism”, an “antibiotic”, and a “measurement” into all relevant interpretations (and expert alerts)

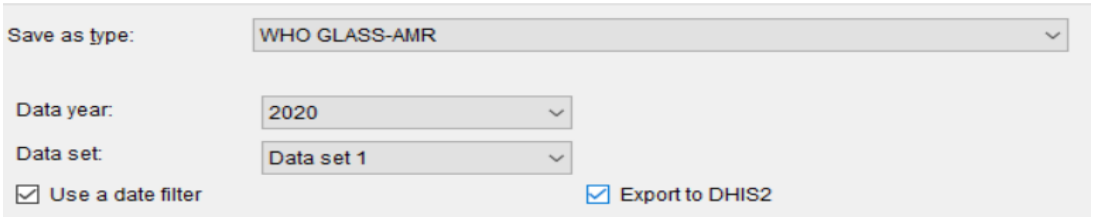
These tables are currently used by WHONET and by MSF’s Mini-LIMS system. We are now collaborating MSF, Wellcome Trust, and many others to further validate develop “table-driven” interpretation so that this could be a common good for use by LIMS developers anywhere.

DHIS2

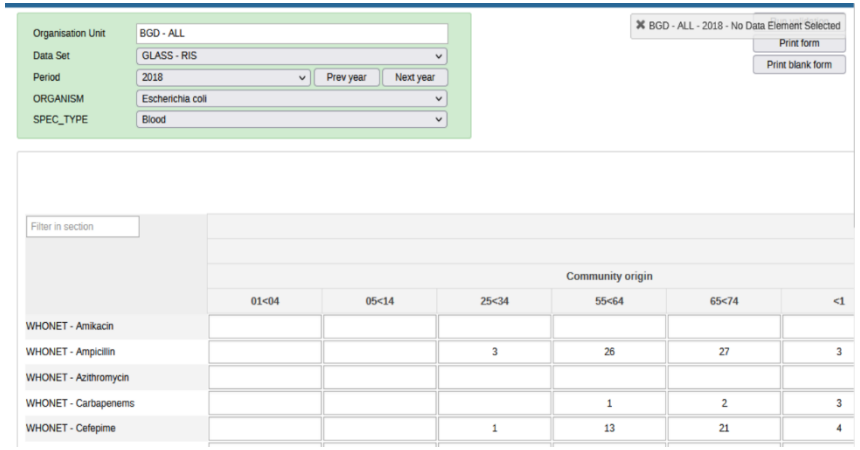
