Antimicrobial Resistance Survey
Joint Action by JPIAMR & VALUE-Dx

A survey about collections of biological material, databases and services relevant for AMR research

PUBLIC REPORT

Content

Executive summary

In the antimicrobial resistance (AMR) field, we currently lack a comprehensive overview with accurate information about available resources and services, where to find them, how they compare to one another, and ways to assess their fitness for reuse in new research. To close this gap, the international consortia JPIAMR and Value-Dx bundled their strengths and set out a survey with the ultimate aim is to get an overview of existing resources and services that are relevant for AMR research and development. The overview could become a central source of information, ready to take up information on future resources and services as well.

This public report describes the steps taken to set up this survey, presents the results, and the future steps that will be taken. With the survey presented in this report, information was collected on a highly aggregated level. It is an important first step in creating a dynamic overview of AMR-related resources and services**.** The AMR community will benefit from this initiative, as it will expand options for innovative research and development and may result in new strategies to tackle the global challenge of AMR.

Background and introduction

ZonMw (the Netherlands Organisation for Health Research and Development) performed, on behalf of the consortia JPIAMR and VALUE-Dx, a survey on resources (collections of biological material and databases) that are relevant for antimicrobial resistance (AMR) research. In parallel, we set out to collect information about services that are provided by research infrastructures and some biobanks. In this report we present the results of the survey.

Aim and ambition of the survey

The AMR research community is eager to gain more accurate information about resources and services available in the field, where to find them, how they compare to one another, and to assess their fitness for reuse in new research. Researchers need such information to be able to find and contact the owner or custodian of such resources to make arrangements for sharing them. We set out the survey to close the current gap of information, and thereby contribute to a strong basis for AMR research. The ultimate aim is to get an overview of existing resources and services that are relevant for AMR research and development. The intention is for the overview to become a central source of information, ready to take up information on future resources and services as well. Our ambition is to improve their findability and reusability, and thereby their sustainability.

This survey was the first step, collecting information on a highly aggregated level about the providers and the availability of their resources and services that are relevant for AMR research. On behalf of VALUE-Dx, two more surveys are set out in 2020, building upon this first survey. The second survey focusses on the needs of users of samples, data, biobanking services and infrastructure. A third survey will be set out to collect more detailed information about individual resources and services, and to address issues related to their findability, reuse, sustainability, and quality.

The AMR community will benefit from this initiative, as it will expand options for innovative research and development. In turn, this may result in new strategies to tackle the global challenge of AMR.

The initiators JPIAMR, VALUE-Dx and ZonMw

JPIAMR is the Joint Programming Initiative on Antimicrobial Resistance. The objective of JPIAMR's work package for Research Infrastructures is to contribute to the return on investment of AMR research funding by supporting enabling activities and infrastructures concerning sharing and re-using data, strains and samples important for AMR research. 'Research infrastructures' (RI) in the context of JPIAMR are databases and collections of strains and samples, including services to use them.

VALUE-Dx is a public private partnership, involving European universities, research institutes and private sector companies active in the development of diagnostic tests for infectious diseases. Its purpose is to transform medical practice to achieve more personalised, evidence-based antibiotic prescription and use in community care settings through the widespread use of clinical and cost-effective innovative diagnostic strategies. VALUE-Dx is funded by Innovative Medicines Initiative (IMI) and co-funded by Wellcome Trust and private companies. The consortium is coordinated by the University of Antwerp, bioMérieux and Wellcome Trust. VALUE-Dx aims at developing sustainable biobanking (with associated databases) and a business model to ensure continuation beyond its funding.

ZonMw is the Netherlands Organisation for Health Research and Development, the public funder of health research in the Netherlands. ZonMw is a member of JPIAMR, and amongst others leader of the work package Research Infrastructures. ZonMw also participates in the consortium of VALUE-Dx.

The survey

Scope: resources and services

The survey addressed existing resources from all the '**One Health' domains**: human, animal, environment. **Figure 1** below shows how resources and services are defined. For resources we distinguished (1) **biobanks** (see '1') and **'non-sample'-databases** (see '2') that are generated in AMR research. Looking more closely to the biobanks, we distinguished:

(1a) **Collections of biological material** containing e.g.:

- Biospecimens (e.g., from body fluids, tissue, environment, food, etc.)
- Samples that are derived from the biospecimens: micro-organisms, or molecular derivatives (e.g., DNA, RNA, protein)

(1b) **Databases that are associated with the collections** to provide information about the specimens, samples and derivatives. For example, the host it was taken from, the antimicrobial resistance of the bacterial strains, genomics, host health status, diagnostics, treatment, quality, protocols and/or publications based upon them.

By **services** we mean those offered by research infrastructures for managing and using the collections and databases (see '3'). Some biobanks also provide services to third parties (see '1d'). Finally, the survey addressed the **documentation (or metadata) for describing the resources** (see '4').

