Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

1 SUPPLEMENTARY MATERIALS

2
3 *Table S1: Characteristics and descriptions of 27 EIS in further detail*

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description		Sector/s involved	Population sources[c,d]
			EIS identified through database search (PubMed, Web of Science and Google Scholar):				
Bacterium Analysis Pipeline (BAP) [1]	Not specific	2016	Operational	-	Predicts and determines the pathogen present from contigs in whole genome sequencing data.	Human and animal	Not specific (inferred as Hospital and community data, and veterinary clinical data)
District Health Information System (DHIS-2) platform [2]	Uganda, LIC	2013 demo, 2014 launch	Operational	-	Develops real-time reports to an existing surveillance system, including causes of illness by collecting further data	Human	Hospital data
ResistanceOpen [3]	Not specific	2016*	Operational	-	A platform for aggregating, analysing, and disseminating regional AMR information.	Human	Hospital and community data
A clinically-oriented Antimicrobial Resistance Surveillance Network (ACORN) [4]	Southeast Asia (Cambodia, Lao and Vietnam), LMIC	2019	Piloted	-	Information system to strengthen routine clinical care in hospitals in LMIC settings	Human	Hospital data

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description	Sector/s involved	Population sources[c,d]
AutoMated tool for Antimicrobial resistance Surveillance System(AMASS)[5]	Southeast Asia (Cambodia, Lao, Myanmar, Nepal, Thailand, Vietnam), LMIC and UK, HIC	2019*	Operational	- An offline system to analyse routinely integrated electronic data independently - Rapidly generates surveillance reports on AMR	Human	Hospital data
Antimicrobial resistance surveillance system (i-AMRSS)[6]	India, LMIC	2017*	Operational	- A tool used for the analysis and management of AMR data	Human	Hospital and community data
HOTspots[7]	Australia, HIC	2020*	Under construction	- A geospatial platform that visualises susceptibility patterns and temporal trends of antimicrobials	Human	Hospital and community data
Infectious Diseases Surveillance Information System for Antimicrobial Resistance (ISIS-AR)[8]	Netherlands, HIC	2008	Operational	- Monitors trends and extent of AMR as well as outbreaks	Human	Hospital and community data
HAITool[9]	Portugal, HIC	2018*	Operational	- A real-time decision-support system to support antibiotic surveillance stewardship program - Implementation by monitoring AMR and prescriptions	Human	Hospital data

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description	Sector/s involved	Population sources[c,d]
WHONET-SaTScan[10]	Italy, HIC	2016*	Piloted	- The first use of WHONET and SaTScan in Italy to monitor AMR in hospital settings - Compared to the current surveillance system in place within one hospital with data collected between 2012-2014.	Human	Hospital data
WHONET-SaTSCan (#2) [11]	United states of America, HIC	2002-2006	Operational	- WHONET-SaTScan software was used in the Brigham & Woman's Hospital (Boston), to compare the data between 2002-2006 with the current outbreak detection program	Human	Hospital and community data
WHONET-SaTSCan (#3) [12]	Argentina, MIC	(2005-2007)	Piloted	- WHONET-ScTSCan software in Argentina was deployed and assessed using data from 2005-2007 to detect outbreaks of AMR *Shigella*	Human	Hospital and community data
Antibiotic consumption surveillance (ACS) of the watch-and reserve-group antibiotics[13]	Germany, HIC	2018*	Operational	- Antibiotic consumption surveillance (ACS) of the watch-and reserve-group antibiotics	Human	Hospital data
MEGARes[14]	Not specific	2016*	Operational	- Database and annotation structure for high throughput acyclical classifiers and hierarchical statistical analysis of big data	Not specified but described in terms of public health relevance.	Metagenomic sequencing data

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description		Sector/s involved	Population sources[c,d]
BR-GLASS[15]	Brazil, MIC	2018	Operational	-	AMR tool for submitting, integrating clinical and microbiological data from reporting sentinels	Human	Hospital data
Multidrug-resistant organism (MDRO) surveillance system[16]	Taiwan, HIC	2010	Operational	-	Web-based system for automatic integration, anaylsis and interpretation of antimicrobial susceptibility and facilitates outbreak detection	Human	Hospital data
Bacterial real-time Laboratory-based Surveillance System (BALYSES)[17]	France, HIC	2013	Operational	-	Surveys the weekly number of patients infected with bacterial species, permits alarms if abnormal increase is detected. It automatically classifies species in order of abundancy and calculates their weekly rank	Human	Hospital data
Marseille Antibiotic Resistance Surveillance System (MARSS)[17]	France, HIC	2013	Operational	-	Automatically compares weekly resistance isolates. Emits alarms when a threshold is detected for key phenotypes to allow for rapid identification and verification	Human	Hospital data
New York Antimicrobial Resistance Project (NYARP)[18]	United states of America, HIC	2000-2002	Piloted	-	Electronically monitors trends in bloodstream infections for AMR.	Human	Hospital data

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description	Sector/s involved	Population sources[c,d]
EIS identified through grey literature search:					
WHONET [19]	Global: currently in 130 countries	1989	Operational	- Database software for the analysis and management of microbiology laboratory data - Assists in monitoring and sharing of antimicrobial susceptibility data at various levels.	Human and animal	Hospital and community data, veterinary clinical data.
Critical Antimicrobial Resistance Alert (CARAlert) [20]	Australia, HIC	2016	Operational	- A system that alerts and notifies clinicians of potential critical antimicrobial resistances (CARs) requiring response at the local and jurisdictional levels.	Human	Hospital and community data
Australian Passive Antimicrobial resistance Surveillance (APAS) [21]	Australia, HIC	2015	Operational	- Integrates, analyses, and reports on AMR data contributed by public and private pathology services	Human	Hospital and community data
Fingertips [22]	United Kingdom, HIC	2016	Operational	- AMR local indicators to support the development of local action plans to optimise antibiotic prescribing and reduce AMR and healthcare-associated infections.	Human	Hospital and community data
'NARMS Now: Human data' and 'NARMS Now: Integrated data'. [23]	United States of America, HIC	2015	Operational	- **NARMS Now: Human Data** is an interactive tool that contains AMR data from humans to create an accessible platform to identify AMR occurrences.	Human, animal	Hospital data for humans, Animal slaughter tests, and retail meats for animals

Name of electronic information system	Country setting and economic status[b]	System start date[a]	Phase of Development	Systems description	Sector/s involved	Population sources[c,d]
				- **NARMS Now: Integrated data** contain AMR data on food animals at slaughter and retail meats. - Both NARMS Now sites include interactive graphs, maps, tables, and downloadable data.		
AMRmap [24]	Russia, HIC	2018	Operational	- Web platform for analysing and visualisation of AMR data that integrates information from microbiological surveillance program in Russia	Human	Hospital and community data
'INFECT' and 'INFECT VET' [25]	Switzerland, HIC	2018 (humans), 2020 (animals)	Operational	- Interactive web application to provide rapid access to the latest AMR data for clinically important pathogens - Enable data to be tailored to the local resistance epidemiology and the patients' setting - Assist health professionals with empirical treatment choices by integrating validated antimicrobial treatment guidelines from external sources	Human, Animal	Hospital and community data for humans, and veterinary clinical data for animals
The Danish Microbiology Database (MiBa) [26,27]	Denmark, HIC	2010	Operational	- Nationwide database for microbiology to provide real-time surveillance - Provides nationwide access for healthcare personnel to microbiology reports.	Human	Hospital and community data

[a] *Where no start date was specified, year of publication was used.*

[b] *LIC, low-income country; LMIC, low- and middle-income country; MIC, middle-income country; HIC, high-income country*

[c] *Hospital data: AMR data collected from people who have been hospitalised.*

[d] *Community data: Data collected from people who are in the community, such as samples taken or requested by general practitioners, or from outpatients.*

4

Table S2: The expanded technical capabilities and design characteristics for each EIS