WHONET Standard reports



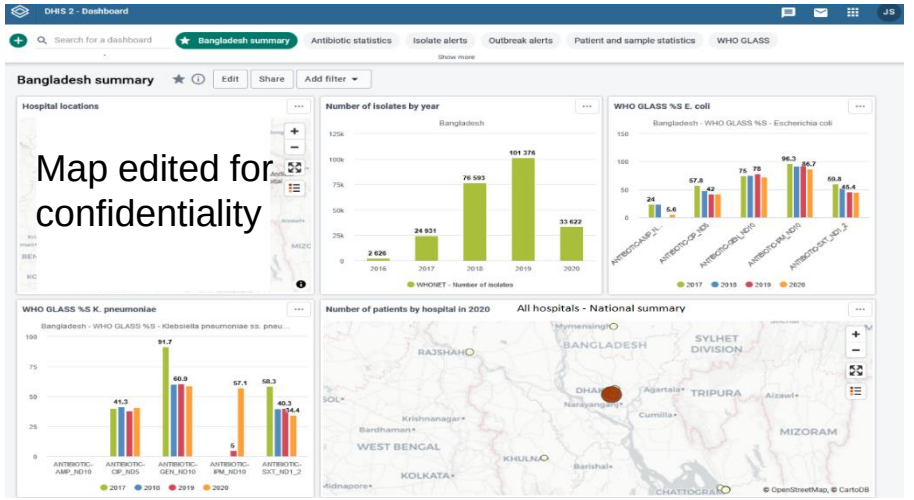
WHO GLASS Export



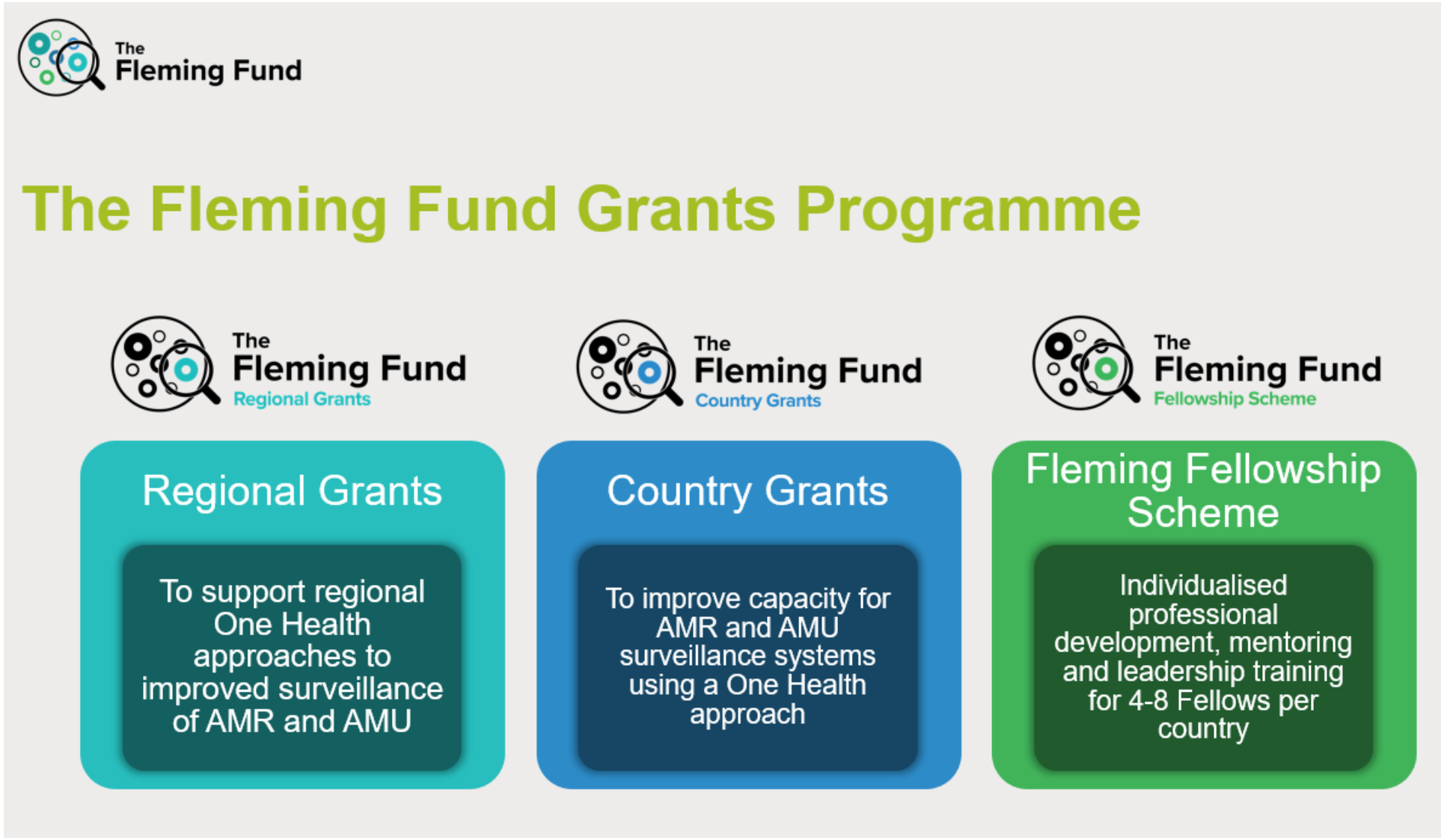
Display of Data Set and Events – WHO GLASS Example



Dashboard display



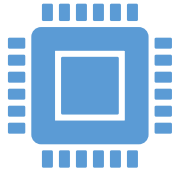
Whats Next for WHONET



Grant Objectives

Workstream 1: Training

Workstream 2: Technical support



Workstream 3: New software development

Desktop application

“Web presence”

