**resistancebank.org**

**Description**

*resistancebank* is a database of antimicrobial resistance (AMR) data extracted from point prevalence surveys (PPS) in food animals and food products. The primary goal of *resistancebank* is to support the production of maps of AMR across different geographic regions, animals and antimicrobial classes for further development of applications (e.g., modelling). Currently, data originates from online scientific journals, reports from governmental agencies. In addition, in India, the database is complemented by records from paper journals, MSc/PhD thesis obtained directly from veterinary schools, as well as unpublished data resulting from local surveillance.

Multiple lines in *resistancebank* can correspond to the same publication: different combinations of the studied animals, sample types, coordinates and antimicrobials studied. When the information corresponding to a field was not available NA is used. In these cases, a request to the corresponding author was sent by e-mail and when appropriate a comment was added in the remark field based on the author’s response.

**Fields of the Database Explanation**

**DOI**: *Digital Object Identifier.*

When not available, the PubMed identification number (PMID) was used. For non-peer-reviewed studies we used a unique alphanumeric string as identifier.

**Author**:*Author’s last name.*

**PubDate**: *Year the article was published.*

First published date.

**ISO3**: *Three-letters country codes.*

For full list available at: https://en.wikipedia.org/wiki/ISO\_3166-1\_alpha-3

**Ycoord**/**Xcoord**: *Latitude/Longitude in decimal degree.*

The X/Y-coordinates define the position of the area where the field sampling was performed. We distinguished four different situations:

1. If the location was provided in decimal degrees this format was used as such,
2. If the location was provided in a degree/minute/second format was converted in decimal degrees.
3. If the samples were converted across an administrative unit, and specific coordinates were not provided for each sampling site the coordinates of the centroid of the administrative unit was used.
4. If several locations were mentioned in the manuscript and that resistance rates could not be disaggregated by location based on the information provided in the manuscript the center of mass between the locations was designated as the geographic coordinates of the study.

**StartDate/EndDate**: *Start date of study, specified in the article.*

This refers to the sampling dates. The following format is used: dd.mm.yy. (e.g., 29.09.19). If the day is not mentioned, the 15th is assumed. If the only value provided is the year, than the first, resp. the last day of the year is taken (for EndDate). If no date is specified, ‘NA’ is used.

**SamplingScheme**: *Sampling methodology used for obtaining samples.*

All sampling methods were categorised into four discrete groups: simple random, systematic, convenience-based and statistically-based (as categorised by [AGISAR](https://apps.who.int/iris/handle/10665/255747)).

Simple random refers to sampling when every element in the population has an equal chance of being selected as part of the sample. Systematic refers to sampling when every n-th element in the population is selected to be part of the sample. Convenience-based (or non-probability) refers to sampling when elements are selected based on their availability, while statistically-based includes all other types of probability sampling methods such as stratified or cluster sampling. When the sampling methodology is unclear or not specified, ‘NA’ is used.

**Species**: *Animal species included in the study.*

All animal species were pooled in the following categories of animals: Buffalo, Camel (dromedary), Cattle (beef cattle, bovine), Chicken (layer, broiler, poultry, avian), Duck, Goat (caprine), Horse, Pig, Rabbit, Sheep (ovine), Turkey.

For studies providing aggregated data for different animal species and/or sample types, an entry was included in *resistancebank* with DOI, country and author but no values were entered in the Rescom% column (see below).

**SampleType** & **SampleOrigin**: *Respectively, the* *macro- and sub-category of* *type of biological samples used to isolate bacteria from.*

All sample types were pooled in four categories: Fecal (droppings, eggshells, litter, stools), Killed Animals (blood, ceacal, gut, lymph nodes, organs), Living Animals (animal swabs), and Products (dairy, eggs, meat). Any PPS with mixed sample type containing meat was categorized as meat, except mixes including killed animals which were categorized as killed animals

**Method**: *Methodology used for antimicrobial susceptibility testing (AST)*

Methods were recorded as either disk diffusion (DD), agar dilution (AD), broth dilution (BD), Etest or the name of the automatic system (e.g., VITEK). Disk diffusion method was assumed when PPS reported the potency of disks used for the AST. When more than one methodology was used, the acronyms of the methods are separated by a \_. When non-standard medium was used to perform AST, the name of medium was recorded in the remark section.

