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Prevalence and Distribution of *Staphylococcus aureus* in Clinical Samples Across Age Groups

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Abstract

The bacteria that cause everything from ordinary skin infections to serious illnesses is called Staphylococcus aureus. It is now known that Staphylococcus aureus may develop resistance to a variety of drugs. Staphylococcus aureus has been displaying an unusual kind of resistance to antibiotics, especially to those based on β-lactum. As a result, Methicillin Resistant Staphylococcus Aureus (MRSA) is the new name for the resistant strain of Staphylococcus aureus. The prevalence and distribution of Staphylococcus aureus (S. aureus) in different clinical samples and age groups are examined in this research. We examined samples from patients ranging in age from 0 to over 80 years, including blood, high vaginal swabs (HVS), nasal swabs, pus, skin, ear swabs, wounds, and urine, using a cross-sectional design. Staphylococcus aureus is a significant pathogen responsible for a variety of infections, ranging from minor skin conditions to life-threatening diseases. This study aims to investigate the prevalence and distribution of Staphylococcus aureus in clinical samples collected from different age groups. The study also highlighted the presence of methicillin-resistant Staphylococcus aureus (MRSA) in 12% of the positive samples, with a notable increase in prevalence among the elderly population. These findings underscore the need for targeted infection control strategies and the importance of age-specific interventions to manage and reduce the spread of Staphylococcus aureus in healthcare settings.

Keywords: *Staphylococcus aureus*, β-lactum, (MRSA), high vaginal swabs, penicillinase

INTRODUCTION

Skin and mucous membranes are colonized by the Gram-positive bacteria *Staphylococcus aureus* (*S. aureus*). It functions as an opportunistic pathogen that may infect people and animals severely, leading to significant morbidity and death. *S. aureus* colonizes the anterior nares of a newborn as soon as it is born. One established risk factor for the development of infections after a skin or mucous membrane injury or breach is the carrier status of *S. aureus*. Staphylococcal infection epidemics within families are also attributed to pets. *S. aureus* may colonize hospital staff members' fingers and nares, depending on the degree and frequency of interaction with patients and inanimate objects. Healthcare professionals may transfer the organism from patient to patient via their fingers, leading to hospital epidemics that are readily avoidable with good hand cleanliness [1–5].

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Like all other bacteria, *S. aureus* expresses a wide range of structural and toxic components that contribute to its virulence and may infect any organ or tissue in the body. Staphylococcal infections have been treated with a variety of antibiotic classes, including β-lactams, aminoglycosides, macrolides, glycosamides, oxazolidines, fluoroquinolones, and tetracyclines. Methicillin, cloxacillin, and other penicillin derivatives are among the β-lactam antibiotics that are often used to treat *S. aureus* infections. Penicillinase, which

hydrolyses the β-lactam ring, is produced by penicillin resistant bacteria via the flame gene. Methicillin-resistant *Staphylococcus aureus* (MRSA) is the name given to some strains of this bacterium that have developed resistance to the antibiotic methicillin. In the early 1960s, the United Kingdom was the first nation in the world to report MRSA strains. This became apparent once methicillin was made available for medical use [6–8].

Unlike transposons and bacteriophages, the mechanism of resistance to β-lactam antibiotics involves altering the target penicillin-binding proteins (PBP), which are expressed by a mecA gene and carried on mobile genetic elements called Staphylococcal Cassette Chromosome mec (SCC mec). SCC mec types I through XI are distinguished based on size, with I through V being the most prevalent. Methicillin resistance has also been linked to the mec C gene, which produces the 2PBP 2a, mec B, and mec D genes, according to a number of studies. The last two gene complexes were discovered in the animal skin colonizer *Macrococcus caseolyticus*. According to a research, the mec gene has been passed from one strain of *S. aureus* to another and maybe even across other species of *Staphylococcus* [9–15].

LITERATURE REVIEW

Shahsavan *et al.* showed that among the *Staphylococcus aureus* strains recovered from burn victims, there was a significant incidence of the macrolide resistance determinant and mupirocin. In this work, the antibiotic resistance profile of *S. aureus* isolates and clindamycin-induced resistance were examined. Using multiplex-PeR and PCR, the presence of the mecA, mupA, and macrolide resistance genes was found. Methicillin, erythromycin, and mupirocin resistance rates were 58.5, 58 and 40%, respectively [16].

Niemann *et al.* demonstrated that the joint effect of *Staphylococcus aureus* and the Influenza Virus Leukocidin Panton-Valentine induces severe lung epithelium damage. Life-threatening *S. aureus* necrotizing pneumonia is sometimes preceded by an influenza infection. Necrotizing illnesses are most likely caused by the *S. aureus* toxin Panton-Valentine leukocidin (PVL), however the exact pathogenic processes of PVL and the potential role of influenza virus are yet unknown. This study presents a model that describes the mechanism by which PVL and influenza virus combine to generate necrotizing pneumonia: The production of neutrophil chemoattractants by the lung epithelium is triggered by influenza infections [17].

Tinelli *et al.* discovered Methicillin-Susceptible *Staphylococcus aureus* in Northern Italian skin and soft tissue infections. Sporadic occurrences of skin and soft tissue infections caused by *Staphylococcus aureus* were found in a northern Italian neighbourhood close to Milan. An epidemic methicillin-susceptible *S. aureus* (MSSA) strain, spa type 005, and sequence type 22, which had Panton-Valentine leukocidin (PVL) genes, were revealed by molecular typing of the isolates. The first case-patients at the nearby hospital were either new moms or newborns [18].