Workstream 1: Training

- Training resources
  - Training modalities: In-person, online, self-training; Basic/refresher, advanced, specialized; Demonstration versus hands-on
  - Training materials: Tutorials, PowerPoints (with facilitator notes), exercises, YouTube videos, course agenda… perhaps certification exam?
  - National and regional trainers
- Training strategies, priorities, and activities
  - Coordinate with WHO, FAO, national partners, others
  - Prioritized training and training-of-trainers

Workstream 2: Technical support

- Technical support resources
  - Technical support materials, Frequently Asked Questions
  - User group discussion forum
  - Technical support individuals
- National and regional technical support strategy, priorities, and activities
  - Coordinate and develop plan with WHO, FAO, countries, others
  - Tiered strategy for first-line, second-line, and third-line technical support

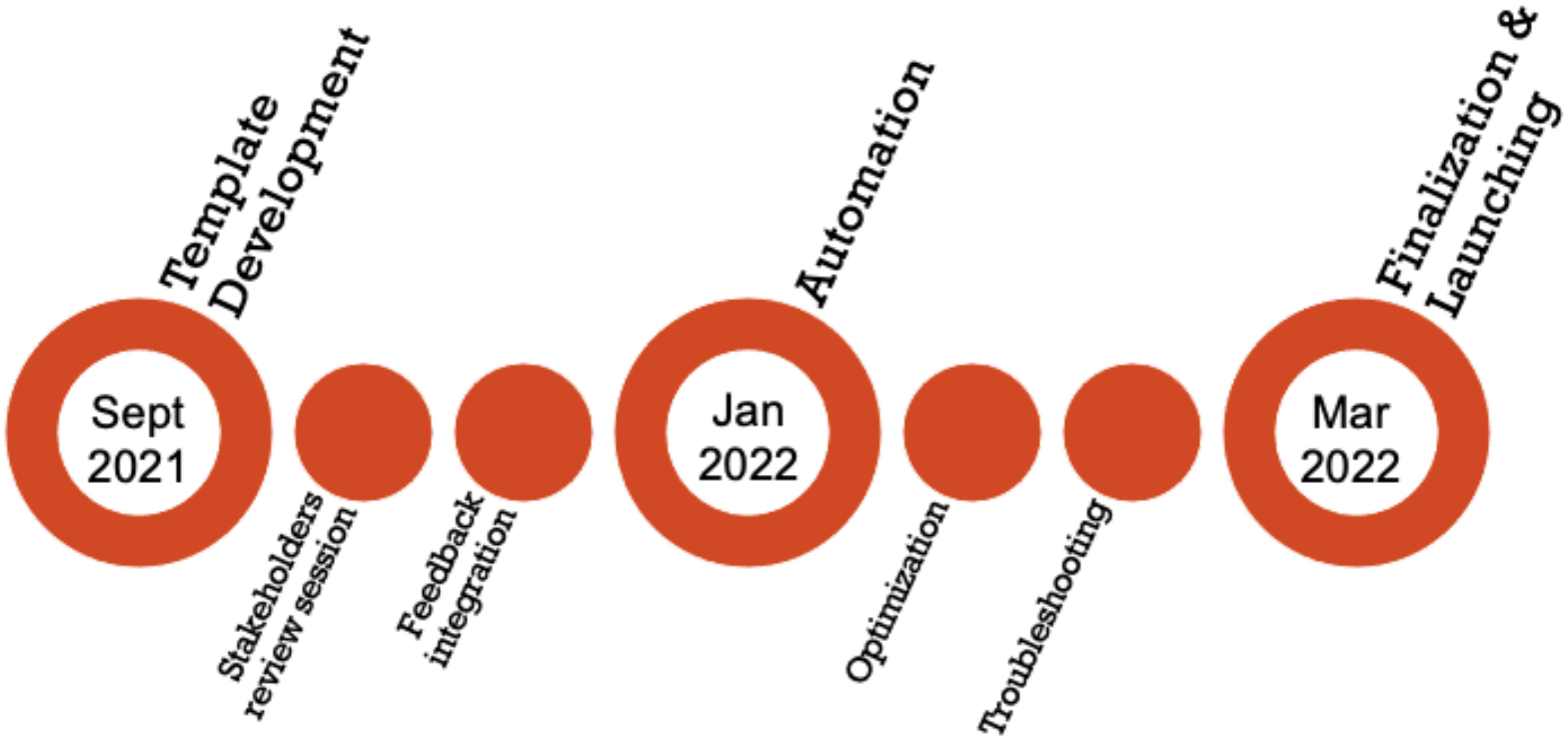
Workstream 3: Software development
WHONET Desktop application