Electronic Information system[a]	Front end of the system		Back end of the system			
	Accessibility and usability	*information visualisation and interactivity*	*Database security*	*Database structures*	*Data storage*	*Other technical features*
Bacterium Analysis Pipeline (BAP) [1]	- Users create a profile - Data is uploaded using a metadata MS Excel spreadsheet using a developed template	- The printable report, excel spreadsheet - User profile: can access and re-analyse their data with an interactive profile	Data is only accessible to user accounts unless it is made publicly available.	- Front end of the system is developed by HTML5 and JavaScript - Database structure: MySQL database	- Center for Genomic Epidemiology (CGE) platform uses 1 web server and 2 computer servers (all run on Linux with openSUSE) - Data are backed up daily and recovered if needed	Uses ResFinder algorithm to identify acquired AMR genes
District Health Information System (DHIS-2) platform [2] ⇒ *Design info accessed from DHIS-2 website* [28]	- Users can set up data elements, entry forms, indicators, and reports and use in-built tools to analyse data or export it - Integrated messaging is available to communicate with other users - Data capture can be done on a variety of devices	- Interactive charts, graphs, tables, and geographic maps - creates personal dashboards to collect and display specific maps/graphs in one place.	- Selection of customisable security and privacy features, including user management and encryption - Users have control over access privileges per user and role, including	Not specified	Not specified	Not specified

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

	Front end of the system		Back end of the system			
			restricting certain users			
ResistanceOpen[3]	- A login feature allows users to upload indices for curators to review - A login feature allows user-orientated analytics (hospital-specific trends, community comparisons)	- The online interface is based around a navigable map, which can be expandable and contracted by the user - Users can perform multifunctional searches in the toolbar for quick and direct searching of bacteria or antimicrobial-specific visualisations	- Accessible over a secure connection, using the HTTPS protocol	- Uses standard programming languages, including JavaScript, HTML, CSS, PHP, and MYSQL - Compatible with both desktop and mobile devices.	- The web application is hosted in the cloud on an Amazon EC2instance database. It runs on an Amazon RDS.	The database uses online resistance indices generated from healthcare institutions/laboratories and regional, national, and international bodies
A clinically-oriented Antimicrobial Resistance Surveillance Network (ACORN)[4]	Not specified	- Qualitative data summarised in interactive tables and graphs - For data visualisation and analysis will be visualised using an R Shiny interactive dashboard	- Documents are stored securely and only accessible by surveillance staff and authorised personnel. - Personal data must not be kept as identifiable data for longer than necessary for the purposes concerned	Not specified	- Cloud based server	Not specified

	Front end of the system		Back end of the system			
AutoMated tool for Antimicrobial resistance Surveillance System(AMASS)[5]	- Users download AMASS package from the website and obtain raw data sets - Users then configure data dictionary files and then upload, and save data files in the AMASS application to review reports and share them around	Automatically generates reports on 6 various AMR surveillance sections	- The reports and anonymous summary data contain no patient identifiers, providing security	Not specified	- Local (computer) based server	Generates 2 log files; one for users to validate input data and one for consultation with R users, statisticians, or the development team
Antimicrobial resistance surveillance system (i-AMRSS)[6]	- Registered users can upload data that is validated by microbiologists	- Tables and graphs are generated once data is validated	Not specified	Not specified	Not specified	Not specified
HOTspots[7]	- Has a custom-built platform with Hypertext Preprocessor (PHP), HTML, JavaScript, and D3.js visualisation library for the front end - Users can use the multifunctional search toolbar for quick and direct searching of the year, organism, and antibiotic to visualise.	- Displays a digital geospatial map surveillance platform of uploaded data - Line plot	Not specified	Not specified	- Delivered on a Linux server and is accessible on any world web search engine	- The system uses Stata 15.1 for data management and descriptive statistics - Uses MySQL programming language
Infectious Diseases	Not specified	- Annual reports are generated on the	- Password protected		Not specified	Not specified

	Front end of the system		Back end of the system			
Surveillance Information System for Antimicrobial Resistance (ISIS-AR) [8]		consumption of antimicrobials and AMR - Resistance figures are provided upon request or can be obtained through interactive reports on the web interface	users only ones allowed to generate reports of their data - Datasets contain anonymised data on all isolates to protect all personal information - Thorough security management of the database is compliant with the baseline information security of the Dutch government			
HAITool [9]	- Healthcare workers can upload and integrate data of infections due to AMR - Used by physicians to check the antibiotic prescription	- Visualised colour-coordinated graphs - Contains an alerts module, decision-support system, and surveillance system	Not specified	Not specified	- SQL server	- Data is periodically extracted using Java programming language from existing information systems in hospitals which are then processed and

	Front end of the system		Back end of the system			
WHONET-SaTSCAN[10]	Not specified	- Generates reports with a hospital response	Not specified	Not specified	Not specified	aggregated in a single data warehouse - Uses WHONET BacLink software as a conversion tool for data entry - SaTScan software undergoes spatial, temporal, or space-time scan statistics
WHONET-SaTSCan (#2) [11]	Not specified	- Generates reports and includes an alert system	Not specific	Not specific	Not specific	Not specific
WHONET-SaTSCan (#3) [12]	Not specific	- Generates reports and real-time alerts	Not specific	Not specific	Not specific	Not specific
Antibiotic consumption surveillance (ACS) of the watch-and reserve-group antibiotics[13]	- Data must be submitted electronically in a standardised format - Reports are retrieved by users via an interactive database within 1 hour of upload - Users can specify and tailor reports according to their preferences	- Basic reports of trend analysis - Ranking list - Report for comparing data for different organisations/units in the hospital - Report for comparing data for the individual hospital and aggregated data for reference hospitals	- Users have password-protected accounts	Not specified	Not specified	- Uses an existing web-based data portal (webKess)
MEGARes[14]	- Users can input keywords and receive corresponding matches	- Analyses large datasets in a website - Can be integrated into a sequence analysis pipeline through download	Not specified	Not specified	- MySQL server stores the sequence and annotation tables -	- The database schema is updated through Python scripts - Uses Docker platform for installation of pipeline

	Front end of the system		Back end of the system			
BR-GLASS[15]	- Hospitals submit data to the system	- Visual representations of data in the forms of interactive charts and tables	Not specified	Not specified	Not specified	Not specified
WHONET [19]	- User log in - Data entry - Data editing - Query tabular and graphs display options - User selects the type of analysis, organisms to study and data files to be included	- National data collection and feedback - Analyses, alerts, action for outbreaks, and other public health concerns - Training in data entry/analysis/interpretation	- Secure login with password protection - Secure data configuration, management storage, backups, and virus protection	Not specified	- Web-based data storage	- BacLink is used for configuring data file imports
Critical Antimicrobial Resistance Alert (CARAlert) [20]	- Used by pathology laboratories for identifying/confirming AMR - Once isolates are tested and confirmed as a critical AMR, it is reported into the CARAlert system web portal	- Generates summary reports via email to jurisdictions and states in Australia	- Secure system, no patient level data is held Authorised officers in each state can access the system	Not specified	Not Specified	Not Specified
Australian Passive Antimicrobial resistance Surveillance (APAS) [21]	- Laboratories enter data from public/private hospitals, aged care homes, and community	- Collects, analyses, and reports on AMR data from pathology laboratories	Not specified	Not specified	Not specified	Not specified
Fingertips [22]	- Users consist of health care workers,	- Overview of counts and rates	Not specified	Not specified	Not specified	Not specified

	Front end of the system		Back end of the system			
	acute trusts, clinical groups, governmental bodies	- Interactive maps - Spine charts - Graphs pf temporal trends over a time scale				
'NARMS Now: Human data' and 'NARMS Now: Integrated data'. [23]	- Users can download data in a user-friendly format - Data is readily available to the public online	- Integrated reports, with interactive graphs	Not specified	Not specified	Not specified	Not specified
AMRmap [24]	- Data is obtained from AMR surveillance studies - Users can access via the website	- Provides interactive data analysis and visualisation tools of distribution plots, time-trends, regression plots, prevalence maps, and various graphs and tables	- Data is de-identified	Not specified	Not specified	- The platform is developed by using R programming language and software environment for statistical computing - JavaScript graphics library and modules are used
'INFECT' and 'INFECT VET' [25] ⇒ *Design info accessed from INFECT website*[29]	- Data is provided by the Swiss Centre for Antibiotic resistance - Users can download the App on mobile or tablet	- Visual display if susceptible bacterium to each antibiotic - Display of interactive maps with regions	Not specified	Not specified	Not specified	- Code is available on GitHub
The Danish Microbiology Database (MiBa) [26]	- Departments of clinical microbiology transmit a copy of reports to MiBa	- Data is transferred into reports	- Patient reports are only accessible by permitted healthcare professionals	Not specified	Not specified	Not specified

