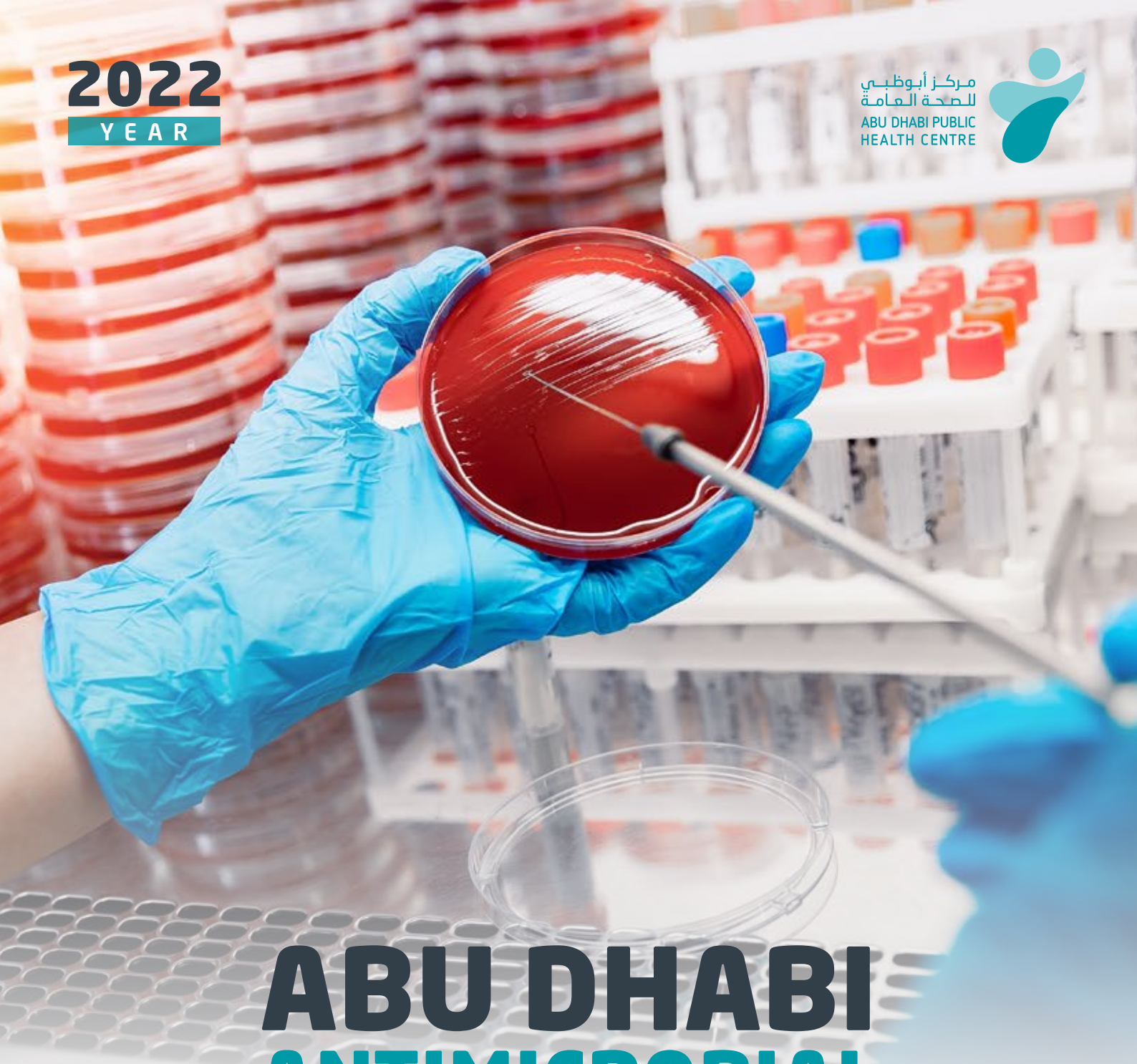
2022
YEAR

مركز أبوظبي للصحة العامة
ABU DHABI PUBLIC HEALTH CENTRE



# ABU DHABI ANTIMICROBIAL RESISTANCE AMR SURVEILLANCE REPORT

PUBLISHED IN 2023

This report is designed to provide insights and recommendations for healthcare workers and should not be used as content for media publication.

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# List of abbreviations

| | |
|---|---|
| **%I** | Percent Intermediate |
| **%MDR** | Percent Multidrug-Resistant |
| **%NS** | Percent Non-Susceptible |
| **%R** | Percent Resistance |
| **%S** | Percent Susceptible |
| **ADPHC** | Abu Dhabi Public Health Center |
| **AMR** | Antimicrobial Resistance |
| **AST** | Antimicrobial Susceptibility Test |
| **CA** | Community-Associated |
| **CLSI** | Clinical and Laboratory Standards Institute |
| **DOH** | Department of Health Abu Dhabi |
| **ECDC** | European Centre for Disease Prevention and Control |
| **EUCAST** | European Committee for Antimicrobial Susceptibility Testing |
| **ESBL** | Extended Spectrum Beta-Lactamase |
| ***E. coli*** | *Escherichia coli* |
| ***E. faecalis /E. faecium*** | *Enterococcus faecalis /Enterococcus faecium* |
| **GLASS** | Global AMR Surveillance System (WHO) |
| **HAAD** | Health Authority Abu Dhabi |
| **HAI** | Healthcare-Associated Infections |
| **HIS** | Hospital Information System |
| **ICU** | Intensive Care Unit |
| ***K. pneumoniae*** | *Klebsiella pneumoniae* |
| **LIS** | Laboratory Information System |
| **MDR** | Multidrug Resistance |
| **MIC** | Minimal Inhibitory Concentration |
| **MSSA** | Methicillin- (oxacillin-) susceptible Staph. aureus |
| **MRSA** | Methicillin- (oxacillin-) resistant Staph. aureus |
| ***M. tuberculosis*** | *Mycobacterium tuberculosis* |
| ***N. gonorrhoeae*** | *Neisseria gonorrhoeae* |
| **N** | Number |
| **NRL** | National Reference Lab |
| ***P. aeruginosa*** | *Pseudomonas aeruginosa* |
| **PHC** | Primary Healthcare Center |
| **PDR** | Pandrug-resistant |
| **RESP.** | Respiratory |
| ***S./Staph. aureus*** | *Staphylococcus aureus* |
| ***S. pneumoniae*** | *Streptococcus pneumoniae* |
| **SEHA** | Abu Dhabi Health Services Company |
| **Spp.** | Species |
| **UAE** | United Arab Emirates |
| **VRE** | Vancomycin-Resistant *Enterococci* |
| **WHO** | World Health Organization |
| **XDR** | Extensively drug resistant |

# Foreword

Antimicrobial resistance (AMR) emerged as one of the most pressing global public health challenges of our time, threatening the effectives of antibiotics and putting countless lives at risk. Therefore, the need for proactive surveillance and monitoring of AMR cannot be overemphasized.

AMR surveillance serves as a vital tool in understanding the patterns, trends and impact of drug resistance within our communities and healthcare systems. It enables us to identify emerging resistant strains, track their spread and assess the effectiveness of our interventions. By gathering and analyzing this information, we gain valuable insight into strategies that will be needed to combat AMR effectively.

Effective AMR surveillance requires collaboration and coordination across multiple sectors. By fostering partnerships and sharing data, we can establish a robust surveillance network, enabling us to detect and respond to AMR rapidly. Through surveillance and analysis, we empower healthcare professionals to make informed decisions and optimize patient care while preserving the effectiveness of our precious antimicrobial resources.

The Ministry of Health and Prevention, UAE Higher Committee for AMR, Abu Dhabi AMR Committee and the AMR focal points in participating surveillance sites and laboratories have actively engaged in extensive efforts to promote awareness, enhance surveillance, and develop evidence-based strategies to combat AMR. The Abu Dhabi Surveillance Program is aligned with these collective efforts, ensuring that we contribute effectively to the national strategies against AMR.

We extend our heartfelt appreciation to our esteemed colleagues and dedicated focal points within the network of participating laboratories and surveillance sites, and the AMR experts, for their tireless efforts, unwavering support, and invaluable contributions to the AMR surveillance network. Their dedication has been beneficial in the successful completion of this report. AMR surveillance is a key support in our efforts against antimicrobial resistance. Together, we can safeguard the effectiveness of antibiotics, protect public health, and build a healthier and more resilient world.


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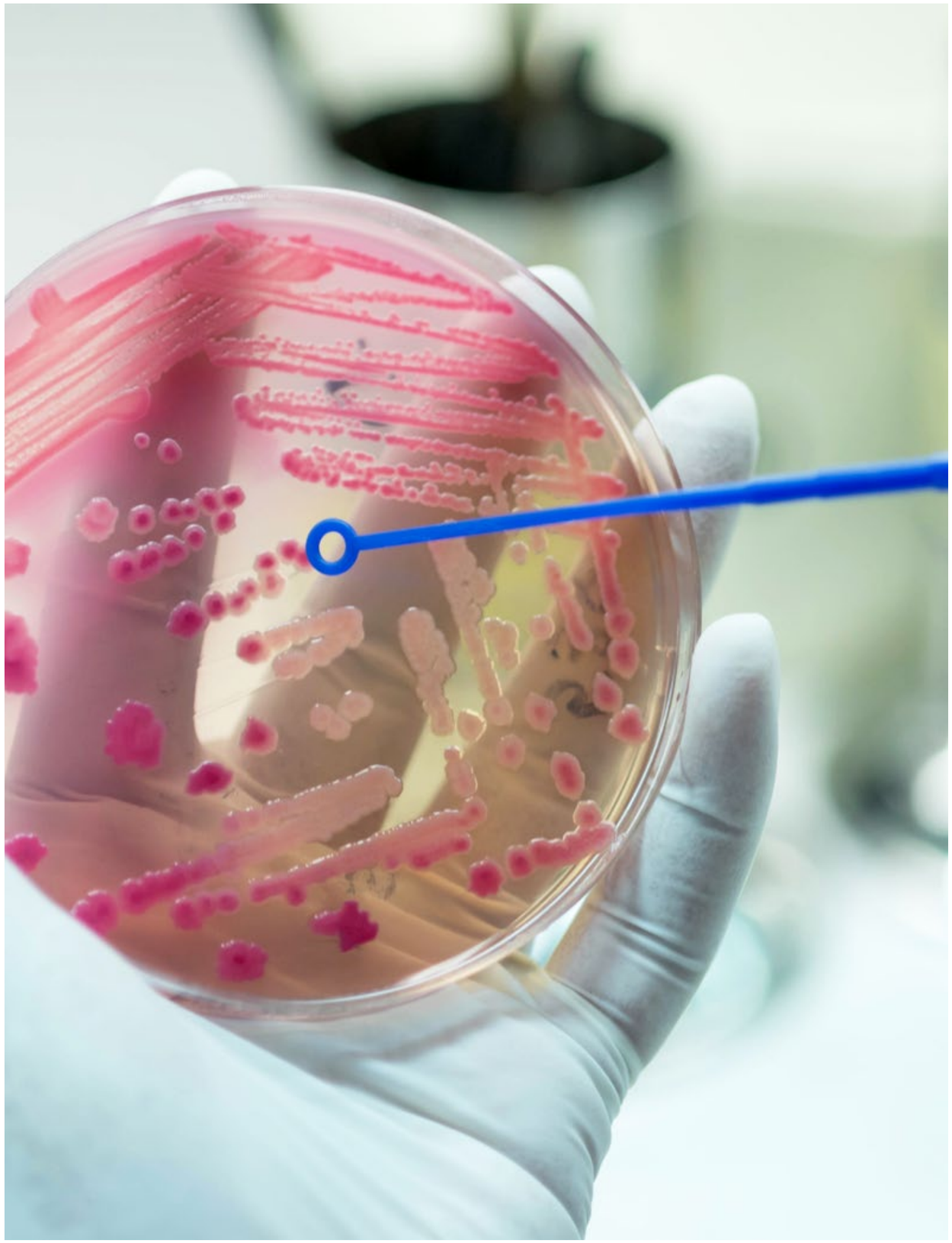


# 01 Executive Summary

The Abu Dhabi AMR surveillance report has been initiated to report and monitor the trend of antimicrobial resistance at the emirate level. The Abu Dhabi AMR surveillance program was implemented in 2010 and is actively contributing to the UAE National AMR Surveillance System which has been established by the Ministry of Health and Prevention.

It is a lab-based surveillance system and currently relies on a network of 17 clinical microbiology laboratories across all regions of the emirate of Abu Dhabi, providing microbiology services for 142 surveillance sites (hospitals, centers, and clinics).

This report presents AMR data on 129,466 isolates from surveillance sites (public and private sector) for the year of 2022. The report includes and compares the trends of priority pathogens over a 13-year reporting period (2010-2022). Data for the reporting year 2022 is presented in form of cumulative antibiograms, as well as more detailed statistics and annual trends for several AMR priority pathogens.

The report concludes by providing valuable recommendations for healthcare professionals on actions to combat AMR development.

# 02 Introduction

Antimicrobial resistance (AMR) has become a major threat to public health worldwide, including the Middle East and the Gulf Region. The impact of AMR on human health manifests in various ways, including prolonged hospital stays, treatment failures and loss of life. In addition, it increases the direct and indirect costs of healthcare.

Antimicrobial resistance (AMR) is the ability of a microorganism to resist the action of one or more antimicrobial medications. Without effective antimicrobials, the success of modern medicine in treating infections would be at an increased risk. Development of AMR is a natural phenomenon caused by mutations in bacterial genes, or by acquisition of exogenous resistance genes carried by mobile genetic elements that can spread horizontally between bacteria. Bacteria can acquire multiple resistance mechanisms and hence become resistant to numerous, or even all, antimicrobial agents used to treat them. This poses a significant challenge as it can greatly restrict the range of treatment options available for infections, while insufficient infection prevention and control measures facilitate the transmission of resistant pathogens.

According to World Health Organization (WHO), overuse and misuse of antimicrobials are the main drivers in the development of drug-resistant pathogens, and the transmission of antimicrobial-resistant microorganisms between humans, animals, and the environment. While antimicrobial use exerts ecological pressure on bacteria and contributes to the emergence and selection of new AMR.

**Table 2.1** provides a summary overview of the current level of AMR in 2022 among relevant and priority pathogens in the emirate of Abu Dhabi (percent resistant isolates, %R), in comparison with the recently published national data.

The overall resistance patterns observed in the Emirate of Abu Dhabi align with the trends observed at the national level, emphasizing the need for comprehensive strategies to address AMR effectively.

**Table 2.1 Current levels of AMR among relevant and AMR priority pathogens in Abu Dhabi compared to national data, Percentage resistant isolates (%R), 2022**

| Priority [a] | Organism | Antibiotic/ Antibiotic class | UAE number of isolates (2020) | % Resistant isolates in UAE (2020) | AD number of isolates (2022) | % Resistant isolates in AD (2022) |
|---|---|---|---|---|---|---|
| **Priority 1: Critical** | *Acinetobacter baumannii* | Carbapenems (IPM, MEM) | 1,772 | 21.9 | 683 | 13.8 |
| | *Pseudomonas aeruginosa* | Carbapenems (IPM or MEM) | 7,322 | 14.5 | 5,441 | 17.0 |
| | Enterobacterales (all) | Carbapenems (IPM or MEM) | 43,085 | 4.0 | 47,827 | 3.1 |
| | *Escherichia coli* | Carbapenems (IPM or MEM) | 26,335 | 1.0 | 20,276 | 0.8 |
| | *Klebsiella pneumoniae* | Carbapenems (IPM or MEM) | 10,760 | 4 | 7,851 | 3.8 |
| | Enterobacterales (all) | Ceftriaxone/ Cefotaxime (ESBL)[b] | 33,273 | 27.6/25.0 | 26,153 | 29.4/24.8 |
| | *Escherichia coli* | Ceftriaxone/ Cefotaxime (ESBL)[b] | 19,103 | 33.0/30.3 | 15,906 | 34.7/30.4 |
| | *Klebsiella pneumoniae* | Ceftriaxone/ Cefotaxime (ESBL)[b] | 7,544 | 29.0/23.0 | 5,979 | 26.2/20.3 |
| **Priority 2: High** | *Enterococcus faecium* | Vancomycin (VRE)[c] | 338 | 8.9 | 238 | 11.3 |
| | *Staphylococcus aureus* | Oxacillin (MRSA)[d] | 14,103 | 35.1 | 10,506 | 36.6 |
| | *Salmonella spp.* (non-typh.) | Fluoroquinolones (ciprofloxacin) | 149 | 5.4 | 546 | 12.6 |
| | *Neisseria gonorrhoeae* | 3rd-generation cephalosporins | 245 | 1.2 | 64 | 0.0 |
| | *Neisseria gonorrhoeae* | Fluoroquinolones (ciprofloxacin) | 272 | 90.0 | 63 | 65.1 |
| **Priority 3: Medium** | *Streptococcus pneumoniae* | Penicillin (oral) | 442 | 13.8 | 494 | 9.5 |
| | *Streptococcus pneumoniae* | Penicillin (meningitis) | 442 | 45.5 | 494 | 66.0 |
| | *Streptococcus pneumoniae* | Penicillin (non-meningitis) | 442 | 3.2 | 494 | 1.2 |
| | *Haemophilus influenzae* | Ampicillin | 723 | 30.7 | 188 | 35.6 |
| | *Shigella spp.* | Fluoroquinolones (ciprofloxacin) | 45 | 20.0 | 43 | 44.2 |

[a] Based on: (WHO, 2017), (Tacconelli, et al., 2018).
[b] ESBL: Extended-spectrum beta-lactamase producer (based on resistance to ceftriaxone and/or cefotaxime),
[c] VRE: Vancomycin-resistant *Enterococcus faecium,*
[d] MRSA: Methicillin (oxacillin)-resistant *S. aureus.*

# 03 Methodology

## 3.1. Data Generation

### 3.1.1. AMR Surveillance System

Public health surveillance is a continuous and systematic collection, analysis, interpretation, and dissemination of health-related data needed for the planning, implementation, and evaluation of public health practice.

AMR Surveillance is used to enhance the understanding of the epidemiology of AMR and can be utilized to:

- Distinguish emerging AMR trends and predict trends of antimicrobial resistance in the emirate level generally and in clinical settings more specifically.
- Create local cumulative antibiograms.
- At healthcare facility levels, it helps to identify clusters and potential outbreaks of community-associated (CA) and healthcare-acquired infections (HAI).
- Monitor and guide the effectiveness of antimicrobial stewardship programs (ASP).
- Develop antibiotic guidelines for common infections, and provide healthcare professionals with empiric antimicrobial treatment choices, tailored to the antibiotic resistance epidemiology in the patient's geographic region and setting.

### 3.1.2. Surveillance Sites:

- The surveillance sites and laboratories are key to generating and collecting AMR surveillance data and reporting it Abu Dhabi Public Health Center (ADPHC) AMR team for AMR surveillance.
- The AMR data submitted includes routine clinical and antibiotic susceptibility testing data from both public and private healthcare facilities.
- Surveillance sites and labs included in this report were identified based on epidemiological needs/gaps, followed by an initial assessment of their location, facility type and size, accessibility, availability of data in the required quality and format, and readiness and willingness to participate. Once identified, strict criteria for participation were applied, including the ability of generating and reporting high quality AMR data, having qualified staff, a quality management system, participation in external quality control and lab accreditation.

### 3.1.3. Surveillance Sites Selection:

- An important step in setting up an AMR surveillance system is the selection of representative surveillance sites that meet the minimal criteria for AMR isolate-level surveillance. While it is ideal to collect data from all facilities in the country, this is often not feasible for obvious and practical reasons. Hence, AMR surveillance is often based on a subset of participating health care facilities and laboratories (AMR surveillance sites). While there is no restriction on the number of sites participating in AMR surveillance, several criteria are recommended for inclusion of the sites, the most important of which is achieving local/regional representation.

- According to WHO GLASS system, when selecting a potential AMR surveillance site, the following criteria should be considered:
- Support and coordination from facility staff to participate in surveillance to comply with protocols for collecting specimens and to generate the necessary clinical, demographic, and epidemiological data.
- Availability of and accessibility to a laboratory with the capacity and capability to perform microbiological diagnostic testing, adequate staffing levels, equipment, and a reliable supply chain.
- Quality laboratory capacity diagnostics/ confirmation and antimicrobial susceptibility testing (AST), logistical feasibility to routinely collect and transport clinical specimens.
- Ability to manage and report surveillance data.
- Sufficient number of patients and volume of laboratory diagnostic activity to allow a meaningful analysis of surveillance data (population- based);
- Demographic, socioeconomic and geographic representativeness.
- Representation of different levels of health care (tertiary, primary, inpatient, outpatient, ICU, adults, Pediatrics etc) .
- Combination of public and private healthcare facilities.

### 3.1.4. Identification of Organisms:

- Participating microbiology laboratories use at least one commercial, automated system for identification of bacteria and/or yeast, including VITEK-2, BD Phoenix, and others such as MicroScan.

### 3.1.5. Antimicrobial Susceptibility Testing (AST):

- Microbiology laboratories use at least one commercial, automated system for routine antimicrobial susceptibility testing, while some use manual testing methods (disc diffusion/ Kirby Bauer). Selected organisms (like Haemophilus or Neisseria) are routinely tested by manual methods (disc diffusion) as per CLSI guideline recommendations. All labs follow the CLSI guidelines for antimicrobial susceptibility testing of bacteria (CLSI-M100) and fungi (CLSI-M60) (CLSI, 2022).