- BacLink interfaces
  - “Clean” versus “messy” LIMS data exports
  - Work with vendors, integrated into BacLink
- WHONET for national/network data managers
- WHONET Automation tool

Workstream 3: Software development
WHONET web presence

- Desktop WHONET accessible through the Cloud
- WHONET for Web – priority features
  - Remote multisite data entry into network database
  - Data file upload feature into network database
  - Guidance on secure transfer of WHONET data files
- Integration with web surveillance platforms and nvisualization tools
  - DHIS2, GLASS, Microreact
- Migration from Microsoft Visual Studio from version .NET 4 to .NET 6

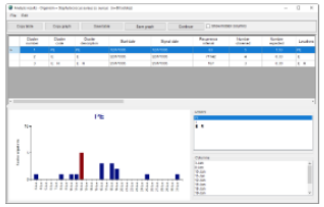
Methodology for development of the Report



WHONET.org

Software

WHONET 2022



WHONET 2022 is a modernized and expanded version of WHONET 5.6. This version supports 44 languages and includes new features for exporting to the **WHO GLASS** data structure. Further information on GLASS can be found using this link.

It includes support for CLSI 2022 M100, M45, M60, M61, as well as EUCAST 2022 bacterial breakpoints. Also included are the most recent CLSI VET01, VET03/04, and VET06 breakpoints.

Download

32-bit installation (88 MB)
64-bit installation (88 MB)

Build date: 2022-05-13
Version: 22.5.13
Release notes

WHONET 5.6

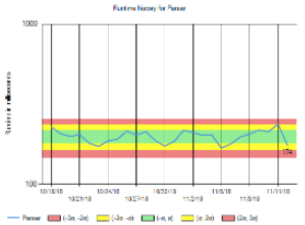
WHONET 5.6 is a desktop application with support for 24 languages and 2022 CLSI and EUCAST breakpoints.

Download

32-bit installation (60 MB)

Build date: 2022-04-20

WHONET Automation Tool



Download

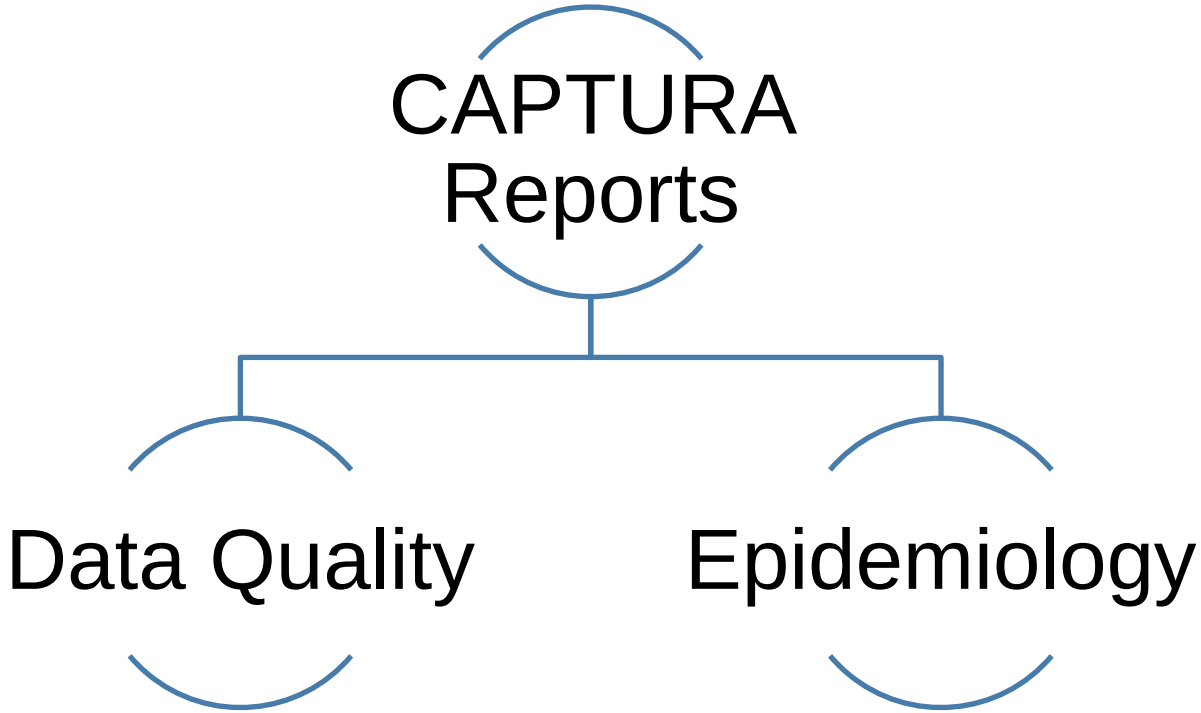
32-bit installation (4.6 MB)
64-bit installation (4.6 MB)