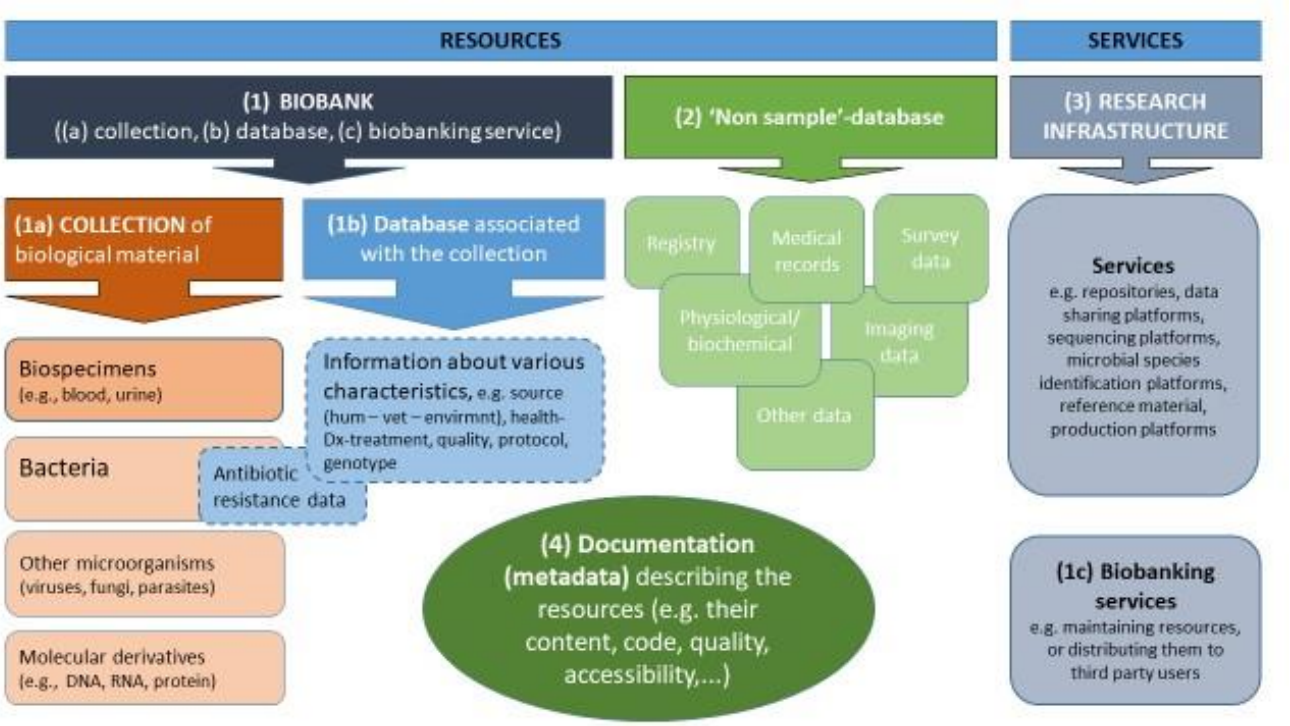


Figure 1: Overview of the resources and services relevant to AMR research, that are targeted by this survey.

More information

To see the complete survey, please visit: https://www.zonmw.nl/fileadmin/zonmw/documenten/Gezondheidsbescherming/AMR_Survey_-_Questions_2.pdf

For more background information, please visit: https://www.zonmw.nl/nl/onderzoek-resultaten/gezondheidsbescherming/resistentie/internationale-samenwerking/survey-amr-joint-effort-jpiamr-value-dx/

Process

A draft survey was composed, after which several rounds of revisions and testing were performed by the consulted parties (see below). This was to ensure alignment / correct use of definitions, understanding, and completeness of the survey.

Consulted parties

- JPIAMR and VALUE-Dx working groups
- JPIAMR Scientific Advisory Board members
- National and international experts

Definitions

For the overview we chose topics and terminology that are commonly used in biobanking and AMR research. In this glossary you will find some definitions that we used for the survey, and the sources from which they were derived.

Topics and terminology

- SBP – Swiss Biobanking Platform: the Bacterial dataset
- BBMRI – ERIC Directory User Manual
- ISO 20387 (2018) Biobanking > 3.Terms and definitions
- GO FAIR: the FAIR principles and ways to assess the reusability ('FAIRness') of a database or collection.
- Sustainability issues are derived from the report on the BBMRI-NL Workshop sustainable infrastructure for sample/data collections

Definitions and their sources: https://www.zonmw.nl/fileadmin/zonmw/documenten/Gezondheidsbescherming/Definitions_and_their_sources_3.pdf

Target group of the survey

The invitation for completing the survey was addressed to owners / custodians, and researchers or other contributors to resources and services, including AMR-related research laboratories, institutes, reference laboratories/centres, infrastructures and networks.

To enhance the exposure of the survey among a relevant target group, we requested contacts to further forward / share the survey. The survey was promoted through various channels including newsletters, social media, workshops and presentations. The good response reflects that this has been widely followed up on, for which we want to express our gratitude!

Preliminary results

Preliminary results have been shared with respondents earlier via e-mail, in an Excel and Powerpoint format. Furthermore, consent/active objection was inquired regarding the presentation of the reported information on resources/services in an online overview.

Privacy

The survey complied with the GDPR-regulations for protecting privacy of respondents. For more information see the privacy statement on the ZonMw website. Respondents could furthermore indicate whether or not they wished to stay involved in this initiative.

Interactive dashboard

In this report we present the results from the survey. As we strive for a dynamic overview, (a selection of) **the results are also presented on the JPIAMR website in the form of a dashboard.** We highly recommend you to visit this dashboard! It is user-friendly and presents the insights and information in a visible and interactive manner. Moreover, whereas this report gives a general overview of the results, in the dashboard the information is coupled to the individual resources and services and allows you to look further into them! Check out the dashboard: https://www.jpiamr.eu/activities/research-infrastructure/

Survey results

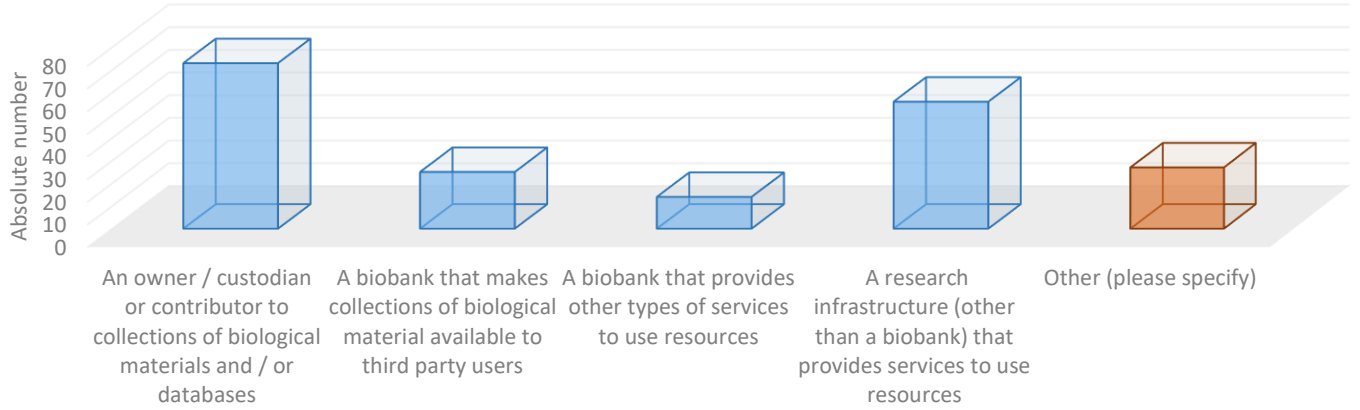
The survey results include information about:

