Using SDTM to Standardize and Store Antimicrobial Resistance Surveillance Data

Dr Yanina Borzykh, Data Manager, IDDO

Meet the Speaker

Dr Yanina Borzykh

Title: Data Manager

Organization: Infectious Diseases Data Observatory

Yanina is a Data Manager at IDDO, working on a wide diseases portfolio, with a primary focus on antimicrobial resistance projects.

She is also a clinician and public health professional by training, with experience in clinical medicine and health research. She holds an Doctor of Medicine qualification, as well as a double Master of Public Health. Her current professional interests include antimicrobial resistance, infectious diseases and global health.

Disclaimer and Disclosures

- *The views and opinions expressed in this presentation are those of the author(s) and do not necessarily reflect the official policy or position of CDISC.*

- *The author(s) have no real or apparent conflicts of interest to report.*

Agenda

1. Infectious Diseases Data Observatory (IDDO)
2. Antimicrobial resistance (AMR)
3. IDDO strategy and approach to AMR
4. Moving forward

Infectious Diseases Data Observatory

Infectious Diseases Data Observatory (IDDO)

- The Infectious Diseases Data Observatory (IDDO) is a scientifically independent, multi-disciplinary coalition of the global infectious disease and emerging infections communities. It provides the methods, governance and infrastructure to translate data into evidence that improves outcomes for patients worldwide.
- Promotes reuse of individual participant data (IPD): existing data is translated into new research questions
- Curates submitted data in-house, produces freely available harmonised datasets

IDDO

INFECTIOUS DISEASES DATA OBSERVATORY

Scan Me

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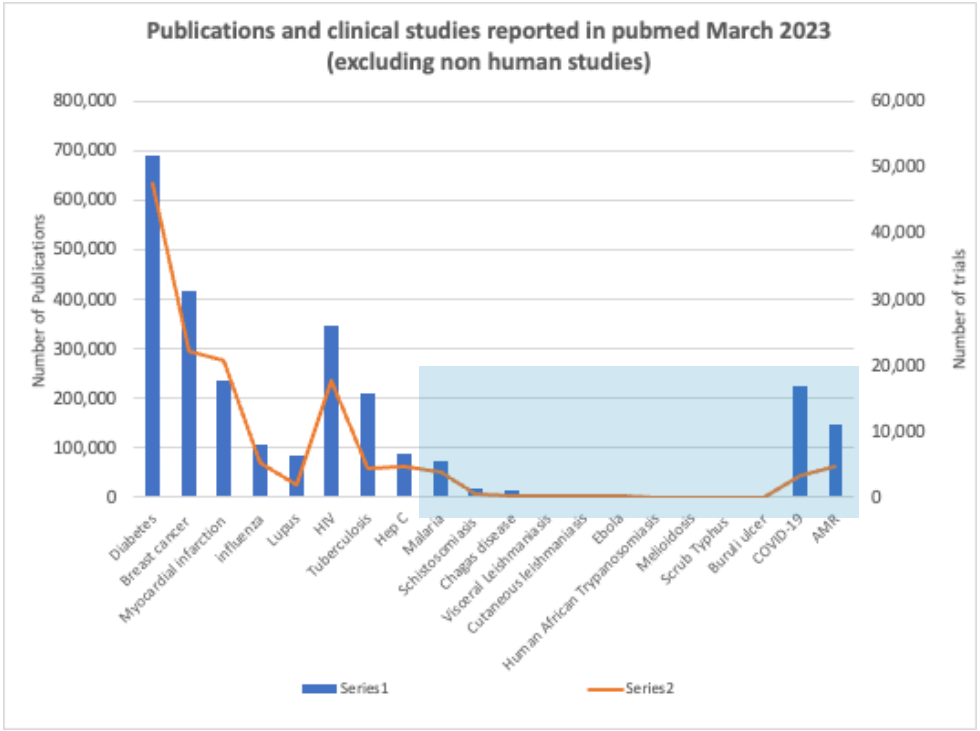
Infectious Diseases Data Observatory (IDDO)



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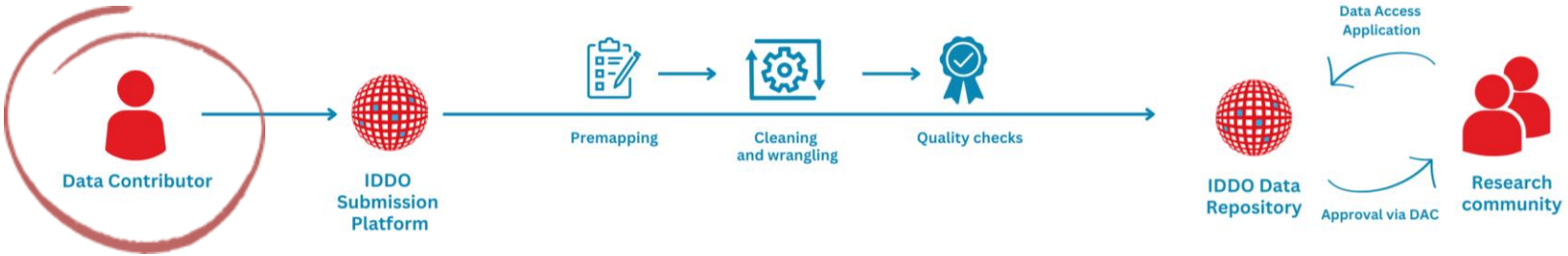

Infectious Diseases Data Observatory (IDDO)

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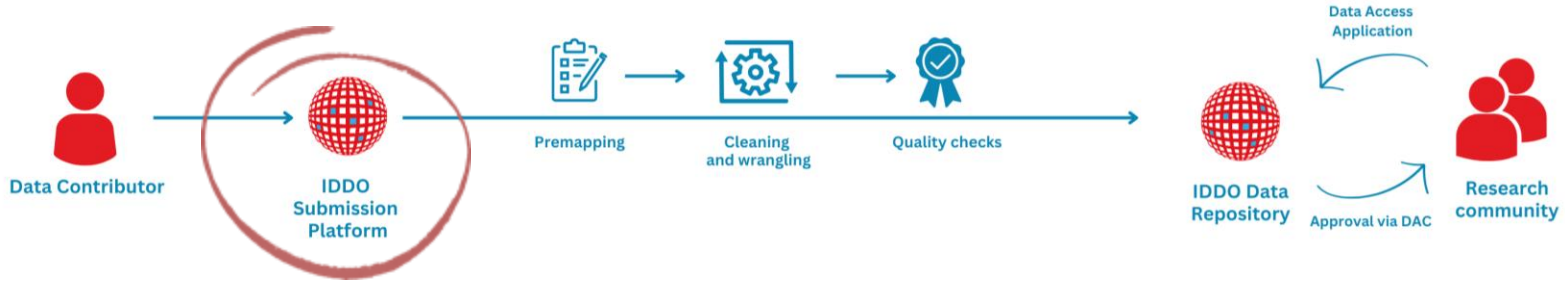