### 3.1.6. Interpretation of Susceptibility Testing Results:

- For interpretation of susceptibility testing results for fungi and yeast, all participating laboratories are routinely applying the CLSI guidelines. If CLSI has not set breakpoints for a certain pathogen/antibiotic combination, then other guidelines are applied and considered, including EUCAST guidelines (EUCAST, 2022) (for tigecycline and amphotericin B), or CDC tentative guidelines (CDC C. auris, 2020) for Candida auris.



- AST data submitted to the AMR surveillance team includes information on the specimen type, specimen collection date, organism name, antibiotic name, AST test method used as well as the measured and/or interpreted AST test results. Wherever available and technically feasible, the measured and numerical AST result are collected and used for the analysis, otherwise the locally interpreted AST result (S/I/R) is used instead.
- Clinical and demographic data for each isolate is extracted from hospital/laboratory information systems (HIS/LIS) when available and technically feasible. This includes information on e.g., patient date of birth, age, gender, nationality, location, location type, clinical specialty/ department, date of admission/discharge, health outcome, etc. Please refer to Annex (1) for further information about the data fields.

### 3.1.7. Clinical and Demographic Data:

- Clinical and demographic data for each isolate is extracted from hospital/laboratory information systems (HIS/LIS) wherever available and technically feasible (82.4%, 14/17 labs)). This includes information on e.g., patient date of birth, age, gender, nationality, location, location type, clinical specialty/department, date of admission/discharge, health outcome, etc.

### 3.1.8. Quality Control:

- All participating microbiology laboratories must comply with governmental quality standards for clinical laboratories and are:
- Operated by a licensed healthcare provider.
- Either lab-accredited, or in the final steps of lab-accreditation, e.g ISO 15189.
- Headed by a licensed clinical pathologist or clinical microbiologist.
- Expected to conduct routine internal quality control testing (ATCC).
- Successfully participating in at least one internationally recognized, external quality assurance program (EQAS), i.e., CAP Pt, ACP-MLE, Joint Commission International (JCI), or REQAS.

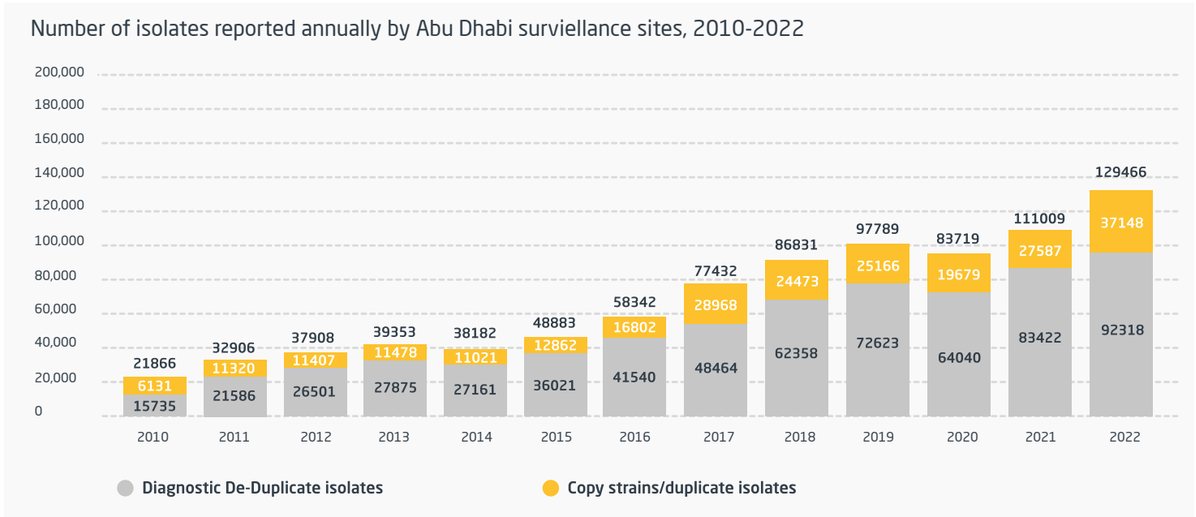
## 3.2. Data Collection

Selected focal points at participating surveillance sites should submit AMR data for the participating sites on a regular basis to the ADPHC AMR Surveillance team (annually, by the end of January of the following year).

The reporting protocol is in line with the UAE national AMR surveillance protocol, which has adopted the global reporting protocols for AMR surveillance (WHO-GLASS, 2015).
The 2022 AMR Surveillance report includes all participating healthcare facilities in the Emirate of Abu Dhabi, minor variation might be reflected in this report in comparison to the national AMR surveillance report. The data reported from 2021 and 2022 may have been affected by the COVID-19 pandemic, potentially due to underreporting of AMR isolates or other unidentified reasons.

Since the start of the AMR surveillance system in Abu Dhabi in 2010, the number of bacterial and fungal isolates reported by participating surveillance sites has increased significantly, as shown in **Figure 3.2.**

**Figure 3.2: Number of isolates reported by Abu Dhabi AMR surveillance sites, by year (2010-2022)**




The Abu Dhabi AMR surveillance system collects information on all bacteria and yeast grown by cultural methods and tested for antimicrobial susceptibility at the participating facilities. For analysis and public health reporting, it focuses then on the following eleven bacterial and fungal pathogens of public health and clinical importance (enhanced surveillance for AMR priority pathogens):

- *Escherichia coli (E. coli)*
- *Klebsiella pneumoniae (K. pneumoniae)*
- *Salmonella* spp. (non-typhoidal)
- *Pseudomonas aeruginosa (P. aeruginosa)*
- *Acinetobacter* spp.
- *Staphylococcus aureus (S. aureus)*
- *Streptococcus pneumoniae (S. pneumoniae)*
- *Enterococcus faecalis (E. faecalis)*
- *Enterococcus faecium (E. faecium)*
- *Candida* spp.
- *Mycobacterium tuberculosis.*

### 3.2.1. Data Submission:

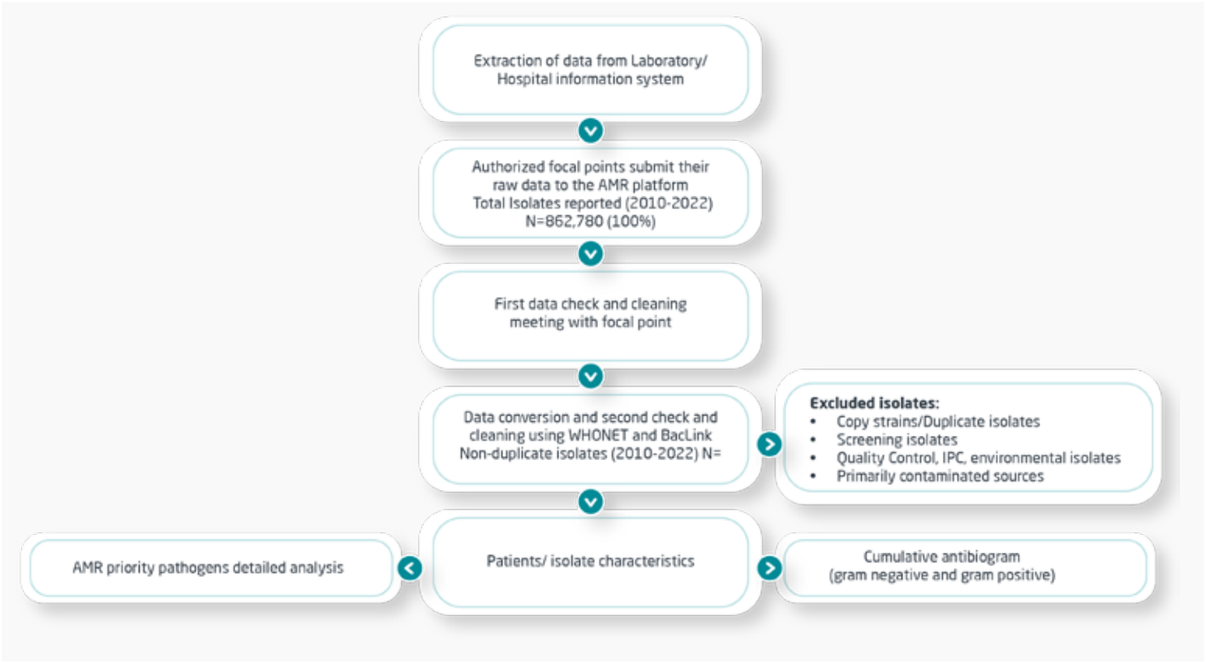
At the healthcare facility level, AMR data is collected and exported from the laboratory/ hospital-information systems (LIS/HIS) or from semi-automated, commercial AST systems. Authorized AMR focal points are submitting the data through a secure file upload platform (https://bpmweb.doh.gov.ae/UserManagement/MainPage.html/) or by Email attachment to AMR@adphc.gov.ae.

The file type preferred to be submitted is in the format of Microsoft Excel (HIS/LIS data files) or CSV text file (e.g. VITEK files). All surveillance sites are encouraged to have their AST machines interfaced with their health information system. Rarely, but still acceptable, few labs which don't have interfaced systems can submit data files which include the results as extracted from AST machines directly (e.g., VITEK-2 or BD Phoenix)**.**

### 3.2.2. Data Cleaning:

After submission of AMR data, the raw data is initially checked and cleaned for plausibility, quality, completeness, and feedback is communicated to the AMR focal point at the surveillance site. If needed, AMR focal points are asked to verify, update, and resubmit the data as applicable. At the ADPHC level, any remaining identifiable quality control strains and screening data is removed from the raw data before further processing and analysis. After conversion of AMR raw data to WHONET format using the BacLink tool, each WHONET AMR data file is checked and cleaned again using a SQLite database browsing tool (DB Browser7). Finally, all WHONET AMR data files are added to Abu Dhabi AMR surveillance database (WHONET, 2022). Figure 3.2.2 illustrates the process in the details.

**Figure 3.2.2 AMR surveillance report data generation and cleaning process**



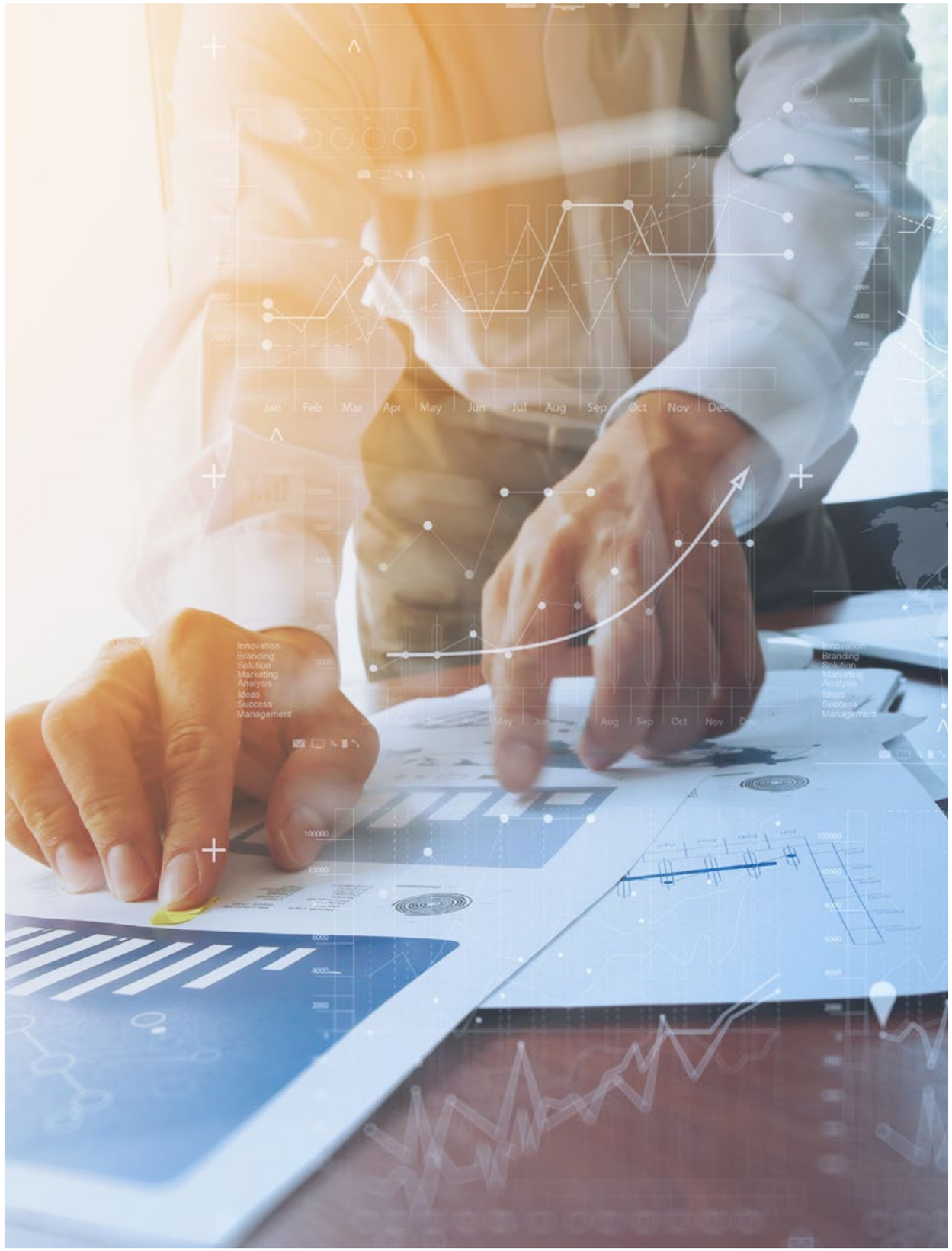
### 3.3. Data Analysis:

Data analysis is conducted using the WHONET 2022 Software for Antimicrobial Resistance Surveillance.

The following data were excluded from analysis, if technically feasible:

- Internal quality control isolates (e.g., weekly ATCC QC strains)
- External quality control isolates (EQAS, i.e., CAP-Pt, ACP-MLE, RCPA, REQAS)
- Isolates labelled as 'screening', 'validation', 'verification', 'proficiency testing', or similar
- Suspected screening isolates, e.g.:
  - *S. aureus* isolates from axilla, nose, groin, umbilicus and perineum
  - *S. agalactiae* (GBS) isolates from vagina (LVS, HVS, rectovaginal, etc.)
- Duplicate isolates (copy strains) i.e., only the first isolate per patient, specimen type and species during the reporting period (one year) was included
- Isolates from primarily contaminated specimen types (e.g. pedibag)
- Other non-diagnostic isolates (e.g. from environmental sampling or for infection control investigations)
- Species for which less than 10 isolates are available for analysis
- Antimicrobial agents that are selectively/not routinely tested (i.e. less than 70% of isolates were tested).
- Antimicrobial susceptibility testing results are presented as the proportion of isolates of a specific microorganism that are:
  - Susceptible (S)
  - Intermediate (I)
  - Resistant (R)
  - Non-Susceptible (NS, i.e. I+R) to a specific antimicrobial agent.

For example, the number of *E. coli* isolates resistant to ciprofloxacin is divided by the total number of *E. coli* isolates in which susceptibility to this antibiotic was tested.



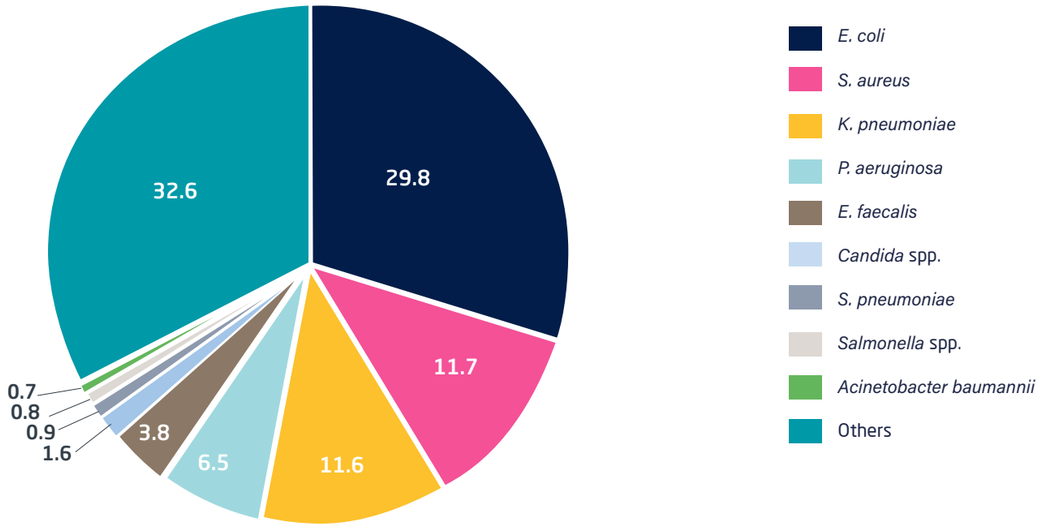
# 04 Results

## 4.1. Patient/ Isolates characteristics

### 4.1.1. Pathogen distribution:

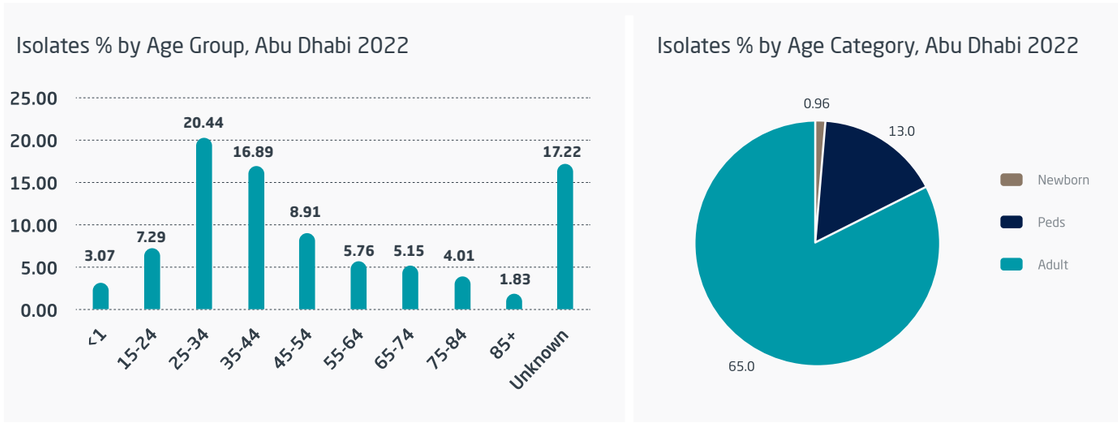
For 2022, all AMR priority pathogens together accounted for 67.4% of the total reported isolates. The most frequently reported pathogens were *E. coli* (29.8 %%) followed by *S. aureus* (11.7%), *K. pneumoniae* (11.6%), and *P. aeruginosa* (6.5%) (Figure 4.1.1).