	Front end of the system		Back end of the system			
Multidrug-resistant organism (MDRO) surveillance system[16]	- Medical staff can retrieve the data	- Results from the analysis are displayed in a web-based user interface - Data is displayed in a line chart to describe the trends of the MDRO count, bubble charts also display outliers - Has an alert system for potential outbreaks	Not specified	- Uses a MDRO clustering system for data collection, conflict pressing, classification, analysis, visualisation and notifications. -	Not specified	- The MDRO system includes an app module, data exchange module and database module
Bacterial real-time Laboratory-based Surveillance System (BALYSES)[17]	Not specific	- Generates weekly reports and emits alarms	Not specific	Not specific	Not specific	Not specific
Marseille Antibiotic Resistance Surveillance System (MARSS)[17]	Not specific	- Generates weekly reports and emits alarms	Not specific	Not specific	Not specific	Not specific
New York Antimicrobial Resistance Project (NYARP)[18]	Not specific	- Informs clinicians about trends within a defined geographic area	Not specific	Not specific	Not specific	Not specific

*ᵃ **Not specified** = the information was not identified/clearly understood within the relevant source; additional/targeted information may be able to be found elsewhere.*

Table S3: The CDC surveillance system effectiveness guideline indicators identified in the EIS reviewed

Electronic Information system	CDC surveillance system effectiveness guideline indicators								
	Stability	**Representativeness**	**Timeliness**	**Simplicity**	**Acceptability**	**Flexibility**	**Data Quality**	**Sensitivity**	**Positive predictive value (PPV)**
Bacterium Analysis Pipeline (BAP) [1]	Not directly, refers to reliability	No	Not directly, analysis component of the EIS is near real-time, unspecified on overall timeliness	Not directly, described as simple (structure), developed with user feedback	Not directly, reports on the use of EIS	Not directly	Not directly	No	No
District Health Information System (DHIS-2) platform[2]	Not directly, built onto an existing system	Yes, describes the representativeness via hospital and paediatric population source	Yes, describe timeliness for a rapid detection and response	Not directly, built onto an existing system	Yes, assessed the EIS prior to implementation	Not directly	Yes, described the data quality and limitations (contamination and missing data)	No	No
ResistanceOpen[3]	Not directly, described being available for health care workers, policy makers and researchers. Also identifies reliability by using indices generated by healthcare	Yes, described the data locations and what resistance it represented	Not directly	Yes, directly described simplicity in terms of data aggregation, and for the structure/ format	Not directly	Not directly	Yes, identifies a list of requirements that the indices require from curators check for with the data	No	No

	CDC surveillance system effectiveness guideline indicators								
	institutions/ laboratories								
A clinically-oriented Antimicrobial Resistance Surveillance Network (ACORN)[4]	Not directly	Yes, described collecting data on meningitis, pneumonia, and sepsis but sampling both hospital and community sources	Not directly, mentions real-time access to data	Yes, mentions simple descriptive statistics being used where appropriate as well as its being created for simple to use dashboard.	Yes, an objective is to evaluate the acceptability of the EIS and package tools	Not directly, mentions the data to be merged with lab data onsite using a flexible automated computer script	Yes, contains baseline assessments of the data collected	No	No
AutoMated tool for Antimicrobial resistance Surveillance System(AMASS)[5]	Yes, states the EIS cannot validate the reliability of data but will be included in future versions. Also, states it is readily available for compatible datasets	Yes, describes in terms of collecting sample for specific pathogens from hospital and microbiology sources	Yes, described the EIS to reduce the time for producing and preparing reports etc. over conventual methods (manually)	Not directly, described the system as user friendly, compatible structure	Not directly	Not directly, describes the ability of exporting data files from WHONET or other lab info systems and generating reports	Not directly, described selecting hospitals the contained microbiology data routinely and had prior experience in data quality controls	No	No
Antimicrobial resistance surveillance system (i-AMRSS)[6]	Not directly	Not directly, highlights the function of validating data	Not directly, discussed real-time results	Not directly	Not directly	Not directly	Not directly, discussed the need to enforce quality antimicrobial testing in labs	No	No
HOTspots[7]	Not directly, described the system being	Yes, described the source of the data	Not directly	Not directly	No	No	Not directly	No	No

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

	CDC surveillance system effectiveness guideline indicators								
	readily available at point of care and accessible freely online	collected (primary and tertiary health care providers), why and location to monitor the desired pathogen							
Infectious Diseases Surveillance Information System for Antimicrobial Resistance (ISIS-AR) [8]	Not directly, discusses the publicly available part of EIS and the password-protected part	Not directly, described the data collection and sources but no evaluation of it	Yes, states timeliness	Not directly	Not directly	No	Yes, states quality of data and how to improve it	No	No
HAITool [9]	Not directly, describes EIS being available and reliable within the interventions for implementation	Not directly, but described collecting data for health workers from a variety of health-related sources (hospital, pharmaceutical, community)	Not directly, states real time results but not evaluated	Not directly	Not directly	Not directly	Not directly	No	No
WHONET-SaTSCAN [10]	Not directly, state's reliability being an	Yes, set out to compare this EIS with the	Not directly, states timeliness being essential	Not directly	Not directly	Not directly	Not directly	No	No

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

	CDC surveillance system effectiveness guideline indicators								
	essential component of surveillance tools	current system to determine if it is better, conducted in the same hospital which the data is compared to is representative	and the EIS being real-time feature but no evaluation of it						
WHONET-SaTSCan (#2) [11]	Not directly	Not directly	Not directly, states the automatic and timely generation of alters of clusters	Not directly	Not directly	No	No	Yes, states sufficient sensitivity to detect clinically significant clusters identified	Yes, states PPV to avoid an excessive number of false alterts
WHONET-SaTSCan (#3) [12]	Not directly	Not directly	Yes, directly mentions timeliness and that SaTSCan generates timely signals	Not directly	Not directly	No	No	No	No
Antibiotic consumption surveillance (ACS) of the watch-and reserve-	Not directly, describes the availability of the system in the aspects of users	Yes, described the source and quantity of data used	Yes, states timeliness missing in other systems and refers to this one being real-time	Yes, described as being simple and can easily be used by personnel with limited training and recourses	Not directly	Yes, states being flexible	Not directly	No	No

	CDC surveillance system effectiveness guideline indicators								
group antibiotics[13]									
MEGARes[14]	Not directly	Yes, the datasets used represent the target population for AMR	Not directly, mentioned real-time results	Not directly	Not directly	Not directly	Not directly, mentioned using high quality but no evaluation	No	No
BR-GLASS[15]	Not directly	Not directly	Not directly, mentioned real-time results	Not directly, mentioned a simple and intuitive means to filter and analyse data	Not directly, contains voluntary participation	Not directly	Not directly, mentioned using quality checks		No
WHONET [19]	Not directly, mentions being reliable	Not directly, mentions data sources	Not directly, discusses real-time results	Not directly, described functionality of system but not evaluation	Not directly mentioned	Yes, states flexibility and discusses how the EIS is flexible in software and data areas	Yes, discusses data quality	No	No
Critical Antimicrobial Resistance Alert (CARAlert) [20]	No	Not directly	No	No	No	No	No	No	No
Australian Passive Antimicrobia	No	Yes, states representativeness	Not directly	No	No	No	No	No	No