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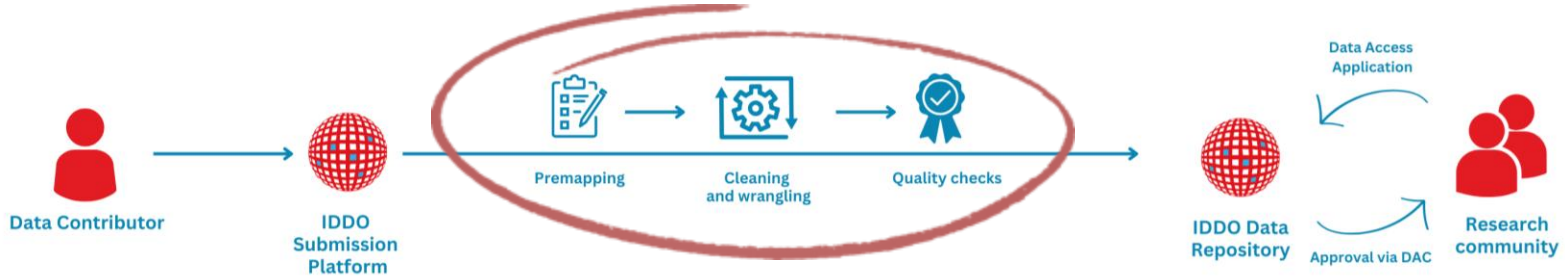

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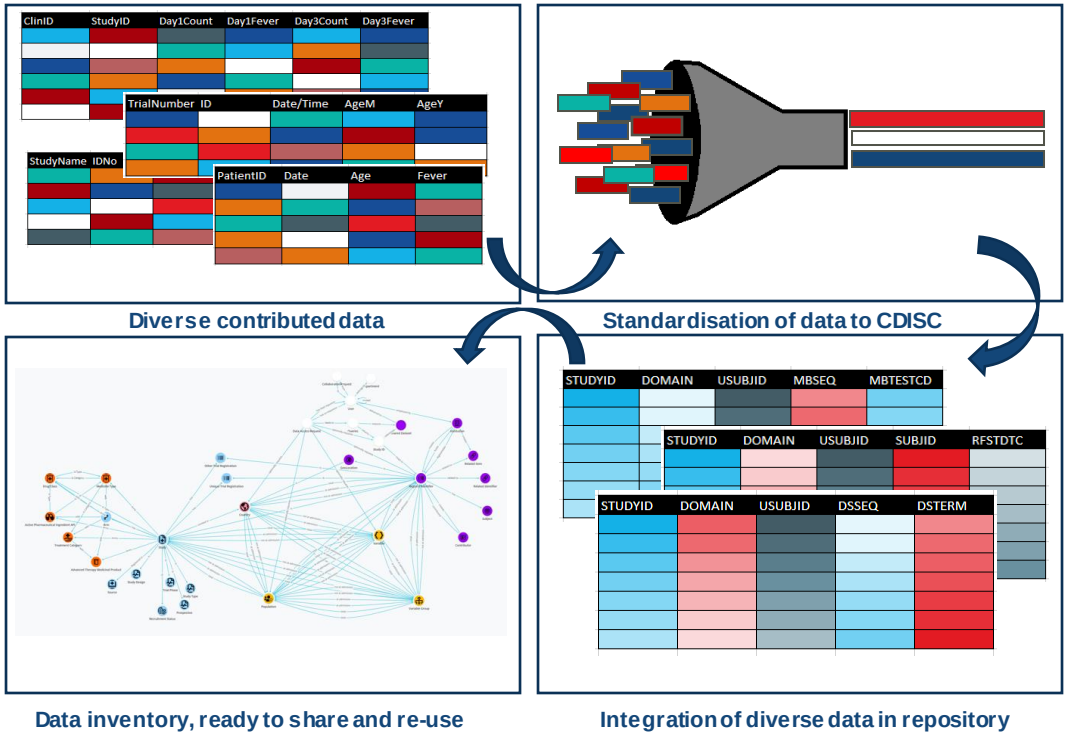

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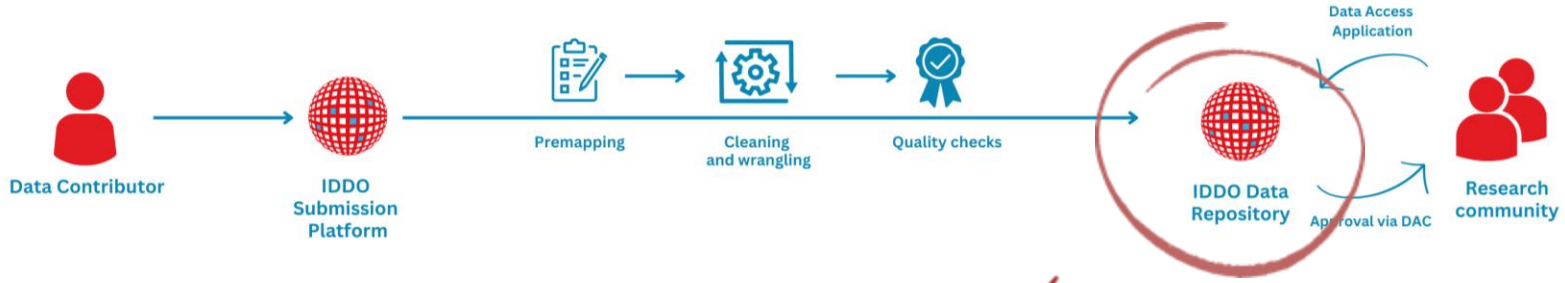