**Figure 4.1.1: Distribution of reported AMR priority pathogens in Abu Dhabi 2022, by pathogen**



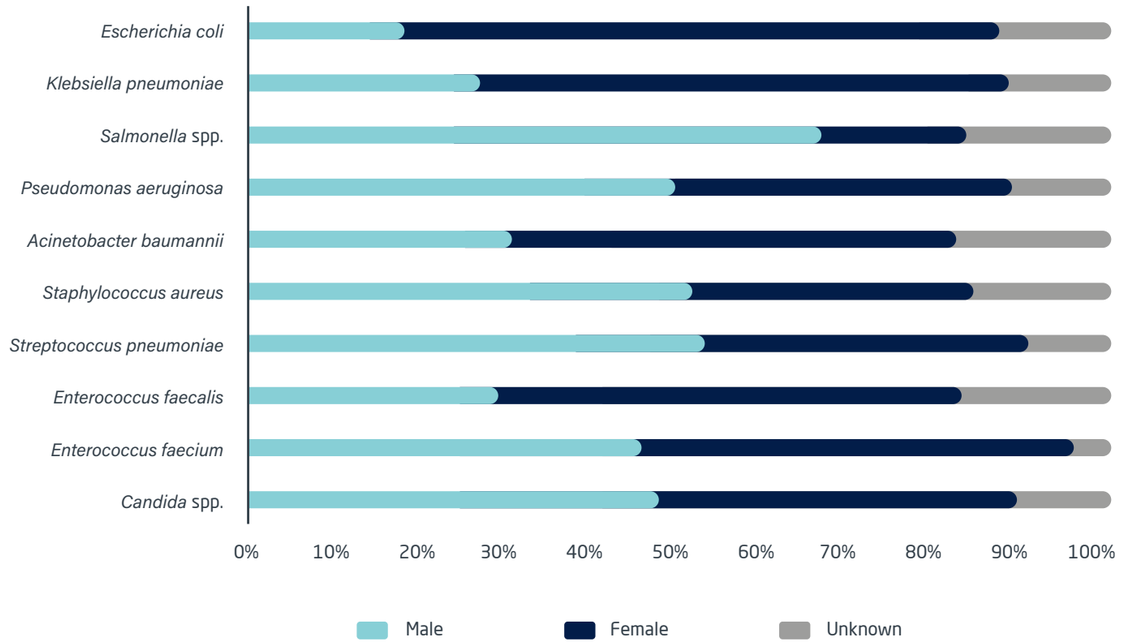

### 4.1.2. Age-group:

**Figure 4.1.2: Distribution of reported AMR Priority pathogens Abu Dhabi 2022, by age group and age category**



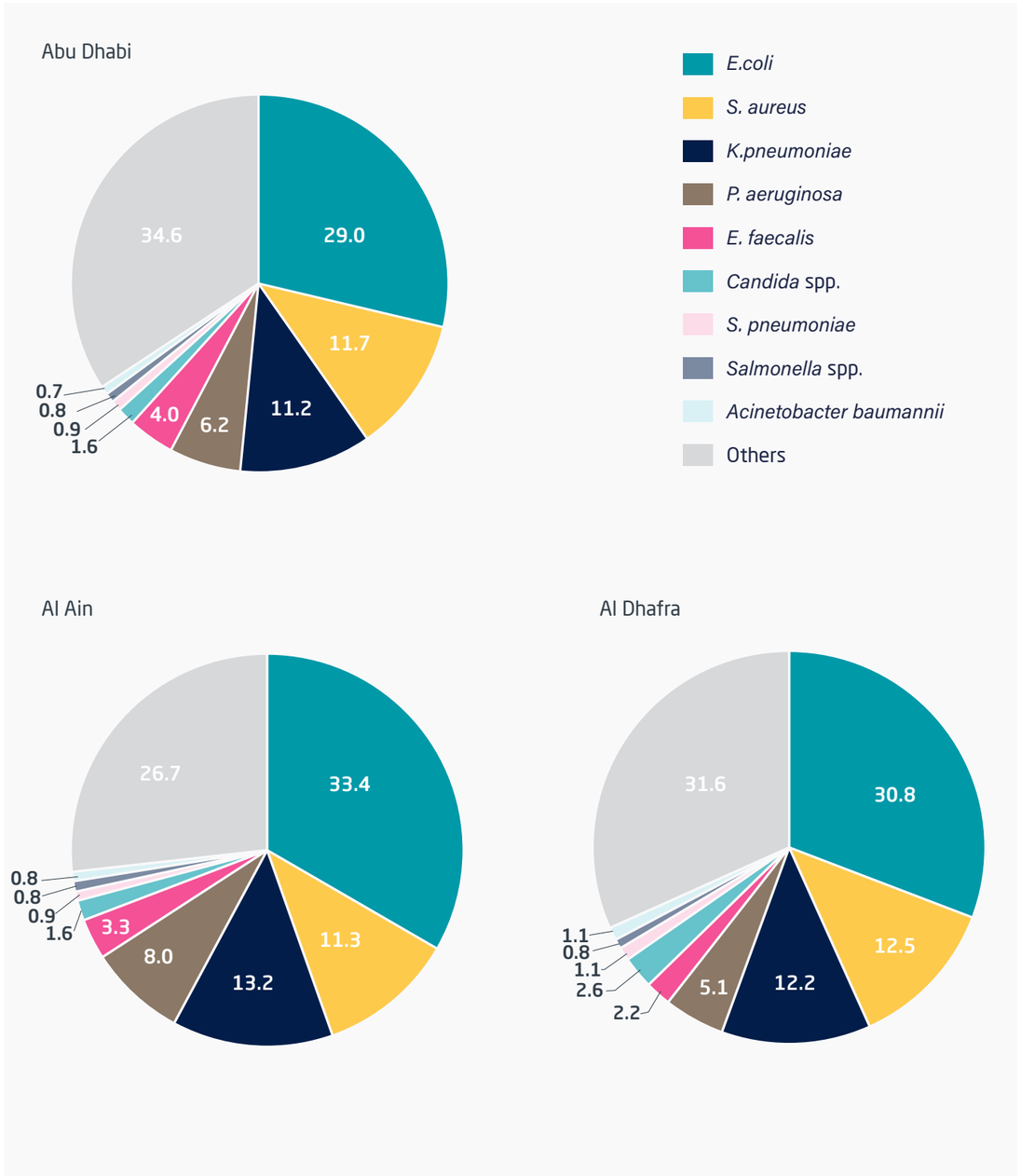

### 4.1.3. Gender

**Figure 4.1.3: Distribution of reported AMR priority pathogens Abu Dhabi 2022, by gender**



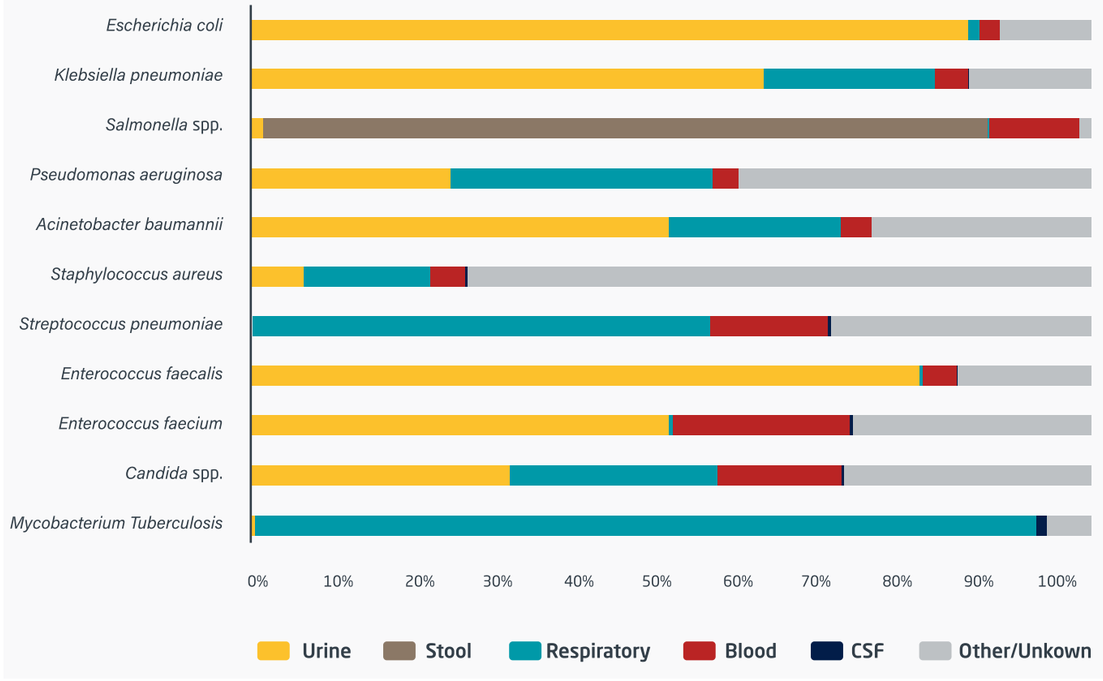
## 4.1.4. Region

**Figure 4.1.4: Distribution of all reported AMR priority pathogens among Abu Dhabi Regions, 2022**




## 4.1.5. Isolate source

**Figure 4.1.5: Distribution of all reported AMR priority pathogen among all Abu Dhabi Regions, by isolate source**



# 05 AMR Priority Pathogens

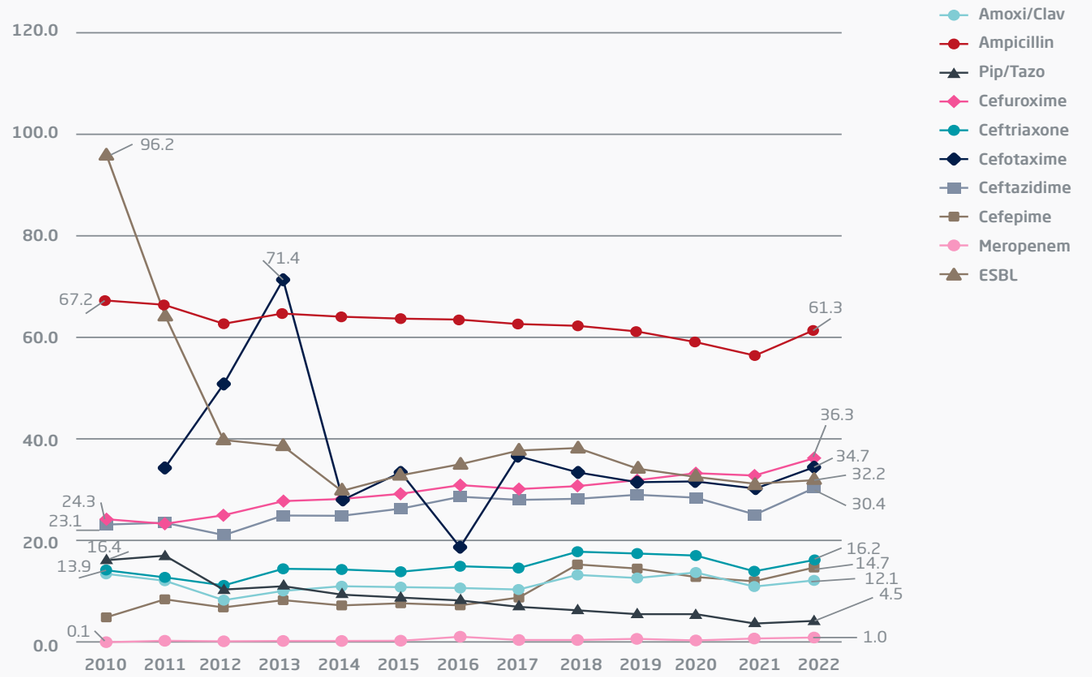
## 5.1. *Escherichia coli*

**Table 5.1: Percentages of resistant isolates for *Escherichia coli*, isolates from all sources, Abu Dhabi 2022 (total number of *E. coli* isolates= 27,545)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Ampicillin | 26,000 | 61.3 | 1.1 | 37.5 |
| Amoxicillin/clavulanic acid | 26,011 | 12.1 | 10.1 | 77.8 |
| Piperacillin/tazobactam | 26,644 | 4.5 | 1.1 | 94.4 |
| Cefuroxime (oral) | 15,633 | 36.3 | 5.6 | 58.0 |
| Ceftriaxone | 12,708 | 34.7 | 0.3 | 65.0 |
| Cefotaxime | 15,905 | 30.4 | 0.9 | 68.7 |
| Extended-spectrum β-lactamase | 12,446 | 32.2 | 0.0 | 67.8 |
| Ceftazidime | 22,258 | 16.2 | 2.4 | 81.4 |
| Cefepime | 22,336 | 14.7 | 4.5 | 80.8 |
| Ertapenem | 17,342 | 2.1 | 0.3 | 97.5 |
| Imipenem | 20,276 | 0.8 | 0.8 | 98.4 |
| Meropenem | 24,172 | 1.0 | 0.3 | 98.7 |
| Gentamicin | 27,429 | 8.6 | 0.4 | 91.0 |
| Tobramycin | 5,602 | 8.1 | 4.5 | 87.4 |
| Amikacin | 23,098 | 0.3 | 0.1 | 99.6 |
| Ciprofloxacin | 26,912 | 30.7 | 6.0 | 63.3 |
| Trimethoprim/sulfamethoxazole | 27,342 | 35.0 | 0.0 | 65.0 |
| Fosfomycin[a] | 11,241 | 1.1 | 0.1 | 98.8 |
| Nitrofurantoin | 26,232 | 2.0 | 3.0 | 95.0 |
| Multidrug-resistant[b] | 27,545 | 42.2 | - | - |
| Extensive Drug resistance (possible) | 27,545 | 2.5 | - | - |
| Pan-drug resistance (possible) | 27,545 | 0.05 | - | - |

[a] Fosfomycin and Nitrofurantoin: Isolates from urinary tract only.
[b] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).

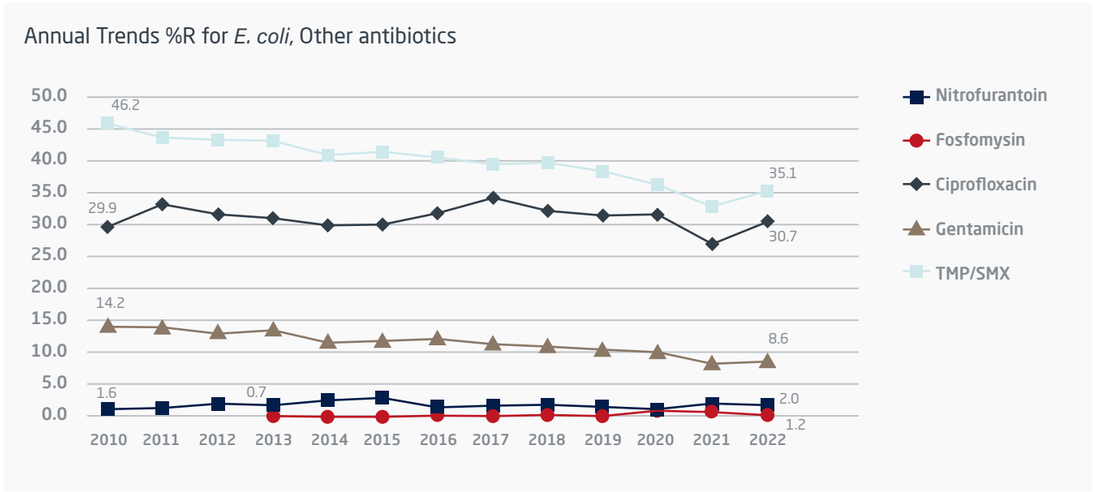
**Figure 5.1.1.: Annual trends for percentage of isolates resistant (%R) for *Escherichia coli*, Abu Dhabi, 2010-2022 - Beta-lactam Antibiotics**




For beta-lactam antibiotics, *Escherichia coli* shows increasing trends of resistance for

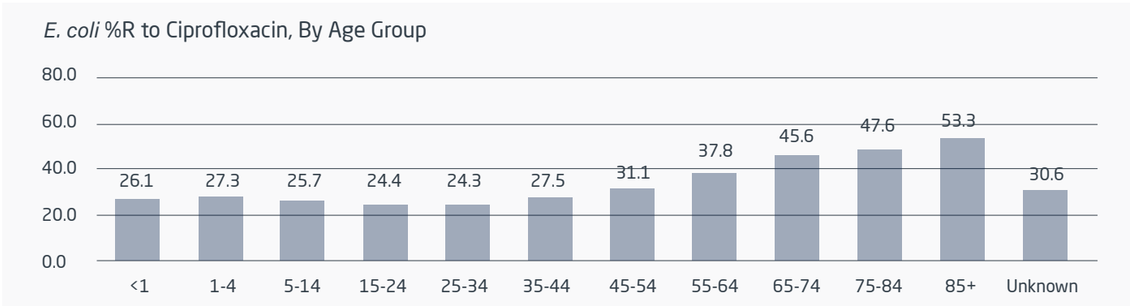
- Slight increase of percentages noted for second-generation (cefuroxime), third-generation (cefotaxime, ceftriaxone, ceftazidime) and fourth-generation cephalosporins (cefepime).
- Broad-spectrum penicillins trends are decreasing for piperacillin/tazobactam and amoxicillin/clavulanic acid.
- Resistance to carbapenems (imipenem, meropenem) is low (≤1%).

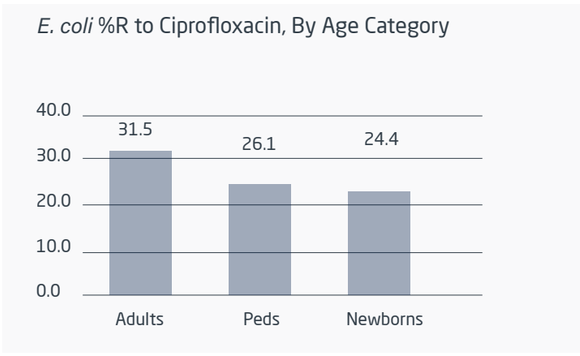
## Figure 5.1.2: Annual trends for percentage of isolates resistant (%R) for *Escherichia coli*, Abu Dhabi, 2010-2022 - Other antibiotics

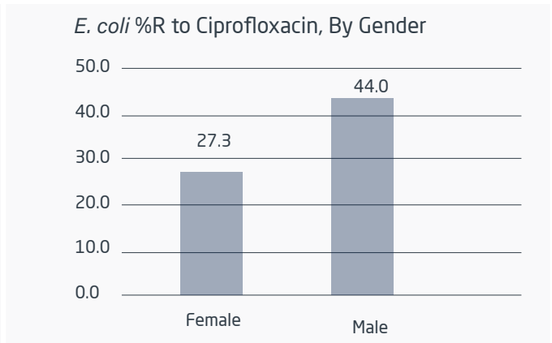


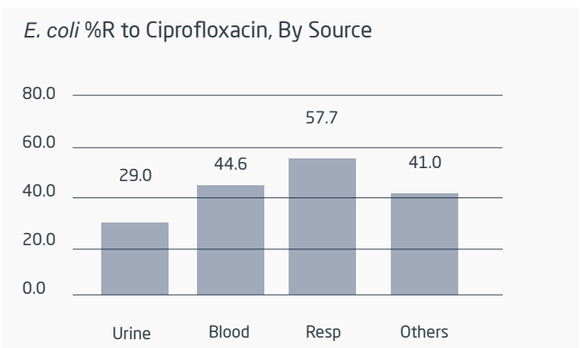

*E. coli* shows fluctuating trends of resistance for Fluoroquinolones (ciprofloxacin) and decreasing or horizontal trends of resistance for Trimethoprim/sulfamethoxazole, aminoglycosides (Gentamicin) and Nitrofurantoin.

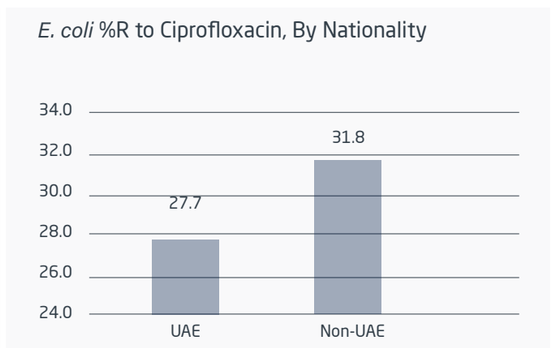
## Figure 5.1.3 Percentage of isolates resistant (%R) to fluoroquinolones (ciprofloxacin) for *Escherichia coli*, Abu Dhabi 2022 - By age group, age category, gender, nationality status, isolate source, and patient location type

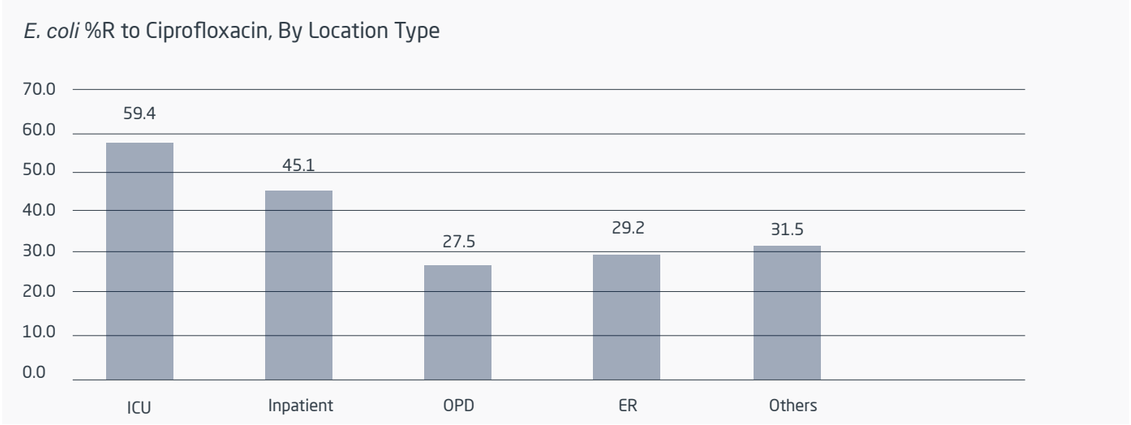


## 5.2. *Klebsiella pneumoniae*

**Table 5.2: Percentages of resistant isolates for *Klebsiella pneumoniae*, isolates from all sources, Abu Dhabi 2022 (Total number of *K. pneumoniae* isolates=10,727)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Ampicillin | 10,169 | 86.6 | 11.8 | 1.6 |
| Amoxicillin/clavulanic acid | 9,797 | 14.3 | 5.6 | 80.1 |
| Piperacillin/tazobactam | 10,471 | 10.1 | 3.6 | 86.2 |
| Cefuroxime (oral) | 6,061 | 29.8 | 1.4 | 68.7 |
| Ceftriaxone | 5,123 | 26.0 | 0.7 | 73.3 |
| Cefotaxime | 5,979 | 20.3 | 1.9 | 77.8 |
| Extended-spectrum β-lactamase | 4,799 | 21.2 | - | 78.8 |
| Ceftazidime | 8,784 | 17.8 | 3.9 | 78.3 |
| Cefepime | 8,747 | 11.8 | 3.0 | 85.2 |
| Ertapenem | 6,796 | 5.2 | 0.4 | 94.3 |
| Imipenem | 7,851 | 3.8 | 1.6 | 94.6 |
| Meropenem | 9,515 | 3.8 | 0.4 | 95.8 |
| Gentamicin | 10,672 | 5.7 | 0.4 | 93.8 |
| Tobramycin | 2,542 | 7.1 | 3.0 | 89.9 |
| Amikacin | 8,893 | 2.3 | 0.4 | 97.3 |
| Ciprofloxacin | 10,511 | 19.0 | 4.6 | 76.4 |
| Trimethoprim/sulfamethoxazole | 10,640 | 20.1 | 0.0 | 79.8 |
| Nitrofurantoin [a] | 7,365 | 19.9 | 46.1 | 34.0 |
| Multidrug-resistant [b] | 10,727 | 23.8 | - | - |
| Extensive Drug resistance (possible) | 10,727 | 6.5 | - | - |
| Pan-drug resistance (possible) | 10,727 | 1.10 | - | - |

[a] Nitrofurantoin: Isolates from urinary tract only.
[b] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).

