TATFAR

United to Combat Antimicrobial Resistance

Data for Action:
Using Available Data Sources at the Country Level to Track Antibiotic Use

A publication addressing TATFAR's Actions and Recommendations

Key Area I: Appropriate Therapeutic Use in Human and Veterinary Medicine – Action 1.1: Guidance for Assessing Appropriate Use

Available online:
https://www.cdc.gov/drugresistance/tatfar/Using-Available-Data-Sources-Track-Antibiotic-Use-508.pdf

About TATFAR

TATFAR was created in 2009 to address the urgent threat of antimicrobial resistance (AMR). TATFAR's technical experts from Canada, the European Union (EU), Norway, and the United States (U.S.) collaborate and share best practices to strengthen domestic and global efforts in the fight against AMR.

Key Areas Focus to Reduce the Threat of AMR

1. Improve appropriate therapeutic use of antimicrobial drugs in medical and veterinary communities

2. Prevent healthcare and community-associated drug-resistant infections

3. Develop strategies for improving the pipeline of new antimicrobial drugs

Purpose of Resource

Tracking how healthcare providers prescribe antibiotics to treat their patients is a critical step to understand how antibiotics are used. With this information, experts can identify targets for interventions to improve use. Improving the way we prescribe and use antibiotics, a concept referred to as "antibiotic stewardship," can protect patients from harm and combat antibiotic resistance. However, tracking and collecting data on antibiotic use varies by country.

This resource is for public health agencies, governments, and other stakeholders interested in examples of data sources to quantify antibiotic use across the spectrum of human healthcare and assess how antibiotics are used. The value of these indicators and datasets will vary by country based on availability and reliability of prescribing data, as well as patient-level data in healthcare settings.

It is important to note that some data sources may not directly permit assessments of prescribing appropriateness, but rather signal areas that need further exploration or track trends in prescribing.

Types of Antibiotic Use Data

Countries use a variety of different metrics to assess antibiotic consumption practices and trends depending on available data sources and practical applications in country, including:

- **Defined Daily Dose** (DDD): A metric to assess the volume of antibiotic consumption.

  Many countries use this statistical measure to standardize the comparison of drug usage between different drugs and between different healthcare environments. The DDD is the assumed average

maintenance dose per day for a drug used for its main indication in adults. Many countries and studies use this metric.

- **Number of prescriptions per population:** A metric to assess volume of antibiotic consumption.

  Some countries use this metric, often described as overall and by individual agents and classes in the outpatient setting. These data can provide an important baseline to track trends in antibiotic consumption over time. This approach is especially useful when data on dose and duration for each prescription are difficult to obtain or not available.

- **National healthcare encounter surveys, administrative, or claims data:** Data to characterize antibiotic prescribing related to a healthcare visit or episode.

  These data will typically include specific information on payment, patient demographics and diagnosis, prescriptions, and diagnostic testing. These data permit calculation of prescriptions per visit, which is helpful in assessing healthcare provider prescribing behavior.

- **Quality measures:** Measures which typically focus on one specific action related to improving health care and rely upon administrative data from claims or electronic health records specific to patients meeting certain criteria.

  Countries can use quality measures to assess prescribing appropriateness at the country level and drive healthcare improvement within a facility, health system, or health plan. Countries can also use these measures to incentivize providers, publish peer-to-peer comparisons, or for public health decision making.

- **Point prevalence surveys:** A survey conducted at a point in time to identify all patients receiving antibiotics, capture patients with a specific syndrome who received antibiotics, or assess prescribing of a specific antibiotic or class.

  Countries can use the data to assess appropriateness of antibiotic use in healthcare settings to characterize potential for improvement in prescribing. Countries can also use these surveys to examine prescribing patterns for diagnoses, such as urinary tract infections (UTI), community-acquired pneumonia (CAP), and specific antibiotics.

Appropriate Antibiotic Prescribing

Understanding which prescriptions are likely appropriate versus inappropriate is an important first step in using data for action to target interventions or education for the general public, healthcare providers, or policymakers.

Appropriate antibiotic prescriptions are those that are warranted by diagnosis after taking into account clinical guidance, as well as a physical exam and possible diagnostic testing. In addition to determining if an antibiotic is needed, assessing prescribing appropriateness can also include whether the drug selected, as well as the dose and duration, are consistent with current clinical guidance and best practices. Clinical guidelines for individual diagnoses should serve as a foundation when using prescribing data to determine if a prescription was appropriate or not.

