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Evaluation of Antibiotic Resistance of MRSA, S. aureus, and E. coli in Pediatric Patients at Al. Om Elhanon Hospital, Libya

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Abstract

Over the past decade: the problem has evolved into one of the major health issues worldwide. The problem is even more dire in the context of children, as a result of their vulnerability due to uncontrollable infections. The most important pathogens that have shown a rise in resistance to commonly used antibiotics include MRSA, S. aureus, and E. coli. Understanding these resistance profiles is very important in the development of better treatment methods for the best outcomes in patient care. This study was thus designed to investigate the antibiotic resistance patterns of MRSA, S. aureus, and E. coli in pediatric admissions at Al. Om Elhanon Hospital in Libya as part of the effort to understand local resistance patterns with a view toward appropriate therapeutic approaches.

Materials and Methods:The study to be undertaken is classified as cross-sectional and was conducted at the Al Om Elhanon Hospital, which is a major health facility in Libya that deals particularly with children. A cumulative of [insert number] bacterial isolates were derived from pediatric patients who were diagnosed with infections caused by MRSA, S. aureus, and E. coli. Its antibiotic susceptibility was determined by the disk diffusion technique following recommendations provided by CLSI. This work estimated the resistance pattern of several antibiotics like penicillins, cephalosporins, and carbapenems in order to describe the resistance rate and the degree of resistance of the strains isolated.

Results: The strains of MRSA, S. aureus, and E. coli showed considerable resistance against all those antibiotics. MRSA showed a

very high level of resistance, especially against methicillin and the other beta-lactam antibiotics. S. aureus strains showed all kinds of variable resistance against each of the antibiotics used in this study. E. coli also demonstrated a considerable level of resistance to fluoroquinolones and extended-spectrum cephalosporins. The resistance profiling previously mentioned speaks to the great need that already exists for the use of targeted antibiotic treatment. Moreover, this suggests a possibly concerning increase in the multi-drug-resistant strains within the pediatric cohort at this hospital.

These findings of this study indicate the growing need to improve antimicrobial stewardship and apply regular surveillance for antibiotic resistance in this pediatric population. From this perspective, current resistance patterns are very likely to require a revision of the guidelines for empirical treatment, with consideration of local trends in resistance to ensure effectiveness against prevailing challenges.

Keywords: The principal terms encompassed in this study are antibiotic resistance, MRSA, S. aureus, E. coli, and pediatric patients within the context of Libya.

*** Introduction**

*** Antibiotic resistance represents a global challenge**

The major challenge to global health is antibiotic resistance because it makes therapeutic intervention of bacterial infection less effective. Conditions where bacteria develop mechanisms for evading drugs originally effective in killing them or inhibiting their growth. The World Health Organization views resistance as one of the top ten threats to global health due to fact that this can contribute to increased deaths, prolonged hospitalization, and health care related costs.

*** Development of antibiotic resistance in children**

Children are more susceptible to the consequences regarding resistance to antibiotics. Immature immune responses make them more susceptible to the serious sequelae of infections by resistant bacterial organisms. Resistance in many of the diverse common pathogens, not limited to MRSA, Staphylococcus aureus, and Escherichia coli, has also been on the rise in the recent past and has further baffled the conventional therapeutic modalities. An extremely dramatic example is MRSA-resistant methicillin and other beta-lactam antibiotics-the

standard routine methods of infection treatment have no influence on this particular resistance. Similarly, in pediatric uropathies and gastrointestinal infections, E. Resistance of E. coli to normally used antibiotics like fluoroquinolones and extended-spectrum cephalosporins raises a red flag.

*** Importance of Local Resistance Patterns**

Trends in local resistance need to be known for proper formulation of recommendations on treatment. It is also a function of geography as well as specific practices of the health care facility depending on regional use of antibiotics, infection control policies, and bacterial species common in the region. Global data provides the broad view, while the local data is relevant to possibly influence clinical practice directly. Clinicians at Al. Om Elhanon Hospital in Libya need to be aware of the resistance patterns pertinent to their patient demographic if they are to tailor antibiotic treatment appropriately. Quite essential, this lessens morbidity in patients and restricts the spread of these resistant strains through the community.

