

# Stethoscopes: A potential source of hospital-acquired infection of methicillin-resistant *Staphylococcus aureus*

Sanjib Mani Regmi<sup>1\*</sup>, Shanti Pradhan<sup>1</sup>, Prajit Sing Bhandari<sup>2</sup>, Sushil Kumar Chaudhary<sup>3</sup>, Gyanendra Gautam<sup>1</sup>, Kripa Ghimire<sup>1</sup>, Sanij Singh<sup>4</sup>, Prabin Shrestha<sup>5</sup>

<sup>1</sup>Department of Microbiology, Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal,

<sup>2</sup>Department of Pharmacy, Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal, <sup>3</sup>Department of Microbiology, Universal College of Medical Sciences and Teaching Hospital, Bhairahawa, Nepal,

<sup>4</sup>Department of Emergency Medicine, Nepal Medicit, Kathmandu, <sup>5</sup>Department of Emergency Medicine, Gandaki Medical College Teaching Hospital and Research Center, Pokhara, Nepal

## ABSTRACT

**Introduction:** The stethoscope, an essential tool for medical examination, can be an important vehicle for the transmission of drug-resistant pathogens like methicillin-resistant *Staphylococcus aureus*. Thus, this study aimed to detect the stethoscope as a potential source for hospital-acquired methicillin-resistant *Staphylococcus aureus* infection.

**Methods:** This descriptive cross-sectional study was carried out from January to February, 2023 in the Department of Microbiology by collecting swab samples from medical interns' stethoscopes. Ethical clearance from the Institutional Review Committee was obtained (Ref. No. 139/078/079). *Staphylococcus aureus* were isolated and methicillin resistance was detected using cefoxitin disc following Clinical and Laboratory Standards Institute guidelines. Consecutive non-probability sampling was used. Data analysis was done using a Statistical Package on Social Sciences version 26.0. **Results:** From a total of 103 swabs, 89(86.40%) showed growth, among which 41(46.10%) were identified as *Staphylococcus aureus*. Out of 41, *Staphylococcus aureus* identified, 13(31.7%) were methicillin-resistant. Methicillin-resistant strains were mainly isolated from emergency and intensive care units, 3(23.1%). More than fifty percent of the strains were resistant to azithromycin, ciprofloxacin, and ofloxacin. None of the strains were resistant to linezolid. **Conclusions:** Detection of methicillin-resistant *Staphylococcus aureus* on the stethoscope used by medical interns working in critical areas of our institution is of utmost concern. This basic data is an eye opener for vigilance surveillance and practicing of disinfecting stethoscopes and hand hygiene among health workers in health care centers.

**Keywords:** Antibiotic resistance, methicillin-resistant *Staphylococcus aureus*, stethoscope.

## \*Correspondence:

Dr. Sanjib Mani Regmi  
Department of Microbiology  
Gandaki Medical College Teaching Hospital and  
Research Center, Pokhara, Nepal  
Email: sanjibmaniregmi@gmail.com  
ORCID iD: <https://orcid.org/0000-0003-0589-3605>

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## INTRODUCTION

Hospital-acquired infections (HAIs) are a major health problem worldwide and are preventable.<sup>1</sup> Routinely used medical devices such as stethoscopes, play an important role in the spread of HAIs and multidrug-resistant (MDR) microorganisms.<sup>2</sup> Stethoscope a 'physician's third hand' that comes in direct contact with the patient during examination is less regarded as a vector for spreading diseases and its disinfection is not well established.<sup>3</sup> It might harbor pathogenic microorganisms including drug-resistant pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is of utmost concern worldwide as there are 94,000 cases and 19,000 deaths that occur due to MRSA annually, of them 86% are HAIs.<sup>4</sup>

There are many studies showing the transmission of microorganisms via stethoscope but the role of stethoscope in transmission of MRSA is least explored, particularly in our region. Thus, this study aimed to determine stethoscope as a potential source for transmission of MRSA in our hospital setting.