Build date: 2021-09-23
Version: 21.9.23

The Automation Tool can be configured to execute an entire workflow of data processing, aggregation, and analysis steps. It includes optional services which either run on a set schedule, or are triggered in response to new files appearing in designated "watched" locations. You can configure any set of analyses you wish, from simple statistics to sophisticated outbreak detection. The system also has integrated process monitoring and email alerts for:

- Missing input files
- Duplicated input files
- Lower- or higher-than-expected row counts
- Lower- or higher-than-expected individual process runtimes
- Duplicated row counts per institution on successive days
- Error messages
- Daily reports

CAPTURA Reports



Data Quality Report

Data entry and management

- Data volume
- Completeness and validity of data entry

Quality control

- Quality control testing
- Quality control alerts

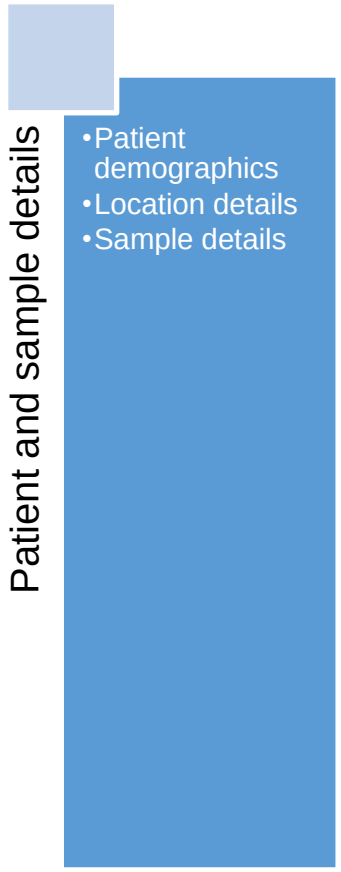
Organism results

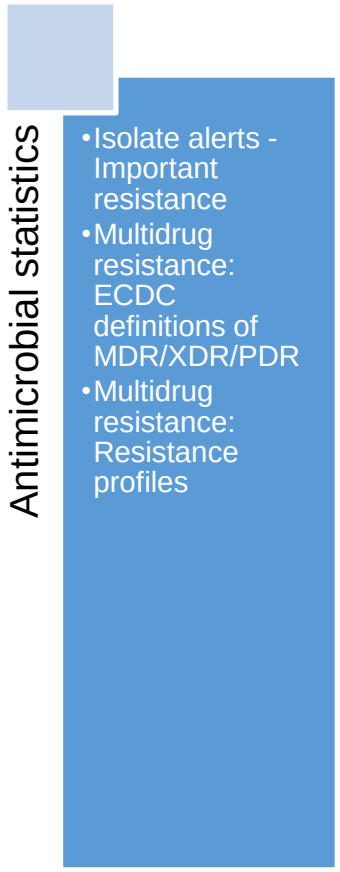
- Capacity for organism identification
- Capacity for the isolate of fastidious organisms
- Blood culture results