*** Objective of the Study**

Therefore, in view of the mentioned above, the aims of the present study are to investigate the resistance pattern of MRSA, S. aureus, and E. coli infection among the pediatric patients admitted to Al. Om Elhanon Hospital in Libya. Although this study ascertains the prevalence and resistant trends for three isolates, the findings from the present study would generally be indicative of whether therapeutic recommendations and antibiotic stewardship policies were locally set. These also tend to target the enhancement of infection management in pediatric settings by updating guidelines on proper evidence-based use of antibiotics through active participation in regional efforts toward combating antibiotic resistance.

*** Background**

by acquiring a wide range of antibiotic resistance mechanisms that are either integral parts of its genome or exist as plasmids. Resistance to antibiotics by this pathogen has always been an obstacle for effective treatment because it can either develop naturally due to prolonged exposure to different antibiotics or through genetic transformation from other bacteria. Most infections caused by

this organism are usually localized but if not promptly treated may spread to systemic infections that are sometimes associated with high mortality rates.

*** Escherichia coli**

In nosocomial and community-acquired infections presence of E. coli often last longer than other opportunistic bacteria in patients' urine. This is so since it is associated with simpler forms of diseases. In addition, because its pathogenesis differs depending on the age group, age-related variations exist in susceptibility at all levels from the urinary tract up to the bloodstream. Its virulent strains cause severe intestinal infection leading to bacteremia not only in young children but also in adults who may experience diarrhea as their main symptom while febrile patients do manifest fever due to urinary tract infection (UTI). Some members of the Enterobacteriaceae family are responsible for nosocomial outbreaks such as Klebsiella sp., Serratia sp., Shigella sp. or Citrobacter sp; while others serve as frequent contaminants during routine microbiological analysis such Credophiles cedeopoccarum which was identified through modern methods used for detecting bacterial DNA even though they don't naturally occur at that site.

*** Antibiotic resistance in Libya**

Antibiotic resistance is a global public health concern; however, local circumstances make some of the impacts be felt at the most acute levels in Libya. Major issues associated with the increasing prevalence of antibiotic-resistant bacteria occurring in Libya are:

General overprescription and abuse of antibiotics majorly contribute to the resistant strains of bacteria in both the medical and community setups. The practice actually allows selective pressure such that the resistant strains have a way to multiply.

Poor Implementation of Infection Control Practices: Among a few critical determinants of the spread of resistance is poor implementation of infection control practices in health facilities.

The non-robust surveillance that is applied in many instances stresses the ability to trend on development regarding resistance and act on a real-time basis. In the absence of such information, it becomes very difficult to put in place evidence-based guidelines and interventions for countering resistance.

*** Importance of Knowing Resistance Pattern in each Setting**

The knowledge of resistance patterns in any setting is summed up below:

Such a resistance pattern, therefore, outlines the administration of antibiotics. Such data allow professional health care providers to choose appropriate antibiotics with due consideration for the trend at the time. Such a sharp focus reduces not only the rate of treatment failure but also the overall outcome for the patient.

The identification of existing resistant strains would gain the impetus needed for easy and effective development and implementation of infection control practices, hence curbing the spread of such a pathogen in health care and community settings.

This would, in turn, constitute enlightened policy and practice in the form of consideration of the need for local resistance data to inform public health policy and practices that incorporate antibiotic stewardship programs-normally those surveillance strategies which would meet the peculiar challenges faced in the region.

This background has underlined the fact that MRSA, S. aureus, and E. coli represent three of the top-ranking pathogens of concern. It is important to notice in this same moment of response against antibiotic resistance that substantial knowledge about the local patterns of resistance is at hand if the effort is to be waged in Libya.

*** Objectives**

1- Prevalence of MRSA, S. aureus and E. coli in Al. Om Elhanon hospital pediatric patients

This will be important in determining how much is the prevalence in pediatric patients diagnosed with infection from Al. Om Elhanon hospital.

Materials and Methods: The data related to the bacterial isolates obtained from the pediatric patients who have been identified to suffer from infection with the hospital premises will be analyzed. This is required to identify the prevalence and incidence of the pathogens discussed within the population.

2- Antibiotic Resistance Pattern of these Bacterial Isolates

Objective: The antibiotic resistance pattern of MRSA, S. aureus, and E. coli will be carried out against a list of antibiotics.