For further applications of *resistancebank*, PPS performing molecular typing or population structure analysis were also recorded. For simplicity, \_PCR (Polymerase Chain Reaction) was added to all studies performing molecular typing (e.g., detection of antimicrobial resistance genes, virulence determinants, mobile genetic elements and MLST) or fingerprinting methods (e.g., PFGE). For PPS reporting whole genome sequencing data, a \_WGS was added.

There are several AST possibilities but they can be grouped into Diffusion or Dilution methods. Guidelines for performing these tests are given by different societies and/or organizations (CLSI, EUCAST, French Society for Microbiology – SFM). Note: antimicrobial concentrations are normally expressed in μg/mL and in μg for the disk content alone.

**Pathogens**: *Bacterial species targeted for the study*

Currently resistancebank.org includes the following organisms: *Campylobacter* spp., *Escherichia coli*, *Enterococcus* spp., non-typhoidal *Salmonella* spp., and *Staphylococcus aureus*.

**Strain**:*Bacterial subtype (not used in this study)*

Some studies focus on the epidemiology of restricted strains within a species. If no specification, NA is introduced.

* For PPS reporting exclusively on strains resistant to a specific antimicrobials, a 3-letter code (see below) was used to indicate their resistance phenotype (e.g., nalidixic acid-resistant – NAL-R). For *S. aureus* and *Enterococcus* spp., the common designations for certain resistant types are used instead (e.g., MRSA and MSSA - methicillin resistant and susceptible *S. aureus*, respectively; VISA and VRSA – vancomycin intermediate and resistant *S. aureus*; and VRE – vancomycin resistant enterococci)
* For PPS reporting on single-species, the designation is included in the strain column (e.g., a study focusing only on *Enterococcus faecium*)*.*
* For PPS reporting on *Salmonella* spp., the serotype was reported in the strain column.
* For PPS reporting on *E. coli* pathotypes and/or serotypes characterized, they are inputted into the strain column (e.g., STEC, O157, ExPEC, etc).
* For studies on the characterization of bacteria carrying specific genetic traits such as antimicrobial resistance genes or virulence determinants, these are specified in the strain column.

**Nsamples**: *Number of samples collected.*

The total number of recovered samples per type at the different sampling sites (butchers, markets, farms or retail/supermarkets).

Note: In many studies the number of samples which were referred to KilledAnimal does not entirely represent the number of animals sampled as different organs may have been used for susceptibility testing. When that was the case, an inquiry to the corresponding author was made for a breakdown of the data collected.

**Prev**: *Number of samples positive for a pathogen divided by the total number of samples collected.*

In the absence of bacteria, Prev%=0. The value is expressed in percentage and rounded to one decimal.

**NIsolates**:*Number of isolates*

The total number of isolates used for AST. Normally this is equal to the number of positive samples (prevalence). Increased numbers in comparison to the samples can be due to recovery of more than one bacterium per sample, whereas lower numbers can be attributed to the use of a representative subset or loss of bacterial viability.

**Compound and ATC-Code**: *Antimicrobial compounds used for susceptibility testing designated by a 3-letter code and its designation in the Anatomical Therapeutic Chemical (ATC) Classification.*

ATC-Code starting with J0 stand for antimicrobials for human systemic use while QJ01for veterinary use. For additional information and ATC-Code searching, please refer to <https://www.whocc.no/atc_ddd_index/> or <https://www.whocc.no/atcvet/atcvet_index/>.