## METHODS

This descriptive cross-sectional study was done in Gandaki Medical College Teaching Hospital and Research Center, Pokhara from January to February 2023. Ethical clearance was obtained from the Institutional Review Committee of Gandaki Medical College with Ref. No. 139/078/079. Informed consent was taken from all the participants. Medical interns who were ready to give consent were enrolled in the study. A consecutive non-probability sampling technique was used and 103 non-repetitive samples were collected from the stethoscope of medical interns which was calculated using the formula:  $n = z^2pq / e^2$  where,  $n$  = sample size which was 94.5,  $z = 1.96$  for 95% confidence interval,  $p$  = prevalence, 14% (Duraipandian et al.),<sup>5</sup>  $q = 1-p$  and  $e$  = margin of error as 7%. Hence, the total sample size calculated was 103.

Samples collected were swabs from the diaphragm of stethoscopes of all the intern doctors of different departments like Medicine, Surgery, Paediatric, Obstetrics and Gynecology, Emergency (ER), and Intensive care unit (ICU). Hundred and three swabs were collected by rolling the sterile swab soaked in sterile peptone water and transported to the Microbiology Laboratory for further processing as per standard microbiological guidelines.<sup>6</sup>

The sample was inoculated on mannitol salt agar (MSA) and incubated at 37°C for 24 hours. Mannitol fermenting colonies that were yellow or golden yellow were sub-cultured on nutrient agar (NA). Colonies on NA were subjected to Gram's staining, catalase test, and coagulase test. Gram-positive cocci that were catalase and coagulase-positive were identified as *S. aureus*. Staphylococcus aureus ATCC number 25923 was used as a reference strain for quality control. Antimicrobial susceptibility test (AST) was done by Kirby Bauer disc diffusion method as per the guidelines of CLSI.<sup>7</sup> Methicillin-Resistant *S. aureus* (MRSA) was identified using cefoxitin disc (30 µg). Antibiotics, penicillin (10 units), azithromycin (15 µg), doxycycline (30 µg), linezolid (30 µg), gentamicin (10 µg), ciprofloxacin (5 µg) and ofloxacin (5 µg) were used for AST of MRSA strains.

All the data collected were entered first in Microsoft Excel 2007 and then descriptive analysis was done using Statistical Package on Social Sciences (SPSS) version 26.0.

## RESULTS

A total of 103 samples of medical interns' stethoscopes from different departments were examined in the study. The swab culture from the stethoscope diaphragm showed growth on 89(86.40%) samples, out of which 41(46.10%) were Staphylococcus aureus, as shown in Table 1.

**Table 1:** Distribution of total cultured sample (N=103)

Organisms	Culture Report n(%)
<b>Growth</b>	89 (86.40%)
• <i>S. aureus</i>	• 41 (46.10%)
• Other organisms	• 48 (53.90%)
<b>No Growth</b>	14 (13.60%)

The majority of the *S. aureus*, 9(22.0%) were isolated from the stethoscope used in the Emergency department. Thirteen (31.7%) of the 41 *S. aureus* isolates were methicillin-resistant. Most of the MRSA, 3(23.1%) was isolated from the stethoscopes of the medical interns working in the Emergency and Intensive care unit departments, as shown in Table 2.

**Table 2:** Distribution of MRSA among different wards

Departments	<i>S. aureus</i>	
	MRSA n(%)	MSSA n(%)
Pediatrics	2(15.4%)	4(14.3%)
Obstetrics and gynecology	2(15.4%)	3(10.7%)
Medicine	2(15.4%)	4(14.3%)
Surgery	1(7.6%)	7(25.0%)
Emergency	3(23.1%)	6(21.4%)
ICU	3(23.1%)	4(14.3%)
<b>Total</b>	<b>13(100%)</b>	<b>28(100%)</b>

Of the total of 13 MRSA isolates, the maximum number of isolates was resistant to azithromycin 10(76.9%) and ofloxacin 8(61.5%), while they were 100% sensitive to linezolid, as shown in Table 3. Nine (69.2%) out of 13 MRSA isolates were found to be MDR.