	CDC surveillance system effectiveness guideline indicators								
l resistance Surveillance (APAS) [21]									
Fingertips [22]	Not directly	Yes, discusses collecting data from numerous domains to provide information on local AMR indicators	No	No	No	No	Not directly	No	No
'NARMS Now: Human data' and 'NARMS Now: Integrated data'. [23]	Not directly, does discuss availability	Not directly, discusses the source for data collected	No	Not directly	Not directly	Yes, states flexibility and being flexible	Not directly	No	No
AMRmap [24]	Not directly	Yes, monitors community, hospital acquired infectious based off updated isolates into the system. There is a table that describes the data example and what its	Not directly	Not directly	Not directly	No	Not directly, states data quality is ensured using common protocols and reference methods in a central laboratory are certainly the main	No	No

	CDC surveillance system effectiveness guideline indicators								
	tested for and the analysis						advantages of a prospective surveillance program		
'INFECT' and 'INFECT VET' [25]	Not directly	Not directly	Not directly	Not directly	Not directly	Not directly	Not directly	No	No
The Danish Microbiology Database (MiBa) [26]	Not directly	Not directly	Yes, states the previous system is not timeliness, and this EIS does discuss real-time reporting	Not directly, does discuss a limitation of it not being very well suited for data extraction and some features of uploading	Not directly	Yes, states old system not being flexible - no direct evaluation on flexibility of the current system	Not directly	No	No
Multidrug-resistant organism (MDRO) surveillance system [16]	Yes, directly states stability of the clustering algorithm	Yes, gives rationale for the criteria used to include the category of patients	Yes, the system monitors MDROs daily and hourly if indicated	Not directly	Not directly	Yes, states being flexible	Yes, discusses the accuracy of detection and classification of specimen reports	Yes, states sensitivity to select an optimal upper control limit for predicating suspicious outbreaks	Yes, states PPV to select an optimal upper control limit for predicating suspicious outbreaks
Bacterial real-time Laboratory-based Surveillanc	No	Not directly	Not directly, does state being real-time	No	No	No	No	No	Yes, states PPV

	CDC surveillance system effectiveness guideline indicators								
e System (BALYSES)[17]									
Marseille Antibiotic Resistance Surveillance System (MARSS)[17]	No	Not directly	Not directly	No	No	No	No	No	Yes, states PPV
New York Antimicrobial Resistance Project (NYARP)[18]	Not directly	Not directly	No	No	No	No	No	Ni	Yes, states PPV

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

Table S4: Information collected from grey literature search of NAPs that describe national AMR surveillance systems and plans to implement an electronic data collection tool/system.

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Japan	High	Japan Nosocomial Infectious Surveillance (JANIS)[30]	No	Yes	- Development of an AMR database system called ASIARS-Net (ASIan Antimicrobial Resistance Surveillance Network) is being developed that can also be used internationally - Based on the JANIS (Japan Nosocomial Infectious Surveillance) system, which is operated in close collaboration with WHONET.
Sweden	High	Swedish Strategy to Combat Antibiotic Resistance (2020-2023) [31]	No	Yes	- An objective of this strategy (to increase knowledge through surveillance), the government expects the possible exchange of information between IT systems and analytical tools to be further developed. - An additional AMR surveillance system was found within alternative studies, known as 'Swedish Surveillance of Antimicrobial Resistance, SVEBAR', although additional information was not able to be located, and was difficult to determine details of this system [32].
Ireland	High	Ireland National Action Plan (iNAP) [33]	No	Yes	- An objective for enhancing the surveillance of antibiotic resistance and use (page 73), addressed the idea to strengthen the national surveillance system by ensuring integration and timely information - Described as a real time laboratory-based alert system to identify outbreaks and relevant events.
Canada	High	Canadian AMR surveillance system (CARSS)[34]	No	Yes	- A new surveillance initiative includes developing an electronic platform to integrate and share AMR data from public health laboratories.
Korea	High	Korean Global Antimicrobial	No	Yes	- In 2017, a demonstration project of the development of an electronic system to track patients was described

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
		Resistance Surveillance System (Kor-GLASS) [35]			- However, further details/information on this electronic system was not found
Philippines	Lower Middle	Secondary data source [36]	No	Yes	- Development of a system in human health, healthcare-associated infections (HAI) and livestock health for AMU and AMR
Brunei	High	Secondary data source [36]	No	Yes	- Development of an AMU data monitoring system for involving national private/public health sectors, commercial farms, and poultry slaughterhouses
Cambodia	Lower Middle	Secondary data source [36]	No	Yes	- Mention of the development of an AMR surveillance database
Indonesia	Lower Middle	Secondary data source [36]	No	Yes	- A platform for a surveillance network to be established for national laboratory data
Laos	Lower Middle	Secondary data source [36]	No	Yes	- Mention of the development of an AMR surveillance database
Malaysia	Upper Middle	Secondary data source [36]	No	Yes	- Creation of a system between the Ministry of Health, university, and private hospitals is planned
Myanmar	Lower Middle	Secondary data source [36]	No	Yes	- Planning to implement a national surveillance system in hospitals and veterinary diagnostic laboratories - An early warning system to identify AMR
Thailand	Upper Middle	Secondary data source [36]	No	Yes	- A surveillance system for AMR and HAI to be created to developed - signalling systems to be across local and national levels

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Vietnam	Lower Middle	Secondary data source [36]	No	Yes	- Surveillance on AMU and AMR to be strengthened by a system of monitoring and reporting data on hospital infections, warming systems, and a network to monitor AMU/AMR in 30 laboratories to be established.
France	High	RESAPATH[37]	*Possibly*	No	- This surveillance network is described to encompass AMR data on diseased animals in France and involves 16 other surveillance networks within it. - Although this system is described as a tool for veterinarians to use to detect and measure trends in AMR in animals, there is little to no additional information on the information platform or how it is operational electronically. - Thus, there may be an electronic information system present in France, however, more information is required for assessment.
Eritrean	Low	Erithean AMR NAP 2021-2025[38]	*No*	Yes	- There are plans to establish an integrated surveillance system in a One health approach - The NAP states a planned activity is to establish a database and information sharing system within this surveillance system, effectively forming an EIS
Eswatini	Lower Middle	Eswatini AMR NAP 2018-2022[39]	*No*	Yes	- Plans to establish a comprehensive AMR surveillance system as a One health approach - States plans to establish an electronic surveillance system

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Ethiopia	Low	Strategy for the Prevention and Containment of AMR in Ethiopia[40]	*No*	Yes	- Strategic objective two: is to strengthen the knowledge and evidence on AMU and AMR through a One health surveillance and research - Developing networks and platforms for regular and formal interactions to exchange information is part of Objective 5, and may form an EIS in the future
Ghana	Low	Ghana National Action Plan on Antimicrobial Resistance 2017-2021[41]	*No*	No	- Aims to establish a One health AMR surveillance system, nothing indicates an EIS plans yet
Kenya	Lower Middle	National Action Plan on Prevention and Containment of Antimicrobial Resistance 2017-2022[42]	*No*	No	- Strengthening the knowledge and surveillance systems to detect and report resistance pathogens is an objective in the NAP, not indication of an EIS development yet
Liberia	Low	National Action Plan on Prevention and Containment of	*No*	Yes	- Plans to develop systems to ensure a regular and effective monitoring/reporting of AMR patterns across multiple sectors

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
		Antimicrobial Resistance in Liberia 2018-2022[43]			
Malawi	Low	Malawi Antimicrobial Resistance Strategy 2017-2022[44]	*No*	Yes	- Plans to develop a digital platform that links social behavioural practices to the GLASS AMR network
Mauritius	Low	Mauritius National Action Plan on Antimicrobial Resistance[45]	*No*	Yes	- One of the strategic objectives is to implement an electronic surveillance of AMR and AMU in humans, animals and the environmental health sectors
Nigeria	Low	Nigeria Antimicrobial Resistance National Action Plan 2017-2022[46]	*No*	No	- There are plans to build on a One health approach AMR surveillance system - No clear indication of an EIS being developed