For antimicrobials without attributed ATC codes, a pseudo code was constructed by using the ATC code of the molecular classification (5 or 6 characters for human and veterinary antimicrobials, respectively) and adding the first character of the compound’s name separated by a - (e.g., Sarafloxacin – J01MA-S; and Mequindox – QJ01MQ-M). Some ATC codes are provided for mixture of compounds (e.g., J01RA01 for penicillins in combination with other antibacterials). Active ingredients’ name were reported in *resistancebank* when commercial drugs were used. The antimicrobials found across all studies are the following (3 letter code, ATC-code): Amoxicillin-Clavulanic Acid (AMC, J01CR02); Ticarcillin-Clavulanic acid (TIM, J01CR03); Piperacillin-Tazobactam (PIT, J01CR05); Ampicillin-Sulbactam (SAM, J01CR01); Ampicillin (AMP, J01CA01); Amoxicillin (AMX, J01CA04); Ticarcillin (TIC, J01CA13); Cloxacillin (CLO, J01CF02); Oxacillin (OXA, J01CF04); Penicillin & Streptomycin (PES, J01RA01); Mecillinam (MEC, J01CA11); Piperacillin (PIP, J01CA12); Flucloxacillin (FLU, J01CF05); Carbenicillin (CAR, J01CA03); Methicillin (MET, J01CF03); Penicillin (PEN, J01CE01); Temocillin (TEM, J01CA17); Dicloxacillin (DIC, QJ51CF01); Nafcillin (NAF, J01CF06); Mezocillin (MEZ, J01CA10); Ceftriaxone (CRO, J01DD04); Ceftazidime (CAZ, J01DD02); Cefalexin (CLX, J01DB01); Cefotaxime (CTX, J01DD01); Cefepime (FEP, J01DE01); Cefoxitin (FOX, J01DC01); Cefalotin (CFL, J01DB03); Ceftiofur (CFU, QJ01DD90); Cefuroxime (CXM, J01DC02); Cefpodoxime (CPD, J01DD13); Cefazolin (CFZ, J01DB04); Cefixime (CFM, J01DD08); Cefamandole (CMD, J01DC03); Cefoperazone (CFP, J01DD12); Moxalactam (MOX, J01DD06); Cefpirome (CPO, J01DE02); Cefotetan (CTT, J01DC05); Cefradine (CFR, J01DB09); Ceftaroline (CPT, J01DI02); Ceftobiprole (CBP, J01DI01); Cefquinome (CFQ, QJ01DE90); Sulbactam-CFP (SFP, J01DD62); Ceftizoxime (CZM, J01DD07); Cephaloridine (CLD, J01DB02); Cefalonium (CLM, QJ51DB90); CTX-Clavulanic acid (CTC, J01DD51); CAZ-Clavulanic Acid (CAC, J01DD52); Cefmetazole (CEM, J01DC09); Cefaclor (CFC, J01DC04); Cefadroxil (CFR, J01DB05); Aztreonam (ATM, J01DF01); Imipenem (IPM, J01DH51); Ertapenem (ERT, J01DH03); Meropenem (MEM, J01DH02); Doripenem (DOR, J01DH04); Kanamycin (KAN, J01GB04); Gentamicin (GEN, J01GB03 ); Neomycin (NEO, J01GB05); Streptomycin (STR, J01GA01); Amikacin (AMK, J01GB06); Tobramycin (TOB, J01GB01); Apramycin (APR, QA07AA92); Netilmicin (NET, J01GB07); Spectinomycin (SPT, J01XX04); Isepamicin (ISP, J01GB11); Ciprofloxacin (CIP, J01MA02); Nalidixic acid (NAL, J01MB02); Enrofloxacin (ENR, QJ01MA90); Norfloxacin (NOR, J01MA06); Ofloxacin (OFX, J01MA01); Oxolinic Acid (OXO, J01MB05); Flumequine (FLQ, J01MB07); Moxifloxacin (MXF, J01MA14); Levofloxacin (LVX, J01MA12); Pefloxacin (PEF, J01MA03); Olaquindox (OLA, QJ01MQ01); Mequindox (MEQ, QJ01MQ-M); Marbofloxacin (MRB, QJ01MA93); Gatifloxacin (GAT, S01AE0E); Lomefloxacin (LOM, J01MA07); Danofloxacin (DAN, QJ01MA92); Carbadox (CRB, QJ01MQ-C); Sarafloxacin (SAR, J01MA-S); Chloramphenicol (CHL, J01BA01); Florfenicol (FFC, QJ01BA90); Thiamphenicol (TFC, J01BA02); Tetracycline (TET, J01AA07); Oxytetracycline (OXT, J01AA06); Doxycycline (DOX, J01AA02); Minocycline (MIN, J01AA08); Tigecycline (TIG, J01AA12); Chlortetracycline (CTE, J01AA03); Sulfamethoxazole-Trimethoprim (SXT, J01EE01); Sulfamethoxazole (SMZ, J01EC01); Sulfafurazole or Sulfisoxazole (SOX, J01EB05); Sulfonamides-Trimethoprim (SUT, J01EE); Sulfonamides (SSS, J01E); Trimethoprim-Sulfadiazine (TDZ, QJ01EW10); Trimethoprim (TMP, J01EA01); Sulfamonomethoxine (SMN, QJ01EQ18); Erythromycin (ERY, J01FA01); Lincomycin (LIN, J01FF02); Clindamycin (CLI, J01FF01); Clarithromycin (CLR, J01FA09); Tylosin (TYL, QJ01FA90); Azithromycin (AZM, J01FA10); Spiramycin (SPI, J01FA02); Tilmicosin (TIL, QJ01FA91); Roxithromycin (ROX, J01FA06); Midecamycin (MID, J01FA03); Vancomycin (VAN, J01XA01); Teicoplanin (TEC, J01XA02); Avoparcin (AVO, J01XA-A); Polymixin B (PMB, J01XB02); Colistin (CST, J01XB01); Linezolid (LIZ, J01XX08); Nitrofurantoin (NIT, J01XE01); Rifampicin (RIF, J04AB02); Quinupristin-Dalfopristin (Q-D, J01FG02); Bacitracin (BAC, J01XX10); Furazidin (FUR, J01XE03); Daptomycin (DAP, J01XX09); Mupirocin (MUP, D06AX09); Fosfomycin (FOF, J01XX01); Fusidic acid (FUS, J01XC01); Metronidazole (MTD, J01XD01); Pristinamycin (PRI, J01FG01); Furazolidone (FRZ, QJ01XE90); Tiamulin (TIA, QJ01XQ01); Novobiocin (NOV, QJ01XX95); Valnemulin (VAL, QJ01XQ02).