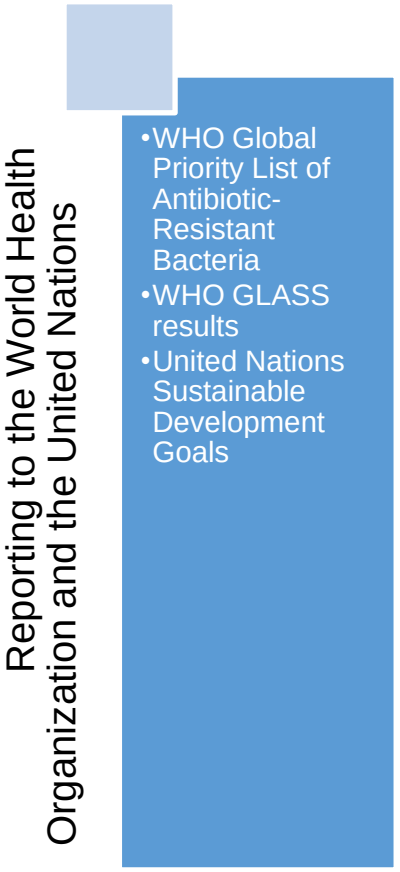
Antimicrobial susceptibility test practices

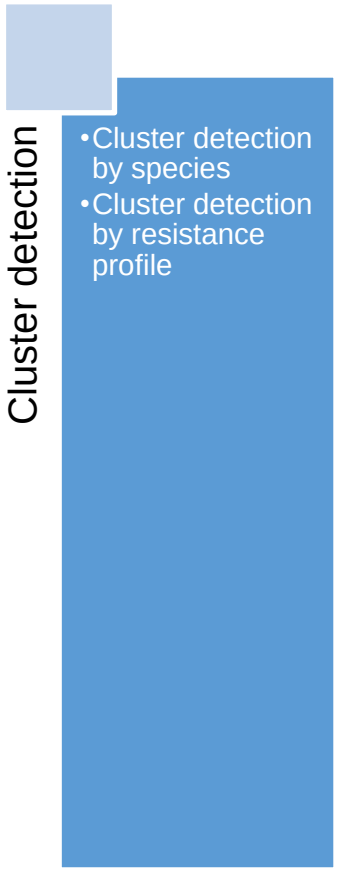
- Antibiotic Configuration
- Antibiotic tests without validated breakpoints
- Regularity of antimicrobial testing
- Antimicrobial susceptibility test measurements