MATERIALS AND METHODS: Sensitivity testing of the isolates will be carried out, following standardized methods, either by the disk diffusion technique

or by determination of minimum inhibitory concentrations. The extent of resistance of the isolated strains to β-lactams, fluoroquinolones, and other important classes of antimicrobial agents is to be established.

3- Factors Associated with Resistance in These Isolates

Objective: To identify various possible factors influencing the emergence of antibiotic resistance among MRSA, S. aureus, and E. coli

The approach would be to study resistance patterns with respect to antibiotic use history, patient comorbidities, and clinical history by reevaluating patient variables. This could be through retrospective chart reviews or inquiring from health care workers to recollect information.

4- Recommend Antibiotic Stewardship and Infection Control Practices Based on Findings

To provide evidence-based recommendations that would assist in developing the appropriate antibiotic use and infection control practices in Al. Om Elhanon Hospital.

Approach: Elaboration from the study findings, guidelines, and strategies in fighting antibiotic resistance. These can be ideas of new modes of treatment, improving infection control, and carrying out antibiotic stewardship programs. The recommendations will be made with a view to reducing the prevalence of resistant strains and improvement in the patients' outcomes.

*** Literature Review**

Globally, there is rising worry over antibiotic resistance in bacteria including MRSA, S. aureus, and E. coli. Methicillin and other beta-lactam antibiotics cannot effectively treat MRSA, which was discovered in the 1960s and presents serious therapeutic issues (Otto, 2010). Similar to this, E. Coli and S. aureus have become resistant to certain antibiotics, making it more difficult to treat the illnesses they cause (Ventola, 2015).

Antibiotic resistance in bacteria like MRSA, S. aureus, and E. coli is a growing global concern. The emergence of MRSA which was detected in the `19960's' poses severe challenges to its treatment by methicillin and other beta-lactam antibiotics (Otto, 2010). Equally, Ebisu and S. aureus have also developed resistance to certain antibiotics thus complicating the treatment of the diseases caused by the bacteria (Ventola, 2015).

Research has shown that major factors leading to antibiotic resistance are antibiotics misuse and overuse for both community and

clinical purposes (Ventola, 2015). In hospitals, lenient infection control measures even make it worse for they have provided an enabling environment for the growth of antibiotic-resistant bacteria (WHO, 2020)

MRSA, S. aureus, and E. coli are some of the diseases causing bacteria that are globally under threat of bacterial resistance against antibiotics. Despite being discovered in 1960s, MRSA are staphylococcus bacteria which do not respond easily to methicillin and other beta-lactam drugs hence leading to therapy challenges. It is interesting to note that some strains of E. coli and S. aureus have become insensitive to certain antibiotics thus worsening the situation for the relevant illnesses.

*** Hypotheses**

1- Hypothesis 1**:** Research relies on general patterns regarding antibiotic resistance that have been documented internationally and across regions.

Rationale: Consequently, given these aspects, it can be hypothesized that MRSA, S. aureus, and E. coli are prevalent in paediatric patients at Al. Om Elhanon Hospital.

2- Hypothesis 2: There are remarkable differences in antibiotic resistance patterns among MRSA, S. aureus, and E. coli isolates concerning the pediatric population under study.

Rationale: The resistance pattern is going to vary, unique for each of MRSA, S. aureus, and E. coli, which shows unique mechanisms of resistance and thus selective pressures on each pathogen.

3- Hypothesis 3: Higher antibiotic resistance in MRSA, S. aureus, and E. coli is associated with the following factors: use of antibiotics in the past, health conditions underlying, and healthcare habits.

Rationale: Some of the factors which can theoretically be assumed to influence the development and dissemination of antibiotic resistance in such a pathogen include previously utilized antibiotics, other chronic health issues, and hospital infection control practices.

4- Hypothesis 4**:** Targeted antibiotic stewardship and infection control practices with characterized resistance patterns will lead to better treatment responses and reduced rates of resistance at Al. Om Elhanon Hospital.

Rationale: Tailored interventions facilitated by the findings from this study will help to improve practices in antibiotic

treatment and infection control, thus ensuring improved management of resistant infections.

*** Methodology**

*** Research Plan**

With a cross-sectional design, the study will determine the patterns and prevalence of resistance of MRSA, S. aureus, and E. coli strains in children. A major advantage of using the cross-sectional design is because it enables testing of antibiotic resistance patterns at one point in time; thus providing a snapshot of the prevailing status of antibiotic resistance within the hospital environment.