GO FAIR

GDPR

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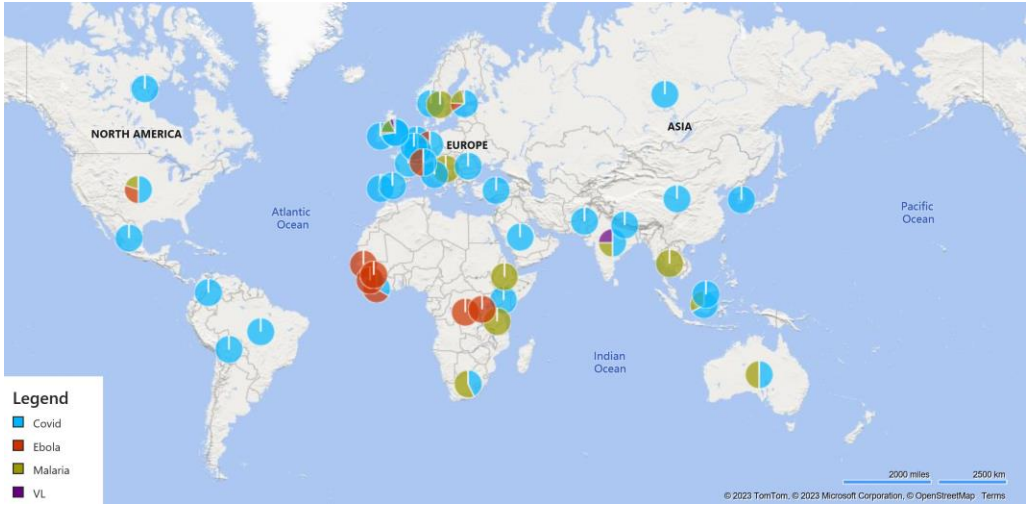
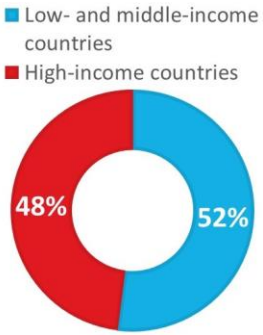
Infectious Diseases Data Observatory (IDDO)

Infectious Diseases Data Observatory (IDDO)





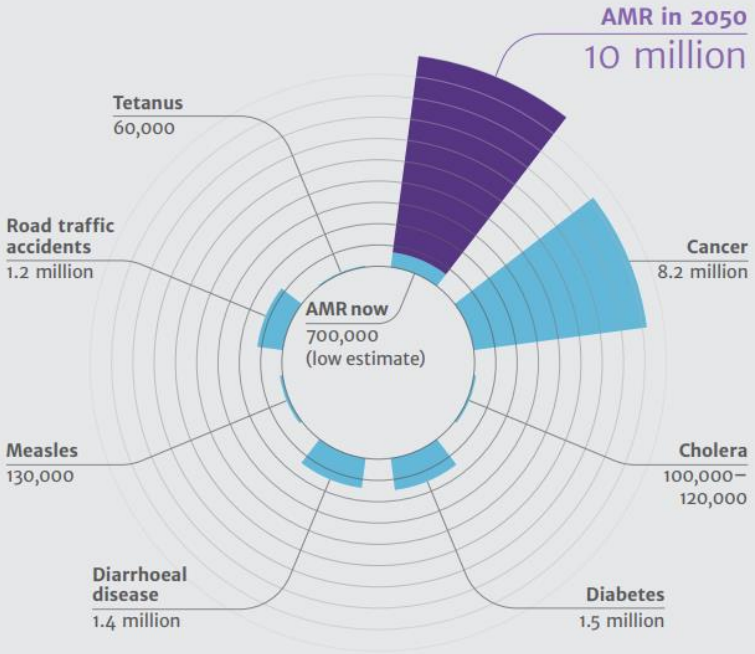
Proportion of data access including researchers from LMIC settings


WORLDWIDE ANTIMALARIAL RESISTANCE NETWORK
WWARN
COVID-19
VISCERAL LEISHMANIASIS
MEDICINE QUALITY
SCHISTOSOMIASIS
SOIL-TRANSMITTED HELMINTHIASES
EBOLA
CHAGAS
IDDO
INFECTIOUS DISEASES DATA OBSERVATORY
ANTIMICROBIAL RESISTANCE
SCRUB TYPHUS
MELIOIDOSIS
LYMPHATIC FILARIASIS
NOMA
MYCETOMA
TRACHOMA
HIV
Research themes: active building scoping
Learn more: iddo.org info@iddo.org @IDDOnews

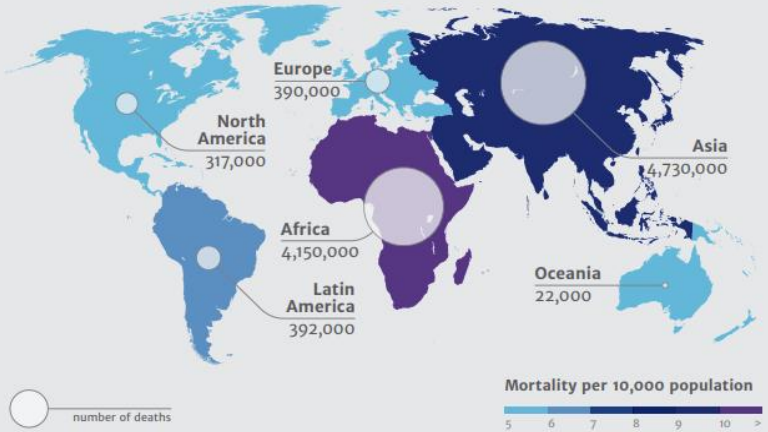
Antimicrobial resistance (AMR)

And why is it important?

Deaths attributable to AMR every year compared to other major causes of death



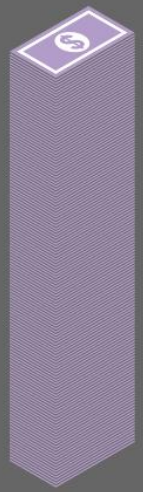
Deaths attributable to AMR every year by 2050



O'Neill J Tackling drug-resistant infections globally: final report and recommendations. Review on Antimicrobial Resistance, London,2016

Less than 5%

of venture capital investment in pharmaceutical R&D between 2003 and 2013 was for antimicrobial development.



