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# A meta-analysis of the Prevalence and Risk Factors of Community-acquired MRSA among Students at Abasyn University in Peshawar, Pakistan

Abstract: *Staphylococcus aureus is the most pathogenic species in the genus, having been linked to nosocomial infections as well as community-acquired infections. In healthy people, it frequently colonises the skin and mucous membranes asymptomatically, especially the anterior nares. These days, community-acquired MRSA is a significant issue. The goal of the current investigation was to determine MRSA's detrimental consequences in Khyber Pakhtunkhwa. Fifty samples were gathered from Abasyn University students in Peshawar for this purpose. The samples were taken using sterile nasal swabs, and they were inoculated on nutritional agar medium within eight hours. Catalase and coagulase tests revealed the presence of Staphylococcus aureus. Thirty of the fifty samples tested positive for Staphylococcus aureus. The following antibiotics were used: vincomycin, oxyacillin, augmentin, ampicillin, and foxittin. MRSA prevalence was 76.66%.*

**Key Words:** Staphylococcus Aureus, Community-acquired MRSA, Vincomycin, Oxyacillin, Augmentin, Ampicillin, Foxittin

## Introduction

The spherical, Gram-positive bacteria *Staphylococcus aureus* has a diameter of around one micrometre. Because cell division occurs in multiple planes, its cells cluster together to resemble grapes. Staphylococcus are facultative anaerobes that may produce energy by fermentation, which mostly produces lactic acid and aerobic respiration. Staphylococcus is oxidize-negative, and catalase-positive, and requires complex nutrients, such as numerous amino acids and vitamin B, for growth. These characteristics set them apart from Streptococcus sp. According to Plata et al. (2009), S. aureus can withstand sodium chloride concentrations as high as 1.7 molar with great tolerance. About 20–30% of people in general are thought to be carriers of *S. aureus*. Heyman (2004) said.

*S. aureus* generates medium-sized "golden" colonies on a rich medium. *S. aureus* colonies frequently induce β-hemolysis on sheep blood agar plates (Ryan & Ray, 2004). Coagulase, which S. aureus produces, combines with blood prothrombin to transform fibrinogen into fibrin, which causes plasma to coagulate. Coagulase-negative staphylococci, as the genus is collectively known, are distinguished from *S. aureus* by blood coagulation (Ryan & Ray, 2004)

Because it has a broad range of virulence factors, *Staphylococcus aureus* is a pathogen that can get past any defence mechanism in the host

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(Plata *et al.,* 2009). From a clinical perspective, antibiotic resistance is the main issue that doctors deal with while treating S. aureus infections because of the possibility of therapeutic failure and the ensuing poor prognosis. (Costa and others, 2013) As the most virulent species in the Staphylococcus genus, *S. aureus* is linked to nosocomial infections as well as infections acquired in the community. In healthy people, it frequently colonises the skin and mucous membranes asymptomatically, especially the anterior nares (Costa et al., 2013)

*S. aureus* infections have been treated with penicillin and its derivatives, such as methicillin (Rayner and Munckh, 2005). The penicillin-binding protein PBP 2A is encoded by the mecA gene, which is the cause of methicillin resistance (Wielders *et al.,* 2002). In order to address penicillin-resistant S. aureus, the penicillinase-resistant antibiotic methicillin was released in 1959. However, within a year, the late Professor Patricia Jevons revealed that the first human *S. aureus* strain was methicillin-resistant in a UK hospital (Kim, 2009).

The concept of community that has been gained has an inherent ambiguity. When comparing the time and location of MRSA acquisition to the infection or disease initiation, there is ambiguity. According to certain research, it is generally accepted that if MRSA is found 48 to 72 hours after a patient's admission to the hospital, the MRSA is likely brought in by the patient from the community. This is known as community-acquired MRSA (Salgado *et al.*, 2003).

Methicillin-resistant *Staphylococcus aureus* (MRSA) is now known to produce community-acquired (CA) infections in individuals who do not have known MRSA risk factors. In otherwise healthy children and young adults, CA-MRSA strains primarily cause moderate skin and soft tissue infections, although they can occasionally result in pneumonia and severe necrotizing fasciitis (Ruiz de Gopegui and Cercenado, 2008). Around the world, methicillin-resistant *Staphylococcus aureus* (MRSA) has been discovered as a nosocomial infection (Diekema *et al.,* 2007).