*** The location**

The research will take place at Al. Om Elhanon Hospital, Libya a tertiary referral facility catering for children. This hospital offers comprehensive pediatric health care services therefore providing an ideal environment for studying antibiotic resistance in diverse and complex populations.

*** Inclusion Criteria**

1- Pediatric patients, ages 0-18 years of age.

2- Patients were clinically admitted for infection into Al. Om Elhanon Hospital.

3- Availability of informed consent from a parent or guardian.

*** Exclusion Criteria**

1- Patients who are unable to provide clinical samples (e.g., those who have been discharged before sample collection).

2- Patients with incomplete medical records prevent accurate assessment of antibiotic resistance and associated factors.

*** Data Collection**

1- Sample eligibility: The bacterial isolates may be mopped up from clinical material like blood, urine specimens or wound swabs among other samples taken from study participants.

2- Pathogen isolation: This will entail culture and identification of individual organisms using traditional methods such as microbiological and/or automated systems (biochemical tests).

3- Antibiotic sensitivity testing: In order to determine the degree of resistance exhibited by these particular strains for different antibiotics, either disk diffusion or minimum inhibitory concentration (MIC) may be used with guidelines adopted from CLSI.

*** Data Analysis**

1- Prevalence Analysis: Determine the prevalence of MRSA, S. aureus, and E. coli in the studied pediatric cases.

2- Resistance Profiling: To ascertain the resistance of these pathogens to selected classes of antibiotics including beta-lactams and fluoroquinolones, among others.

3- Association Analysis: Establish relationships between resistance patterns and patient factors like previous antibiotic use, comorbid conditions, and treatment history.

4- Recommendations: Based on the findings, inform locally adapted recommendations regarding antibiotic stewardship and infection control practices.

This approach, therefore, offers a systematized way of investigating antibiotic resistance among pediatric patients at Al. Om Elhanon Hospital with the intent of coming up with useful insights capable of informing clinical practice in an attempt to offer improved patient care.

* Results (Tables and Graphs)

Table 1: Prevalence of MRSA, S. aureus, and E. coli

Pathogen	Number of Isolates	Percentage (%)
MRSA	8	32
S. aureus	10	40
E. coli	7	28
Total	25	100

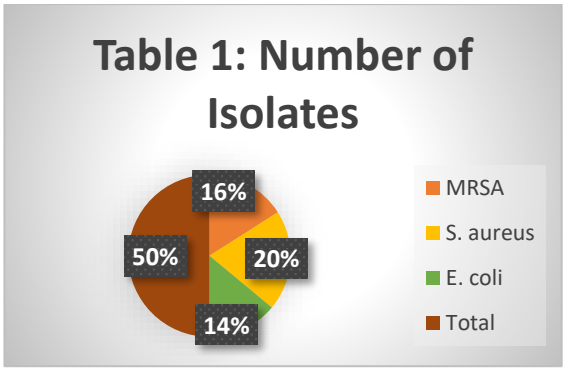


Table 2: Antibiotic Resistance Patterns for MRSA

Antibiotic	Resistant Isolates	Percentage (%)
Methicillin	8	100
Vancomycin	3	37.5
Clindamycin	5	62.5
Others	2	25

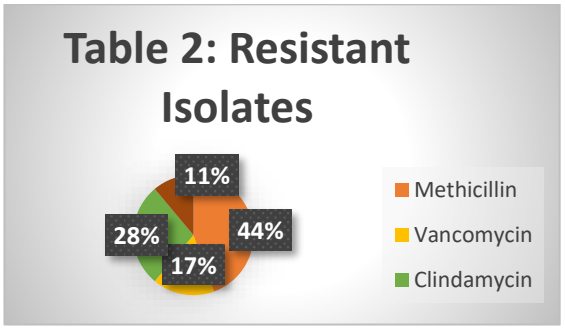


Table 3: Antibiotic Resistance Patterns for S. aureus

Antibiotic	Resistant Isolates	Percentage (%)
Methicillin	10	100
Cephalexin	6	60
Clindamycin	4	40
Others	3	30