1. General information

In total 127 responses to the survey were received, from 28 different countries.
Countries, on alphabetical order: Austria, Belgium, Canada, China, Croatia, Czech, Denmark, Egypt, Estonia, Finland, France, Germany, Ghana, India, Italy, Netherlands, Nepal, Nigeria, Norway, Poland, Portugal, Slovenia, South-Korea, Spain, Sweden, Swiss, UK, USA

The survey included closed-ended, multiple choice, and open questions. In several instances multiple answers were possible. In case relevant, responses to the category 'Other (please specify)' have been included. In this report no personal details are included.

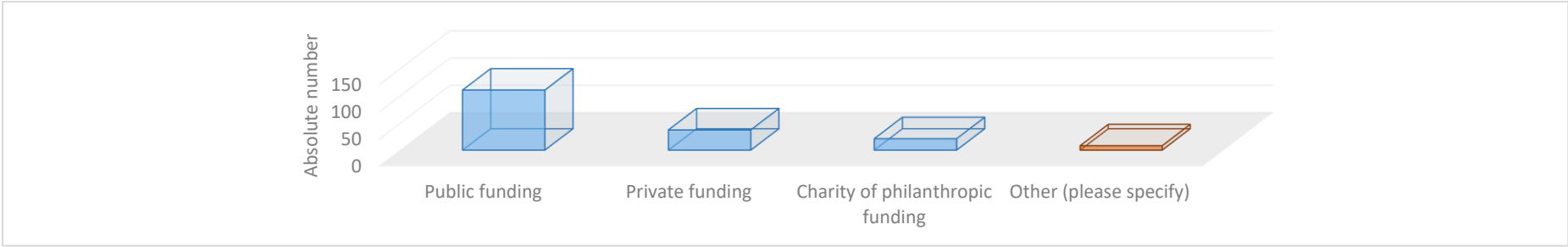
Characteristics of the respondents and/or their institute



(Public) health institutes	Private
• National institute • Public Health Institute • Healthcare • Health Board is responsible of the surveillance of infectious diseases incl. collecting strains, genotyping etc. • Public Biomedical Research Institute (https://www.ibis-sevilla.es/inicio.aspx?lang=en-US) • National Institute of Public Health (databases)	• Global pharmaceutical company • IVD manufacturer which provides and acquires some biological materials under specific agreement • Diagnostic company that uses biological materials for validation of diagnostic tests • Platform for accelerating R&D for new antibiotics and alternatives • Contract research organisation, not for profit • Contract research organization that can provide research support, data science
Reference laboratory	**Advice/guidance/educational**
• National Reference Laboratories for notifiable bacterial animal diseases • National Reference Laboratory with culture collection unit	• Provider of guidance to NHS, research participant, methodology development • Provide advice to manufacturers who need access to biobanked specimens

• Mere preserving of clinical isolates of medical interest and use them for future use/reference	• A teaching institution that teaches on AMR (among other topics)
Other (no specific category)	
• The ARLG Laboratory Center Central Lab is responsible for the identification and distribution of bacteria isolates listed in the ARLG Virtual Biorepository Catalogue • An international network of critical care research groups • Modelling and analyses services, such as epidemiology and statistics	

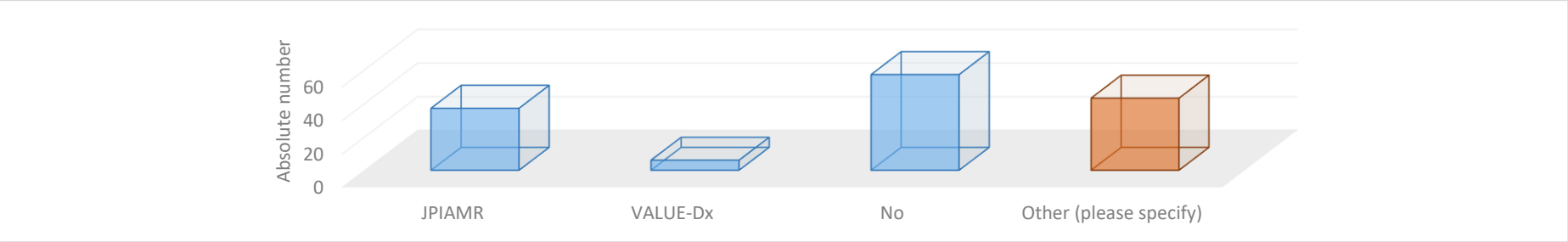
Type of funding the resources and/or services are running on



Other

Through services	**No funding**
• Through the services offered by the biobank. Biobank has a fare pricing • Revenues from services	• Not funded currently • No external funding
Other (no specific category)	
• Fees charged for supply of cultures and services is re-invested in the institute (Research or equipment) • Limited funds from peer review granting agencies • National reference activities and research	