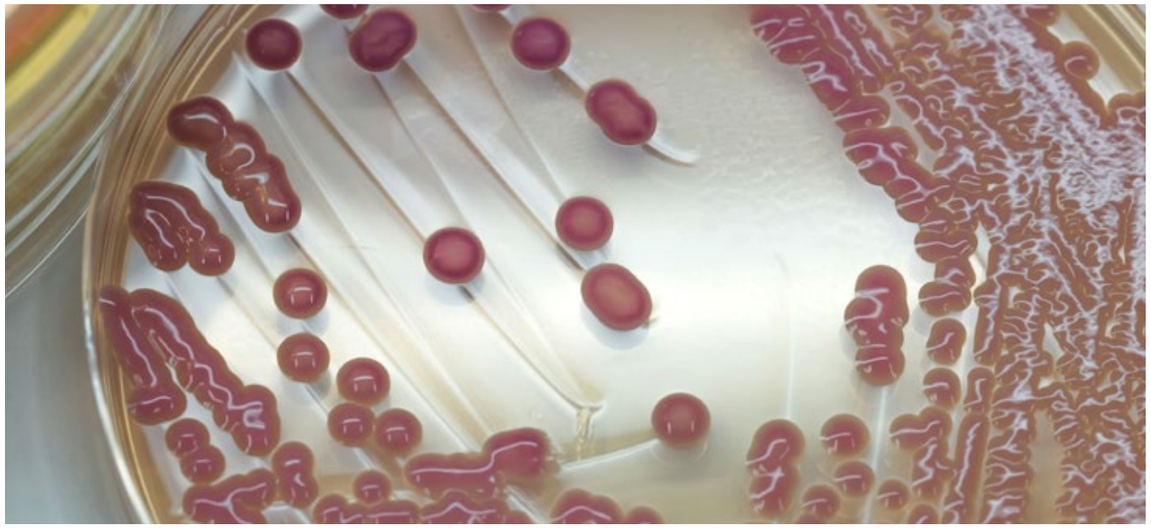
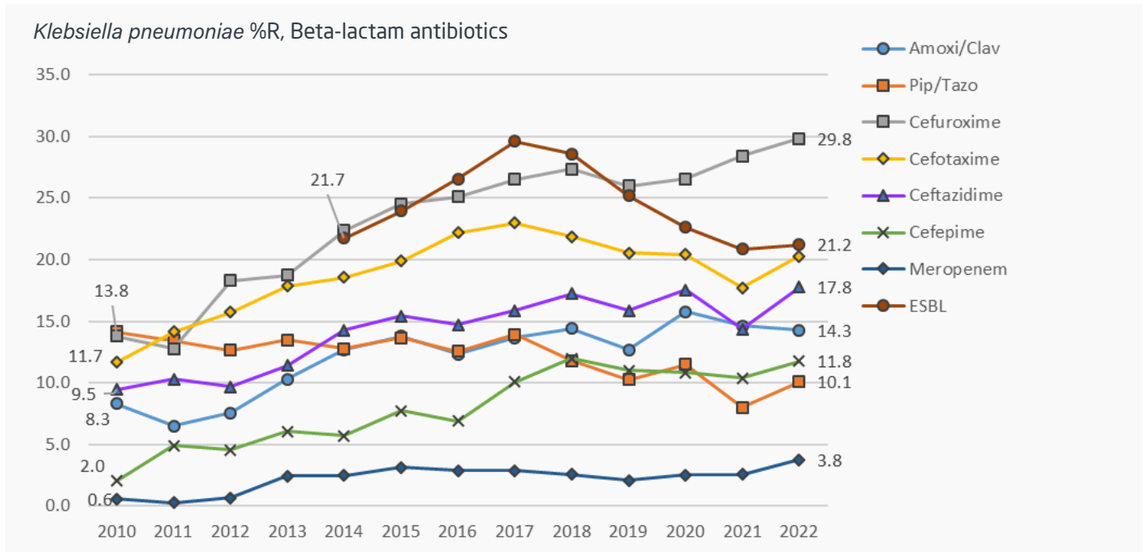


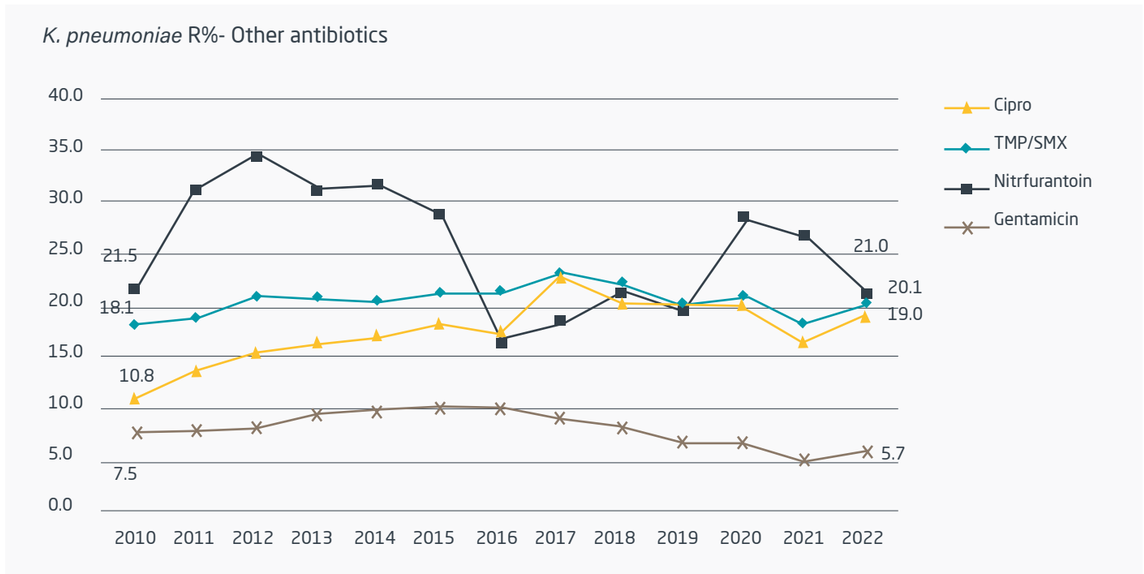
**Figure 5.2.1: Annual trends for percentage of isolates resistant (%R) for Klebsiella pneumoniae, Abu Dhabi, 2010-2022 - Beta-lactam Antibiotics**




*Klebsiella pneumoniae* shows overall increasing trends of resistance for most beta-lactam antibiotics including:

- Broad-spectrum penicillins (amoxicillin/clavulanic acid) – but not piperacillin/ tazobactam,
- Second-generation (cefuroxime), third-generation (ceftazidime, cefotaxime) and fourth-generation (cefepime) cephalosporins,

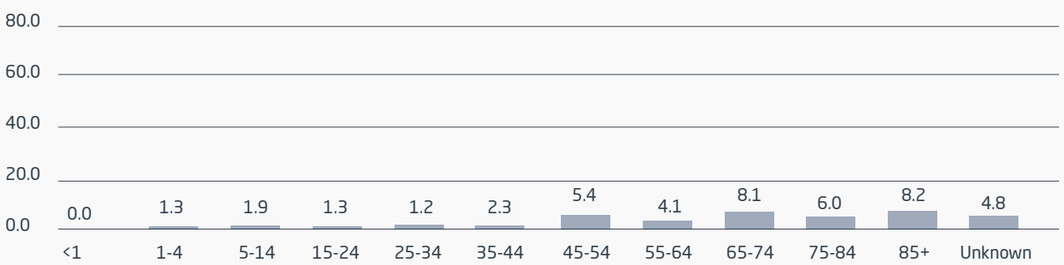
**Figure 5.2.2: Annual trends for percentage of isolates resistant (%R) for *Klebsiella pneumoniae*, Abu Dhabi, 2010-2022 - Other antibiotics**



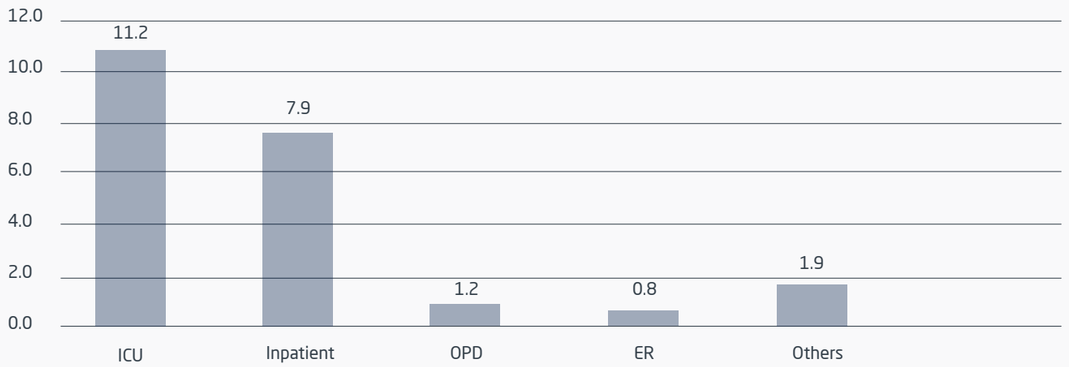

*Klebsiella pneumoniae* shows increasing trends of resistance to fluoroquinolones (ciprofloxacin) and a fluctuating, but overall decreasing trend of resistance to nitrofurantoin.

**Figure 5.2.3: Percentage of isolates resistant (%R) to Meropenem for *Klebsiella pneumoniae*, Abu Dhabi 2022 - By age group, age category, gender, nationality status, isolate source, and patient location type**

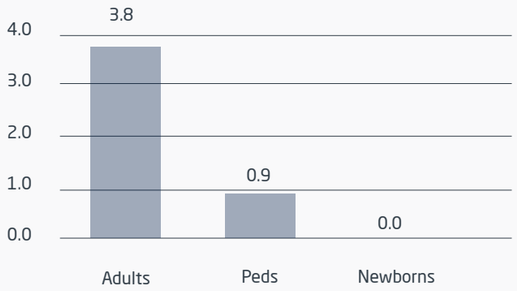
*Klebsiella pneumoniae* R% to Meropenem, by Age Group



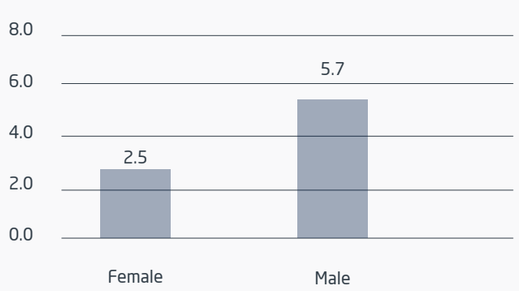

*Klebsiella pneumoniae* R% to Meropenem, by Location Type



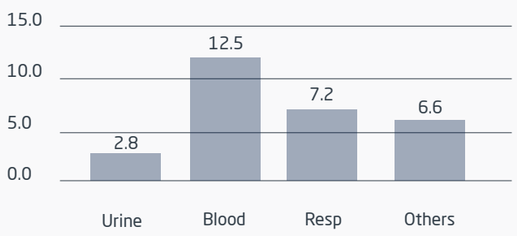

*Klebsiella pneumoniae* R% to Meropenem, by Age Category



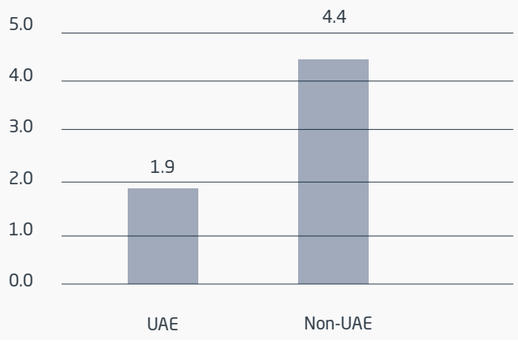

*Klebsiella pneumoniae* R% to Meropenem, by Gender




*Klebsiella pneumoniae* R% to Meropenem, by Source




*Klebsiella pneumoniae* R% to Meropenem, by Nationality



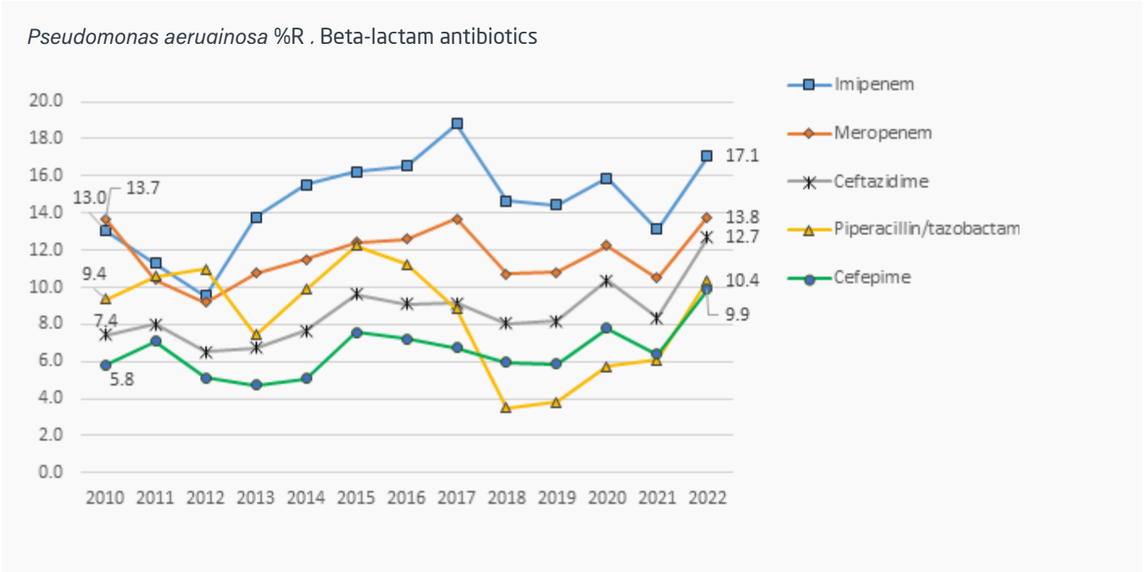

## 5.3. *Pseudomonas aeruginosa*

**Table 5.3: Percentages of resistant isolates for *Pseudomonas aeruginosa*, isolated from all sources, Abu Dhabi 2022 (Total number of isolates= 5,967)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Piperacillin/tazobactam | 5,451 | 10.4 | 5.8 | 83.8 |
| Ceftazidime | 5,847 | 12.7 | 4.7 | 82.6 |
| Cefepime | 5,712 | 9.9 | 3.3 | 86.8 |
| Imipenem | 5,441 | 17.0 | 1.6 | 81.4 |
| Meropenem | 5,778 | 13.8 | 3.5 | 82.7 |
| Gentamicin | 5,858 | 5.7 | 4.1 | 90.2 |
| Tobramycin | 3,965 | 3.9 | 0.4 | 95.7 |
| Amikacin | 5,740 | 3.8 | 1.3 | 94.9 |
| Ciprofloxacin | 5,815 | 13.8 | 5.0 | 81.2 |
| Multidrug-resistant (MDR)[a] | 5,967 | 16.1 | - | - |
| Extensive Drug resistance (possible) | 5,967 | 12.7 | - | - |
| Pan-drug resistance (possible) | 5,967 | 1.2 | - | - |

[a] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).

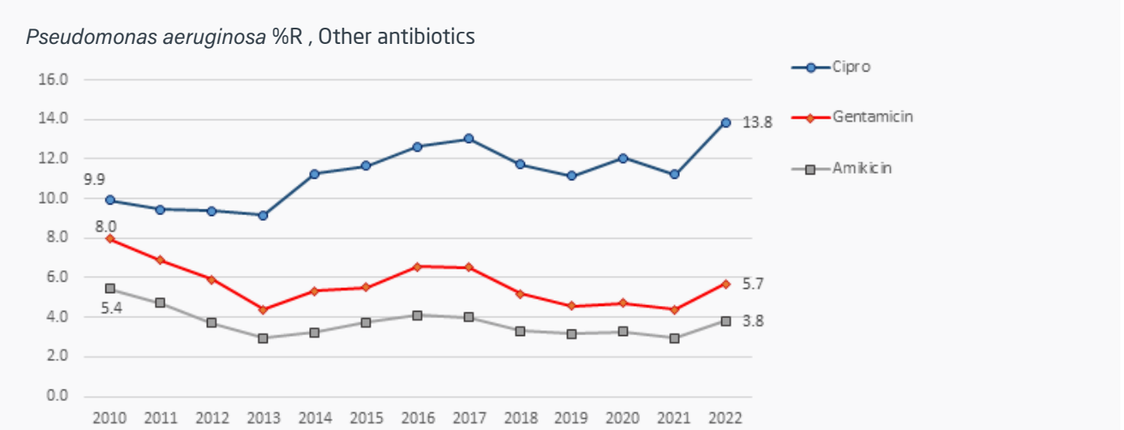
**Figure 5.3.1: Annual trends for percentage of isolates resistant (%R) for *Pseudomonas aeruginosa*, Abu Dhabi, 2010-2022 - Beta-lactam antibiotics**




- *Pseudomonas aeruginosa* shows overall a slight increase in resistance trends to Beta-lactam antibiotics, including broad-spectrum penicillins (piperacilllin-tazobactam: from 9.4 %R (2010) to 10.4 %R (2022), and for 3rd- and 4th-generation cephalosporins (ceftazidime, cefepime).

- Resistance trends for carbapenems are diverse: imipenem (IMP) shows a slightly increasing long-term trend of resistance (from 13 to 17 %R) whereas meropenem (MEM) shows a horizontal long-term trend of resistance (from 13.7 to 13.8 %R). For the past five years (short term, 2017-2022) both carbapenems (IMP, MEM) are showing a decreasing trend of resistance.

**Figure 5.3.2: Annual trends for percentage of isolates resistant (%R) for *Pseudomonas aeruginosa*, Abu Dhabi, 2010-2022 - Other antibiotics**




*Pseudomonas aeruginosa* shows an increase in trend of resistance for fluoroquinolones (ciprofloxacin) from 9.9 to 13.8 %R over the last 13 years, and a decreasing trend of resistance for aminoglycosides (gentamicin, amikacin).

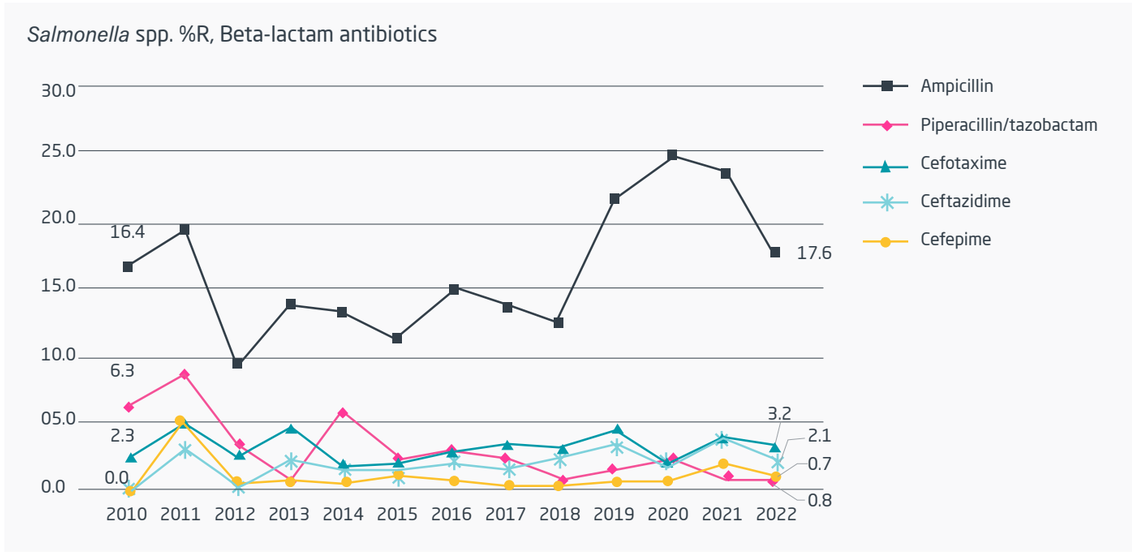
## 5.4. *Salmonella* spp. (Non-typhoid)

**Table 5.4: Percentages of resistant isolates for *Salmonella* spp., isolates from all sources, Abu Dhabi 2022 (Total number of isolates=867)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Ceftriaxone | 262 | 5.0 | 0.4 | 94.7 |
| Cefotaxime | 474 | 3.2 | 0.0 | 96.8 |
| Ceftazidime | 621 | 2.1 | 0.3 | 97.6 |
| Ertapenem | 516 | 1.4 | 0.2 | 98.4 |
| Imipenem | 602 | 0.7 | 0.7 | 98.7 |
| Meropenem | 651 | 0.2 | 0.0 | 99.8 |
| Ciprofloxacin | 546 | 12.6 | 4.2 | 83.2 |
| Multidrug-resistant (MDR)[a] | 738 | 8.8 | - | - |

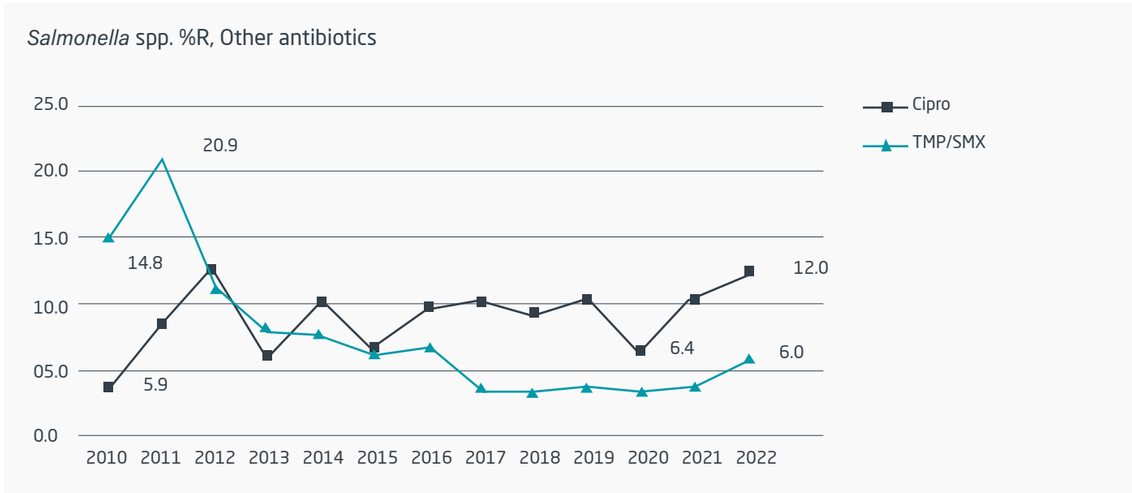
[a] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).