Recent hospitalisation or surgery, living in an assisted living facility, dialysis, and indwelling percutaneous medical devices and catheters are known risk factors for MRSA infection. However, MRSA cases have recently been reported in healthy community members who do not have any known risk factors for MRSA acquisition. These infections are called community-acquired (CA)-MRSA because they appear to have been acquired in the community (Naimi *et al.,* 2003).

MRSA colonisation or infection rates differ depending on the population under study, the type of healthcare facility, and the geographic area. Patients' locations within the facility have an impact on the incidence of MRSA colonisation in acute-care settings. Chaix *et al.* (2006) revealed that the ICU had a reported prevalence of MRSA infection or colonisation ranging from 4% to 8%. Urban and rural communities are experiencing an increase in the prevalence of community-acquired MRSA infections (Methicillin-resistant *Staphylococcus aureus*).

The demographic under study, the type of healthcare facility, and the geographic location all influence the rates of MRSA colonisation or infection. The location of patients within a facility affects the frequency of MRSA colonisation in acute-care settings. According to reports, the ICU has a 4%–8% prevalence of MRSA infection or colonisation (Chaix et al., 2006). Methicillin-resistant *Staphylococcus aureus* (MRSA) infections obtained through community settings are becoming more common in both urban and rural areas. Though the infections are by no means limited to these categories, the statistical risk is higher for sports, military personnel, prison inmates, intravenous drug abusers, homeless children in the creche, and some American communities.

## Material and Methods

The Microbiology Department of Abasyn University Peshawar was the site of the study. *Staphylococcus aureus* which is resistant to antibiotics (oxacillin) was isolated and identified as part of the investigation. The samples came from the male students of Abasyn University in Peshawar. 50 samples in all, along with other data, were gathered. Age, whether or not antibiotics were taken within a month, serious illnesses identified during sample collection, district name, etc.

## Collection of Samples:

A moistened, sterile swab was used to gather samples. It was inserted up to two to three centimetres into each nostril, spun for five seconds, and then quickly sealed with a cap. After that, the swab was labelled and aseptically sent to a lab for additional examination.

## Culturing and Inoculation of Samples:

After collection, the samples were brought to the lab in less than eight hours. The soup that was infected was kept in an incubator at 370°C.

## Identification of S.aureus:

After 24 hours colonies were observed on *S.aureus.*

## Gram staining:

Gram staining was used to differentiate and identify gram-positive *S.aureus.*

## Microscopy

Stained slides were observed under a microscope for the presence of grape-like cocci clusters.

## Biochemical Tests

For the confirmation of the organism, the following biochemical tests were performed.

## Catalase test:

This test assisted in separating the bacteria that produce catalase enzymes from the bacteria that do not. The breakdown of hydrogen peroxide into oxygen and water is accelerated by catalase. This phase involves the identification of S. aureus because it is a catalase-producing bacterium. smeared a slide with a few drops of hydrogen peroxide solution. Selecting a colony of the organisms using a sterilised wire loop, and submerge it in the hydrogen peroxide solution. The presence of active bubbles suggested that the organism was catalase-positive. The presence of active bubbles suggested that the organism was catalase-positive. However, if no bubbles formed, the test was deemed unsuccessful.

## Coagulase test:

This is also used to identify the *S. aureus* species that produce the coagulase enzymes that turn fibrinogen into fibrin, causing plasma to clot. used a micropipette to transfer a few drops of human plasma obtained from the centrifugation of human blood onto a slide. A colony of the test organism was selected and carefully combined with the plasma that had earlier been produced by centrifuging human blood using sterilised wire. A positive test result was recorded if the sample clustered within ten seconds. However, if no clumping developed after ten seconds, the test was deemed unsuccessful.

## Antibiotic susceptibility testing:

Using the disc diffusion method, all of the detected *S. aureus* isolates were then inoculated on nutrient agar plates for their antibiotic susceptibility test. For this, the antibiotic Methicillin discs were utilised. The sample is referred to as methicillin-susceptible *Staphylococcus aureus* (MSSA) if a zone of inhibition forms around it after 24 hours, and methicillin-resistant Staphylococcus aureus (MRSA) if no zone of inhibition forms around the disc.

## Results

Fifty samples in all were processed. Thirty of them had growth findings that were favourable for Staphylococcus aureus. Students at ABASYN UNIVERSITY in Peshawar provided samples. The samples were brought to the ABASYN UNIVERSITY MICROBIOLOGY, where they were processed in accordance with standard operating protocols.