Involvement respondent in research consortium

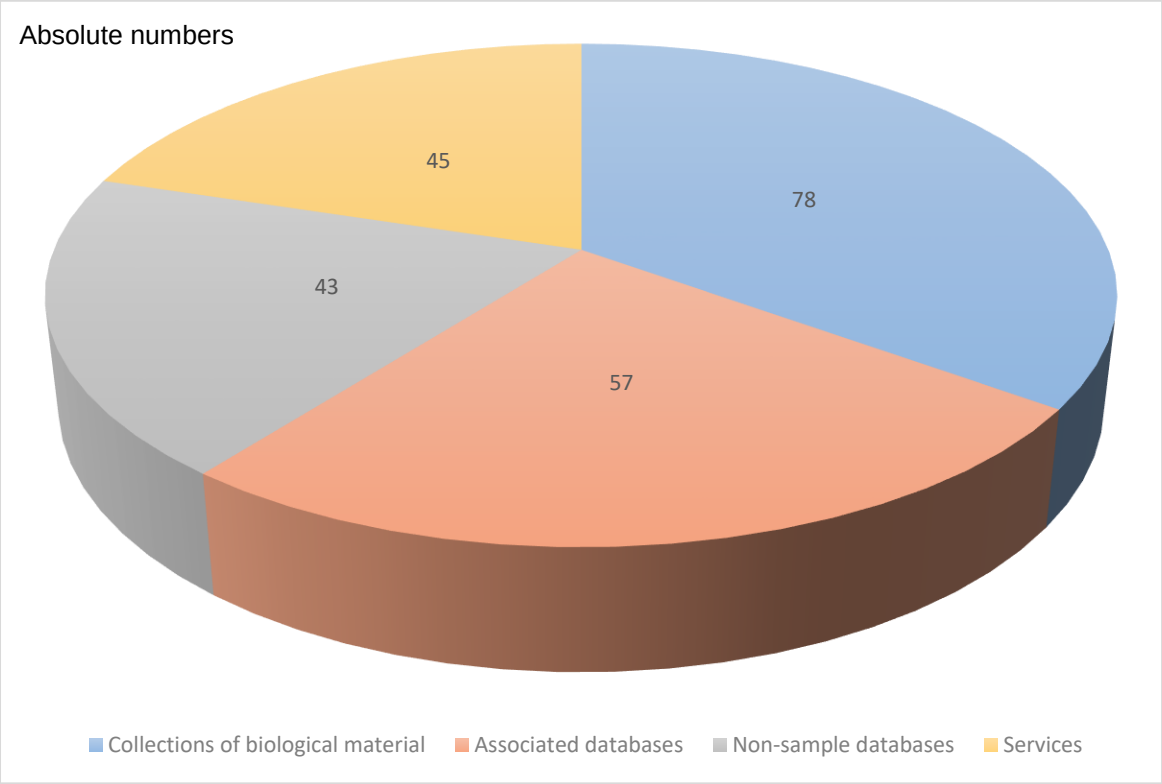


Other

MIRRI	IMI
• Microbial Resources Research Infrastructure (MIRRI), ERIC submission stage 1 • Joint Research Unit MIRRI-IT	• IMI Translocation • TRISTAN, an IMI sponsored study on new imaging methods for drug induced lung disease • IMI ND4BB
Other EC funded/contribution	
• OneHealth EJP • OHEJP-IMPART • Databases" hosted by the European Commission in Villa Borghi, Italy in May 2019 • EU-JAMRAI • Involvement in several consortia from EU/IMI projects (eg R-GNOSIS, MOSAR, SATURN, PREPARE, COMBACTE) • EU-ITN (Marie Curie Actions)	• FP7-HEALTH-2011-two-stage COLLABORATIVE PROJECT (Grant Agreement number: 278232) • EFFORT (FP7), ENGAGE (EFSA co-funded) • FP6, FP7 • TRANSPOSE (EU) • COMBACTE-CDI • RELENT • DIREKT • DRIVE-AB
National consortia	**Other (no specific category)**
• NCOH One Health - AMR • A partnership with the Institute for Health Metrics and Evaluation, University of Washington, USA	• ERINHA: European Infrastructure on Highly Pathogenic Agents • ESGIAI: Study Group for Implant-Associated Infections

• ZonMw • German Centre for Infectious Diseases Research (www.dzif.de) • AMR initiative, Trond Mohn Stiftelsen, Norway • Spanish Network for Research in Infectious Diseases-REIPI • Gecco (Dutch) • ARLG Laboratory Center Studies - Antibacterial Resistance Leadership Group	• EARS-Net - The European Antimicrobial Resistance Surveillance Network (ECDC) • CCRE-survey • EVAg, PITBUL, WHF MODRAD • Malaria Genomic Epidemiology Network

2. Types of resources and / or services

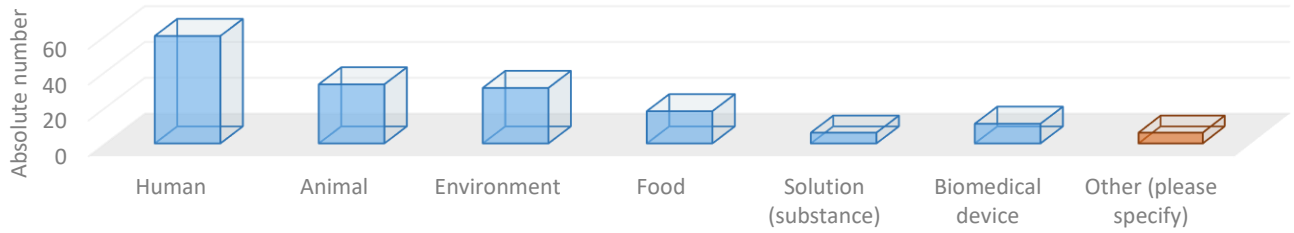


We will now present the results per category, being:

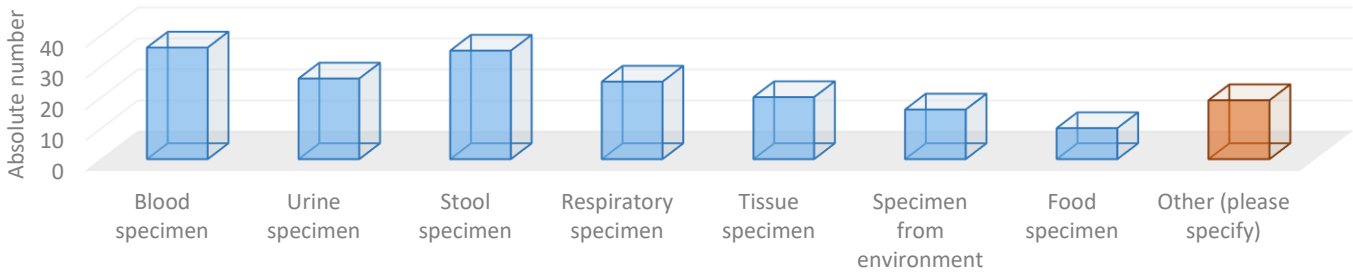
- Collections(s) of biological material
- Associated database(s)
- 'Non-sample' database(s)
- Service(s)
- Additional resources that respondents are aware of

2.1 Collection(s) of biological material (total nr: 78)

Isolation source(s)



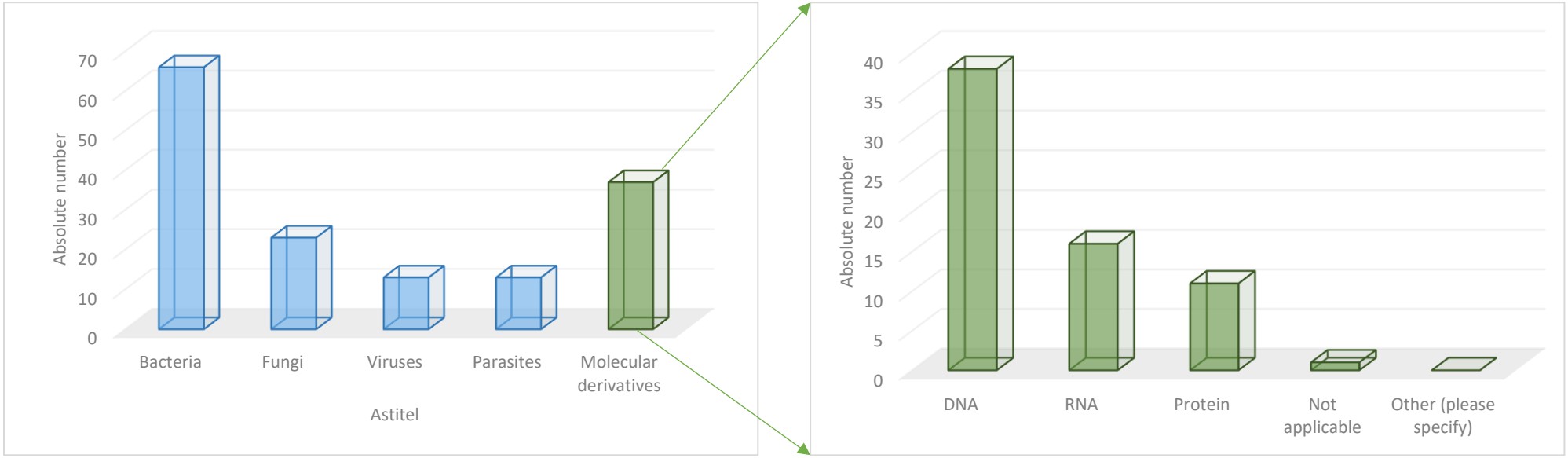
Type of biospecimen(s)



Other

Isolates only
• Only holding isolates, not the primary samples • Only pure cultures of microbes and also genomic DNA samples extracted from these • The collection only include bacterial isolates • No storing of the different specimens, but the microbes are isolate from all these specimen. This includes also other normally sterile fluids as cerebrospinal fluid • Only bacteria isolated from different sources by others

Type of sample(s) isolated from the biospecimen(s)



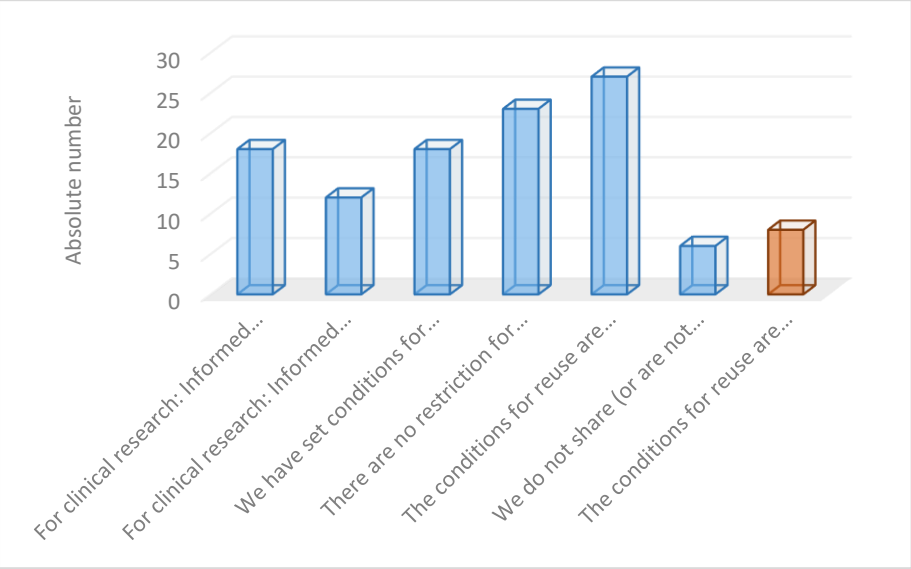
Willing to provide information on the location of the collection(s) of biological material