Total venture capital investment

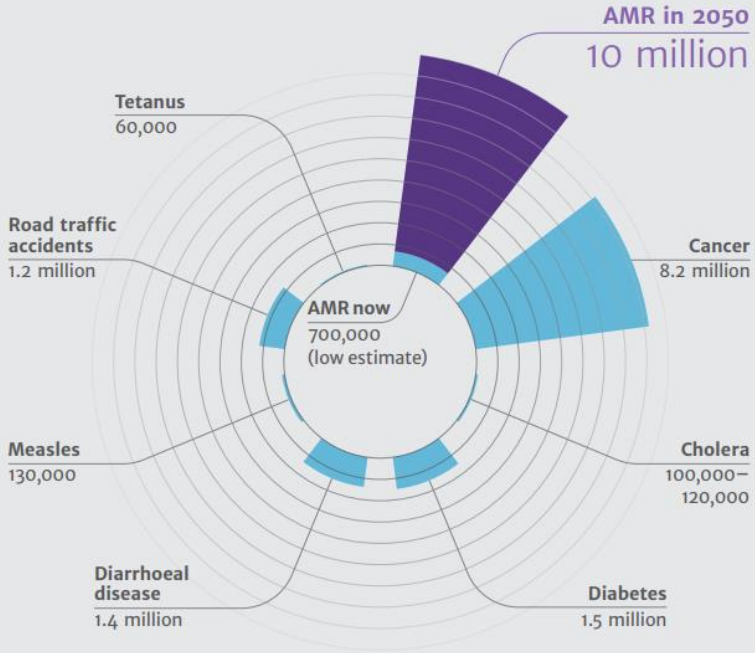
$38bn

Antimicrobial venture capital investment

$1.8bn

Deaths attributable to AMR every year

compared to other major causes of death



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WHO Global Action Plan, 2015

Objective 1: Improve awareness and understanding of antimicrobial resistance through effective communication, education and training

Objective 2: Strengthen the knowledge and evidence base through surveillance and research

Objective 3: Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures

Objective 4: Optimize the use of antimicrobial medicines in human and animal health

Objective 5: Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions

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WHO Global Action Plan - national responses

Measuring the global response to antimicrobial resistance, 2020–21: a systematic governance analysis of 114 countries

Jay Patel, Anne Harant, Genevie Fernandes, Ambele Judith Mwamelo, Wolfgang Hein, Denise Dekker, Devi Sridhar

Lancet Infect Dis 2023; 23: 706–18

Published Online January 16, 2023 https://doi.org/10.1016/S1473-3099(22)00796-4

See Comment page 640

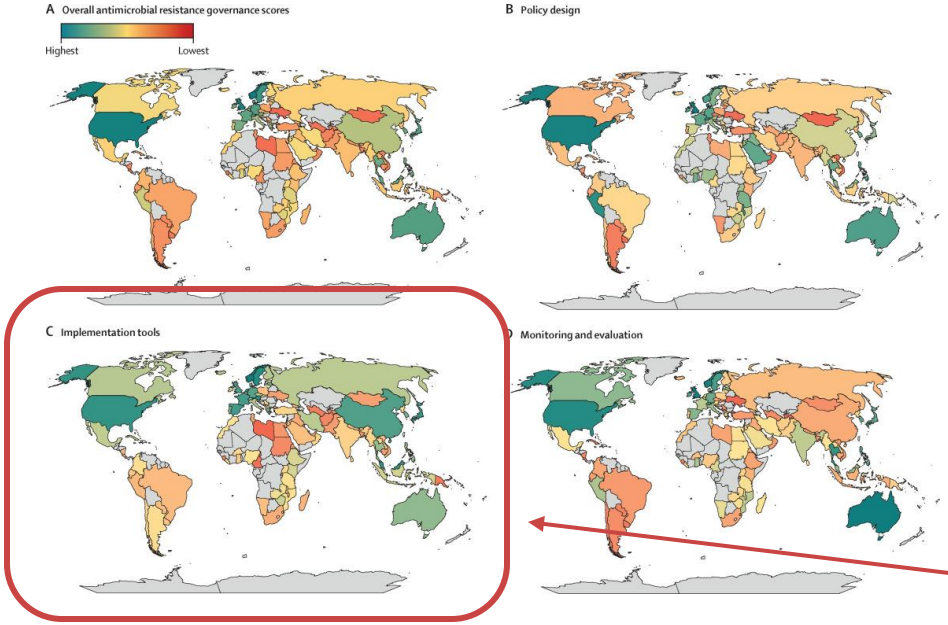
Global Health Governance Programme, Usher Institute, University of Edinburgh, Edinburgh, UK (J Patel, G Fernandes PhD, A J Mwamelo MPH, Prof D Sridhar PhD); **School of Dentistry, Faculty of Medicine and Health, University of Leeds, Leeds, UK** (J Patel); **German Institute of Global and Area Studies, Hamburg, Germany** (A Harant PhD, Prof W Hein PhD); **Faculty of Business, Economics and Social Sciences, University of Hamburg, Hamburg, Germany** (A Harant); **Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany** (D Dekker PhD)

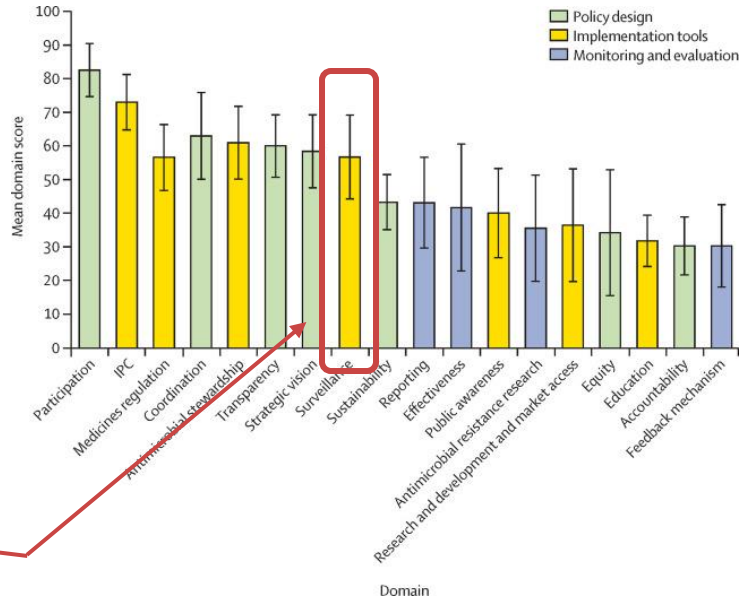
Summary

Background Understanding strategic commitments and policy responses to overcome antimicrobial resistance at the national, regional, and global levels is required to evaluate current progress and direct future planning. National action plans (NAPs) are the primary mechanism for guiding national strategy and action for antimicrobial resistance governance. Although several NAPs have been developed, no comprehensive content analysis of these plans exists. Using a governance framework, we aimed to assess all publicly available NAPs on antimicrobial resistance.