**Figure 5.4.1: Annual trends for percentage of isolates resistant (%R) for *Salmonella* spp., Abu Dhabi, 2010-2022 - Beta-lactam antibiotics**




For *Salmonella spp.* (non-typhoidal), an increasing trend of resistance was observed for aminopenicillins (ampicillin) but not for broad-spectrum penicillins (piperacillin-tazobactam). Resistance to third-generation cephalosporins and carbapenems are low, (<5% R for cefotaxime, ceftazidime and <1 %R for carbapenems during the period between 2014-2022).

**Figure 5.4.2: Annual trends for percentage of isolates resistant (%R) for *Salmonella* spp., Abu Dhabi, 2010-2022 -Other antibiotics**




Resistance to fluoroquinolones (ciprofloxacin) has been overall increasing since 2010, from 3.9 %R (2010) to 12.6% (2022), whereas TMP/SMX showed an overall downward trend to now 6.0 %R (2022).

## 5.5. *Acinetobacter baumannii*

**Table 5.5: Percentages of resistant isolates for *Acinetobacter baumannii*, isolates from all sources, Abu Dhabi 2022 (Total number of isolates=651)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Piperacillin/tazobactam | 649 | 16.6 | 3.1 | 80.3 |
| Ceftazidime | 650 | 14.0 | 4.8 | 81.2 |
| Cefepime | 530 | 15.7 | 2.3 | 82.1 |
| Imipenem | 638 | 13.8 | 0.3 | 85.9 |
| Meropenem | 648 | 14.4 | 0.5 | 85.2 |
| Gentamicin | 650 | 12.2 | 2.3 | 85.5 |
| Tobramycin | 375 | 9.9 | 2.1 | 88.0 |
| Amikacin | 141 | 14.2 | 0.7 | 85.1 |
| Ciprofloxacin | 648 | 16.7 | 2.5 | 80.9 |
| Trimethoprim/Sulfamethoxazole | 647 | 10.5 | 0.0 | 89.5 |
| Minocycline | 255 | 1.2 | 3.1 | 95.7 |
| Tetracycline | 120 | 15.8 | 2.5 | 81.7 |
| Multidrug-resistant [a] | 650 | 20.7 | - | - |
| Extensive Drug resistance (possible) | 650 | 13.2 | - | - |
| Pan-drug resistance (possible) | 650 | 1.9 | - | - |

[a] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).

**Figure 5.5.1: Annual trends for percentage of isolates resistant (%R) for *Acinetobacter baumannii*, Abu Dhabi, 2011-2022 - Beta-lactam antibiotics**

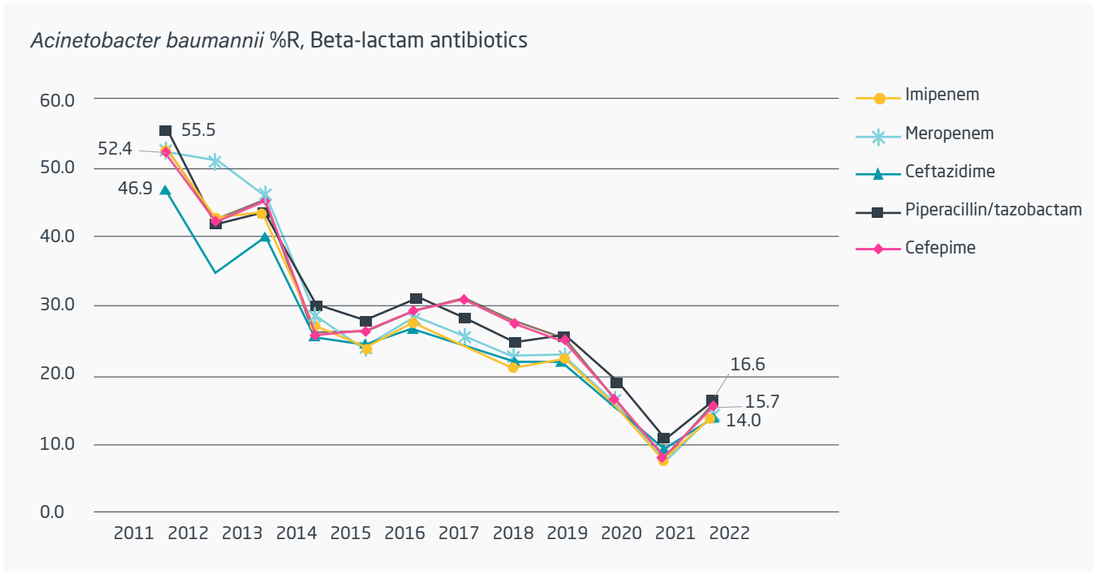
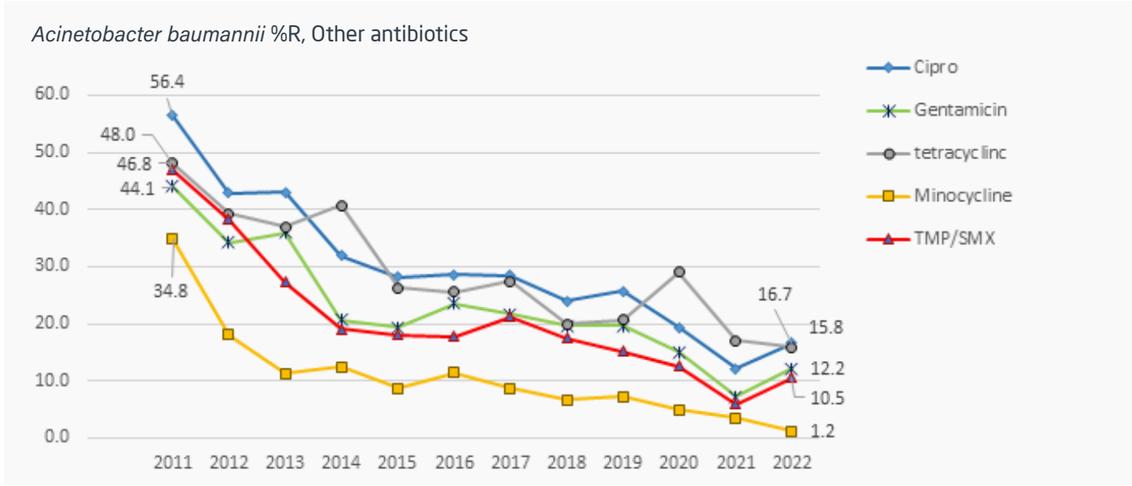


**Figure 5.5.2: Annual trends for percentage of isolates resistant (%R) for *Acinetobacter baumannii*., Abu Dhabi, 2011-2022 -Other antibiotics**




*Acinetobacter* spp. shows decreasing trends of resistance for all beta-lactam antibiotics and other antibiotics including aminoglycosides, fluoroquinolones, trimethoprim/sulfamethoxazole, minocycline and tetracycline.

## 5.6. *Staphylococcus aureus*

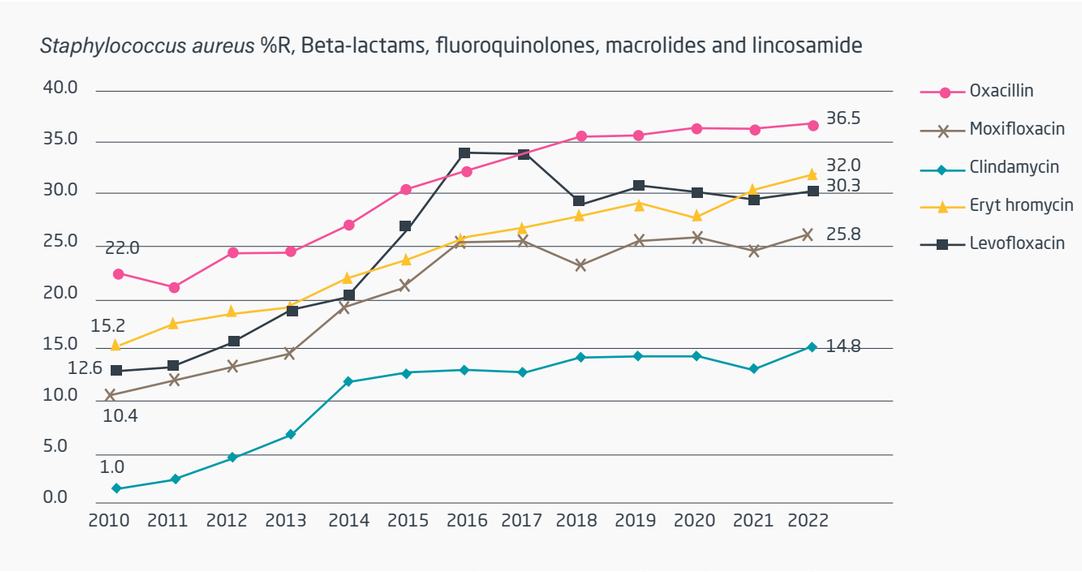
**Table 5.6: Percentages of resistant isolates for *Staphylococcus aureus*, isolates from all sources, Abu Dhabi 2022 (Total number of isolates=10,723)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Oxacillin[a] | 10,506 | 36.6 | 0.0 | 63.4 |
| Gentamicin | 10,523 | 8.9 | 2.0 | 89.1 |
| Rifampicin | 7,653 | 0.4 | 0.1 | 99.5 |
| Ciprofloxacin | 5,967 | 31.3 | 1.2 | 67.4 |
| Levofloxacin | 5,893 | 30.3 | 1.8 | 67.9 |
| Moxifloxacin | 8,225 | 25.8 | 6.5 | 67.6 |
| Trimethoprim/sulfamethoxazole (TMP/SMX) | 10,578 | 23.2 | 0.0 | 76.7 |
| Clindamycin | 10,434 | 14.8 | 0.2 | 85.0 |
| Erythromycin | 10,401 | 32.0 | 1.5 | 66.5 |
| Linezolid | 9,244 | 0.2 | 0 | 99.8 |
| Vancomycin | 10,394 | 0.2 | 0.0 | 99.7 |
| Quinupristin/Dalfopristin | 2,199 | 16.0 | 0.0 | 84.0 |
| Tigecycline[b] | 8,594 | 0.2 | 0.0 | 99.8 |
| Multidrug-resistant MDR[c] | 10,694 | 41.7 | - | - |
| Extensive Drug resistance (possible) | 10,694 | 0.12 | - | - |
| Pan-drug resistance (possible) | 10,694 | 0.0 | - | - |

[a] MRSA/MSSA is calculated as resistance/susceptibility to oxacillin: %MRSA = 36.6% and %MSSA = 63.4%.
[b] Tigecycline: EUCAST breakpoints (S≤0.5, R>0.5)
[c] Multidrug resistance (MDR) was defined as isolate being either a MRSA or having acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).



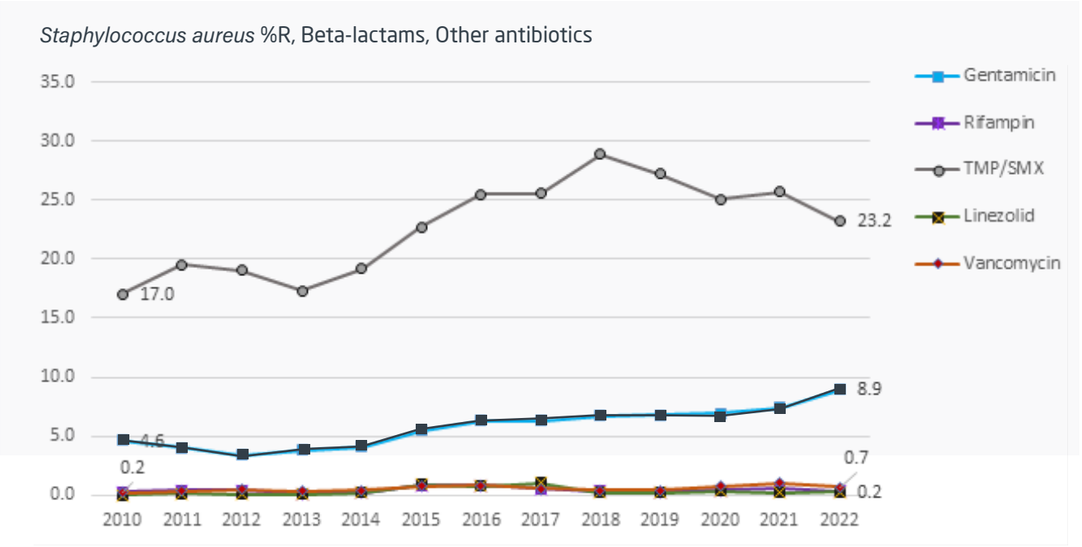
**Figure 5.6.1: Annual trends for percentage of isolates resistant (%R) for *Staphylococcus aureus*, Abu Dhabi, 2010-2022 - Beta-lactams, fluoroquinolones, macrolides and lincosamides**




*Staphylococcus aureus* shows increasing trends of resistance for beta-lactams, fluoroquinolones, macrolides, and lincosamides:

- Beta-lactam antibiotics: %MRSA increased from 22% (2010) to 36.6% (2022).
- Fluoroquinolones: resistance to levofloxacin and moxifloxacin increased from 112.6%/10.4% (2010) to 30.3%/25.8% (2022), respectively.
- Macrolides: resistance to erythromycin increased from 15.2% (2010) to 32% (2022).
- Lincosamides: resistance to clindamycin increased from 1% (2010) to 14.8 % (2022).

**Figure 5.6.2: Annual trends for percentage of isolates resistant (%R) for *Staphylococcus aureus*, Abu Dhabi, 2010-2022 - Other Antibiotics**



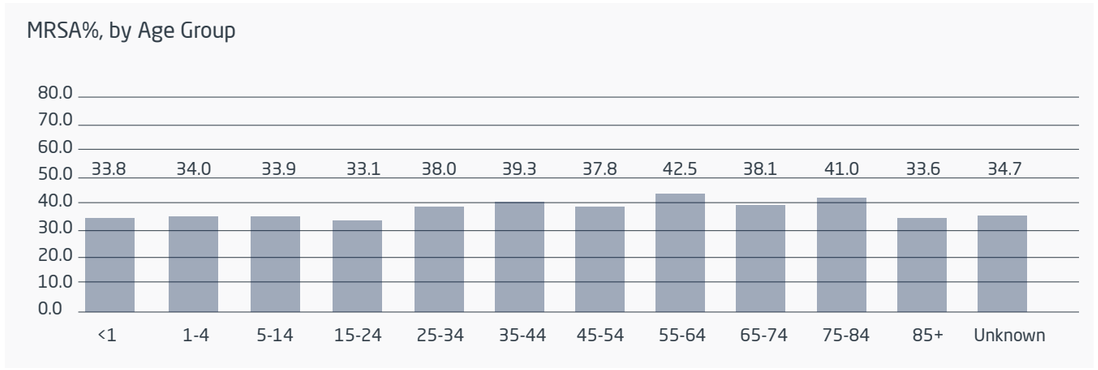
Overall, *Staphylococcus aureus* shows increasing trends of resistance for other antibiotics:

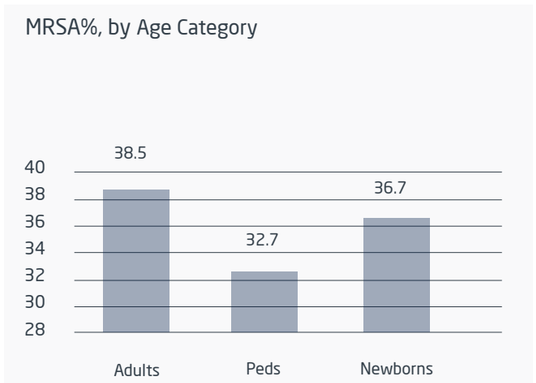
- Trimethoprim/sulfamethoxazole: resistance increased from 17.0 %R (2010) to 23.2 %R (2022)
- Aminoglycosides (gentamicin): resistance increased from 4.6 %R (2010) to 8.9 %R (2022)

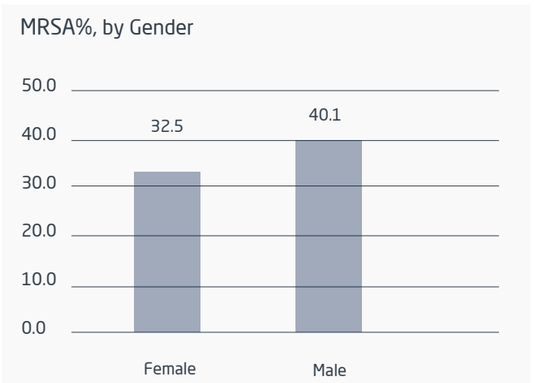
Resistance to rifampin and linezolid remains very low (< 1%).

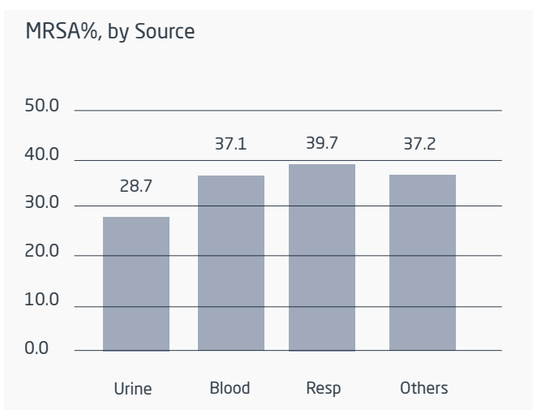
Confirmed resistance to glycopeptides (vancomycin, teicoplanin) was not observed.