Some available data on antibiotic prescribing, though robust, do not directly indicate whether the prescription is appropriate or not. An example of this is national prescribing data, which captures the volume of antibiotic prescriptions and is available in many countries, but may not include diagnosis information. These data, however, can be very useful to national and local governments, as well as health systems and policymakers, to see where variability exists in prescribing volume. They can potentially be used to target stewardship efforts to high volume populations, localities, or health systems.

Examples and Resources: Antibiotic Use Data by Healthcare Setting

Outpatient Setting

National Prescribing Data

- **Canada:** Canada purchases proprietary data from a vendor to assess antibiotic use, and publishes the results annually in the **Canadian Antimicrobial Resistance Surveillance Systems (CARSS) Report** (https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2017-report-executive-summary.html).

- **European Union:** The European Surveillance of Antimicrobial Consumption Network (ESAC-Net) collects national data on antimicrobial use in EU Member States and two European Economic Area (EEA) countries (Iceland and Norway). ESAC-Net publishes the data in annual reports. The EU Member States submit either sales or reimbursement data, or a combination of both. The surveillance data on antimicrobial use are publicly available through an interactive online database on the **European Centers for Disease Control and Prevention (ECDC) website** (https://ecdc.europa.eu/en/antimicrobial-consumption/surveillance-and-disease-data/database).

- **Norway:** A national database captures total antibiotic use (human and animals) in Norway and a prescription registry captures all prescriptions purchased by individuals. These sources do not include clinical information (i.e., infectious diagnosis). However, the data can be used to track antibiotic prescribing over time in the outpatient setting and can be compared over time. Prescriber data are also included. Moreover, a veterinary prescription database covers prescriptions for veterinary use, meaning all antibiotic use in the country is captured. The antibiotic use data are published in annual reports.

  - *Usage of Antimicrobial Agents and Occurrence of Antimicrobial Resistance in Norway. Tromsø / Oslo 2017* (http://www.antibiotikaresistens.no/)

  - **National Strategy against Antibiotic Resistance 2015–2020** (https://www.regjeringen.no/en/dokumenter/national-strategy-against-antibiotic-resistance/id2424598/).

- **United States:** The U.S. purchases proprietary data from a vendor to assess antibiotic transactions and use. U.S. Centers for Disease Control and Prevention (CDC) used the data to track antibiotic prescribing trends and geographic variability over time in outpatient settings. CDC publishes data in annual reports and on an interactive, electronic platform:

  - **Outpatient Antibiotic Prescriptions — United States, 2015** (http://www.cdc.gov/antibiotic-use/community/programs-measurement/state-local-activities/outpatient-antibiotic-prescriptions-US-2015.html)

□ **Outpatient Antibiotic Use Data** (https://gis.cdc.gov/grasp/PSA/AUMapView.html)

Administrative/Claims Data

- **Canada**: The Public Health Agency of Canada has used data from a sentinel physician network (purchased proprietary data) to track diagnoses for which antimicrobials are most likely to be recommended in Canada. Analysis of these data are published annually in the **CARSS Report** (http://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2017-report-executive-summary.html).
- **United States**: CDC has used proprietary administrative data to estimate patterns of U.S. outpatient antibiotic use in recent years. These data can be used to examine pharmacy claims data for outpatients with employer-based health insurance.

  □ Comparison of Antibiotic Prescribing in Retail Clinics, Urgent Care Centers, Emergency Departments and Traditional Ambulatory Care Settings in the United States. Palms, DL, Hicks LA, Bartoces M, et al. JAMA Intern Med. 2018 Sept 1; 178(9):1267-1269. Available at http://www.ncbi.nlm.nih.gov/pubmed/30014128.

Survey Data on Healthcare Encounters

- **United States**: The National Ambulatory Medical Care Survey (NAMCS) and National Hospital Ambulatory Medical Care Survey (NHAMCS), administered annually by CDC, captures patient visits in outpatient settings. These data can be used to determine diagnosis-specific visit rates, as well as visit-based antibiotic prescribing. Find more information about **Ambulatory Health Care Surveys** (http://www.cdc.gov/nchs/ahcd/about_ahcd.htm)

  □ Prevalence of Inappropriate Antibiotic Prescriptions Among US Ambulatory Care Visits, 2010-2011. Fleming-Dutra KE, Hersh AL, Shapiro DJ et al. JAMA. 2016 May 3; 315(17):1864-73. Available at www.ncbi.nlm.nih.gov/pubmed/27139059.