Methods We systematically reviewed the contents of NAPs on antimicrobial resistance from 114 countries, applying a governance framework containing 18 domains and 54 indicators in three integral areas: policy design, implementation tools, and monitoring and evaluation. As well as manually searching NAPs and doing online and literature searches that were relevant to specific indicators from repository inception to June 1, 2022, several data sources were used to generate scores, including the Tripartite Antimicrobial Resistance Country Self-Assessment Survey, the Global Antimicrobial Resistance and Use Surveillance System, the Global Antimicrobial Resistance Research and Development Hub, and various WHO datasets. NAPs were included if the country had also submitted the NAP to the Tripartite Antimicrobial Resistance Country Self-Assessment Survey 2020–21, if the NAP was retrievable through a publicly accessible database or website, and if the NAP was either published in English or eligible for machine translation. Three researchers independently reviewed each NAP and were initially blinded to the evaluations of other researchers. They generated a score using a quantification system for each of 54 indicators. The Cochrane protocol for ensuring reliability was followed. The three researchers were then unblinded and met to resolve any disagreements in scoring to reach a consensus agreement. In each case of discrepancy, consensus was reached between the researchers. We developed criteria to standardise the process of quantifying each indicator. We also weighted and collated relevant national data from various sources to generate composite scores concordant with the key governance areas. We transformed these data to a scale of 0 (worst) to 100 (best), ranked countries on the basis of their mean scores, and used descriptive statistics to analyse global and regional trends.

WHO Global Action Plan - national responses





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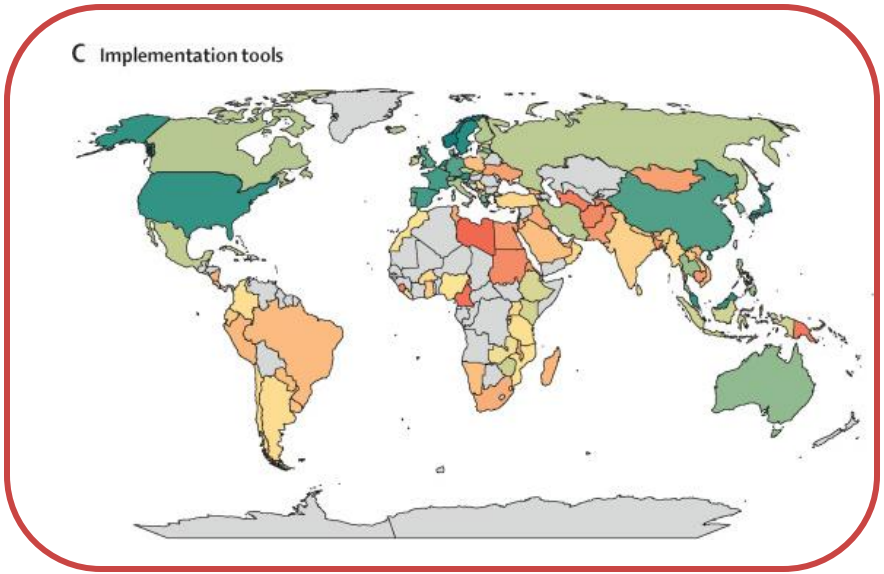

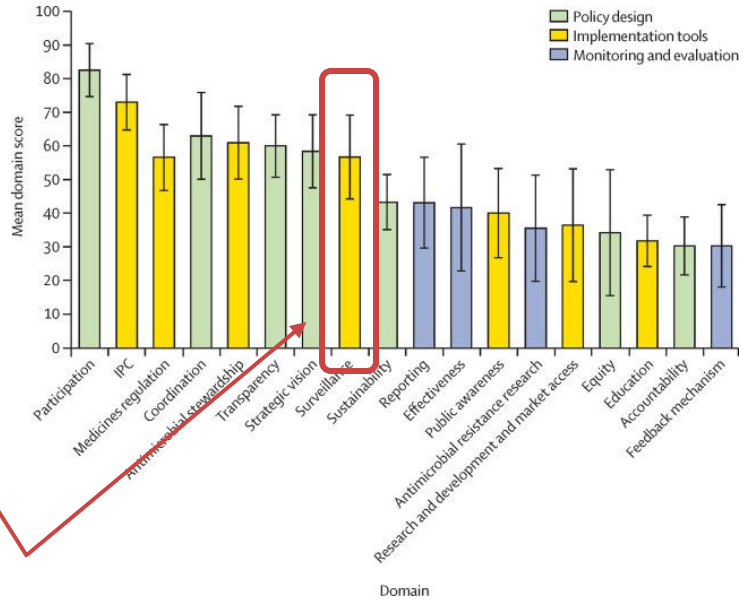

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IDDO strategy and approach to AMR

IDDO AMR strategy

- Resources
- AMR Knowledge Hub
- Project resources
- Reporting and changes to ongoing grants
- What is AMR?
- Documents library
- Media library

AntibioticDB is a open-access database of antibacterial compounds that indicates the stage of development of each agent, including discontinued agents, drugs under pre-clinical development, those in clinical trials. This database includes over 1000 compounds which are currently in pre-clinical development, in phases 1-3 of clinical trials, in phase 4 of clinical development either awaiting approval, or recently approved or if the compound has been discontinued. This dfatabase intends to serve as reference or as starting points for future research and re-development.

Platform
AntibioticDB

Focus
Antimicrobial R&D Encyclopedia

Description
A resource section that define many terms across the antimicrobial R&D field.

Platform
Antimicrobial Encyclopedia

Focus
Antibiotic discovery and development

Description
antiSMASH (analysis of secondary metabolic biosynthetic gene clusters) allows the rapid genome-wide identification, annotation and analysis of secondary metabolite biosynthesis gene clusters in bacterial and fungal genomes. It integrates and cross-links with a large number of in silico secondary metabolite analysis tools that have been published earlier.