**Table 3:** Antibigram of MRSA isolates

Antibiotic	Resistance	Sensitive
Penicillin	13(100%)	0%
Azithromycin	10(76.9%)	3(23.1%)
Doxycycline	6(46.2%)	7(53.8%)
Linezolid	0%	13(100%)
Gentamicin	4(30.8%)	9(69.2%)
Ciprofloxacin	7(53.8%)	6(46.2%)
Ofloxacin	8(61.5%)	5(38.5%)

## DISCUSSION

Every year, hospital-acquired infections occur at a rate of 5 to 10 per 100 hospital admissions.<sup>8</sup> Many pathogenic organisms including MRSA can be transmitted through healthcare provider's hands and medical equipments like digital thermometers, latex gloves, stethoscopes etc. to the patients in the hospital. There has been an increase in reports of the risk of transmitting antibiotic-resistant microorganisms between patients through the stethoscope.<sup>9</sup> Centers for Disease Control and Prevention (CDC) guidelines have also stated that "the stethoscope can be contaminated and spread diseases."<sup>10</sup> Usually, the junior healthcare workers (HCWs) are either unaware of the importance of disinfecting the stethoscope or rarely put their knowledge into practice, compared to the senior

HCWs.<sup>8</sup> Hence, this study aimed to find the frequency of colonization of methicillin-resistant *S. aureus* on the stethoscopes of interns stationed in various departments of this tertiary-level hospital.

In our study, 86.40% of the stethoscopes had bacterial contamination. Incidence of stethoscope contamination differs, ranging from 50% to 100% in different studies.<sup>9,11-13</sup> The stethoscope gets contaminated by microbes present on the patient's skin, the HCW's hands, the white coat, or even contact with blood and body secretions. Above all, it is very common equipment, used on every patient, and has become an important vehicle for the transmission of microorganisms. Therefore, disinfection of stethoscope before and after use on each patient should be emphasized in medical schools.

According to this study, 46.1% of the growth was *S. aureus*, which was similar to the study done by Naeem et al. (45.7%)<sup>14</sup> and Uneke et al. (41.6%)<sup>15</sup>, while it was more than the study done by Venkatesan et al.<sup>11</sup> These varies in presence of *S. aureus* in stethoscope may be due to the individual disinfecting practice of health care provider and also the ability of *S. aureus* to survive in inanimate objects for a variable amount of time.

Among the isolated *S. aureus*, 31.7% were MRSA, which was in accordance with the study done by Merlin et al.(32.0%)<sup>16</sup> and Singh et al.(35.7%).<sup>10</sup> This rate of incidence was quite higher than the studies done by Bhatta et al.(3.4%)<sup>9</sup>, Naeem et al.(7.9%)<sup>14</sup> and Venkatesan et al.(10.3%).<sup>11</sup> Almost 94,000 cases of invasive MRSA infections are reported annually, and 86.0% of them are hospital-acquired, which has led to 19,000 deaths every year.<sup>4</sup> Infection prevention guidelines are not strictly followed by junior health care providers. Therefore, infection control guidelines should be strictly followed and monitored time and again.

The current study also discovered that MRSA isolate was more frequently detected from stethoscopes used in critical areas such as Emergency and ICU (23.1%), which is concerning because these departments typically deal with critically ill patients. At times, the spread of such drug-resistant bacteria can be of the highest concern of hospital infection prevention policy.

A significant number of MRSA strains (69.2%) isolated from the stethoscope, were multidrug resistant in this study. Linezolid which was found susceptible to all the isolates should be used very wisely in treating MRSA strains. We should be aware that antibiotic-resistant strains can cause severe nosocomial infections and may require contact isolation and vigorous treatment to limit their transmission.

This study was done among medical interns only, so it could have been more informative if it had included consultants, residents, medical officers, and nurses as well.

## CONCLUSIONS

Detection of drug-resistant pathogens like MRSA in the stethoscope of interns alarms us for the upcoming danger in our institution. The present findings call for the reinforcement of hospital infection prevention strategies. Simple yet, important strategies like hand hygiene and disinfecting the less critical but commonly used medical equipment like stethoscopes could more likely limit the transmission of virulent pathogens circulation in the hospital environment.

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## AUTHORS' CONTRIBUTION

SMR contributed to study design, lab work, data analysis, manuscript preparation, and review. SP contributed to the study design, data review, and manuscript preparation. PSB contributed to Lab work and manuscript preparation. SKC contributed to the design, data review, and manuscript preparation. GG contributed to data analysis and manuscript review. KG contributed to data analysis and grammar correction. SS contributed to the manuscript review and grammar correction. PS contributed to lab work and manuscript preparation. Final editing and confirmation have been given by all authors.

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