Electronic Health Record Data

- **Norway**: There is ongoing research in primary care where data from electronic health records have been used to better understand appropriate antibiotic use.

  □ Improving antibiotic prescribing in acute respiratory tract infections: cluster randomised trial from Norwegian general practice (prescription peer academic detailing (Rx-PAD) study). Gjelstad S, Høye S, Straand J, et al. BMJ. 2013 Jul 26; 347:f4403. https://www.ncbi.nlm.nih.gov/pubmed/23894178.

Quality Measures

- **European Union**: The ESAC-Net reports quality indicators for antimicrobial consumption in the community, for example, the relative consumption of quinolones; the ratio of the consumption of broad-spectrum to the consumption of narrow-spectrum penicillins, cephalosporins, and macrolides; and the seasonal variation of antibiotic consumption. **Quality indicators for antibiotic consumption in the community are available online** (https://ecdc.europa.eu/en/antimicrobial-consumption/database/quality-indicators).

ECDC, European Food Safety Authority (EFSA) and Emergency Medical Associates (EMA) recently proposed indicators for antimicrobial consumption in a **Joint Scientific Opinion publication** (https://www.efsa.europa.eu/en/efsajournal/pub/5017). For the community, the proposed indicator is the ratio of the consumption of broad-spectrum penicillins, cephalosporins, macrolides, and fluoroquinolones to the consumption of narrow-spectrum penicillins, cephalosporins, and macrolides.

- **Norway**: Norway's Interdepartmental Coordination Group uses quality indicators to measure implementation of the targets outlined in Norway's National Strategy against Antibiotic Resistance 2015–2020. The measures reported include:

    - Total human use in DDD/1000 inhabitants/day

    - Total use of antibiotics for respiratory tract infections

    - Proportion of narrow spectrum antibiotics

    - Number of prescriptions

  More information is available: **National Strategy against Antibiotic Resistance** (http://www.regjeringen.no/en/dokumenter/national-strategy-against-antibiotic-resistance/id2424598/).

- **United States**: The U.S. has several organizations that collect and report quality measures related to appropriate antibiotic use. One is the National Committee for Quality Assurance (NCQA) which currently reports on three measures that indicate if antibiotics are being used appropriately:

    - Appropriate testing for children with pharyngitis

    - Appropriate treatment for children with upper respiratory infections

    - Avoidance of antibiotics in adults with acute bronchitis

  The data used for performance measure reporting by NCQA is the **Healthcare Effectiveness Data and Information Set** (http://www.ncqa.org/hedis).

    - Variation in U.S. outpatient antibiotic prescribing quality measures according to health plan and geography. Roberts RM, Hicks, LA, Bartoces M. Am J Manag Care. 2016 Aug; 22(8):519-23. Available at www.ncbi.nlm.nih.gov/pubmed/27541698.

Inpatient Setting

National Prescribing Data

- **Canada**: Proprietary data are purchased from a vendor on the volume of antimicrobials purchased by hospitals. These data allow for an ecologic view of the amount of antimicrobials entering the hospital system, and for assessing changes over time. Canada reports these national data annually in the **CARSS Report** (http://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-2017-report-executive-summary.html).

Canada also collects antibiotic use data that has been prescribed within sentinel acute-care hospitals participating in the Canadian Nosocomial Infection surveillance Program (CNISP). Canada also publishes this data in the CARSS Report (page 98-101).

- **European Union**: The ESAC-Net collects data on antimicrobial use in EU Member States and two EEA countries (Iceland and Norway). ESAC-Net publishes the data in annual reports and on the ECDC website. The Member States submit either sales or reimbursement data, or a combination of both. ESAC-Net surveillance data on antimicrobial use are publicly available through an **interactive online database** (https://ecdc.europa.eu/en/antimicrobial-consumption/surveillance-and-disease-data/database).