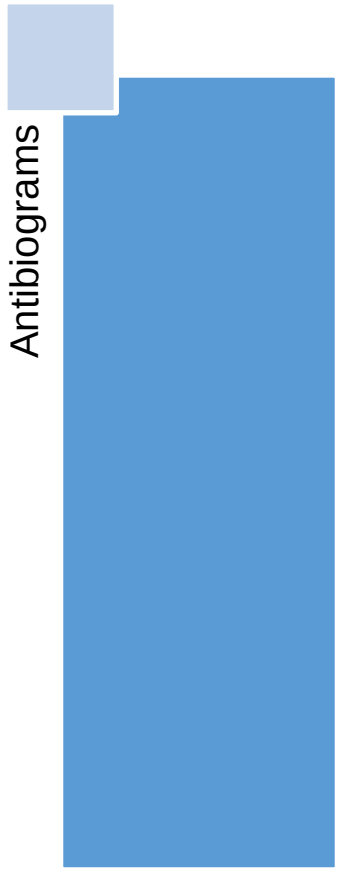
Data Epidemiology Report



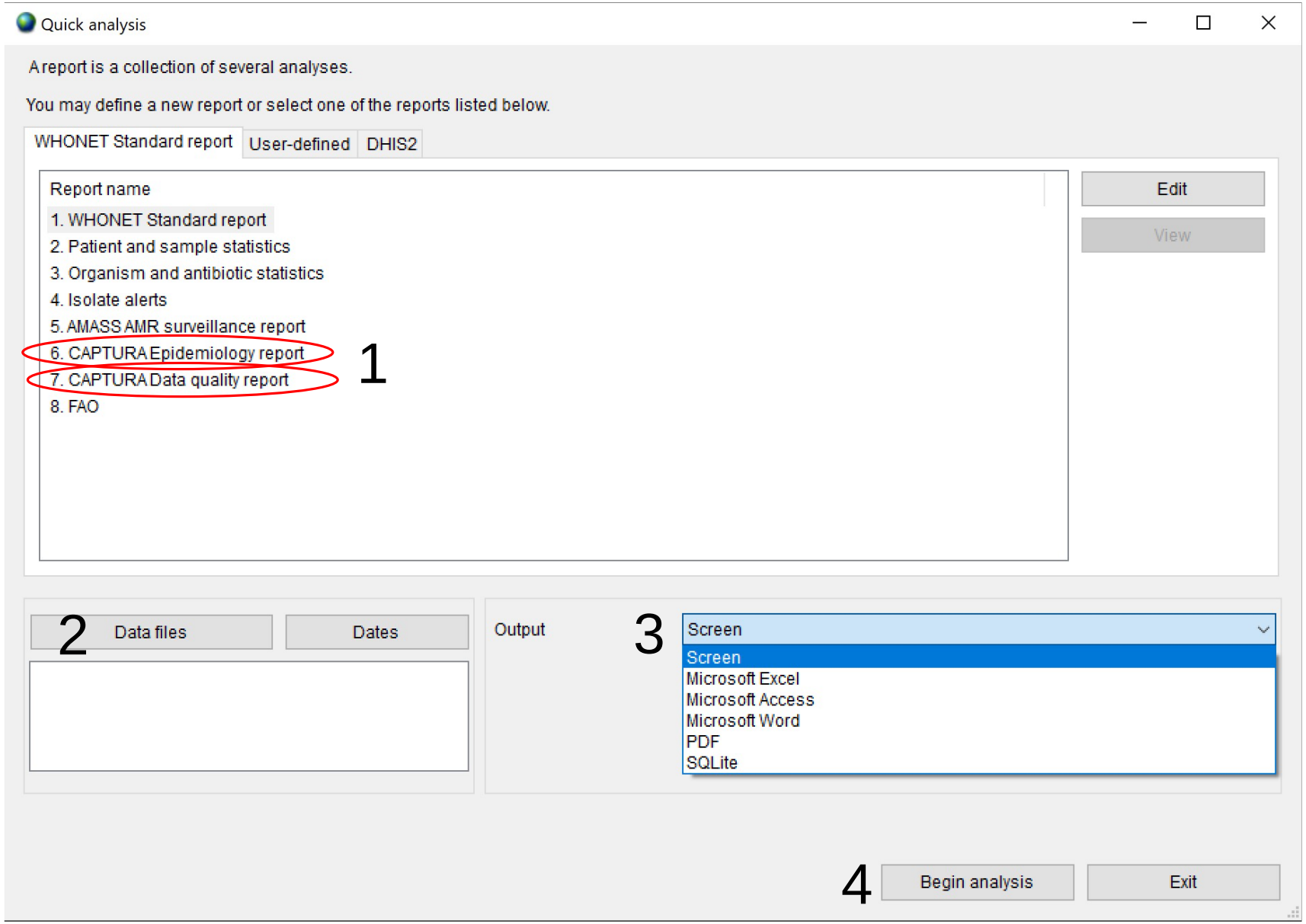








Reports


Quick analysis
A report is a collection of several analyses.
You may define a new report or select one of the reports listed below.
WHONET Standard report
User-defined
DHIS2
Report name
1. WHONET Standard report
2. Patient and sample statistics
3. Organism and antibiotic statistics
4. Isolate alerts
5. AMASS AMR surveillance report
6. CAPTURA Epidemiology report
7. CAPTURA Data quality report
8. FAO
1
Edit
View
2
Data files
Dates
Output
3
Screen
Screen
Microsoft Excel
Microsoft Access
Microsoft Word
PDF
SQLite
4
Begin analysis
Exit

Thanks