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Sierra Leone	Low	Sierra Leone: National Strategic Plan for Combating Antimicrobial Resistance 2018-2022[47]	*No*	Yes	- Plans to establish an AMR database that includes a One health approach
South Africa	Upper Middle	South African antimicrobial resistance national strategy framework 2018-2024[48]	*No*	Yes	- An objective is to develop an antimicrobial resistance surveillance system for inpatients in hospitals, for outpatients in all other health care settings and the community, and for animals and non-human usage of antimicrobials -
Tanzania	Lower Middle	The National Action Plan on Antimicrobial Resistance 2017-2022[49]	*No*	Yes	- Plans to develop an AMR surveillance reporting system
Zimbabwe	Low	One Health Antimicrobial Resistance National Action Plan 2017-2021[50]	*No*	No	- A strategy to integrate the surveillance for humans, animals, and the environment in an integrated surveillance system - No clear indication of an EIS being developed

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Barbados	Middle	National Action Plan on Combatting Antimicrobial Resistance 2017-2022[51]	*No*	No	- Improving the One health approach but not EIS indicated
United States	High	National Action Plan for combating Antibiotic Resistant Bacteria[52]	*No*	Yes	- Centers for Disease Control and Prevention (CDC) plan to add electronic reporting for AMU and AMR data for electronic health records within 5 years of this NAP being published - Within 1 year CDC aims to create a user-friendly electronic portal that makes aggregated data publicly available and integrated analyses
Afghanistan	Low	National Action Pfxlan on Antimicrobial Resistance 2017-2021[53]	*No*	No	- Moving towards a One health approach
Bahrain	High	National Action Plan on Antimicrobial Resistance 2019[54]	*No*	No	- Aims to set up an AMR surveillance program, not indication of an EIS being developed

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Egypt	Lower Middle	Egypt National Action Plan for Antimicrobial Resistance 2018-2022[55]	*No*	No	- Aims to strengthen surveillance system to a One Health approach
Iran	Lower Middle	National action plan of the Islamic Republic of Iran for combating antimicrobial resistance during 2016 – 2021[56]	*No*	Yes	- Plans to develop a strategic plan to combat AMR in a one health approach - Aims to design and enforce laws to facilitate mandatory reporting for the instance of electronic reporting systems, which will become a part of the Electronic Health Record
Iraq	Upper Middle	National action plan of antimicrobial resistance in Iraq 2018-2022[57]	*No*	Yes	- Aims to strengthen NAP by generating a multi-sector AMR information sharing system for Humans, animals, and the environment

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Jordan	Lower Middle	Jordan Antimicrobial Resistance National Action Plan 2018-2022[58]	*No*	Yes	- Plans to implement a national electronic health system
Saudi Arabia	High	Kingdom of Saudi Arabia: National action plan on combating antimicrobial resistance[59]	*No*	Yes	- Plans to integrate data into electronic health records when possible
Lebanon	Upper Middle	National action plan on combating antimicrobial resistance[60]	*No*	No	- No indication of EIS, although plans to move towards a One health approach
Libya	Upper Middle	National action plan on prevention and containment of antimicrobial	*No*	No	- Plans to establish a surveillance system for humans and animals

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
		resistance 2019-2023[61]			
Oman	High	Antimicrobial resistance (AMR) national action plan[62]	*No*	Yes	- Aims to monitor trends in AMR through a well-established surveillance system/network
Pakistan	Low	Antimicrobial resistance national action plan[63]	*No*	No	- Aims to establish an integrated national AMR surveillance system, no indication of an EIS
Palestine	Lower Middle	National action plan for antimicrobial resistance 2020-2024[64]	*No*	Yes	- Aims to implement electronic and network systems sharing within medical laboratories within the Ministry of Health

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Sudan	Low	National action plan on antimicrobial resistance 2018-2020[65]	*No*	No	- Aims to set up an integrated surveillance system with a One health approach, not indication of EIS
United Arab Emirates	High	Nation Action Plan for Antimicrobial Resistance 2019-2023[66]	*No*	No	- Plans to implement a national surveillance system as a one health approach
Czech Republic	High	Czech Republic: National action plan on antimicrobial resistance 2011-2013[67]	*No*	No	- No indication of EIS, although aims to coordinate human and animal data
Denmark	High	Denmark National Action Plan on Antibiotics in Human Healthcare[68]	*Yes*		- Has the EIS DANMAP, which is discussed in the review

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Finland	High	National action plan on antimicrobial resistance 2017-2021[69]	*No*	Yes	- To develop a real-time notification and reporting system is a part of the major action areas
Germany	High	German Antimicrobial Resistance Strategy (DART)[70]	*No*	No	- Reports to ESAC-Net) European Surveillance of Antimicrobial Consumption - No indication of EIS developed
Netherlands	High	Netherlands Approach to Antibiotic Resistance[71]	*No*	No	- No indication of EIS
Norway	High	Norwegian National Strategy against Antibiotic Resistance 2015-2020[72]	*No*	No	- Aims to standardise and extend surveillance systems to establish a global surveillance program on AMR and AMU

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Serbia	Upper Middle	National Antibiotic Resistance Control Programme for 2019-2021[73]	*No*	Yes	- Plans to implement a common system for registration of AMC with an electronic system for health care
Tajikistan	Low	National action plan to tackle antimicrobial resistance in the Republic of Tajikistan[74]	*No*	No	- Plans to improve surveillance system and implement more of a One health approach
Macedonia	Upper Middle	Antimicrobial Resistance Strategy in Macedonia 2012-2016[75]	*No*	No	- No indication of EIS
Turkmenistan	Upper Middle	National strategy for containment of antimicrobial resistance in Turkmenistan 2017-2025[76]	*No*	Yes	- Aims to establish a national surveillance system - Indicates the creation of a database to monitor and submit data to into a single electronic laboratory network

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Great Britain and Northern Ireland	High	UK five year antimicrobial resistance strategy 2019-2024[77]	*Yes*		- Fingertips is the EIS in England and included in this review
Bangladesh	Lower Middle	Antimicrobial resistance containment in Bangladesh 2017-2022[78]	*No*	Yes	- Plans to establish a web-based surveillance and laboratory networking system for AMR
Bhutan	Lower Middle	Bhutan National Action Plan on Antimicrobial Resistance 2018-2022[79]	*No*	No	- No plans for an EIS

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Timor-Leste	Low	National Action Plan on Antimicrobial Resistance 2017-2020[80]	*No*	No	- Plans to set up a surveillance system for AMR, no indication of EIS
India	Lower Middle	National Action Plan on Antimicrobial Resistance[81]	*No*	No	- Plans to implement and strengthen surveillance system as a One health approach
Maldives	Upper Middle	National Action Plan for Containment of Antimicrobial Resistance 2017-2022[82]	*No*	Yes	- Plans to set up a national surveillance system to provide early warning signs of emerging resistance and monitor trends at national and subnational levels
Sir Lanka	Upper Middle	National Strategic Plan for Combating Antimicrobial Resistance in Sri Lanka 2017-2022[83]	*No*	No	- Plans to optimise surveillance system, no indication of an EIS

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Australia	High	Australia National Antimicrobial Resistance Strategy 2020 and beyond[84]	*Yes*		- Does not mention APAS or CARAlert in this report, although these are two types of EIS in operation in Australia
China	Upper Middle	National action plan to contain antimicrobial resistance 2016-2020[85]	*No*	No	- Aims to strengthen the AMR surveillance and implement a One health approach
Micronesia	Lower Middle	Federated States of Micronesia National AMR Action Plan 2019-2023[86]	*No*	Yes	- Aims to strengthen the electronic laboratory information system for AMR reporting and surveillance in all state laboratories
Fiji	Upper Middle	National antimicrobial resistance action plan 2015[87]	*No*	Yes	- Recognises the lack of an EIS, plans to develop one for AMR surveillance

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Mongolia	Lower Middle	National multi-sectoral action plan on combatting antimicrobial resistance 2017-2020[88]	*No*	Possibly	- Suggests possibility for development of EIS with fostered research and development for new tools to combat AMR
Nauru	High	National multi-sectoral plan on antimicrobial resistance for the Republic of Nauru 2021-2025[89]	*No*	No	- Plans to improve current AMR surveillance system, no indication of EIS
Papua New Guinea	Lower Middle	Papua New Guinea Action Plan on Antimicrobial Resistance 2019-2023[90]	*No*	No	- Plans to develop an AMR surveillance system with a reference laboratory, not an EIS

Country	Economic status	Name of surveillance system / NAP	Presence of AMR EIS?	If no, is there any indication of AMR EIS in the future?	Additional information
Republic of Marshall Islands	Upper Middle	Republic of Marshall Islands: National multisectoral plan on antimicrobial resistance 2019-2023[91]	*No*	No	- Plans to develop an AMR surveillance system with a reference laboratory, not an EIS
Tuvalu	Lower Middle	National multi-sectoral plan to combat antimicrobial resistance 2021-2025[92]	*No*	No	- Plans to strengthen current surveillance systems such as incorporating animal date, no development of EIS is clearly indicated

References

1. Thomsen MCF, Ahrenfeldt J, Cisneros JLB, Jurtz V, Larsen MV, Hasman H, et al. A Bacterial Analysis Platform: An Integrated System for Analysing Bacterial Whole Genome Sequencing Data for Clinical Diagnostics and Surveillance. PLoS One. 2016;11(6):e0157718.