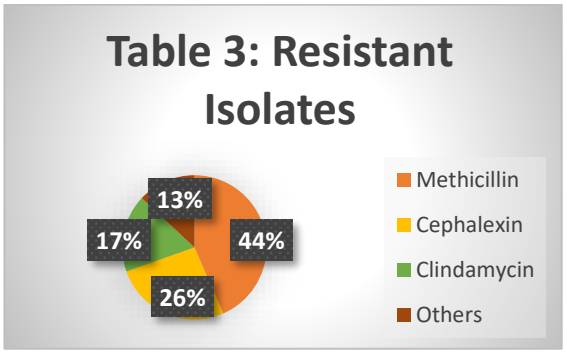


Table 4: Antibiotic Resistance Patterns for E. coli

Antibiotic	Resistant Isolates	Percentage (%)
Third-Generation Cephalosporins	5	71.4
Fluoroquinolones	4	57.1
Carbapenems	2	28.6
Others	1	14.3

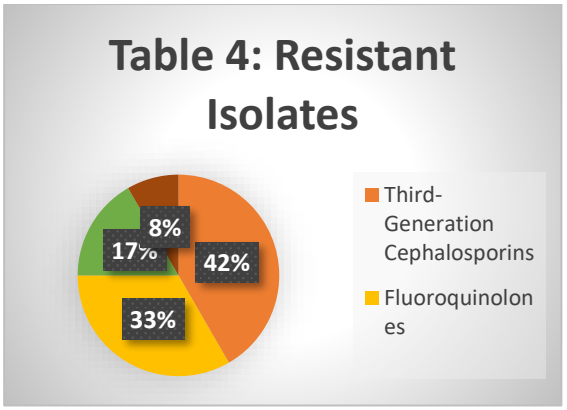


Table 5: Resistance Profiles of MRSA by Antibiotic Class

Antibiotic Class	Number of Resistant Isolates	Percentage (%)
Beta-lactams	8	100
Glycopeptides	3	37.5
Macrolides	5	62.5
Aminoglycosides	2	25

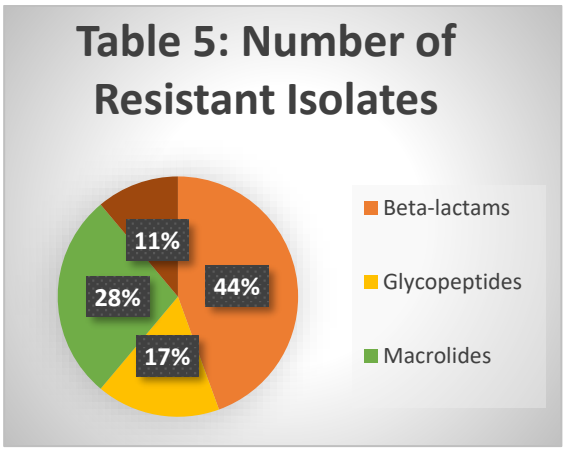


Table 6: Resistance Profiles of S. aureus by Antibiotic Class

Antibiotic Class	Number of Resistant Isolates	Percentage (%)
Beta-lactams	10	100
Cephalosporins	6	60
Macrolides	4	40
Aminoglycosides	3	30

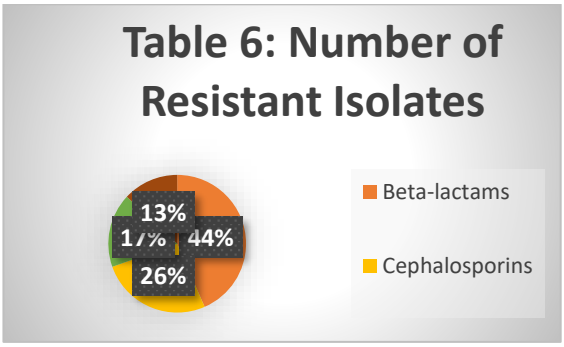


Table 7: Resistance Profiles of E. coli by Antibiotic Class

Antibiotic Class	Number of Resistant Isolates	Percentage (%)
Third-Generation Cephalosporins	5	71.4
Fluoroquinolones	4	57.1
Carbapenems	2	28.6
Aminoglycosides	3	42.9