Platform
antiSMASH

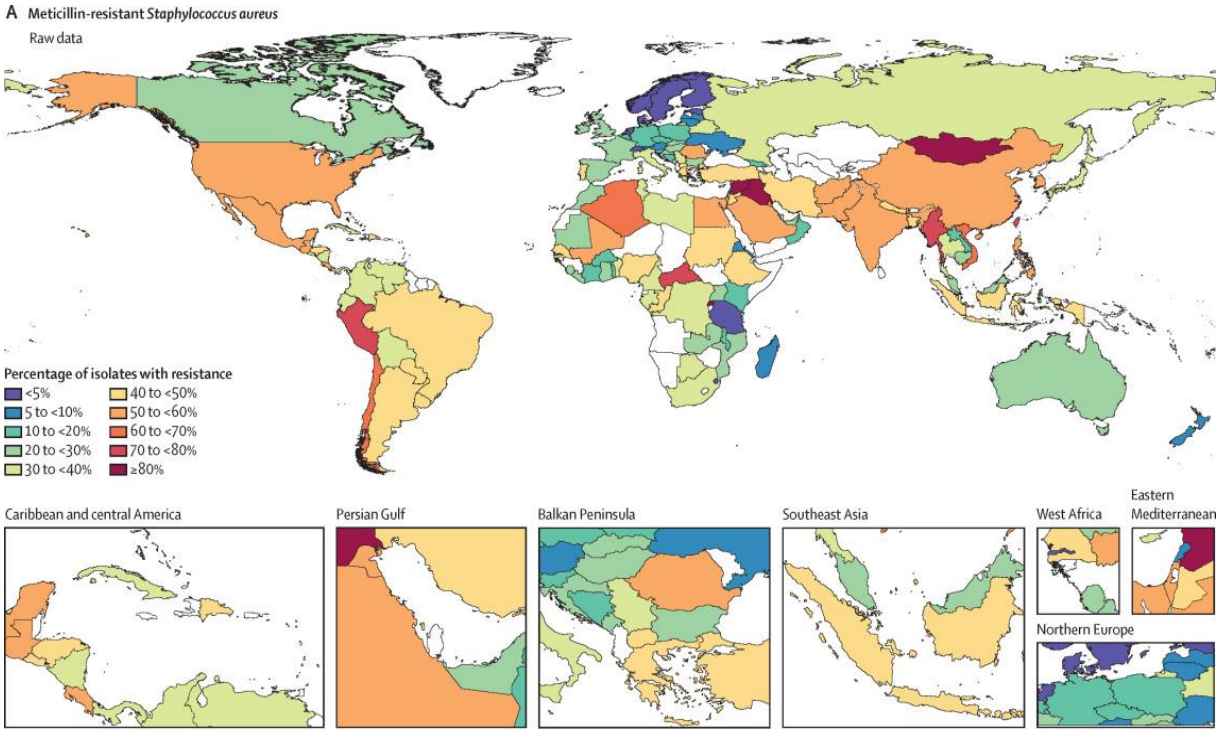
Focus
Antibiotic discovery and development

Description
Antibiotic Resistant Target Seeker (ARTS 2.0) is a tool to automate the process of performing target direct genome mining, search for potential novel antibiotic targets, and prioritize putative secondary metabolite gene clusters. The tool provides the opportunity to explore secondary metabolite gene clusters and uncover new resistant targets; screen secondary metabolite gene

Platform
ARTS 2.0

https://www.jpiamr.eu/resources/amr-knowledge-hub/amr-data-platforms/

Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis



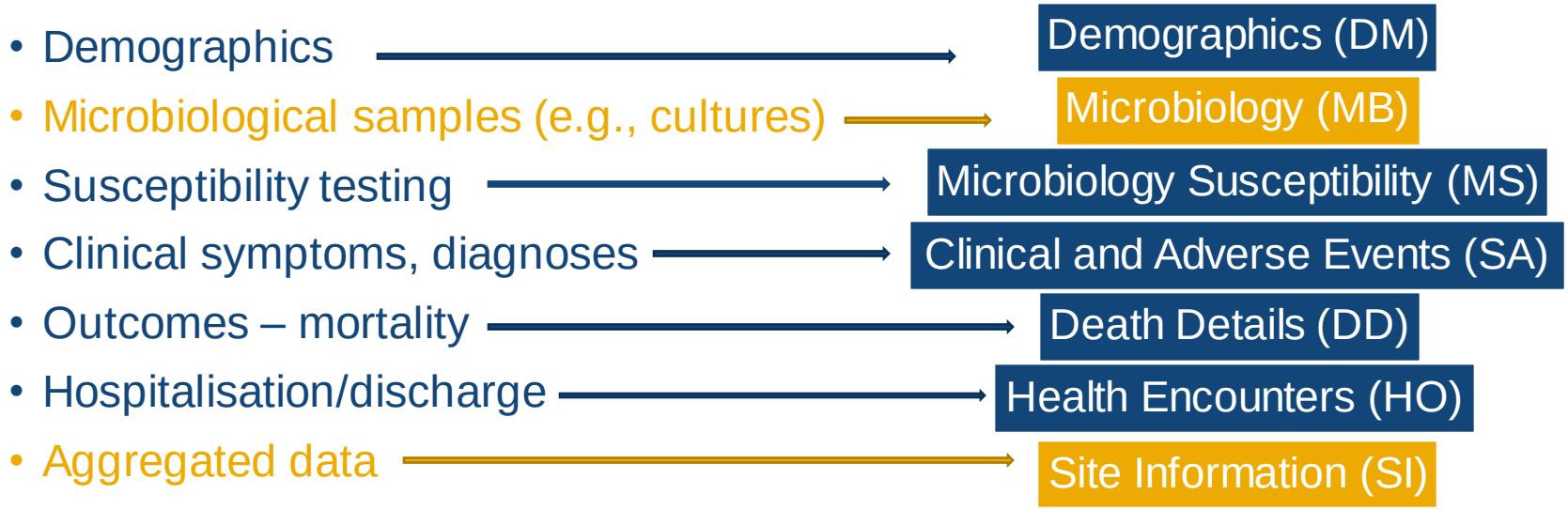
GRAM study, Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis, Lancet 2019

Need for a large, harmonized **clinical** AMR data repository

Types of AMR data

- Demographics → Demographics (DM)
- Microbiological samples (e.g., cultures) → Microbiology (MB)
- Susceptibility testing → Microbiology Susceptibility (MS)
- Clinical symptoms, diagnoses → Clinical and Adverse Events (SA)
- Outcomes – mortality → Death Details (DD)
- Outcomes – discharge → Health Encounters (HO)
- Aggregated data → Site Information (SI)