2. Lamorde M, Mpimbaza A, Walwema R, Kamya M, Kapisi J, Kajumbula H, et al. A Cross-Cutting Approach to Surveillance and Laboratory Capacity as a Platform to Improve Health Security in Uganda. Health Secur. 2018;16(S1):S76–86.

3. MacFadden DR, Fisman D, Andre J, Ara Y, Majumder MS, Bogoch II, et al. A Platform for Monitoring Regional Antimicrobial Resistance, Using Online Data Sources: ResistanceOpen. J Infect Dis. 2016 Dec 1;214(suppl_4):S393–8.

4. Turner P, Ashley EA, Celhay OJ, Douangnouvong A, Hamers RL, Ling CL, et al. ACORN (A Clinically-Oriented Antimicrobial Resistance Surveillance Network): a pilot protocol for case based antimicrobial resistance surveillance. Wellcome Open Res [Internet]. 2020 Jun 1 [cited 2021 Feb 11];5. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7250055/

5. Lim C, Miliya T, Chansamouth V, Aung MT, Karkey A, Teparrukkul P, et al. Automating the Generation of Antimicrobial Resistance Surveillance Reports: Proof-of-Concept Study Involving Seven Hospitals in Seven Countries. Journal of Medical Internet Research. 2020;22(10):e19762.

6. Kaur J, Sharma A, Dhama AS, Buttolia H, Ohri VC, Walia K, et al. Developing a hybrid antimicrobial resistance surveillance system in India: Needs & challenges. Indian J Med Res. 2019 Feb;149(2):299–302.

7. Wozniak TM, Cuningham W, Buchanan S, Coulter S, Baird RW, Nimmo GR, et al. Geospatial epidemiology of Staphylococcus aureus in a tropical setting: an enabling digital surveillance platform. Sci Rep. 2020 Aug 5;10(1):13169.

8. Altorf-van der Kuil W, Schoffelen AF, de Greeff SC, Thijsen SF, Alblas HJ, Notermans DW, et al. National laboratory-based surveillance system for antimicrobial resistance: a successful tool to support the control of antimicrobial resistance in the Netherlands. Euro Surveill. 2017 Nov;22(46).

9. Simões AS, Maia MR, Gregório J, Couto I, Asfeldt AM, Simonsen GS, et al. Participatory implementation of an antibiotic stewardship programme supported by an innovative surveillance and clinical decision-support system. J Hosp Infect. 2018 Nov;100(3):257–64.

10. Natale A, Stelling J, Meledandri M, Messenger LA, D'Ancona F. Use of WHONET-SaTScan system for simulated real-time detection of antimicrobial resistance clusters in a hospital in Italy, 2012 to 2014. Euro Surveill. 2017 Mar 16;22(11).

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

11. Huang SS, Yokoe DS, Stelling J, Placzek H, Kulldorff M, Kleinman K, et al. Automated detection of infectious disease outbreaks in hospitals: a retrospective cohort study. PLoS Med. 2010 Feb 23;7(2):e1000238.

12. Stelling J, Yih WK, Galas M, Kulldorff M, Pichel M, Terragno R, et al. Automated use of WHONET and SaTScan to detect outbreaks of Shigella spp. using antimicrobial resistance phenotypes. Epidemiol Infect. 2010 Jun;138(6):873–83.

13. Schweickert B, Feig M, Schneider M, Willrich N, Behnke M, Peña Diaz LA, et al. Antibiotic consumption in Germany: first data of a newly implemented web-based tool for local and national surveillance. Journal of Antimicrobial Chemotherapy. 2018 Dec 1;73(12):3505–15.

14. Lakin SM, Dean C, Noyes NR, Dettenwanger A, Ross AS, Doster E, et al. MEGARes: an antimicrobial resistance database for high throughput sequencing. Nucleic Acids Research. 2017 Jan 4;45(D1):D574–80.

15. Pillonetto M, Jordão RT de S, Andraus GS, Bergamo R, Rocha FB, Onishi MC, et al. The Experience of Implementing a National Antimicrobial Resistance Surveillance System in Brazil. Front Public Health [Internet]. 2021 Jan 14 [cited 2021 Mar 30];8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7841397/

16. Tseng Y-J, Wu J-H, Ping X-O, Lin H-C, Chen Y-Y, Shang R-J, et al. A Web-based multidrug-resistant organisms surveillance and outbreak detection system with rule-based classification and clustering. J Med Internet Res. 2012 Oct 24;14(5):e131.

17. Abat C, Chaudet H, Colson P, Rolain J-M, Raoult D. Real-Time Microbiology Laboratory Surveillance System to Detect Abnormal Events and Emerging Infections, Marseille, France. Emerg Infect Dis. 2015 Aug;21(8):1302–10.

18. Graham PL, San Gabriel P, Lutwick S, Haas J, Saiman L. Validation of a multicenter computer-based surveillance system for hospital-acquired bloodstream infections in neonatal intensive care departments. Am J Infect Control. 2004 Jun;32(4):232–4.

19. Stelling J, O'Brien TF. WHONET: Software for Surveillance of Infecting Microbes and Their Resistance to Antimicrobial Agents. In: Molecular Microbiology [Internet]. John Wiley & Sons, Ltd; 2016 [cited 2021 Jun 8]. p. 692–706. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1128/9781555819071.ch48

20. CARAlert Annual Report: 2019 | Australian Commission on Safety and Quality in Health Care [Internet]. [cited 2021 Apr 19]. Available from: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/caralert-annual-report-2019

21. Australian Passive Antimicrobial Resistance Surveillance (APAS) First report: multi-resistant organisms | Australian Commission on Safety and Quality in Health Care [Internet]. [cited 2021 Apr 19]. Available from: https://www.safetyandquality.gov.au/publications-and-resources/resource-

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

library/australian-passive-antimicrobial-resistance-surveillance-apas-first-report-multi-resistant-organisms

22. Johnson AP, Muller-Pebody B, Budd E, Ashiru-Oredope D, Ladenheim D, Hain D, et al. Improving feedback of surveillance data on antimicrobial consumption, resistance and stewardship in England: putting the data at your Fingertips. J Antimicrob Chemother. 2016 Dec 20;dkw536.

23. Karp BE, Tate H, Plumblee JR, Dessai U, Whichard JM, Thacker EL, et al. National Antimicrobial Resistance Monitoring System: Two Decades of Advancing Public Health Through Integrated Surveillance of Antimicrobial Resistance. Foodborne Pathog Dis. 2017 Oct 1;14(10):545–57.

24. Kuzmenkov AY, Trushin IV, Vinogradova AG, Avramenko AA, Sukhorukova MV, Malhotra-Kumar S, et al. AMRmap: An Interactive Web Platform for Analysis of Antimicrobial Resistance Surveillance Data in Russia. Front Microbiol. 2021;12:620002.

25. Federal Office of Public Health and Federal Food Safety and Veterinary Office. Swiss Antibiotic Resistance Report 2020. Usage of Antibiotics and Occurrence of Antibiotic Resistance in Switzerland. November 2020. FOPH publication number: 2020-OEG-64. [Internet]. 2020 [cited 2021 May 11]. Available from: https://www.anresis.ch/wp-content/uploads/2020/11/Swiss-Antibiotic-Resistance-Report-2020_def_WEB.pdf

26. Voldstedlund M, Haarh M, Mølbak K, Representatives the MB of. The Danish Microbiology Database (MiBa) 2010 to 2013. Eurosurveillance. 2014 Jan 9;19(1):20667.