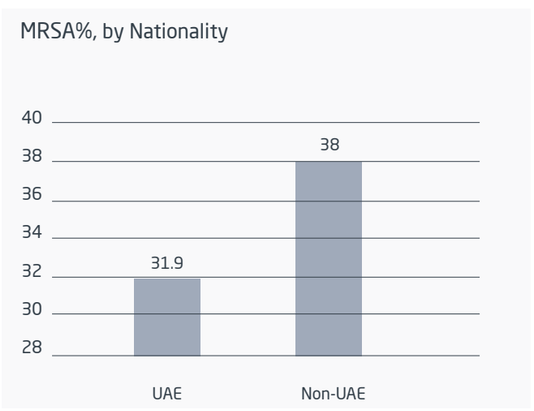
**Figure 5.6.3: Percentage of isolates resistant to oxacillin (%MRSA) for *Staphylococcus aureus*, Abu Dhabi, 2022 - By age category, age group, gender, nationality and source.**

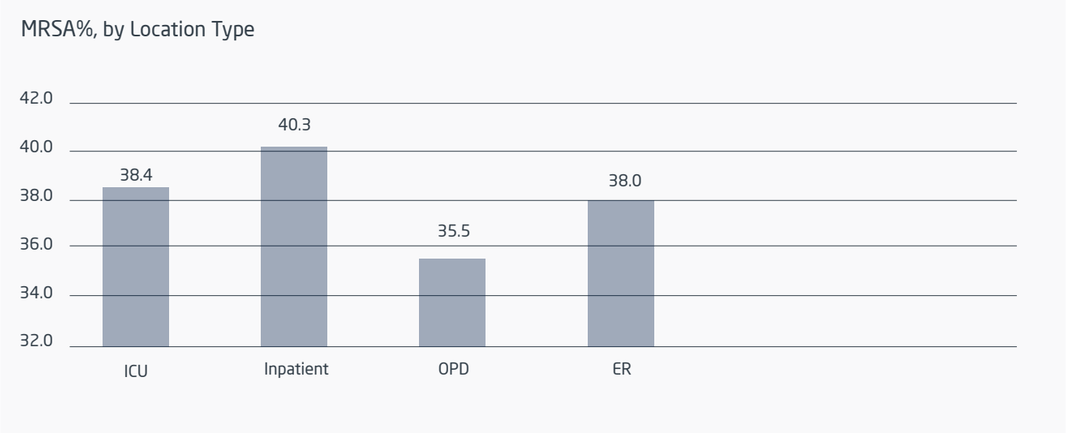


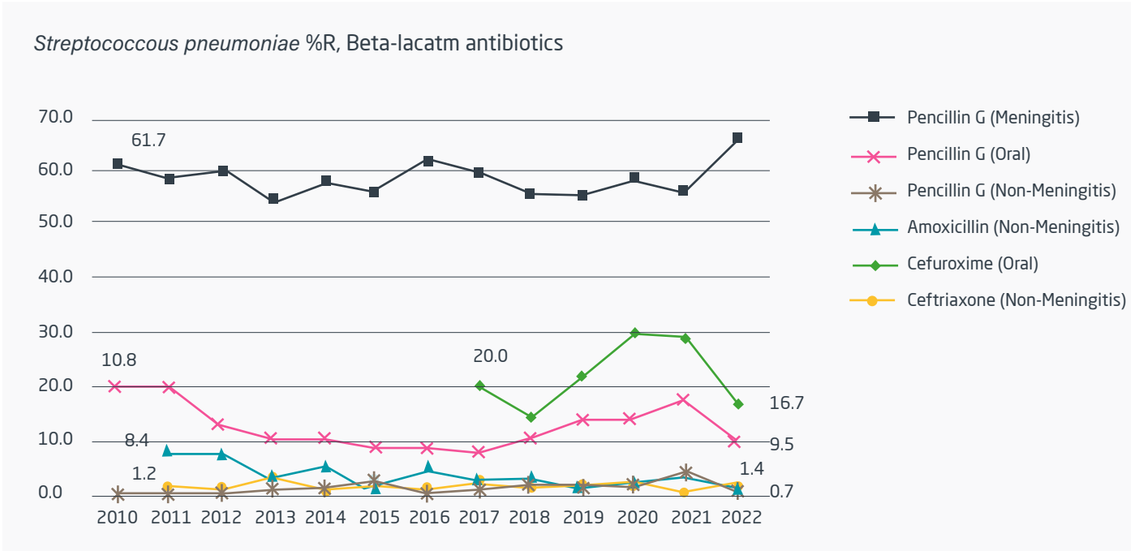




## 5.7. *Streptococcus pneumoniae*

**Table 5.7: Percentages of resistant isolates for *Streptococcus pneumoniae*, isolates from all sources, Abu Dhabi 2022 (Total number of isolates= 785)**

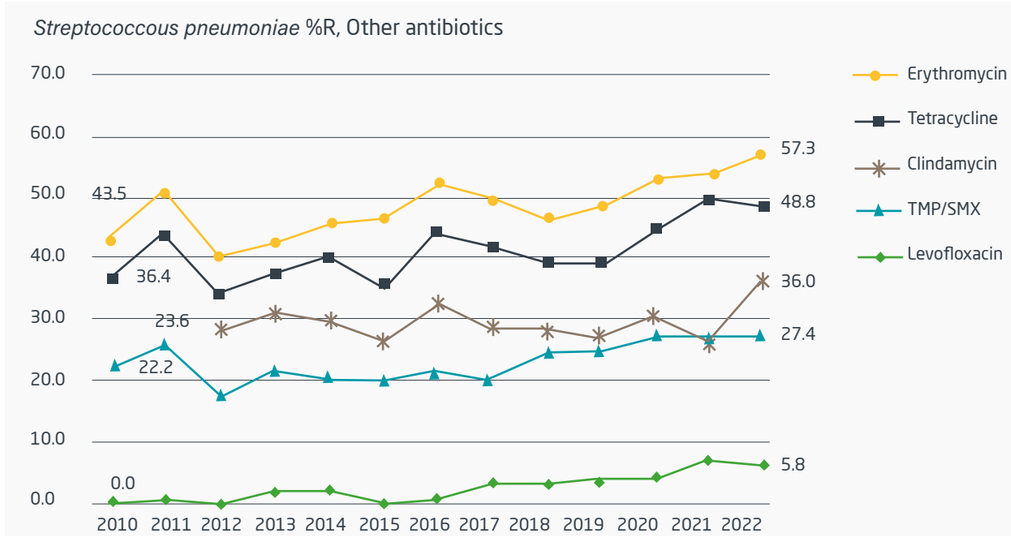
| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Penicillin G (oral breakpoints) | 494 | 9.5 | 56.3 | 34.0 |
| Penicillin G (non-meningitis breakpoints) | 494 | 1.2 | 1.0 | 96.2 |
| Penicillin G (meningitis breakpoints) | 494 | 66.0 | 0.0 | 34.0 |
| Amoxicillin (non-meningitis breakpoints) | 140 | 0.7 | 7.1 | 92.1 |
| Cefuroxime (oral breakpoints) | 42 | 16.7 | 2.4 | 81.0 |
| Cefotaxime (non-meningitis breakpoints) | 359 | 1.9 | 3.3 | 94.7 |
| Ceftriaxone (non-meningitis breakpoints) | 647 | 1.4 | 0.8 | 97.8 |
| Rifampin | 266 | 0.0 | 0.0 | 100.0 |
| Levofloxacin | 412 | 5.8 | 0.2 | 93.9 |
| Moxifloxacin | 698 | 1.4 | 0.1 | 98.4 |
| Trimethoprim/Sulfamethoxazole (TMP/SMX) | 766 | 27.4 | 11.7 | 60.8 |
| Clindamycin | 639 | 36.0 | 1.3 | 62.6 |
| Erythromycin | 744 | 57.3 | 0.1 | 42.5 |
| Linezolid | 734 | 0.0 | 0.1 | 99.7 |
| Vancomycin | 764 | 0.0 | 0.0 | 99.7 |
| Quinupristin/Dalfopristin | 104 | 0.0 | 1.9 | 98.1 |
| Tetracycline | 765 | 48.8 | 0.4 | 50.7 |

**Figure 5.7.1: Annual trends for percentage of isolates resistant (%R) for *Streptococcus pneumoniae*, Abu Dhabi, 2010-2022 - Beta-lactam Antibiotics**




For beta-lactam antibiotics, *Streptococcus pneumoniae* shows moderately increasing trend of resistance for Penicillin G (meningitis breakpoint) but otherwise a stable/decreasing trend of resistance for other beta-lactams

**Figure 5.7.2: Annual trends for percentage of isolates resistant (%R) for *Streptococcus pneumoniae*, Abu Dhabi, 2010-2022 - Other Antibiotics**




For non-beta-lactam antibiotics, *Streptococcus pneumoniae* shows moderately increasing trends of resistance for

- Macrolides: resistance to erythromycin increased from 43.5 % (2010) to 57.3 % (2022).
- Trimethoprim/sulfamethoxazole resistance increased from 22.2 % (2010) to 27.4 % (2022).
- Fluoroquinolones resistance increased from 0 %R (2012) to 5.8 %R (2022) for levofloxacin.

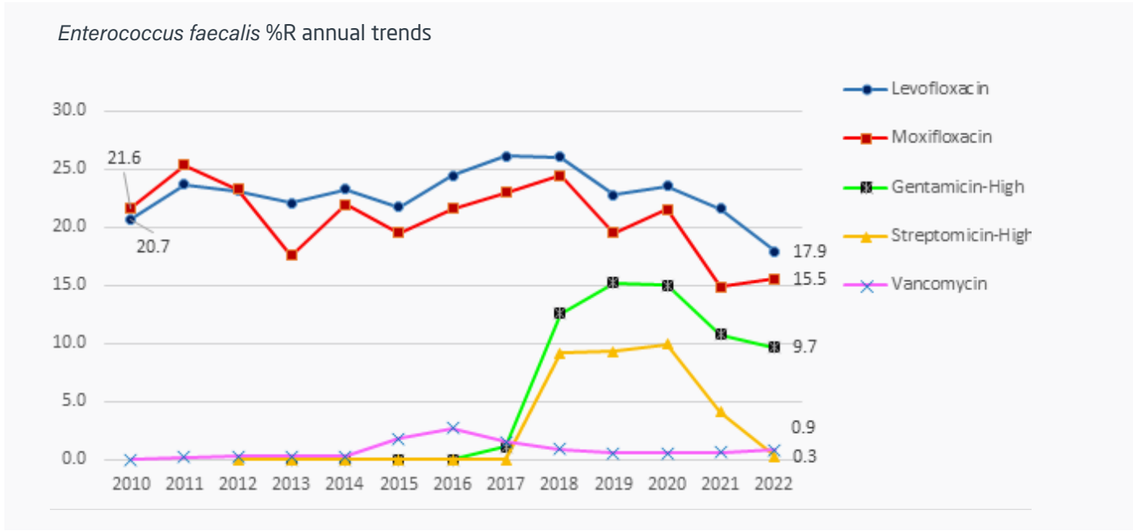
## 5.8. *Enterococcus faecalis* and *Enterococcus faecium*

**Table 5.8: Percentages of resistant isolates for *Enterococcus faecalis* and *Enterococcus faecium*, isolates from all sources, Abu Dhabi 2022**

| Antibiotic | *Enterococcus faecalis* N=3,515 | | | | *Enterococcus faecium* N=240 | | | |
|---|---|---|---|---|---|---|---|---|
| | Isolates (N) | %R | I% | S% | Isolates (N) | %R | I% | S% |
| Ampicillin | 3,482 | 0.6 | 0.0 | 99.3 | 237 | 65.0 | 0.0 | 35.0 |
| Gentamicin-High | 1,096 | 9.7 | 0.0 | 89.7 | 95 | 10.5 | 0.0 | 89.5 |
| Streptomycin-High | 1,532 | 0.3 | 0.1 | 99.7 | 110 | 0.9 | 0.0 | 99.1 |
| Levofloxacin | 2,074 | 17.9 | 4.1 | 78.0 | 103 | 55.3 | 10.7 | 34.0 |
| Moxifloxacin | 322 | 15.5 | 2.8 | 81.7 | 10 | 40.0 | 0.0 | 60.0 |
| Linezolid | 3,452 | 0.8 | 1.2 | 98.0 | 236 | 2.5 | 4.2 | 93.2 |
| Vancomycin | 3,484 | 0.9[b] | 0.1 | 99.0 | 238 | 11.3[b] | 0.0 | 88.7 |
| Teicoplanin | 1,690 | 0.7 | 0.1 | 99.2 | 144 | 9.0 | 0.7 | 90.3 |
| Tigecycline[c] | 2,684 | 0.3 | 0.0 | 99.7 | 167 | 0.6 | 0.0 | 99.4 |
| Multidrug-resistance[a] | 3,515 | 8.8 | - | - | 240 | 46.5 | - | - |
| Extensive drug resistance | 3,515 | 0.42 | - | - | 240 | 9.2 | - | - |
| Pan-drug resistance | 3,515 | 0 | - | - | 240 | 0 | - | - |

[a] Multidrug resistance (MDR) was defined as acquired non-susceptibility (NS) to at least one agent in three or more antimicrobial classes (Magiorakos, et al., 2012).
[b] %VRE for Enterococcus spp. = 1.7%
[c] Tigecycline: EUCAST breakpoints (S ≤0.25, R>0.25).

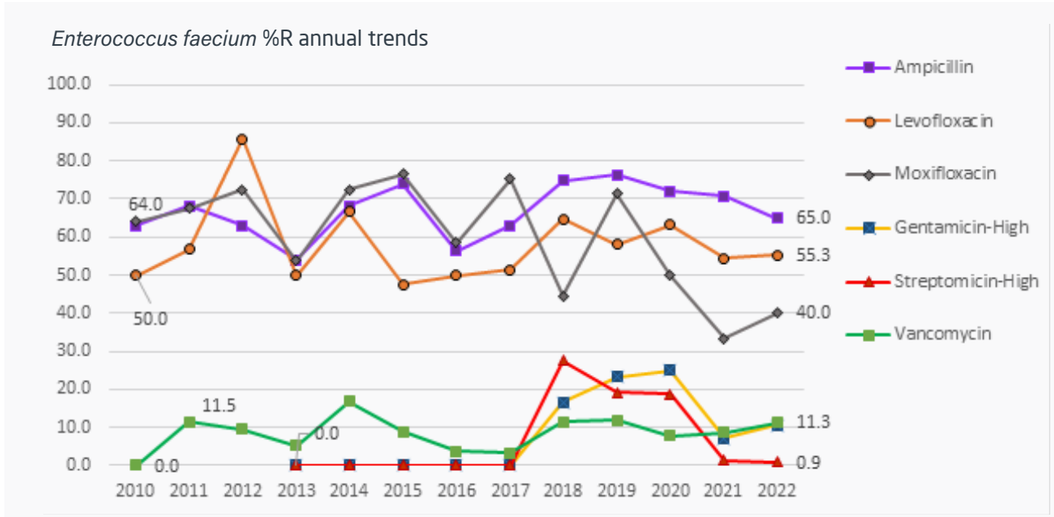
**Figure 5.8.1: Annual trends for percentage of isolates resistant (%R) for *Enterococcus faecalis*, Abu Dhabi, 2010-2022**




*Enterococcus faecalis* shows:

- Decreasing resistance to Fluoroquinolones (Levofloxacin) from 20.7% (2010) to 17.9% (2022).
- Aminoglycosides: resistance to gentamicin-HL (high level) increased since (2016) from 0% to 9.7 %R in (2022) but its recently trending down, similar to streptomycin-HL.
- Resistance to vancomycin (%VRE) remains very low over the years.

**Figure 5.8.2: Annual trends for percentage of isolates resistant (%R) for *Enterococcus faecium*, Abu Dhabi, 2010-2022**




*Enterococcus faecium* shows a fluctuating but horizontal increase trend of resistance for glycopeptides (vancomycin): Resistance to vancomycin (%VRE) increased from 0.0% (2010) to 11.3% (2022).

*Enterococcus faecium* shows high resistance levels for ampicillin reached to 65% (2022) but no obvious significant trend was observed.

Resistance of E. faecium to gentamicin-HL and streptomycin-HL was not observed in the period 2010-2016, however, starting in 2017, both antibiotics show an increasing trend of resistance, currently at 11.4 %R for gentamicin (high level), and 0.9 %R for streptomycin (high level).

## 5.9. *Candida* spp.

**Table 5.9.1: Percentage of susceptible isolates for commonly reported *Candida* spp. from all sources, Abu Dhabi, 2022 (Cumulative antibiogram)**

| *Candida* | Isolates (N) | Triazoles | | Polyenes | Echinocandins | |
|---|---|---|---|---|---|---|
| | | FLU[a] | VOR[b] | AMB[c] | CAS[d] | MIF[e] |
| *C. albicans* | 589 | 96.1 | 95.9 | 95.1 | 97.4 | 98.0 |
| *C. auris* | 209 | 16.7 | NA | NA | 88.3 | 95.5 |
| *C. glabrata* | 189 | 3.6 | NA | 96.8 | 44.4 | 97.2 |
| *C. tropicalis* | 324 | 95.3 | 98.8 | 98.4 | 97.8 | 98.4 |
| *C. parapsilosis* | 199 | 77.4 | 89.5 | 96.8 | 99.5 | 99.5 |

[a]FLU=Fluconazole [b]VOR=Voriconazole [c]AMB=Amphotericin-B [d]CAS=Caspofungin [e]MIF=Micafungin

- EUCAST breakpoints (S≤1, R>1) are used for amphotericin B for *C. albicans, C. glabrata, C. krusei, C. parapsilosis, and C. tropicalis* (EUCAST, 2022).
- CDC tentative breakpoints for Candida auris (CDC *C. auris*, 2020)
- NA= Not Applicable

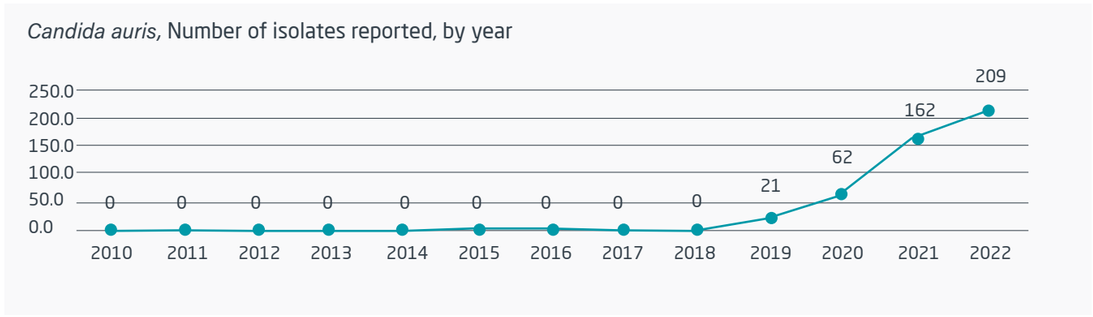
**Table 5.9.2: Percentages% of resistant, intermediate, and susceptible isolates for *Candida albicans* compared with *Candida auris* isolates from all sources, Abu Dhabi, 2022**

| Anti-fungal | *Candida albicans* N= 597 | | | | *Candida auris* N=209 | | | |
|---|---|---|---|---|---|---|---|---|
| | Isolates (N) | %R | I% | S% | Isolates (N) | %R | I% | S% |
| Amphotericin B* | 584 | 4.8 | 0.2 | 95 | 209 | NA | NA | NA |
| Caspofungin | 595 | 1.7 | 0.8 | 97.5 | 188 | 11.7 | 0.0 | 88.3 |
| Fluconazole | 595 | 2.0 | 1.8 | 96.1 | 209 | 83.3 | 0.0 | 16.7 |
| Micafungin | 593 | 1.7 | 0.3 | 98.0 | 198 | 4 | 0 | 95.5 |
| Voriconazole[a] | 592 | 2.7 | 1.4 | 95.9 | 157 | NA | NA | NA |

*Note: some automated systems overcall Amphotericin B resistance for *Candida auris*

[a] Fluconazole susceptibility are used as a surrogate for second generation triazole susceptibility assessment for *C. auris*. However, according to CDC isolates that are resistant to fluconazole may respond to other triazoles occasionally

**Figure 5.9.1: *Candida auris*: Number of all reported isolates including positive screening, from all sources, by year**




The number of reported isolates of *Candida auris* increased between 2010 and 2022 from N=0 to N=209.

## 5.10. *Mycobacterium tuberculosis*

**Table 5.10 : Percentages of resistant isolates for *Mycobacterium tuberculosis*, isolates from all sources, Abu Dhabi 2022. (Total number of isolates= 605)**

| Antibiotic | Isolates (N) | %R | I% | S% |
|---|---|---|---|---|
| Rifampin | 602 | 1.3 | 0.0 | 98.7 |
| Ethambutol | 602 | 0.3 | 0.2 | 99.5 |
| Isoniazid | 600 | 7.3 | 2.2 | 90.5 |
| Pyrazinamide | 604 | 1.8 | 0.0 | 98.2 |
| Streptomycin | 183 | 4.4 | 0.0 | 95.6 |
| Multidrug-resistant (INH+RIF) | 605 | 1.3 | - | - |

**Figure 5.10.1: Percentages of resistant (%R) isolates for *Mycobacterium tuberculosis*, isolates from all sources, Abu Dhabi 2022 (Number of *M. tuberculosis* isolates =605)**

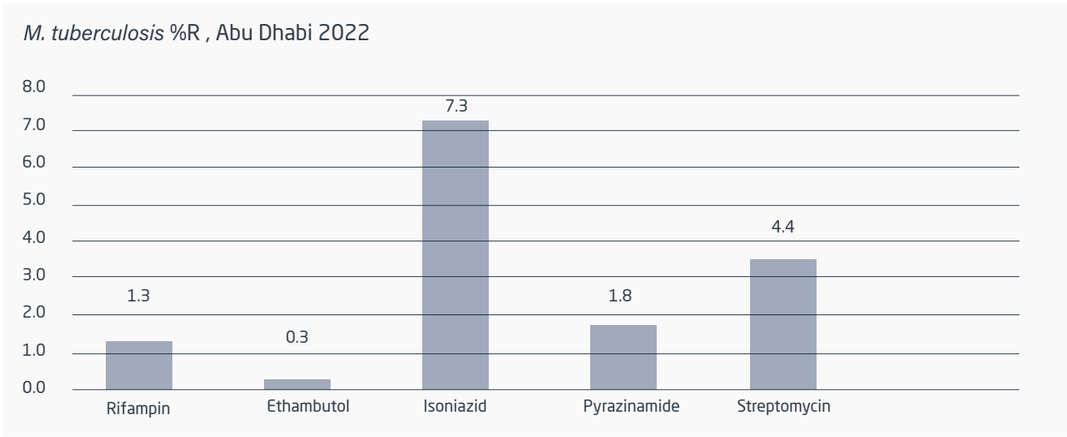
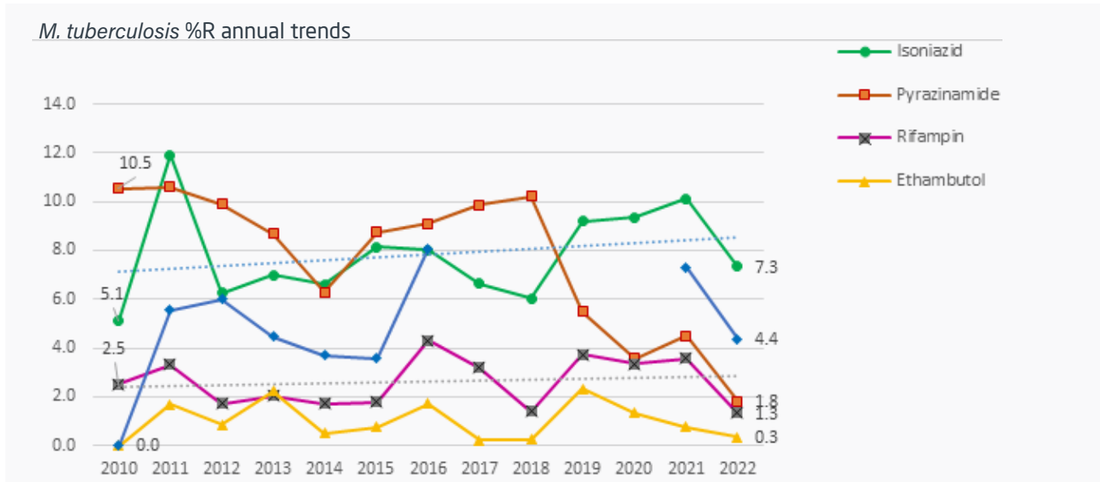



**Figure 5.10.2: Annual Trends for percentage of isolates resistant (%R) for *Mycobacterium tuberculosis*, Abu Dhabi, 2010-2022**




*Streptomycin testing in microbiology laboratory was suspended from 2016 to 2020.