Types of AMR data



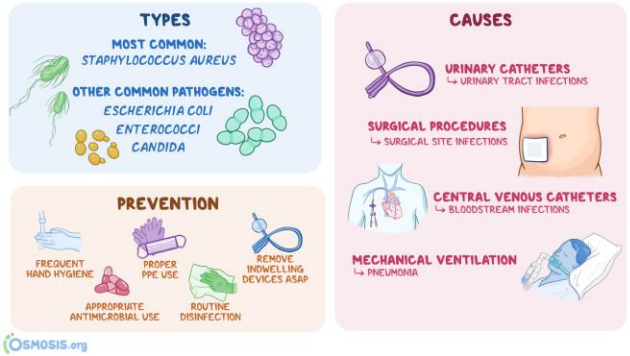
MB domain

STUDYID	DOMAIN	USUBJID	MBSEQ	MBTESTCD	MBTEST	MBTSTDTL	MBORRES	MBSTRESC	MBDTC
AMR1	MB	AMR1_AUT_63	1	MCORGIDN	Microbial Organism Identification	IDENTIFICATION	Escherichia coli	ESCHERICHIA COLI	2009-03-25
AMR1	MB	AMR1_FRA_56	1	MCORGIDN	Microbial Organism Identification	IDENTIFICATION	Pseudomonas aeruginosa	PSEUDOMONAS AERUGINOSA	2017-04-03

Types of infection:

1. Community-acquired (CAI)
2. Hospital acquired (HAI)

Often multi-drug resistant (MDR) infections



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?

STUDYID	DOMAIN	USUBJID	MBSEQ	MBTESTCD	MBTEST	MBTSTDTL	MBORRES	MBSTRESC	MBINFCAT	MBDTC
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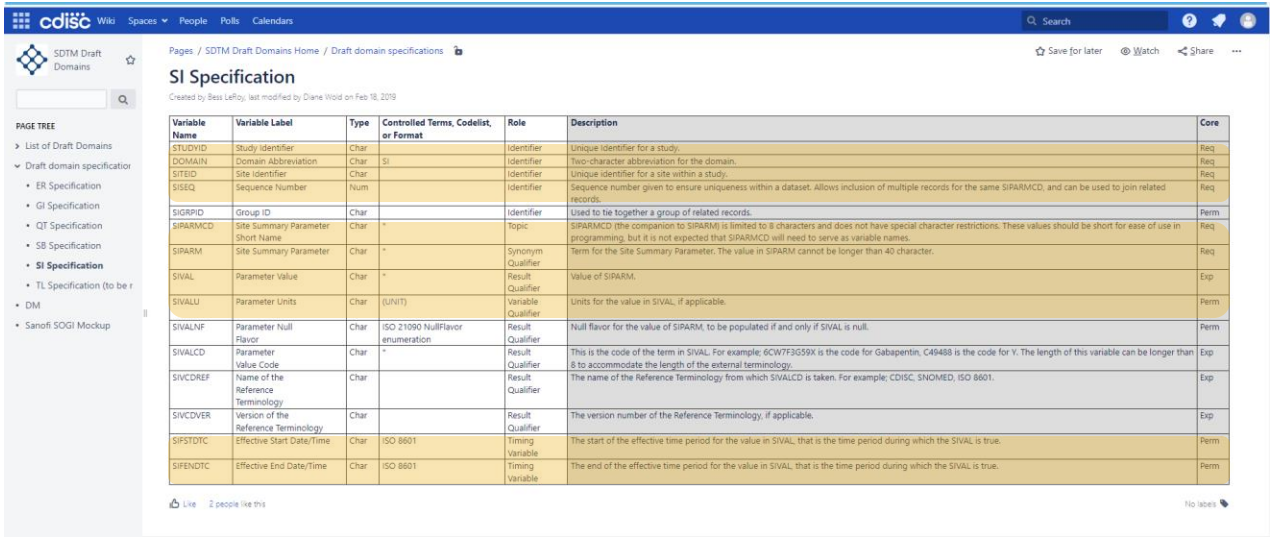
SI domain

- Why add a new domain?
  - Aggregated surveillance reports
  - Healthcare facility specifications need to be considered



Variable Name	Variable Label	Type	Controlled Terms, Codelist, or Format	Role	Description	Core
STUDYID	Study Identifier	Char		Identifier	Unique identifier for a study.	Req
DOMAIN	Domain Abbreviation	Char	SI	Identifier	Two-character abbreviation for the domain.	Req
SITEID	Site Identifier	Char		Identifier	Unique identifier for a site within a study.	Req
SISEQ	Sequence Number	Num		Identifier	Sequence number given to ensure uniqueness within a dataset. Allows inclusion of multiple records for the same SIPARMCD, and can be used to join related records.	Req
SIGRPID	Group ID	Char		Identifier	Used to tie together a group of related records.	Perm
SIPARMCD	Site Summary Parameter Short Name	Char	*	Topic	SIPARMCD (the companion to SIPARM) is limited to 8 characters and does not have special character restrictions. These values should be short for ease of use in programming, but it is not expected that SIPARMCD will need to serve as variable names.	Req
SIPARM	Site Summary Parameter	Char	*	Synonym Qualifier	Term for the Site Summary Parameter. The value in SIPARM cannot be longer than 40 character.	Req
SIVAL	Parameter Value	Char	*	Result Qualifier	Value of SIPARM.	Exp
SIVALU	Parameter Units	Char	(UNIT)	Variable Qualifier	Units for the value in SIVAL, if applicable.	Perm
SIVALNF	Parameter Null Flavor	Char	ISO 21090 NullFlavor enumeration	Result Qualifier	Null flavor for the value of SIPARM, to be populated if and only if SIVAL is null.	Perm
SIVALCD	Parameter Value Code	Char	*	Result Qualifier	This is the code of the term in SIVAL. For example: 6CW7F3G59X is the code for Gabapentin, C49488 is the code for Y. The length of this variable can be longer than 8 to accommodate the length of the external terminology.	Exp
SIVCDREF	Name of the Reference Terminology	Char		Result Qualifier	The name of the Reference Terminology from which SIVALCD is taken. For example: CDISC, SNOMED, ISO 8601.	Exp
SIVCDVER	Version of the Reference Terminology	Char		Result Qualifier	The version number of the Reference Terminology, if applicable.	Exp
SIFSTDTC	Effective Start Date/Time	Char	ISO 8601	Timing Variable	The start of the effective time period for the value in SIVAL, that is the time period during which the SIVAL is true.	Perm
SIFENDTC	Effective End Date/Time	Char	ISO 8601	Timing Variable	The end of the effective time period for the value in SIVAL, that is the time period during which the SIVAL is true.	Perm