- Yes: 71%
- No: 29%

Website	Description
• http://arlg.org >> https://arlgcatalogue.org/arlgCatalogue/advancedSearch?search= • http://arlg.org/about-the-center • http://arlg.org/laboratory-center-strain-access • http://bacdive.dsmz.de/ • http://bccm.belspo.be/ • http://bccm.belspo.be/about-us/bccm-ihem • http://bccm.belspo.be/catalogues/itm-catalogue-search	• An annual publication giving current information and listing events or aspects of the previous year, especially in a particular field. • Catalogue (list maintained at the Scientific Direction of the Hospital) • care.gu.se but not until publishing

• http://catalogue-crbip.pasteur.fr/recherche_catalogue • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://imas12.es/servicios/biobanco-i12/ • http://www.imibic.org • http://www.inmi.it/servizio/laboratorio_di_microbiologia_e_banca_biologica • http://www.malariagen.net/data • http://www.pasteur.fr/fr/crbip • http://www.pasteur.fr/fr/crbip • http://www.redbiobancos.es/Plataforma.aspx?encabezado1%24txtBusqueda=colecciones# • http://refs.wdcm.org/home.htm • http://research.pasteur.fr/fr/team/crbip/ • http://research.pasteur.fr/fr/team/crbip/ • http://www.sanquin.org/research/donor-studies-projects/index • http://www.sanquin.nl/dis • http://www.tbbiorepository.org/ >> https://www.tbbiorepository.org/samples-available • http://www.uc.pt/en/uid/ucccb • http://www.westerdijkinstitute.nl/Collections/	• FBMH, University of Manchester • Microbiology laboratory of Agris Sardegna • Paper-based catalogue (https://doi.org/10.2217/fmb-2017-0061)

Opportunities or restrictions for reusing the collection(s)



ANSWER CHOICES
For clinical research: Informed consent from the participants is available, and allows access / reuse only in the project in which the material was collected
For clinical research: Informed consent from the participants is available, and allows access / reuse of the collection(s) in future/multiple research projects
We have set conditions for access / reuse of the collection(s) in research outside our group
There are no restriction for access / reuse of the collection(s) in research within our group
The conditions for reuse are available upon request
We do not share (or are not able to share) our collection(s)
The conditions for reuse are available online (URL):

The conditions for reuse are available online
• http://arlg.org/laboratory-center-strain-access • http://bccm.belspo.be/services/mta • http://bccm.belspo.be/sites/default/files/documents/Forms/BCCM/F442C_MTA.pdf • http://www.tbbiorepository.org/biospecimen-access • http://www.westerdijkinstitute.nl/images/pdf/MTA-CBS.pdf • http://www.wi.knaw.nl

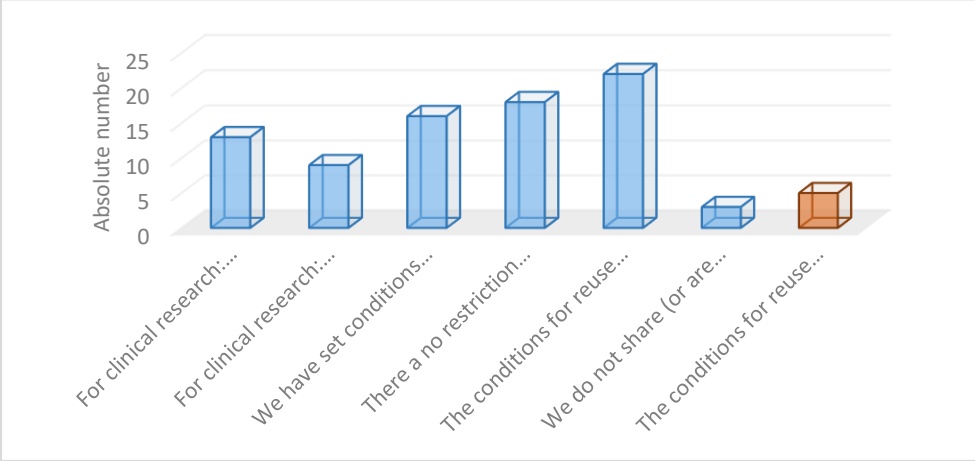
2.2 Associated database(s) (total nr: 57)

Willing to provide information on the location of the associated database(s)

- Yes: 65%
- No: 35%

Information on the location
• ARLG Virtual Biorepository (VB) Catalogue https://arlgcatalogue.org/arlgCatalogue • http://bccm.belspo.be/catalogues • http://bccm.belspo.be/catalogues/itm-catalogue-search • http://care.gu.se when it is published • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • http://imas12.es/servicios/biobanco-i12/ • http//www.imibic.org • http://www.malariagen.net/data • Microbiology Laboratory of Agris Sardegna • http://www.redbiobancos.es/Plataforma.aspx?encabezado1%24txtBusqueda=colecciones# • http://www.tbbiorepository.org/ • http://www.westerdijkinstitute.nl/Collections/DefaultInfo.aspx?Page=Home

Opportunities or restrictions for reusing the associated database(s)



ANSWER CHOICES
For clinical research: Informed consent from the participants is available, and allows access / reuse only in the project in which the data was collected
For clinical research: Informed consent from the participants is available, and allows access / reuse of the data in future/multiple research projects
We have set conditions for access / reuse of the data in research outside our group
There a no restriction for access / reuse of the data in research within our group
The conditions for reuse are available upon request
We do not share (or are not able to share) our data
The conditions for reuse are available online (URL):

The conditions for reuse are available online
• http://arlg.org/laboratory-center-strain-access • http://bccm.belspo.be/services/mta • http://bccm.belspo.be/sites/default/files/documents/Forms/BCCM/F442C_MTA.pdf • http://www.tbbiorepository.org/biospecimen-access • http://www.westerdijkinstitute.nl/images/pdf/MTA-CBS.pdf • http://www.wi.knaw.nl