Table 1

***Presence of S.aureus in students***

| AGE | NUMBER OF TOTAL STUDENTS | NUMBER OF POSITIVE CASES Percentage(%) |
|---|---|---|
| 21-22 | 13 | 7(23.33%) |
| 22-24 | 12 | 11(36.66%) |
| 25-26 | 12 | 8(26.66%) |
| 27-28 | 13 | 4(13.33%) |
| TOTAL | 50 | 30 |

The presence of *S. aureus* in nasal samples from Abasyn University Peshawar students is shown in Table 1. The age-based analysis of S. aureus presence is displayed in the table. Age groupings are used to separate all of the samples. Students in the age group 25–26 had the lowest rate of the bacteria (26.66%), while students in the age group 22–24 had the highest percentage (36.66%). However, students in the age group of 27–28 (13.33%) obtained the fewest *S. aureus* isolates.

Table 2

*Average of MRSA and MSSA among the isolated samples*

| | Number of samples | Percentage |
|---|---|---|
| MRSA | 23 | 76.66% |
| MISA | 4 | 13.33% |
| MSSA | 3 | 10% |
| TOTAL | 30 | 100% |

In accordance with CLSI-2014, the resistance, intermediate, and susceptibility patterns were examined. Methicillin resistance was present in 76.66% of the *S. aureus* isolates, as Table 3.03 demonstrates. Ten per cent of the isolates exhibited methicillin sensitivity. Additionally,

**Table 3**

*Antibiogram analysis of isolated MRSA*

| Antibiotics | Resistant | Intermediate | Sensitive |
|---|---|---|---|
| OX | 23(76.66%) | 4(13.33%) | 3(10%) |
| FOX | 8(26.66%) | 2(6.66%) | 20(66.66%) |
| AUG | 13(43.33%) | 8(26.66%) | 9(30%) |
| AMP | 15(50%) | 5(16.66%) | 10(33.33%) |
| VA | 10(33.33%) | 4(13.33%) | 16(53.33%) |

Table 04. provides information about the antibiogram of several drugs against *S. aureus*. The chart makes it clear that OX had the greatest resistance (76.66%) to S. aureus, followed by AMP (50%) and AUG (43.33%).In a similar vein, *S. aureus* was discovered to be more responsive to FOX (66.66%) than VA (53.33%). The least sensitive pattern against *S. aureus* was displayed by OX (10%).

## Discussion

According to Hussain *et al.* (2001), our MRSA isolates were identical to those of other community-acquired MRSA isolates, supporting the theory that MRSA strains originate and circulate in the population rather than only spreading from hospitals. Considering that our MRSA-positive individuals did not require hospitalisation. There is one more transmission-related concept, though. This indicates that the environment of hospitals has a higher rate of MRSA transfer from carriers to healthy populations.

However, our reference study did not support this notion. Instead, it showed that individuals with prolonged hospital stays who had antibiotic treatment, as well as dialysis and surgery patients, as well as those with compromised immune systems generally, are more vulnerable to MRSA infections. Then, it doesn't matter if those individuals have ties to a community or hospital .*S. aureus* nasal carriers, especially those involved in food preparation and distribution, need to be kept out of the workplace and treated until decolonization. Nevertheless, following a local administration of antibiotics, MRSA may continue to exist, colonise more nasal locations, or, throughout the course of treatment, gain resistance to previously sensitive medicines. Thus, it is safe to implement straightforward yet efficient measures, such as improving workplace and personal hygiene, to stop the spread of MRSA (Ljiljana 2010).

The reference research also made it obvious that MRSA transmission rates were higher during the Middle Ages. It has been shown that subjects in the age group of 14 to 50 have the highest nasal carriage rate of the organism (Shakya 2010). The above remark was also limited by our findings. In this study, the age group of 22–24 years old had a higher frequency of MRSA (36.66%).

According to the reference study, the colonisation rate in the community is higher than in the hospital setting. However, Chacko *et al.* (2009) found that *S. aureus* had a higher level of resistance to several drugs. He proposed that the likelihood of acquiring the germs during a hospital stay or visit is higher than that of acquiring MRSA in the community.

Our 76.66% MRSA colonisation rate appears to be quite high when compared to the 1.2% rate reported in a study by Mari *et al.* (2002) and the 1% rate observed at the University of Chicago clinic. Chicago is one of the cities where community-acquired MRSA infection has increased noticeably, indicating that even this minimal amount of colonisation can result in notable infection rates. While MRSA has 0% resistance to vincomycin,

according to research by Joshi S *et al.* (2013), the current study has a higher rate of 33.3% MRSA resistance. Conflicting outcomes could arise from variations in temperature, weather, hospital stays, or antibiotic treatment.

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