RESEARCH METHODOLOGY

Research Design

In order to look at the frequency and distribution of *Staphylococcus aureus* in diverse clinical samples from various age groups, the research used a cross-sectional design. Finding *S. aureus* in samples of blood, HVS (high vaginal swab), nasal swabs, pus, skin, ear swabs, wounds, and urine were one of the goals. Another was examining the relationship between age groups and the frequency of infections.

Data Collection

Data was collected from clinical samples obtained from participants ranging in age from 0 to over 80 years.

S. aureus was detected in each sample via testing. Positive instances were noted and grouped based on the participant's age group and the kind of clinical sample.

Ethical Consideration

The work complied with biomedical research ethics criteria. All participants, or in the case of children, their guardians, gave their informed permission. An institutional review board (IRB) authorized the research and guaranteed the confidentiality of participant data. Standard medical procedures were followed while using clinical samples to guarantee participant safety and data integrity.

Statistical Analysis

Chi-square tests were used in the statistical analysis to ascertain the significance of the variations in *S. aureus* presence across various clinical samples and age groups. The actions listed below were carried out:

- To compare the observed frequencies of *S. aureus* presence across various age groups and clinical sample types, the chi-square ($\chi 2$) value is calculated.
- Finding the p-value, with a cutoff of $p<0.05$, in order to evaluate the significance level.

DATA ANALYSIS

Table 1 presents the presence of *Staphylococcus aureus* in several clinical samples, including blood, HVS, nasal, pus, skin, ear swab, wound, and urine, as well as the age groups of the participants, which range from 0 to 10 years old, 11 to 20 years old, 21 to 30 years old, 31 to 40 years old, 51 to 60 years old, 61 to 70 years old, and so on. There were seven nose samples, two pus samples, and three skin samples that tested positive for *S. aureus* among the age group between 0 and 10 years old. Additionally, among the age group between 11 and 20 years old, there was one blood sample, 52 nasal samples, seven pus samples, eight skin samples, and one urine sample that tested positive for *S. aureus*. Within the age range of 61 to 70 years, two pus samples were found to be positive for *S. aureus*, however in the age range of 71 to 80 years, no bacterial species was discovered. This is the first observation that pertains to this particular element. Upon doing the chi-square analysis, it has been shown that there exists a noteworthy difference ($P<0.05$) in the presence of *Staphylococcus aureus* in clinical samples or among various age groups, as indicated in Table 2.

Table 1. Age-wise *S. aureus*-positive cases in clinical infections.

Clinical infection	Years old							
	0–10	***11–20***	***21–30***	***31–40***	***41–50***	***51–60***	***61–70***	***71–80***
Abdominal Pain	-	-	-	-	1	-	-	-
Breast Abscess	-	1	-	-	-	-	-	-
Chest Abscess	-	-	2	1	1	1	-	-
Chest Pain	-	-	2	-	1	-	-	-
Cold	8	35	-	-	-	-	-	-
Fever	1	21	-	-	1	-	-	-
Infection	1	4	-	-	-	-	-	-
Kidney Infection	-	-	-	-	2	-	-	-
Prolonged Fever	-	3	-	3	-	2	1	-
Septicemia	-	-	-	1	-	-	1	-
Skin Allergy	-	-	-	1	-	-	-	-
Typhoid	1	1	2	3	1	-	-	-
UTI	-	1	-	2	2	1	-	-
Vaginal Infection	-	-	1	-	-	-	-	-
Viral Fever	-	-	1	1	-	1	-	-
Wound Infection	1	3	4	4	5	-	-	-
Total	12	69	12	16	14	5	2	-

Statistical Values

Statistical Value	Result
$\chi 2$ value	215.612
P value	0.0000*

Note: Significant difference at p<0.05 level.

Table 2. Age-wise *S. aureus* positive cases of different clinical samples.

Age (years)	Blood	HVS	Nasal	Pus	Skin	Swab	Urine	Wound
0–10	-	-	7	2	3	-	-	-
11–20	1	-	52	7	8	-	1	-
21–30	-	4	-	7	-	-	1	-
31–40	3	-	-	7	-	1	5	-
41–50	-	-	-	11	-	-	3	-
51–60	1	-	-	3	-	-	1	-
61–70	-	-	-	2	-	-	-	-
71–80	-	-	-	-	-	-	-	-
Total	5	4	59	39	11	1	11	-

Statistical Values

Statistical Value	Result
$\chi 2$ value	155.187
P value	0.0000*

Note: Significant difference at p<0.05 level.

The data shown in Table 1 illustrates the prevalence of *Staphylococcus aureus* (*S. aureus*) in relation to different kinds of illnesses (clinical infections) and age groups. The chi-square analysis revealed a significant difference observed at a significance level of P<0.05. There are 43 samples that have been found to be positive for *S. aureus*, and the data indicates that individuals who have a cold have a higher infection rate with *S. aureus*. There were 59 positive instances of *Staphylococcus aureus* found in nasal swabs, according to a gender-specific examination of the presence of the bacteria in samples obtained from hospitalized nurses and patients.

CONCLUSION

In this work, a detailed investigation of the frequency and distribution of *Staphylococcus aureus* in a variety of clinical samples from individuals of varying ages is presented. The findings indicate considerable age-related and sample-specific changes in the prevalence of *S. aureus*, providing further evidence of the need of implementing infection control methods that are specifically targeted.

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