Resistance percentage of M. tuberculosis to first-line anti-TB medications ranged from 0.3% for ethambutol to 7.3% for isoniazid in 2022.

Although a lower %R was observed for Rifampin in 2022 (1.3%), comparing it to 2010 (2.5%), the overall trend is slightly increasing (dotted line).

Isoniazid showed a slightly increasing trend of resistance over period of time from 2010 to 2022, and Pyrazinamide showed a significant decreasing resistance trend from 10.5% (2010) to 1.8% (2022).

# 06 Summary overview of AMR trends in the Emirate of Abu Dhabi (2010-2022)

## 6.1. Gram-Negative Bacteria

**Table 6.1: Antimicrobial resistance trends, Abu Dhabi, (2010-2022) of Gram-negative bacteria**

| Antibiotic Class/ Sub Class | *E. coli* | *Klebsiella pneumoniae* | *Pseudomonas aeruginosa* | *Salmonella* spp *(non-typhoid)* | *Acinetobacter baumannii* |
|---|---|---|---|---|---|
| Aminopenicillins (Ampicillin) | ↓ | NA | R | ↑ | R |
| Amoxicillin/Clavulanic Acid | ↓ | ↑ | R | - | R |
| Piperacillin /Tazobactam | ↓ | ↓ | → / ↑ | ↓ | ↓ |
| 3rd/4th generation cephalosporins | ↑ | ↑ | ↑ | ↓ | ↓ |
| Carbapenems (IMP/MEM) | ≤1 %R | ↑ | ↑ | ↑ | ↓ |
| Fluoroquinolones (Ciprofloxacin) | → / ↑ | ↑ | → / ↑ | ↑ | ↓ |
| Aminoglycosides (Gentamicin) | ↓ | ↓ | NA | NA | ↓ |
| Trimethoprim/Sulfamethoxazole (TMP/SMX) | ↓ | ↑ | R | ↓ | ↓ |

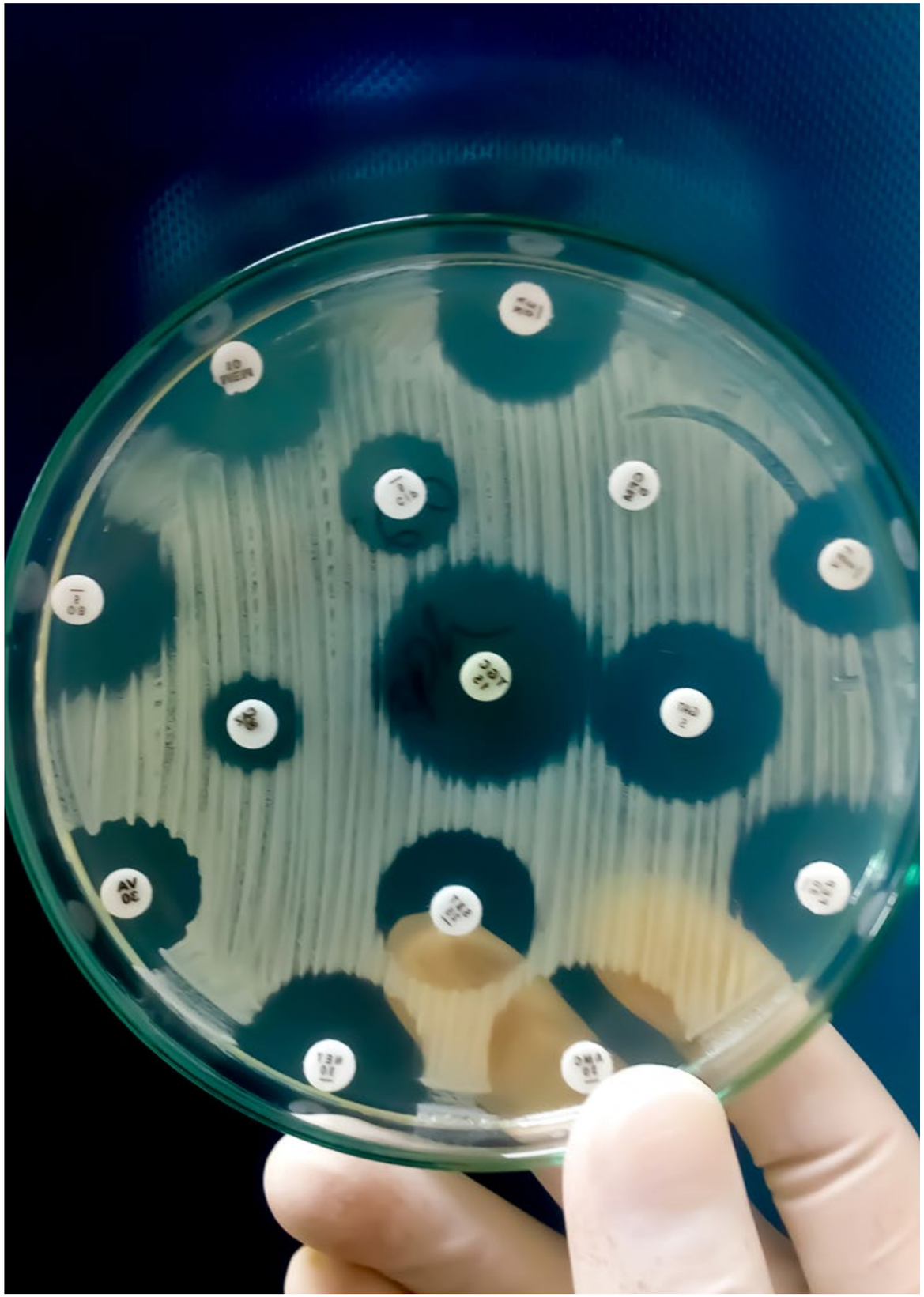
→ / ↑ / ↓ decreasing/increasing/horizontal trend of percentage resistant isolates (%R), R: intrinsically resistant,
N/A: Non-applicable.
Stable, resistance rate less than 1 percent (≤1% R )

## 6.2. Gram-Positive Bacteria

**Table 6.2: Antimicrobial resistance trends, Abu Dhabi, (2010-2022) of Gram-positive bacteria**

| Antibiotic Class/ Sub Class | *Staphylococcus aureus* | *Streptococcus pneumoniae* | *Enterococcus faecalis* | *Enterococcus faecium* |
|---|---|---|---|---|
| Beta-lactam antibiotics | ↑ (OXA) | ↑ (PEN)/ ↑ (CTX) | ↑ (AMP) | ↑ (AMP) |
| Macrolides (Erythromycin) | ↑ | ↑ | N/A | N/A |
| Lincosamides (Clindamycin) | ↑ | ↑ | N/A | N/A |
| Aminoglycosides (Gentamicin) | ↑ | N/A | ↑ | ↑ |
| Fluoroquinolones (Levo/Moxi) | ↑ | ↑ | ↓ | ↑(Levo)/ ↓(Moxi) |
| Glycopeptides | → ( ≤1 %R) | → (0 %R) | ≤1 %R | ↑ |
| Trimethoprim/sulfamethoxazole | ↑ | ↑ | R | R |

→ / ↑ / ↓ Increasing/decreasing/stable trends.
OXA: Oxacillin, PEN: Penicillin, CTX: Cefotaxime (non-meningitis breakpoints), AMP: Ampicillin
N/A: Non-applicable, R: Intrinsically resistant



# 07 Cumulative Antibiogram

## 7.1. Table: Gram-negative Cumulative Antibiogram for the Emirate of Abu Dhabi (2022)

Percent susceptible isolates (%S [a])

| Gram-negative Bacteria | Isolates | Penicillins | | | β-Lactams Cephalosporins | | | | Carbapenems | | | | Aminoglycosides | | | FQ | Other | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | AMP | AMC | TZP | CZO | CXM | CTX | CAZ | FEP | IPM | MEM | ETP | AMK | GEN | TOB | CIP | ATM | SXT | NIT [b] |
| **Gram-negative bacteria (all)** | 57,898 | - | 71 | 91 | - | - | 73 | - | 84 | 91 | 95 | 94 | 98 | 91 | 89 | 71 | 39 | 73 | 75[b] |
| *Haemophilus influenzae* [c] | 918 | 79 | 95 | - | - | 97 | - | - | - | - | - | - | - | - | - | 100 | - | 87 | - |
| *Moraxella (catarrhalis)* [d] | 392 | - | 98 | - | - | - | - | - | - | - | - | - | - | - | - | 100[f] | - | 95 | - |
| **Enterobacterales** | 47,827 | 27 | 72 | 92 | 43 | 58/61[i] | 74 | - | 84 | 93 | 98 | 96 | 99 | 92 | 89 | 70 | 52 | 73 | 76[b] |
| *Citrobacter koseri* | 1,142 | R | 94 | 94 | 81 | 60/76[i] | 94 | - | 95 | 99 | 99 | 97 | 100 | 99 | 99 | 96 | - | 98 | 72[b] |
| *Enterobacter cloacae* | 1,195 | R | R | 83 | R | 29/46 [i] | 83 | - | 86 | 91 | 95 | 90 | 98 | 93 | 93 | 84 | - | 87 | 42[b] |
| *Enterobacter aerogenes (K. aer.)* | 1,186 | R | R | 86 | R | R | 85 | - | 93 | 74 | 98 | 96 | 100 | 97 | 97 | 92 | - | 94 | 23[b] |
| *Escherichia coli* [e] | 27,545 | 38 | 78 | 94 | 45 | 58/60 [i] | 69 | - | | 98 | 99 | 98 | 100 | 91 | 87 | 63 | 44 | 65 | 95[b] |
| *Klebsiella pneumoniae* | 10,727 | R | 80 | 86 | 54 | 68/69 [i] | 78 | - | 85 | 95 | 96 | 94 | 97 | 94 | 90 | 77 | 36 | 80 | 34[b] |
| *Klebsiella oxytoca* | 515 | R | 71 | 89 | 40 | 59/61 [i] | 81 | - | 80 | 94 | 96 | 92 | 98 | 94 | 92 | 82 | - | 82 | 73[b] |
| *Morganella morganii* | 438 | R | R | 97 | R | R | 78 | - | 96 | 27 | 99 | 99 | 100 | 83 | 80 | 54 | - | 69 | R |
| *Proteus mirabilis* | 1,130 | 61 | 82 | 99 | 63 | 83/85 [i] | 90 | - | 93 | 12 | 97 | 94 | 98 | 82 | 82 | 68 | - | 65 | R |
| *Salmonella spp. (Non-Typhoid)* | 867 | 82 | 92 | 99 | - | - | 97 | - | 98 | - | - | - | - | - | - | 72[g] | - | 94 | R |
| *Salmonella spp. (Typhi, Paratyphi)* | 89 | 69 | 91 | 95 | - | 59/69[i] | 80 | - | 82 | - | - | - | - | - | - | 25 | - | 74 | - |
| *Serratia marcescens* | 1,019 | R | R | 92 | R | R | 91 | - | 95 | 56 | 98 | 98 | 99 | 97 | 89 | 88 | 81[f] | 99 | R |
| **Non-fermenting gram neg. rods** | 8,725 | R | R | 82 | - | - | - | 81 | 84 | 81 | 83 | R | 91 | 86 | 90 | 79 | 32 | 79 | - |
| *Acinetobacter baumannii* | 651 | R | R | 80 | - | - | - | 81 | 82 | 86 | 85 | R | 85 | 86 | 88 | 81 | R | 90 | - |
| *Pseudomonas aeruginosa* | 5,967 | R | R | 84 | - | R | R | 83 | 87 | 81 | 83 | R | 95 | 90 | 96 | 81 | 47 | R | R |
| *Stenotrophomonas maltophilia* [h] | 589 | R | R | R | - | - | R | 61 | R | R | R | R | R | R | R | - | R | 79 | - |

[a] The %S for each organism/antimicrobial combination was generated by including the first isolate only of that organism encountered on a given patient during 2022 (de-duplicated data). [b] NIT: Nitrofurantoin data from urine isolates only. [c] *H. influenzae*: disc diffusion data (KB): LVX 99 %S, CRO 97 %S, AZM (-), CLR 25 %S. [d] *M. catarrhalis*: CLR (-), ERY 83 %S, AZM (-), LVX 81 %S, TCY 65 %S. [e] *E. coli* (urinary tract isolates): FOS 99 %S. [f] A small number of isolates were tested (N<30), and the percentage susceptible should be interpreted with caution. [g] Ciprofloxacin results for *Salmonella* spp. (non-typhoid) refer to extra-intestinal (non-stool) isolates only. [h] *S. maltophilia*: MNO 100 %S, TCC 100 %S. [i] Cefuroxime: oral/parenteral breakpoints.

**AMC**=Amoxicillin/Clavulanic acid, **AMK**=Amikacin, **AMP**=Ampicillin, **ATM**=Aztreonam, **AZM**=Azithromycin, **CAZ**=Ceftazidime, **CIP**=Ciprofloxacin, **CLR**=Clarithromycin, **CRO**=Ceftriaxone, **CTX**=Cefotaxime, **CXM**=Cefuroxime, **CZO**=Cefazolin, **ETP**=Ertapenem, **ERY**=Erythromycin, **FEP**=Cefepime, **FOS**=Fosfomycin, **GEN**=Gentamicin, **IPM**=Imipenem, **LVX**=Levofloxacin, **MEM**=Meropenem, **MNO**=Minocycline, **NIT**=Nitrofurantoin, **SXT**=Trimethoprim/Sulfamethoxazole, **TCC**=Ticarcillin/Clavulanic acid, **TCY**=Tetracycline, **TOB**=Tobramycin, **TZP**=Piperacillin/Tazobactam.

%S=Percent of isolates susceptible, FQ=Fluoroquinolones, MIC=Minimal inhibitory concentration data only, unless mentioned otherwise (usually derived by antibiotic susceptibility testing platforms), except for *H. influenzae* and *M. catarrhalis* (disc diffusion data), N=Number, spp.=species, R=intrinsically resistant, (.) =No data available, small number of isolates tested (N<30), antimicrobial agent is not indicated, or not effective clinically. Interpretation standard: CLSI M100 ED31:2021. Presentation standard: CLSI M39-A4:2014. Data analysis: WHONET 2022.

## 7.2. Table: Gram-positive Cumulative Antibiogram for the Emirate of Abu Dhabi (2022)

Percent susceptible isolates (%S [a])

| Gram-positive bacteria | Isolates | β-Lactams | | | | | | Macrolides | | Aminoglycosides | | | FQ | | Glycopept. | | Other | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | AMP | PEN | AMC | OXA | CRO | CTX | ERY | CLI | GEN | GEH | STH | LVX | MFX | VAN | TEC | SXT | NIT[b] | LNZ | TCY | RIF | QDA |
| **Gram-positive bacteria (all)** | 31,039 | - | - | - | - | - | - | 49 | 67 | - | - | - | 76 | 57 | 99 | 97 | 66 | 97 | 99 | - | - | - |
| *Enterococcus spp.* | 4,069 | 97 | - | - | - | R | R | - | R | R | 92 | 100 | 76 | 82 | 98 | 99 | R | 96 | 98 | - | - | - |
| *Enterococcus faecalis* | 3,515 | 99 | - | - | - | R | R | 15 | R | R | 90 | 100 | 78 | 82 | 99 | 99 | R | 98 | 98 | 23 | - | R |
| *Enterococcus faecium* | 240 | 35 | - | - | - | R | R | - | R | R | 90 | 99 | 34 | 60[f] | 89 | 90 | R | 48 | 93 | 29 | - | 93 |
| *Staphylococcus aureus* | 10,723 | - | - | 63[c] | 63 | - | - | 67 | 85 | 89 | - | - | 68 | 68 | 99 | 99 | 77 | 99 | 100 | 85 | 100 | 83 |
| MSSA [j] | 6,979 | - | - | 100 | 100 | - | - | 72 | 89 | 96 | - | - | 75 | 75 | 100 | 100 | 79 | 99 | 100 | 89 | 100 | 88 |
| MRSA [j] | 3,632 | - | - | - | - | - | - | 56 | 77 | 75 | - | - | 53 | 53 | 100 | 100 | 72 | 98 | 99 | 78 | 99 | 75 |
| Coagulase-neg. staphylococci (CNS) | 4,846 | - | - | 40[c] | 40 | - | - | 37 | 67 | 79 | - | - | 80 | 78 | 98 | 90 | 85 | 98 | 98 | 77 | 95 | 89 |
| *Staphylococcus epidermidis* | 1,381 | - | - | 38[c] | 38 | - | - | 28 | 63 | 73 | - | - | 70 | 60 | 99 | 89 | 75 | 96 | 99 | 79 | 95 | 91 |
| *Staphylococcus saprophyticus* | 434 | - | - | 34[c] | 34 | - | - | 41 | 79 | 100 | - | - | 99 | 100 | 99 | 99 | 95 | 100 | 98 | 93 | 99 | 89 |
| *Staphylococcus lugdunensis* [g] | 220 | - | - | 78 [c] | 78 | - | - | 81 | 83 | 93 | - | - | 95 | 92 | 98 | 99 | 99 | 100 | 100 | 95 | 98 | 92 |
| *Streptococcus pneumoniae* | 785 | - | 96[d] | - | - | 98[e] | 95[e] | 43 | 63 | - | - | - | 94 | 98 | 100 | 96 | 61 | - | 100 | 51 | 100 | 98 |
| *Streptococcus pyogenes* [h] | 1,183 | 100[f] | 100 | - | - | 99 | 98 | 50 | 65 | - | - | - | 84 | - | 100 | 100 | - | - | 100 | 62 | - | - |
| *Streptococcus agalactiae* [i] | 8,099 | 98 | 96 | - | - | 99 | 96 | 35 | 44 | - | - | - | 90 | - | 98 | 96 | - | - | 99 | 12 | - | 97 |
| *Streptococcus spp.* (Viridans group) | 706 | 70 | 69 | - | - | 91 | 89 | 52 | 75 | - | - | - | 86 | - | 99 | 100 | - | - | 99 | 65 | - | - |

[a] The %S for each organism/antimicrobial combination was generated by including the first isolate only of that organism encountered on a given patient during 2022 (de-duplicated data). [b] NIT: Nitrofurantoin data from testing urine isolates only. [c] Extrapolated, based on Oxacillin. [d] Data shown is based on non-meningitis breakpoints for Pen G. Pen G (meningitis breakpoints/oral breakpoints): 54 %S. [e] CRO/CTX: Data shown is based on non-meningitis breakpoints. [f] Extrapolated, based on Penicillin G. [g] includes ss bovis and ss saprophyticus. [h] includes *Streptococcus*, beta-haemolytic group A (GAS). [i] includes *Streptococcus*, group B (GBS). Excludes GBS isolates from vagina. [j] *S. aureus*: excludes isolates from axilla, nose, groin, perineum, and umbilicus.

**AMP**=Ampicillin, **AMC**=Amoxicillin/Clavulanic acid, **CLI**=Clindamycin, **CRO**=Ceftriaxone, **CTX**=Cefotaxime, **ERY**=Erythromycin, **GEH**=Gentamicin, high-level, **GEN**=Gentamicin, **LNZ**=Linezolid, **LVX**=Levofloxacin, **MFX**=Moxi-floxacin, **NIT**=Nitrofurantoin, **OXA**=Oxacillin, **PEN**=Penicillin G, **QDA**=Quinupristin/Dalfopristin, **RIF**=Rifampin, **STH**=Streptomycin, high-level, **SXT**=Trimethoprim/Sulfamethoxazole, **TEC**=Teicoplanin, **TCY**=Tetracycline, **VAN**=Vancomycin.

%S=Percent of isolates susceptible, FQ=Fluoroquinolones, GAS=Group A streptococci, GBS=Group B streptococci, Glycopept.=Glycopeptides, MIC=Minimal inhibitory concentration data only, unless mentioned otherwise (usually derived by antibiotic susceptibility testing platforms), MRSA=Oxacillin-resistant *S. aureus*, MSSA=Oxacillin-susceptible *S. aureus*, N=Number, spp.=species, R=intrinsically resistant, (-) =No data available, or small number of isolates tested (N<30), or antimicrobial agent is not indicated or not effective clinically. Interpretation standard: CLSI M100 ED31:2021. Presentation standard: CLSI M39-A4:2014. Data analysis: WHONET 2022.