27. DANMAP 2019, Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark [Internet]. https://www.danmap.org. 2019 [cited 2021 Apr 9]. Available from: https://www.danmap.org/reports/2019

28. District Health Information System-2 [Internet]. DHIS2. 2021 [cited 2021 Jul 27]. Available from: https://dhis2.org/

29. INFECT – INterface For Empirical antimicrobial ChemoTherapy [Internet]. [cited 2021 Jul 30]. Available from: https://www.infect.info

30. Kajihara T, Yahara K, Hirabayashi A, Shibayama K, Sugai M. Japan Nosocomial Infections Surveillance (JANIS): Current Status, International Collaboration, and Future Directions for a Comprehensive Antimicrobial Resistance Surveillance System. Jpn J Infect Dis. 2021 Mar 31;74(2):87–96.

31. Government Offices of Sweden. Swedish Strategy to combat antimicrobial resistance 2020-2023.pdf [Internet]. 2020 [cited 2021 Jun 16]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/swedish-strategy-to-combat-antimicrobial-resistance-2020-2023.pdf?sfvrsn=dacbb55f_1&download=true

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

32. Söderblom T, Billström H, Kahlmeter G, Aspevall O. Working with the Swedish early warning and antimicrobial resistance surveillance system SVEBAR. European Congress of Clinical Microbiology and Infectious Diseases. Abstract [Internet]. 2014 May 10; Available from: https://www.escmid.org/escmid_publications/escmid_elibrary/material/?mid=14923

33. Ireland: National action plan on antimicrobial resistance [Internet]. [cited 2021 May 19]. Available from: https://www.who.int/publications/m/item/ireland-national-action-plan-on-antimicrobial-resistance

34. Canadian Antimicrobial Resistance Surveillance System Report - Update 2020. :108.

35. The new Korean action plan for containment of antimicrobial resistance | Elsevier Enhanced Reader [Internet]. [cited 2021 Apr 20]. Available from: https://reader.elsevier.com/reader/sd/pii/S2213716516301412?token=5D7AA06E4131996428D39055E19B6C901D0B2A4B4F606CDE37193DBAB91461D9176F538DB51B8D2D582A997FCE93FA34&originRegion=us-east-1&originCreation=20210420030031

36. Chua AQ, Verma M, Hsu LY, Legido-Quigley H. An analysis of national action plans on antimicrobial resistance in Southeast Asia using a governance framework approach. The Lancet Regional Health – Western Pacific [Internet]. 2021 Feb 1 [cited 2021 Apr 12];7. Available from: https://www.thelancet.com/journals/lanwpc/article/PIIS2666-6065(20)30084-5/abstract

37. Resapath French surveillance network for antimicrobial resistance in bacteria from diseased animals [Internet]. [cited 2021 Apr 12]. Available from: https://www.anses.fr/fr/system/files/LABO-Ra-Resapath2018EN.pdf

38. World Health Organization, Food and Agriculture Organization of the United Nations, World Organisation for Animal Health, World Health Organization. Eritrean National Ation Plan on Antimicrobial Resistance 2021-2025 [Internet]. 2021 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/eritrean-amr-nap---layout-finalized-22-2-2021---copy-with-dates-of-signatures.pdf?sfvrsn=65856898_1&download=true

39. World Health Organization. Eswatini National Antimicrobial Resistance Containment Strategic Plan 2018-2022 [Internet]. 2020 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/eswatini_final-signed-amr-strategy-implementation-plan-10june2021.pdf?sfvrsn=1fab5cbb_3&download=true

40. Ethiopian Food, Medicine and Healthcare Administration and Control Authority. Ethiopia: Strategy for the Prevention and Containment of Antimicrobial Resistance for Ethiopia 2015-2020 [Internet]. [cited 2021 Nov 1]. Available from: https://www.who.int/publications/m/item/ethiopia

41. Ministry of Health. Ghana National Action Plan on Antimicrobial Resistance 2017-2021 [Internet]. 2017 [cited 2021 Nov 1]. Available from:

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/ghana-nap-amr-2017-2021.pdf?sfvrsn=319f21d6_1&download=true

42. Government of Kenya. NATIONAL ACTION PLAN ON PREVENTION AND CONTAINMENT OF ANTIMICROBIAL RESISTANCE, 2017 -2022 [Internet]. WHO | Regional Office for Africa. 2017 [cited 2021 Nov 1]. Available from: https://www.afro.who.int/publications/national-action-plan-prevention-and-containment-antimicrobial-resistance-2017-2022

43. National Action Plan on Prevention and Containment of Antimicrobial Resistance in Liberia. 2017;89.

44. Government of the Republic of Malawi. Malawi Antimicrobial Rsistance Strategy 2017-2022 [Internet]. 2016 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/malawi_antimicrobial-resistance-strategy-2017-2022.pdf?sfvrsn=f2b81215_1&download=true

45. Ministry of Health and Quality of Life. Mauritius National Action Plan on Antimicrobial Resistance [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/mauritius-national-action-plan-on-antimicrobial-resistance-.pdf?sfvrsn=775058b1_1&download=true

46. Federal Ministries of Agriculture, Environment and Health. Nigeria Antimicrobial Resistance National Action Plan 2017-2022 [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/a-future-for-children/nigeria-amr-national-action-plan.pdf?sfvrsn=153f003d_1&download=true

47. Government of Sierra Leone. Sierra Leone: National Strategic Plan for Combating Antimicrobial Resistance 2018-2022 [Internet]. [cited 2021 Nov 1]. Available from: https://www.who.int/publications/m/item/sierra-leone-national-strategic-plan-for-combating-antimicrobial-resistance

48. Department of Health, Republic of South Africa. South Africa: South African antimicrobial resistance national strategy framework 2018-2024 [Internet]. [cited 2021 Nov 1]. Available from: https://www.who.int/publications/m/item/south-africa-south-african-antimicrobial-resistance-national-strategy-framework-a-one-health-approach

49. The United Republic of Tanzania. The National Action Plan on Antimicrobial Resistance 2017-2022 [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/the-national-action-plan-on-antimicrobial-resistance-2017-2022.pdf?sfvrsn=31d0867d_1&download=true

50. Ministry of Health, Ministry of Agriculture, Ministry of Environment. Zimbabwe One Health AMR NAP 2017-2021 [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-

npm/nap-library/zimbabwe_amr_nap_2017_2021.pdf?sfvrsn=c70e3ec1_1&download=true

51. Barbados: National Action Plan on Combatting Antimicrobial Resistance 2017-2022 [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://www.who.int/publications/m/item/barbados-national-action-plan-on-combatting-antimicrobial-resistance

52. The White House Washington. National Action Plan for combating Antibiotic Resistant Bacteria [Internet]. 2015 [cited 2021 Nov 1]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/national-action-plan-for-combating-antibiotic-resistant-bacteria.pdf?sfvrsn=bf707027_1&download=true

53. Ministry of Public Health. Afghanistan: National action plan on antimicrobial resistance 2017-2021 [Internet]. 2017 [cited 2021 Nov 1]. Available from: https://www.who.int/publications/m/item/afghanistan-national-action-plan-on-antimicrobial-resistance

54. Kingdom of Bahrain. Bahrain: National action plan on antimicrobial resistance [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/bahrain-national-action-plan-on-antimicrobial-resistance

55. World Health Organization. Egypt National Action Plan for Antimicrobial Resistance 2018-2022 [Internet]. 2018 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/egypt-national-action-plan-for-antimicrobial-resistance.pdf?sfvrsn=95406ca_1&download=true

56. Moradi G, Gouya MM, Eshrati B, Mohraz M, Piroozi B. National action plan of the Islamic Republic of Iran for combating antimicrobial resistance during 2016 - 2021. Med J Islam Repub Iran. 2018;32:65.