https://wiki.cdisc.org/display/SDD/SI+Specification

SI domain - example

DOMAIN	SITEID	SISEQ	SIGRPID	SIPARMCD	SIPARM	SIVAL	SIVALU	SISTDTC	SIENDTC
SI	AUT	1		HOTYP	Healthcare Facility Type	Community		2017	2017
SI	AUT	2	AMOXICILLIN	AGTRTUSG	Aggregated Treatment Usage	1655937.99	DDD	2017	2017
SI	AUT	3	AMOXICILLIN	AGTRTUSG	Aggregated Treatment Usage	169220	Packages	2017	2017
SI	AUT	4	AMOXICILLIN	ABTRT	Antibiotic Treatment	AMOXICILLIN		2017	2017
SI	AUT	5	AMOXICILLIN	TRTROUTE	Treatment route	Oral		2017	2017

Created based on the data needs

Why submit data for reuse?

- Advantages of data reuse via IDDO:
  - Sustainability;
  - Secondary data analysis;
  - Equitable and fair access to data;
  - Identifying gaps;
  - Inclusion of the populations underrepresented in research;
  - Facilitates further large-scale analysis;

Moving forward

Plans and moving forward

- Building data availability dashboards
- Providing data summaries
- Pooling data together for further analysis
- Developing SI domain parameters dictionary
- Developing analysis datasets

Plans and moving forward

- Building data availability dashboards
- Providing data summaries
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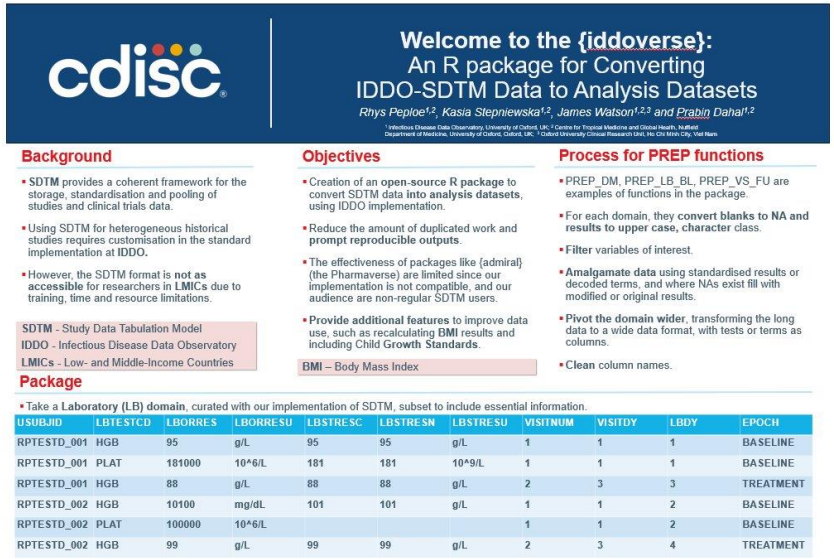
- Developing SI domain parameters dictionary
- **Developing analysis datasets**



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Welcome to the {iddoverse}:
An R package for Converting
IDDO-SDTM Data to Analysis Datasets

Rhys Peploe[1,2], Kasia Stepniewska[1,2], James Watson[1,2,3] and Prabin Dahal[1,2]

[1] Infectious Disease Data Observatory, University of Oxford, UK; [2] Centre for Tropical Medicine and Global Health, Nuffield Department of Medicine, University of Oxford, Oxford, UK; [3] Oxford University Clinical Research Unit, Ho Chi Minh City, Viet Nam

Background

- **SDTM** provides a coherent framework for the storage, standardisation and pooling of studies and clinical trials data.
- Using SDTM for heterogeneous historical studies requires customisation in the standard implementation at **IDDO.**
- However, the SDTM format is **not as accessible** for researchers in **LMICs** due to training, time and resource limitations.

SDTM - Study Data Tabulation Model
IDDO - Infectious Disease Data Observatory
LMICs - Low- and Middle-Income Countries

Objectives

- Creation of an **open-source R package** to convert SDTM data **into analysis datasets**, using IDDO implementation.
- Reduce the amount of duplicated work and **prompt reproducible outputs**.
- The effectiveness of packages like {admiral} (the Pharmaverse) are limited since our implementation is not compatible, and our audience are non-regular SDTM users.
- **Provide additional features** to improve data use, such as recalculating **BMI** results and including Child **Growth Standards**.

BMI – Body Mass Index

Process for PREP functions

- PREP_DM, PREP_LB_BL, PREP_VS_FU are examples of functions in the package.
- For each domain, they **convert blanks to NA and results to upper case, character** class.
- **Filter** variables of interest.
- **Amalgamate data** using standardised results or decoded terms, and where NAs exist fill with modified or original results.
- **Pivot the domain wider**, transforming the long data to a wide data format, with tests or terms as columns.
- **Clean** column names.

Package

- Take a **Laboratory (LB) domain**, curated with our implementation of SDTM, subset to include essential information.

USUBJID	LBTESTCD	LBORRES	LBORRESU	LBSTRESC	LBSTRESN	LBSTRESU	VISITNUM	VISITDY	LBDY	EPOCH
RPTESTD_001	HGB	95	g/L	95	95	g/L	1	1	1	BASELINE
RPTESTD_001	PLAT	181000	10^6/L	181	181	10^9/L	1	1	1	BASELINE
RPTESTD_001	HGB	88	g/L	88	88	g/L	2	3	3	TREATMENT
RPTESTD_002	HGB	10100	mg/dL	101	101	g/L	1	1	2	BASELINE
RPTESTD_002	PLAT	100000	10^6/L				1	1	2	BASELINE
RPTESTD_002	HGB	99	g/L	99	99	g/L	2	3	4	TREATMENT

Please visit IDDO poster, presented by Rhys Peploe, IDDO statistician

Thank You!


IDDO
INFECTIOUS DISEASES DATA OBSERVATORY


GRAM
Global Research on Antimicrobial Resistance


UNIVERSITY OF
OXFORD


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