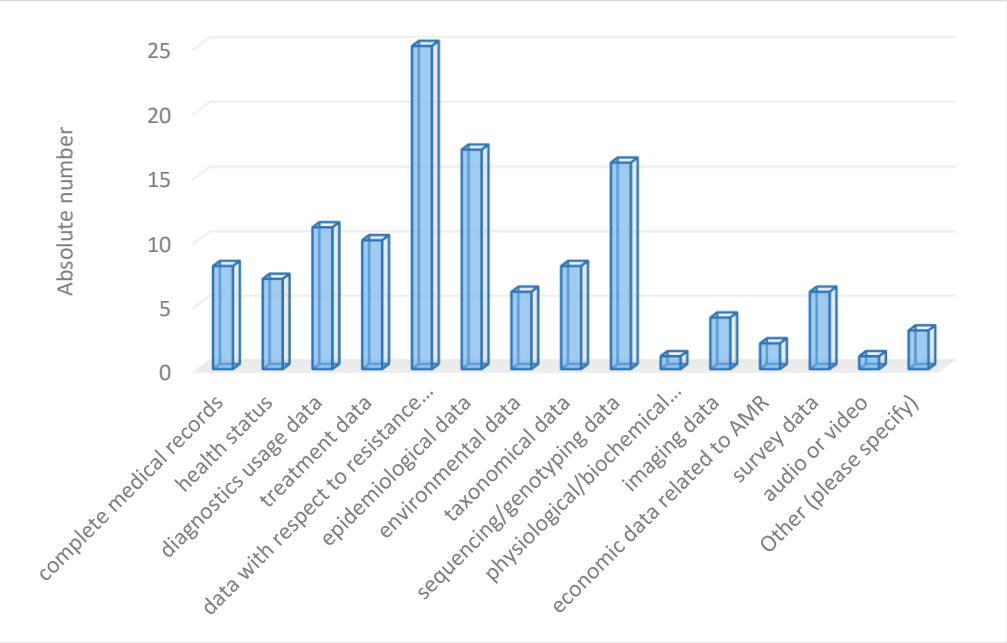
2.3 'Non-sample' database(s) (total nr: 43)

Willing to provide information on the location of the 'non-sample' database(s)

- Yes: 71%
- No: 29%

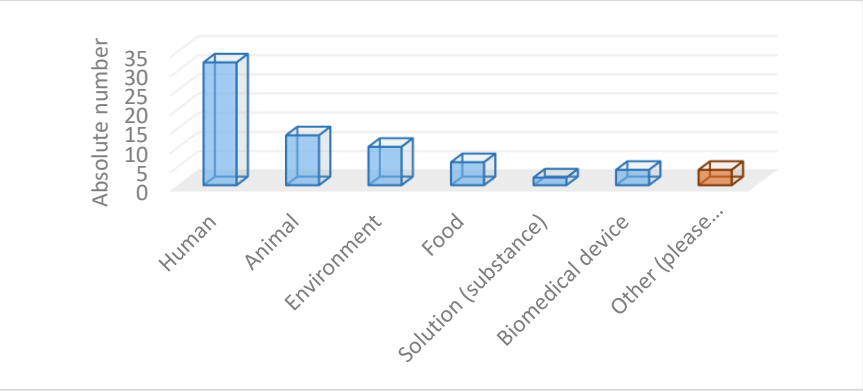
Information on the location
• http://amr.solutions/blog-index.html • http://www.anresis.ch • Accessible through the ARLG VB Catalogue https://arlgcatalogue.org/arlgCatalogue/ • https://www.ares-genetics.cloud/ • http://card.mcmaster.ca • http://e-bioinformatics.net/ucare/ https://www.lumc.nl/org/pheg/research/collaboration/elan-extramuraal-leids-academisch-netwerk/elan-research-informatie-voor-onderzoekers/ • https://catalogue.ceh.ac.uk/documents/35b49db6-8522-4c6b-a779-820268292603 • https://catalogue.ceh.ac.uk/documents/d3498e93-4ac5-4eab-bc1a-eb2328771d24 • https://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml • i2b2 • www.imibic.org • http://Infect.info • www.megares.meglab.org • REDCap • https://www.tbbiorepository.org/common-data-elements • https://www.tno.nl/en/focus-areas/healthy-living/roadmaps/biomedical-health/food-safety/ • https://www.tno.nl/en/focus-areas/healthy-living/roadmaps/biomedical-health/food-safety/risk-management-with-eris/

Types of data that the 'non-sample' database(s) include



ANSWER CHOICES
complete medical records
health status
diagnostics usage data
treatment data
data with respect to resistance (include antimicrobial, resistance phenotype, genotype, susceptibility test, etc.)
epidemiological data
environmental data
taxonomical data
sequencing/genotyping data
physiological/biochemical measurements
imaging data
economic data related to AMR
survey data
audio or video
Other (please specify)