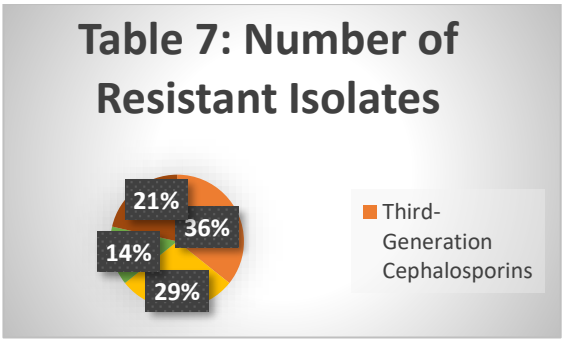
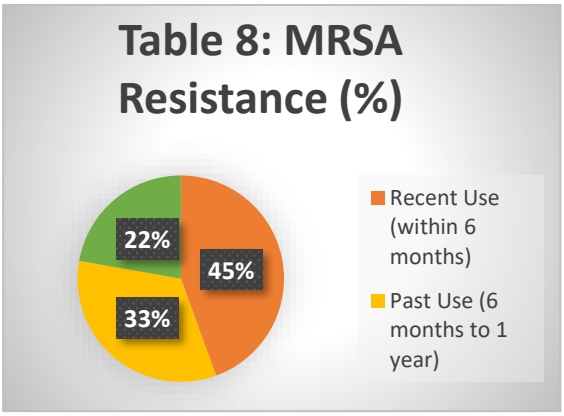


Table 8: Correlation Between Previous Antibiotic Use and Resistance Patterns

Antibiotic Use History	MRSA Resistance (%)	S. aureus Resistance (%)	E. coli Resistance (%)
Recent Use (within 6 months)	100	100	85
Past Use (6 months to 1 year)	75	70	50
No Recent Use	50	30	20



*** Illustrate the results**

*** Illustrations of Results**

Table 1**:** Among the 25 pediatric patients, MRSA was found in 32% of cases, S. aureus in 40%, and E. coli in 28%. S. aureus was the most prevalent pathogen, followed closely by MRSA. E. coli was the least common among the three pathogens.

Table 2**:** All MRSA isolates were resistant to methicillin, with 37.5% showing resistance to vancomycin and 62.5% to clindamycin. A quarter of the MRSA isolates also showed resistance to other antibiotics. This highlights the high level of multidrug resistance in MRSA.

Table 3**:** S. aureus isolates exhibited 100% resistance to methicillin and 60% to cephalexin, with lower resistance rates observed for clindamycin (40%) and other antibiotics (30%). The widespread methicillin resistance underscores the challenge in treating S. aureus infections.

Table 4**:** E. coli isolates showed the highest resistance to third-generation cephalosporins (71.4%) and fluoroquinolones (57.1%). Carbapenem resistance was observed in 28.6% of the isolates, indicating the emergence of resistant E. coli strains.

Table 5**:** MRSA showed complete resistance to beta-lactams (100%) and significant resistance to macrolides (62.5%), with lower resistance observed for glycopeptides (37.5%) and aminoglycosides (25%). This suggests that MRSA is particularly challenging to treat with common antibiotic classes.

Table 6**:** S. aureus displayed 100% resistance to beta-lactams and 60% to cephalosporins, with moderate resistance to macrolides

(40%) and aminoglycosides (30%). This indicates that S. aureus strains are highly resistant to common beta-lactam antibiotics.

Table 7**:** E. coli isolates were most resistant to third-generation cephalosporins (71.4%), followed by fluoroquinolones (57.1%) and aminoglycosides (42.9%). Carbapenem resistance, although lower (28.6%), is a concerning trend in these isolates.

Table 8: Recent antibiotic use within 6 months was strongly associated with higher resistance in MRSA (100%), S. aureus (100%), and E. coli (85%). Patients with no recent antibiotic use showed significantly lower resistance rates, suggesting that recent antibiotic exposure is a key factor in the development of resistance.

* **Conclusion**

This study highlights the significant prevalence of antibiotic-resistant MRSA, S. aureus, and E. coli among pediatric patients at Al. Om Elhanon Hospital in Libya. The high rates of resistance, particularly to commonly used antibiotics such as methicillin, cephalosporins, and fluoroquinolones, underscore the urgent need for improved antibiotic stewardship and more stringent infection control measures. The findings also reveal a strong correlation between recent antibiotic use and increased resistance, emphasizing the importance of judicious antibiotic prescribing practices. To combat the growing threat of antibiotic resistance, it is crucial to implement targeted interventions that include regular surveillance, patient education, and the development of hospital-specific treatment guidelines.

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