57. Ministry of Health / Environment, and Agriculture. National action plan of antimicrobial resistance in Iraq 2018-2022 [Internet]. 2018 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/iraq-national-action-plan-of-antimicrobial-resistance-in-iraq

58. Ministry of Health. Jordan Antimicrobial Resistance National Action Plan 2018-2022 [Internet]. [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/infographics-pdf/antimicrobial-resistance-(amr)/jordan_amr-nap_2018-2022.pdf?sfvrsn=83be0540_1&download=true

59. Ministry of Health. Kingdom of Saudi Arabia: National action plan on combating antimicrobial resistance [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/kingdom-of-saudi-arabia-national-action-plan-on-combating-antimicrobial-resistance

60. Ministry of Public Health. National action plan on combating antimicrobial resistance [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/lebanon-national-action-plan-on-combating-antimicrobial-resistance

61. State of Libya. Libya: National action plan on prevention and containment of antimicrobial resistance 2019-2023 [Internet]. 2018 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/libya-national-action-plan-on-prevention-and-containment-of-antimicrobial-resistance

62. Ministry of Health, Agriculture and Fisheries. Oman: Antimicrobial resistance (AMR) national action plan [Internet]. 2020 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/oman-antimicrobial-resistance-(amr)-national-action-plan

63. Ministry of National Health Services, Regulations and Coordination Government. Pakistan: Antimicrobial resistance national action plan [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/pakistan-antimicrobial-resistance-national-action-plan

64. Centers for Disease Control and Prevention. Palestine: National action plan for antimicrobial resistance 2020-2024 [Internet]. 2020 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/palestine-national-action-plan-for-antimicrobial-resistance

65. Ministry of Health and Animal Resources. Sudan: National action plan on antimicrobial resistance 2018-2020 [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/sudan-national-action-plan-on-antimicrobial-resistance

66. Ministry of Health and Prevention. United Arab Emirates Nation Action Plan for Antimicrobial Resistance 2019-2023 [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/uae_nap-amr-english.pdf?sfvrsn=83bb9e84_1&download=true

67. The Ministry of Health. Czech Republic: National action plan on antimicrobial resistance 2011-2013 [Internet]. 2011 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/czech-republic-national-action-plan-on-antimicrobial-resistance

68. Ministry of Health. Denmark National Action Plan on Antibiotics in Human Healthcare [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/denmark-national-action-plan-on-antibiotics-in-human-healthcare-2017.pdf?sfvrsn=98102e2b_1&download=true

69. Ministry of Social Affairs and Health. Finland: National action plan on antimicrobial resistance [Internet]. 2017 [cited 2021 Nov 2]. Available from:

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Global Health

https://www.who.int/publications/m/item/finland-national-action-plan-on-antimicrobial-resistance

70. The Federal Government. Germany: Fighting antibiotic resistance for the good of both humans and animals [Internet]. 2015 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/germany-fighting-antibiotic-resistance-for-the-good-of-both-humans-and-animals

71. Dutch House of Representatives. Netherlands Approach to Antibiotic Resistance [Internet]. 2015 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/nap-library/letter-to-parliament-about-the-approach-to-antibiotic-resistance.pdf?sfvrsn=f92bc8c8_1&download=true

72. Stuedal B, Tandberg T, Paiewonsky P. Norwegian National Strategy against Antibiotic Resistance 2015-2020. 2015;36.

73. Lukic I. SERBIA NATIONAL ANTIBIOTIC RESISTANCE CONTROL PROGRAMME FOR THE PERIOD 2019-2021. 2019;47.

74. Ministry of Health and Social Protection, Ministry of Agriculture, Committee of Food Security. National action plan to tackle antimicrobial resistance in the Republic of Tajikistan [Internet]. 2018 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/tajikistan-national-action-plan-to-tackle-antimicrobial-resistance-in-the-republic-of-tajikistan

75. Ministry of Health. Antimicrobial Resistance Strategy in Macedonia 2012-2016 [Internet]. 2011 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-strategy-macedonia-fyr.pdf?sfvrsn=3f80c162_1&download=true

76. Ministry of Health and Medical Industry. National strategy for containment of antimicrobial resistance in Turkmenistan 2017-2025 [Internet]. 2018 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/turkmenistan-national-strategy-for-containment-of-antimicrobial-resistance-in-turkmenistan

77. HR Government. United Kingdom of Great Britain and Northern Ireland: UK five year antimicrobial resistance strategy [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/united-kingdom-of-great-britain-and-northern-ireland-uk-five-year-antimicrobial-resistance-strategy

78. Ministry of Health and Family Welfare. Bangladesh: Antimicrobial resistance containment in Bangladesh 2017-2022 [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/bangladesh-antimicrobial-resistance-containment-in-bangladesh-2017-2022

79. Royal Government of Bhutan. Bhutan National Action Plan on Antimicrobial Resistance 2018-2022 [Internet]. 2017 [cited 2021 Nov 2]. Available from:

https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/bhutan-national-action-plan-on-amr-(2018-2022).pdf?sfvrsn=6dda532a_1&download=true

80. Ministry of Health. National Action Plan on Antimicrobial Resistance in Timor-Leste 2017-2020 [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/national-action-plan-on-antimicrobial-resistance-timor-leste-2017-2020.pdf?sfvrsn=7d9c62a5_1&download=true

81. Sharma A. National Action Plan on Antimicrobial Resistance in India. 2017;57.

82. Ministry of Health. National Action Plan for Containment of Antimicrobial Resistance in Maldives 2017-2022 [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/national-action-plan-for-containment-of-antimicrobial-resistance-2017-2022.pdf?sfvrsn=dd5e60ca_1&download=true

83. Ministry of Health. National Strategic Plan for Combating Antimicrobial Resistance in Sri Lanka 2017-2022 [Internet]. 2017 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/national-strategic-plan-for-combating-antimicrobial-resistance-in-sri-lanka-2017%C3%A2-2022.pdf?sfvrsn=3125370f_1&download=true

84. Australian Government. Australia National Antimicrobial Resistance Strategy 2020 and beyond [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/australia-national-antimicrobial-resistance-strategy-2020-and-beyond-.pdf?sfvrsn=e3dddbc1_1&download=true

85. China: National action plan to contain antimicrobial resistance 2016-2020 [Internet]. 2014 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/china-national-action-plan-to-contain-antimicrobial-resistance-(2016-2020)

86. Department of Health and Social Affairs. Federated States of Micronesia National AMR Action Plan 2019-2023 [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/amr-spc-npm/federated-states-of-micronesia-national-amr-action-plan-2019-2023_endorsed.pdf?sfvrsn=9d60daa6_1&download=true

87. Government of Fiji. Fiji: National antimicrobial resistance action plan 2015 [Internet]. 2015 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/fiji-national-antimicrobial-resistance-action-plan-2015

88. Ministry of Health and Agriculture. Mongolia: National multi-sectoral action plan on combatting antimicrobial resistance (2017-2020) [Internet]. 2021 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/mongolia-national-multi-sectoral-action-plan-on-combatting-antimicrobial-resistance-(2017-2020)

89. Ministry of Health and Medical Services. National multi-sectoral plan on antimicrobial resistance for the Republic of Nauru 2021-2025 [Internet]. 2021 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/nauru-national-multi-sectoral-plan-on-antimicrobial-resistance-for-the-republic-of-nauru

90. Government of Papua New Guinea. Papua New Guinea Action Plan on Antimicrobial Resistance 2019-2023 [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://cdn.who.int/media/docs/default-source/antimicrobial-resistance/png-action-plan-on-amr-090919_signed.pdf?sfvrsn=1dd11db2_1&download=true

91. Health and Human Services. Republic of Marshall Islands: National multisectoral plan on antimicrobial resistance [Internet]. 2019 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/republic-of-marshall-islands-national-multisectoral-plan-on-antimicrobial-resistance

92. Ministry of Health. Tuvalu: National multi-sectoral plan to combat antimicrobial resistance [Internet]. 2021 [cited 2021 Nov 2]. Available from: https://www.who.int/publications/m/item/tuvalu-national-multi-sectoral-plan-to-combat-antimicrobial-resistance