- **Norway**: A national sales database captures total antibiotic consumption in individual hospitals. These data allow overview of volume of use and patterns of use. The sources do not include clinical information (i.e., infectious diagnosis), so appropriateness for individuals cannot be assessed, but aggregated data are assessed in view of guidelines for antibiotic prescribing. The data allows tracking of antibiotic prescribing over time in institutions and can be compared over time. Antibiotic use data are published in annual reports:

    - *Usage of Antimicrobial Agents and Occurrence of Antimicrobial Resistance in Norway. Tromsø / Oslo 2017*. Available at www.antibiotikaresistens.no.

    - **National Strategy against Antibiotic Resistance 2015–2020** (http://www.regjeringen.no/en/dokumenter/national-strategy-against-antibiotic-resistance/id2424598)

Administrative/Claims Data

- **United States**: CDC has used proprietary administrative data to estimate patterns of U.S. inpatient antibiotic use. These data can be used to examine antibiotics associated with patients admitted and then discharged from approximately 700 participating acute care hospitals.

    - Estimating National Trends in Inpatient Antibiotic use Among US Hospitals From 2006 to 2012.Baggs J, Fridkin S, Pollack L, et al. JAMA Intern Med. 2016;176(11):1639-1648. Available at https://www.ncbi.nlm.nih.gov/pubmed/27653796.

Electronic Health Record/Facility-Level Data

- **Norway**: Norway has ongoing research projects in hospital settings using data from electronic health records to understand appropriate antibiotic use.

    - Wathne JS, Kleppe LKS, Harthug S, Blix HS, Nilsen RM, Charani E; Bergen Intervention Teams, Smith I. The effect of antibiotic stewardship interventions with stakeholder involvement in hospital settings: a multicentre, cluster randomized controlled intervention study. Antimicrob Resist Infect Control. 2018 Sep 10;7:109. doi: 10.1186/s13756-018-0400-7. Available at https://aricjournal.biomedcentral.com/articles/10.1186/s13756-018-0400-7.

- **United States**: CDC's **National Healthcare Safety Network (NHSN) Antimicrobial Use Option's Standardized Antimicrobial Administration Ratio (SAAR)** (http://www.cdc.gov/nhsn/acute-care-hospital/aur/index.html) allows facilities to voluntarily submit electronic Medical Administration Record antibiotic use data. The SAAR is a metric developed to analyze and report antimicrobial use data in summary form allowing for benchmarking within a facility and among facilities according to different locations and antibiotic categories. The SAAR is not a direct assessment of appropriateness; it identifies where use appears to deviate from predicted use.

Quality Measures

- **European Union**: ECDC, EFSA, and EMA proposed a list of outcome indicators in regards to surveillance of antimicrobial resistance and antimicrobial consumption in humans and food-producing animals in a **Joint Scientific Opinion publication** (https://www.efsa.europa.eu/en/efsajournal/pub/5017). For the hospital sector, the proposed indicator is the consumption of glycopeptides, 3rd and 4th generation cephalosporins, monobactams, carbapenems, fluoroquinolones, polymyxins, piperacillin and enzyme inhibitor, linezolid, tedizolid, and daptomycin (DDD/1000 inhabitants and per day and % of total hospital use).

- **Norway**: Norway's Interdepartmental Coordination Group uses quality indicators to follow up on the targets in **Norway's National Strategy against Antibiotic Resistance 2015–2020** (http://www.regjeringen.no/en/dokumenter/national-strategy-against-antibiotic-resistance/id2424598). The measures reported for hospitals include the use of broad-spectrum antibiotics (hospitals).

Point Prevalence Surveys

- **Canada**: CNISP collects antibiotic use data from sentinel acute care hospitals via periodic point prevalence surveys (conducted approximately every five years). However, CNISP does not collect data on the indication of antibiotic use in these surveys. The CARSS also collects antibiotic use data from community, rural, and northern acute-care hospitals through prevalence surveys, including data on indication of use. CNISP and CARSS will publish the results as they become available.

- **European Union**: The Healthcare-Associated Infections Surveillance Network (HAI-Net), coordinated by ECDC, conducts point prevalence surveys of antimicrobial use in acute care hospitals at regular intervals. **2011-2012 publication** (https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/healthcare-associated-infections-antimicrobial-use-PPS.pdf).