For data analysis, only compounds within the WHO Integrated Surveillance of Antimicrobial Resistance in Foodborne Bacteria were used (Table S2):

**Rescom**: *Percentage of isolates resistant to the relevant antimicrobial compound*

Intermediate-resistant isolates were considered susceptible. All values are rounded to one decimal place. Any value over 0% was rounded to 1%.

When inconsistencies were noted between the resistance rates reported in the main text of a manuscript and the tables, then values reported in the latter were used in resistancebank.org.

**Concg**:*Concentration/amount of antimicrobial used for susceptibility test susceptibility.*

The concentration depends on the assay.For disk diffusion methods, this is the potency of the drug expressed in μg, and hence this variable expresses an amount. In the case of antimicrobial mixtures, report the sum of the two concentrations. For dilution based assays, this is the concentration expressed in μg/mL, because a range is used to indicate the range of concentrations of the assay.

**Guidelines**:*Category of**Guideline document used for performing AST in each PPS*

Refers to the document used to compare AST results against clinical breakpoints to classify a pathogen as phenotypically resistant or susceptible to an antimicrobial. Values correspond to the committee that developed the guidelines, including the EUCAST, and the SFM. Since NCCLS was renamed to CLSI in 2005, all NCCLS documents will be recorded as CLSI.

When the year of the guidelines used was not reported in the PPS the acronym of the committee was reported. In the case of CLSI animal-specific documents (M31), if the document identification was not stated, the term animal was used instead (e.g., CLSI 2004 Animal).

**Breakpoint**:*Resistance breakpoint used for interpreting antimicrobial susceptibility testing results.*

For diffusion methods, the breakpoint is expressed as <= the diameter value in mm of the growth inhibition zone. For dilution methods, the breakpoint is expressed as >= the value of the concentration μg/mL of bacterial growth inhibition. When breakpoints were not yet established for certain antimicrobials, the breakpoint specified by the authors were recorded. These are typically derived from breakpoints of similar molecules or from the literature. As of the June 2019, this concerns 11 surveys associated with AGISAR pathogens in *resistancebank*.

**Remark**:*Comments relative to the publication (first row) or for specific compounds (additional rows).*

**Class**: *Classification of antimicrobials according to their chemical structure.*

**WHO\_MedImp**: *Classification of antimicrobials based on their medical importance for human medicine based on the 6th revision 2018 of the World Health Organization’s report “Critically Important Antimicrobials for Human Medicine”.*