*Data source: Abu Dhabi, United Arab Emirates*

# 08 Summary and Recommendations

This antimicrobial resistance report specifically tailored for the Emirate of Abu Dhabi provides valuable insights into the current state of AMR and offers targeted recommendations for improving patient care, infection control, and antimicrobial stewardship.

**In summary:**

The reported Antimicrobial Resistance (AMR) data in Abu Dhabi can be summarized as follows:

- Antimicrobial Resistance is (overall) high and/or increasing in Abu Dhabi Emirate mainly for *Staph. aureus (MRSA)*, ESBL *E. coli*, and ESBL *K. pneumoniae*.
- However, the AMR trends overall are considered low and/or stable/decreasing in Abu Dhabi Emirate for MDR *Acinetobacter*, MDR *P. aeruginosa*, VRE, and MDR *Mycobacterium tuberculosis*.
- The number of reported isolates of *Candida auris* is significantly increasing in the Emirate of Abu Dhabi, with isolates frequently being resistant to Fluconazole.

Based on additional analysis of national and international AMR surveillance data, the resistance rates of AMR in UAE including Abu Dhabi are considered:

- being relatively low compared to neighboring countries in EMRO region and Central Asian countries region (CAESAR),
- but high compared to western European countries (EARS-Net).

**Recommendations:**

- Improving infection prevention and control by implementing and enforcing rigorous measures to minimize the transmission of resistant pathogens. This includes proper hand hygiene, sterilization practices, update IPC policies according to international guidelines, and adherence to infection control protocols.
- Promoting antimicrobial stewardship by ensuring appropriate antimicrobial usage through following guidelines and DoH policies and standards. We highly encourage the use of the reported cumulative antibiograms in this report, to develop local antibiograms and treatment guidelines that can be used for clinical practice purposes.
- We also encourage healthcare workers to educate their patients about the responsible use of antibiotics and possible side effects to improve the public awareness regarding antimicrobial use and resistance.



# Annex

**Annex (1): Data Fields Collected for AMR Surveillance**

| Nr. | Data Field | Description | Format | Classification |
|---|---|---|---|---|
| 1 | PATIENT_ID | Patient ID (medical record number) | Required | TEXT |
| 2 | PATIENT_EID | Patient Emirates ID nr. | Desirable | TEXT |
| 3 | PATIENT_NAME | Patient name | Desirable | TEXT |
| 4 | PATIENT_DOB | Patient date of birth (DOB) | Required | DATE (dd/mm/yyyy) |
| 5 | PATIENT_AGE | Patient age | Required | NUMERICAL |
| 6 | PATIENT_GENDER | Patient gender | Optional | TEXT |
| 7 | PATIENT_NATIONALITY | Patient nationality | Desirable | TEXT |
| 8 | PATIENT_NAT_STATUS | Patient nationality status | Desirable | TEXT |
| 9 | PATIENT_ADM_DATE | Date of patient admission | Required | DATE (dd/mm/yyyy) |
| 10 | PATIENT_DISC_DATE | Date of discharge (for inpatients) | Desirable | DATE (dd/mm/yyyy) |
| 11 | FACILITY_NAME | Healthcare facility name | Required | TEXT |
| 12 | FACILITY_ID | Healthcare facility ID | Optional | TEXT |
| 13 | FACILITY_LICENCE_NR | Healthcare facility licensing number | Required | TEXT |
| 14 | FACILITY_EMIRATE | Healthcare facility Emirate | Conditional | TEXT |
| 15 | FACILITY_DEPT_NAME | Department/specialty name | Required | TEXT |
| 16 | PATIENT_LOCATION_NAME | Patient location name | Required | TEXT |
| 17 | PATIENT_LOCATION_TYPE | Patient location type | Desirable | TEXT |
| 18 | LAB_NAME | Laboratory name | Required | TEXT |
| 19 | SPECIMEN_PROC_ORDER_NAME | Microbiological procedure ordered | Required | TEXT |
| 20 | SPECIMEN_LAB_NR | Specimen lab number | Required | TEXT |
| 21 | SPECIMEN_TYPE | Specimen type | Required | TEXT |
| 22 | SPECIMEN_DATE_COLLECTED | Specimen collection date | Required | DATE (dd/mm/yyyy) |
| 23 | ORGANISM_NAME | Name of identified organism | Required | TEXT |
| 24 | AST_METHOD | AST susceptibility Method | Conditional | TEXT |
| 25 | AST_RESULT_CAT | AST result (categorical/interpreted) | Required | TEXT |
| 26 | AST_RESULT_NUM | AST result (numerical) | Required | TEXT |
| 27 | ANTIBIOTIC_NAME | Antimicrobial agent tested | Required | TEXT |
| 28 | PATIENT_DISC_STATUS | Patient discharge status | Desirable | TEXT |
| 29 | DIAGNOSIS | Diagnosis | Desirable | TEXT |

## Annex (2): AMR Surveillance sites in the Emirate of Abu Dhabi

| Nr. | Facility Name | Region | Type/Ownership |
|---|---|---|---|
| 1 | Ain Al Khaleej Hospital | Al Ain | Hospital (private) |
| 2 | Al Ain hospital | Al Ain | Hospital (public) |
| 3 | Al Bahia Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 4 | Al Bateen Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 5 | Al Dhafra Family Medicine Center | Al Dhafra | Center/Clinic (public) |
| 6 | Al Dhafra hospitals - Delma island hospital | Al Dhafra | Hospital (public) |
| 7 | Al Dhafra hospitals - Gayathi hospital | Al Dhafra | Hospital (public) |
| 8 | Al Dhafra hospitals - Liwa hospital | Al Dhafra | Hospital (public) |
| 9 | Al Dhafra hospitals - Madinat Zayed hospital | Al Dhafra | Hospital (public) |
| 10 | Al Dhafra hospitals - Mirfa hospital | Al Dhafra | Hospital (public) |
| 11 | Al Dhafra hospitals - Silla hospital | Al Dhafra | Hospital (public) |
| 12 | Al Ettihad Health Center | Abu Dhabi | Center/Clinic (public) |
| 13 | Al Falah Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 14 | Al Faqah Health Center | Al Ain | Center/Clinic (public) |
| 15 | Al Hayar Healthcare Center | Al Ain | Center/Clinic (public) |
| 16 | Al Hili Healthcare Center | Al Ain | Center/Clinic (public) |
| 17 | Al Jahili Healthcare Center | Al Ain | Center/Clinic (public) |
| 18 | Al Khaleej Primary Health Center | Abu Dhabi | Center/Clinic (public) |
| 19 | Al Khatim Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 20 | Al Khazna Healthcare Center | Al Ain | Center/Clinic (public) |
| 21 | Al Madina Occupational Health Center | Abu Dhabi | Center/Clinic (public) |
| 22 | Al Manhal Primary Health Center | Abu Dhabi | Center/Clinic (public) |
| 23 | Al Maqam Healthcare Center | Al Ain | Center/Clinic (public) |
| 24 | Al Maqtaa Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 25 | Al Mushrif Children's Speciality Center | Abu Dhabi | Center/Clinic (public) |
| 26 | Al Muwaeji Healthcare Center | Al Ain | Center/Clinic (public) |
| 27 | Al Nahda Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 28 | Al Niyadat Healthcare Center | Al Ain | Center/Clinic (public) |
| 29 | Al Quaa Healthcare Center | Al Ain | Center/Clinic (public) |
| 30 | Al Rahba hospital | Abu Dhabi | Hospital (public) |
| 31 | Al Remah Healthcare Center | Al Ain | Center/Clinic (public) |
| 32 | Al Rowdha Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 33 | Al Samha Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 34 | Al Shamkha Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 35 | Al Shwaib Healthcare Center | Al Ain | Center/Clinic (public) |
| 36 | Al Towayya Healthcare Center | Al Ain | Center/Clinic (public) |
| 37 | Al Yahar Healthcare Center | Al Ain | Center/Clinic (public) |
| 38 | Al Zafrana Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 39 | American Surge Center | Abu Dhabi | Center/Clinic (private) |
| 40 | Baniyas Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 41 | Bida Mutawa Clinics | Al Dhafra | Center/Clinic (public) |
| 42 | Cleveland Clinic Abu Dhabi | Abu Dhabi | Hospital (public) |
| 43 | Corniche hospital | Abu Dhabi | Hospital (public) |
| 44 | Cosmesurge Al Ain Clinic | Al Ain | Center/Clinic (private) |
| 45 | Cosmesurge and NMC Clinic Delma Street | Abu Dhabi | Center/Clinic (private) |
| 46 | Cosmesurge BAS Clinic | Abu Dhabi | Center/Clinic (private) |
| 47 | Cosmesurge Conrad Clinic | Abu Dhabi | Center/Clinic (private) |
| 48 | Cosmesurge Khalifa Clinic | Abu Dhabi | Center/Clinic (private) |
| 49 | Cosmesurge Zakher Al Ain Clinic | Al Ain | Center/Clinic (private) |
| 50 | Danat Al Emarat Clinic for Women and Children | Abu Dhabi | Center/Clinic (private) |
| 51 | Danat Al Emarat Hospital | Abu Dhabi | Hospital (private) |
| 52 | Emirates International Hospital Al Ain | Al Ain | Hospital (private) |
| 53 | Health Management System (HMS) Abu Dhabi Center (DPSC) | Abu Dhabi | Center/Clinic (public) |
| 54 | Health Management System (HMS) Al Ain Center (DPSC) | Al Ain | Center/Clinic (public) |
| 55 | Health Plus Diabetes and Endocrinology Center | Abu Dhabi | Center/Clinic (private) |
| 56 | Health Plus Family Health Center - Al Bandar | Abu Dhabi | Center/Clinic (private) |
| 57 | Health Plus Family Health Center - Al Forsan | Abu Dhabi | Center/Clinic (private) |
| 58 | Health Plus Fertility and Women's Health Center - Al Karama area | Abu Dhabi | Center/Clinic (private) |
| 59 | IMA - Golden Health Mobile Medical Unit | Abu Dhabi | Center/Clinic (private) |
| 60 | IMA - Sehaty Medical Center | Abu Dhabi | Center/Clinic (private) |
| 61 | Imperial College London Diabetes Center Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 62 | Imperial College London Diabetes Center Al Ain | Al Ain | Center/Clinic (private) |
| 63 | Imperial College London Diabetes Center Zayed Sports City Branch | Abu Dhabi | Center/Clinic (private) |
| 64 | Madinat Khalifa Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 65 | Madinat Mohamed Bin Zayed Healthcare Center | Abu Dhabi | Center/Clinic (public) |
| 66 | Mafraq hospital | Abu Dhabi | Hospital (public) |
| 67 | Mediclinic Airport Road Hospital | Abu Dhabi | Hospital (private) |
| 68 | Mediclinic Al Ain hospital | Al Ain | Hospital (private) |
| 69 | Mediclinic Al Bateen | Abu Dhabi | Center/Clinic (private) |
| 70 | Mediclinic Al Bawadi | Al Ain | Center/Clinic (private) |
| 71 | Mediclinic Al Jowhara Hospital | Al Ain | Hospital (private) |
| 72 | Mediclinic Al Madar | Al Ain | Center/Clinic (private) |
| 73 | Mediclinic Al Marmoura | Abu Dhabi | Center/Clinic (private) |
| 74 | Mediclinic Al Mussafah | Abu Dhabi | Center/Clinic (private) |
| 75 | Mediclinic Al Noor Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 76 | Mediclinic Al Yahar | Al Ain | Center/Clinic (private) |
| 77 | Mediclinic Baniyas | Abu Dhabi | Center/Clinic (private) |
| 78 | Mediclinic ENEC | Al Dhafra | Center/Clinic (private) |
| 79 | Mediclinic Gayathi | Al Dhafra | Center/Clinic (private) |
| 80 | Mediclinic Khalifa City A | Abu Dhabi | Center/Clinic (private) |
| 81 | Mediclinic Madinat Zayed | Al Dhafra | Center/Clinic (private) |
| 82 | Mediclinic Zakher | Al Ain | Center/Clinic (private) |

| Nr. | Facility Name | Region | Type/Ownership |
|---|---|---|---|
| 83 | Mezyad Healthcare Center | Al Ain | Center/Clinic (public) |
| 84 | Moorfields Eye Hospital Center – Al Marina | Abu Dhabi | Center/Clinic (private) |
| 85 | Neima Healthcare Center | Al Ain | Center/Clinic (public) |
| 86 | NMC ADNOC OHC | Abu Dhabi | Center/Clinic (private) |
| 87 | NMC Alpha Medical Center, Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 88 | NMC Family Medical Center (Al Bateen) | Abu Dhabi | Center/Clinic (private) |
| 89 | NMC Golden Sands Medical Center | Abu Dhabi | Center/Clinic (private) |
| 90 | NMC Karama Medical Center | Abu Dhabi | Center/Clinic (private) |
| 91 | NMC Medical Center Al Wadi | Al Ain | Center/Clinic (private) |
| 92 | NMC Medical Centre Mohammed Bin Zayed | Abu Dhabi | Center/Clinic (private) |
| 93 | NMC Medical Specialty Medical Center, Khalidiya, Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 94 | NMC Mesk AlMadina Medical Centre LLC | Abu Dhabi | Center/Clinic (private) |
| 95 | NMC Oxford Medical Center, Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 96 | NMC Provita International Medical Center Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 97 | NMC Provita International Medical Center Al Ain | Al Ain | Center/Clinic (private) |
| 98 | NMC Royal Family Medical Center (Al Mussafah) | Abu Dhabi | Center/Clinic (private) |
| 99 | NMC Royal hospital Khalifa City A | Abu Dhabi | Hospital (private) |
| 100 | NMC Royal Medical Center Sama Tower Abu Dhabi | Abu Dhabi | Center/Clinic (private) |
| 101 | NMC Royal women's Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 102 | NMC Shahama Medical Center | Abu Dhabi | Center/Clinic (private) |
| 103 | NMC Specialty Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 104 | NMC Specialty Hospital Al Ain | Al Ain | Hospital (private) |
| 105 | NMC UAE University Clinics | Al Ain | Center/Clinic (private) |
| 106 | Oud Al Touba Healthcare Center | Al Ain | Center/Clinic (public) |
| 107 | Reem Hospital | Abu Dhabi | Hospital (private) |
| 108 | SEHA Kidney Care Center - Abu Dhabi | Abu Dhabi | Center/Clinic (public) |
| 109 | SEHA Kidney Care Center - Al Ain | Al Ain | Center/Clinic (public) |
| 110 | SEHA Kidney Care Center - Central | Abu Dhabi | Center/Clinic (public) |
| 111 | Sheikh Khalifa Medical City | Abu Dhabi | Hospital (public) |
| 112 | Sheikh Shakhbout Medical City | Abu Dhabi | Hospital (public) |
| 113 | Sheikh Zayed Mosque Clinic | Abu Dhabi | Center/Clinic (private) |
| 114 | Sir Baniyas Clinic | Al Dhafra | Center/Clinic (public) |
| 115 | Sweihan Healthcare Center | Al Ain | Center/Clinic (public) |
| 116 | Tawam Al Wagan hospital | Al Ain | Hospital (public) |
| 117 | Tawam hospital | Al Ain | Hospital (public) |
| 118 | VPS Burjeel Day Surgery Center, Al Reem island | Abu Dhabi | Center/Clinic (private) |
| 119 | VPS Burjeel Farha Hospital Al Ain | Al Ain | Hospital (private) |
| 120 | VPS Burjeel Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 121 | VPS Burjeel Medical Center, Al Zeina | Abu Dhabi | Center/Clinic (private) |
| 122 | VPS Burjeel Medical Center, Barari Mall Al Ain | Al Ain | Center/Clinic (private) |
| 123 | VPS Burjeel Medical Center, Shahama | Abu Dhabi | Center/Clinic (private) |
| 124 | VPS Burjeel Medical Center, Shamkha | Abu Dhabi | Center/Clinic (private) |
| 125 | VPS Burjeel Medical Center, Yas Mall | Abu Dhabi | Center/Clinic (private) |
| 126 | VPS Burjeel Medical City Abu Dhabi | Abu Dhabi | Hospital (private) |
| 127 | VPS Burjeel MHPC Marina Medical Center | Abu Dhabi | Center/Clinic (private) |
| 128 | VPS Burjeel Oasis Medical Center | Al Dhafra | Center/Clinic (private) |
| 129 | VPS Burjeel Royal Hospital Al Ain | Al Ain | Hospital (private) |
| 130 | VPS Burjeel Tajmeel Kid's Park Medical Center | Abu Dhabi | Center/Clinic (private) |
| 131 | VPS Lifecare Hospital Baniyas | Abu Dhabi | Hospital (private) |
| 132 | VPS Lifecare Hospital Musaffah | Abu Dhabi | Hospital (private) |
| 133 | VPS Lifecare Razeen Medical Center | Abu Dhabi | Center/Clinic (private) |
| 134 | VPS Lifeline Medical Center | Abu Dhabi | Center/Clinic (private) |
| 135 | VPS LLH Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 136 | VPS LLH Hospital Musaffah | Abu Dhabi | Hospital (private) |
| 137 | VPS LLH Medical Centre (Shabiya 11) | Abu Dhabi | Center/Clinic (private) |
| 138 | VPS Medeor 24x7 Hospital Abu Dhabi | Abu Dhabi | Hospital (private) |
| 139 | VPS Occupational Medicine Center Musaffah | Abu Dhabi | Center/Clinic (private) |
| 140 | Wahat Al Aman Home Healthcare LLC Abu Dhabi | Abu Dhabi | Home Healthcare |
| 141 | Wahat Al Aman Home Healthcare LLC Al Ain | Al Ain | Home Healthcare |
| 142 | Zhaker Healthcare Center | Al Ain | Center/Clinic (public) |

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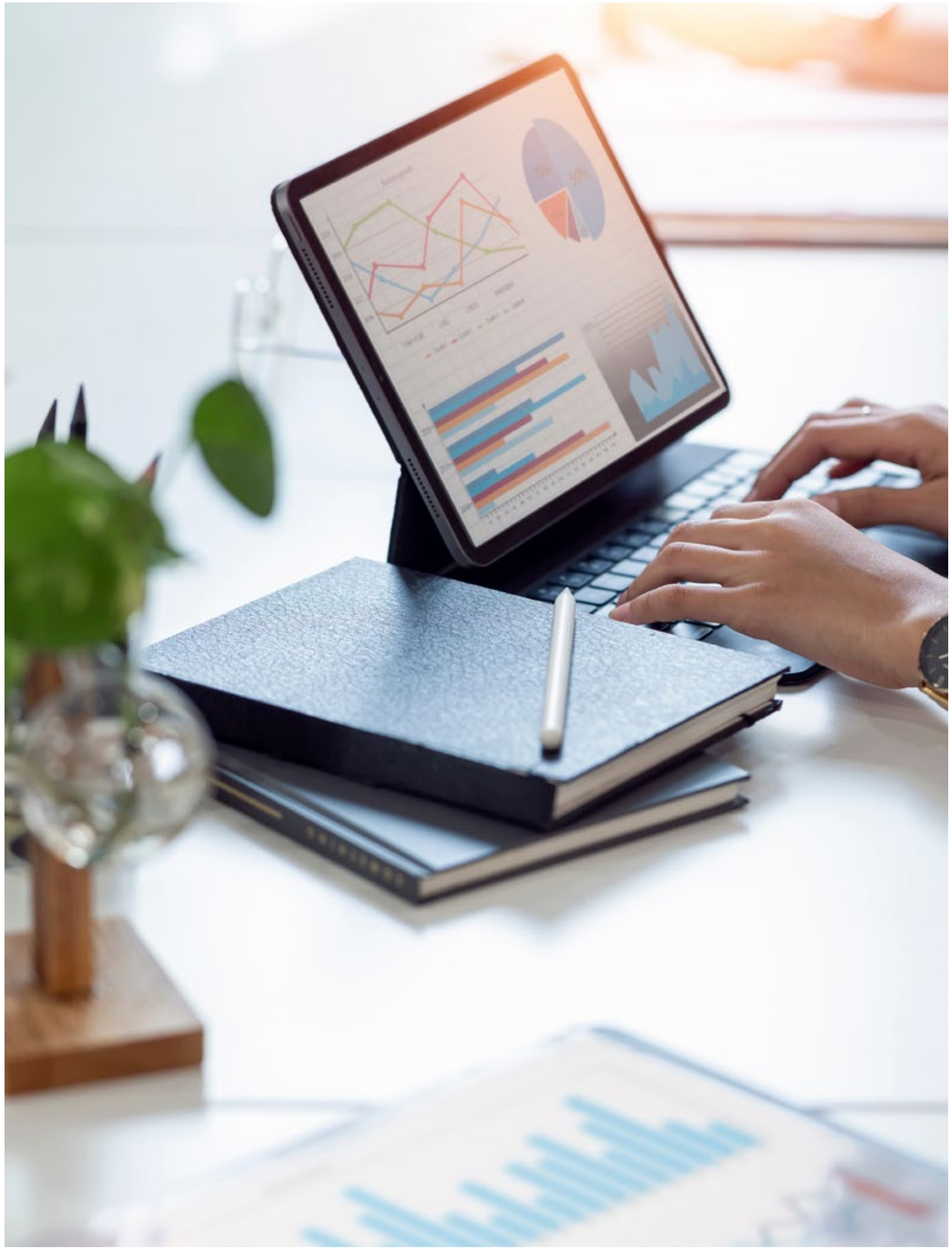

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