Hosts or sources

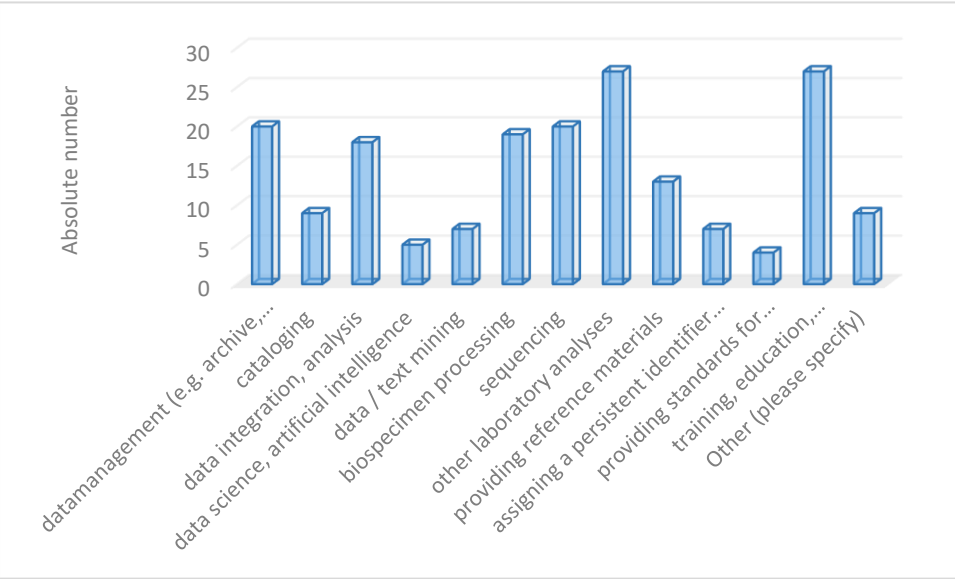


Other

- Published literature.
- Regulatory actions, political events
- Pediatric population

2.4 Service(s) (total nr. 45)

Type of service



ANSWER CHOICES
datamanagement (e.g. archive, repository) and work flow
cataloging
data integration, analysis
data science, artificial intelligence
data / text mining
biospecimen processing
sequencing
other laboratory analyses
providing reference materials
assigning a persistent identifier to resources (e.g. a DOI code)
providing standards for interoperability (codebooks or metadata)
training, education, communication
Other (please specify)

Willing to provide information on the location of service(s)

- Yes: 89%
- No: 11%

Information on the location
• http://amr.solutions/blog-index.html • http://www.anresis.ch • Accessible through the ARLG VB Catalogue https://arlgcatalogue.org/arlgCatalogue/ • https://www.ares-genetics.cloud/ • http://card.mcmaster.ca

- http://e-bioinformatics.net/ucare/ https://www.lumc.nl/org/pheg/research/collaboration/elan-extramuraal-leids-academisch-netwerk/elan-research-informatie-voor-onderzoekers/
- https://catalogue.ceh.ac.uk/documents/35b49db6-8522-4c6b-a779-820268292603
- https://catalogue.ceh.ac.uk/documents/d3498e93-4ac5-4eab-bc1a-eb2328771d24
- https://catalogue-crbip.pasteur.fr/recherche_catalogue.xhtml
- i2b2
- www.imibic.org
- http://Infect.info
- www.megares.meglab.org
- REDCap
- https://www.tbbiorepository.org/common-data-elements
- https://www.tno.nl/en/focus-areas/healthy-living/roadmaps/biomedical-health/food-safety/
- https://www.tno.nl/en/focus-areas/healthy-living/roadmaps/biomedical-health/food-safety/risk-management-with-eris/

3. Additional resources that respondents are aware of

- http://bccm.belspo.be/
- https://www.beiresources.org/
- https://card.mcmaster.ca/
- https://www.cdc.gov/drugresistance/resistance-bank/index.html
- https://cge.cbs.dtu.dk/services/ResFinder/
- https://www.dsmz.de/
- hhttp://www.izslt.it/crab/en/ricerca/
- ttp://www.izs-sardegna.it/
- mayas.singh@fndr.in
- naturatlity@sfr.fr
- https://www.ncbi.nlm.nih.gov
- NCBI AMR
- Nethmap
- https://github.com/arpcard/amr_curation
- https://www.phe-culturecollections.org.uk/products/bacteria/antimicrobialresistancereferencestrains.aspx
- http://www.redbiobancos.es
- www.reipi.org
- https://www.uniss.it/
- https://www.unica.it/unica/
- Windi@resistomap.com
- https://wordpress.com/stats/day/infectionsinsurgery.org
- WHO GLASS, ECDC TESSY database

Conclusion

In this survey on resources (collections of biological material and databases) and services that are relevant for antimicrobial resistance (AMR) research, a total of 127 responses were received, with respondents from 28 different countries. The majority of the respondents and/or their institutes are 'An owner/custodian or contributor to a collection of biological material and/or database(s)' or are associated to 'A research infrastructure (other than a biobank) that provides services to use resources'. Most resources described in response to this survey are running on public funding.

The collections of biological material, as described in response to this survey, primarily have 'human' as isolation source, followed by 'animal', 'environment', and 'food'. The collections of biological material contain various specimens, with the most abundant being 'blood' and 'stool'. The sample type that is most abundantly isolated from the specimens is 'bacteria'. A large fraction of the collections also contains molecular derivatives, with DNA being the most abundant molecular derivative. The majority of the collections of biological material also have a database associated to it, meaning databases that are associated with the collections to provide information about the specimens, samples and derivatives. The most abundant response to 'Opportunities or restrictions for reusing the collection(s) and/or their associated database(s)' is that 'the conditions for reuse are available upon request'.

Most 'non-sample' databases, as described in response to this survey, contain 'data with respect to resistance', followed by 'epidemiological data' and 'sequencing/genotyping data' as most abundant types of data. Similar to the collections of biological material, most of the data within the 'non-sample' databases have 'human' as host/source, followed by 'animal', 'environment', and 'food'.

The most abundant types of services as described in response to this survey, meaning those offered by research infrastructures for managing and using the collections and databases, are: 'other laboratory analyses', 'training, education, communication', 'datamanagement and work flow', data integration, analysis', 'biospecimen processing, 'sequencing'.

In general, the majority of the respondents and/or their institutes are willing to provide information on the location of the resources and services.

This survey was the first step, collecting information on a highly aggregated level, about the providers and their availability of resources and services that are relevant for AMR research. On behalf of VALUE-Dx, two more surveys are set out in 2020, building upon this first survey. The second survey focusses on the needs of users of samples, data, biobanking services and infrastructure. A third survey will be set out to collect more detailed information about individual resources and services, and to address issues related to their findability, reuse, sustainability, and quality.

Contact

For any questions about the survey or its results please contact jpiamr@zonmw.nl, using the heading ‘AMR survey’.

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