- **Norway**: The Norwegian Institute of Public Health conducts mandatory point prevalence surveys focused on healthcare-associated infections and antimicrobial use in hospitals. Norwegian Institute of Public Health has gather the antibiotic use data since 2015 and it covers all hospitals in Norway. **Error! Hyperlink reference not valid.**

  - Broad-spectrum antibiotics in Norwegian hospitals. Holen Ø, Alberg T, Blix HS, et al. Tidsskr Nor Laegeforen. 2017 Mar 7;137(5):362-366. Available at www.ncbi.nlm.nih.gov/pubmed/28272566.

- **United States**: CDC's **Emerging Infections Program** (http://www.cdc.gov/ncezid/dpei/eip/index.html) has conducted multiple point prevalence surveys focused on healthcare-associated infections and antimicrobial use in hospitals and nursing homes. Participating EIP sites gather data from a sample of facilities.

  - Prevalence of antimicrobial use in US acute care hospitals, May-September, 2011. Magill SS, Edwards J, Beldavs Z, et al. JAMA. 2014 Oct 8; 312:1438-46. Available at www.ncbi.nlm.nih.gov/pubmed/25291579.

  - Vital signs: improving antibiotic use among hospitalized patients. Fridkin S, Baggs J, Fagan R, et al. MMWR Morb Mortal Wkly Rep. 2014 Mar 7, 63:194-200. Available at www.ncbi.nlm.nih.gov/pubmed/24598596.

Long-term Care and Nursing Homes

National Prescribing Data

- **United States**: The U.S. uses proprietary data purchased from a vendor to assess antibiotic transactions in nursing homes at national and state levels. CDC will use the data to track antibiotic prescribing trends and geographic variability over time in response to regulatory requirements to implement stewardship in nursing homes and identify opportunities to improve prescribing practices.

Electronic Health Record/Facility-Level Data

- **United States**: CDC is working with nursing home electronic health record and pharmacy vendors to quantify antibiotic use nationally and at the facility level and define the most useful antibiotic use benchmarks for the nursing home setting.

Point Prevalence Surveys

- **Canada**: The CARSS collects antibiotic use data from long-term care facilities across Canada via voluntary point prevalence surveys. Canada plans to conduct the surveys on a regular basis. Canada will publish results from the pilot of the prevalence surveys in the CARSS Report.

- **European Union**: The HAI-Net conducts point prevalence surveys of antimicrobial use in long-term care facilities at regular intervals: April May 2013 publication, **Point prevalence survey of healthcare-associated infections and antimicrobial use in European long-term care facilities** (https://ecdc.europa.eu/sites/portal/files/media/en/ publications/Publications/healthcare-associated-infections-point-prevalence-survey-long-term-care-facilities-2013.pdf)

- **Norway**: The Norwegian Institute of Public health conducts mandatory point prevalence surveys focused on healthcare-associated infections and antimicrobial use in long-term care facilities. Norway has gathered data on antibiotic use since 2015 and it covers all long-term care facilities.

  - **Norsk overvåkings-system for antibiotikabruk og helsetjeneste-assosierte infeksjoner (NOIS)** (https://www.fhi.no/hn/helseregistre-og-registre/nois/)

▫ Antibiotic use and infections in nursing homes. Alberg T, Holen Ø, Blix HS, et al. Tidsskr Nor Laegeforen. 2017 Mar 7; 137(5):357-361. Available at www.ncbi.nlm.nih.gov/pubmed/28272565

▪ **United States**: CDC's Emerging Infections Program has conducted point prevalence surveys to quantify healthcare-associated infections and antimicrobial use in a subset of nursing homes. CDC uses these data to estimate the national burden in U.S. nursing homes. CDC also uses data from this survey to assess the quality of prescribing for specific conditions, such as urinary tract infections. Findings from the pilot of the prevalence survey have been published:

▫ Prevalence of Antimicrobial Use and Opportunities to Improve Prescribing Practices in U.S. Nursing Homes. Thompson ND, LaPlace L, et al. J Am Med Dir Assoc. 2016 Dec 1; 17(12):1151-1153. Available at www.ncbi.nlm.nih.gov/pubmed/27751803.

▫ Measuring Antibiotic Appropriateness for Urinary Tract Infections in Nursing Home Residents. Eure T, LaPlace LL, Melchreit R, et al. Infect Control Hosp Epidemiol. 2017 Aug; 38(8):998-1001. Available at www.ncbi.nlm.nih.gov/pubmed/28560933.