DOI: https://doi.org/10.3329/medtoday.v38i1.87905

ORGINAL ARTICLE OPEN ACCESS

Evaluation of Bacterial Profile of Hand and Stethoscope of Doctors with their Knowledge, Attitude and Practice of Hygiene in a Tertiary Teaching Hospital

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Abstract

Introduction: *The rapid resurgence of infectious disease severity observed in recent times has multimodal underlying causes. Healthcare associated infection is not an uncommon but often neglected subset of overall infection burden. Physicians play a central role both in conveying and preventing the nosocomial spread. The stethoscope and dominant hand of physicians can transmit infection if their knowledge, attitude and practice pertaining these surfaces are suboptimal.* ***Materials and Methods:*** *We undertook a cross-sectional study to evaluate the knowledge attitude and practice of 70 physicians working in a tertiary teaching hospital related to hand and stethoscope hygiene and their paired sample (n=140) bacteriological profile. Smear sample was collected from each participant's dominant hand and stethoscope diaphragm to determine the bacterial load and antibiogram.* ***Result:*** *90% or more physicians know about the role of their hand and stethoscope as a potential mean to spread infection to patients. They also are aware (90%) that consistent hand and stethoscope hygiene can reduce the risk significantly but unfortunately only 18.6% of them were found to clean hands before every patient contact and 61.4% had stated that they clean their stethoscope diaphragm rarely. E. coli was the predominant (55%) organism found in paired hand and stethoscope swabs followed by pseudomonas (8%) and klebsiella (3%). Almost 1 in 3 (33.8%) samples had no growth. 89.5% of all swabs collected from Medicine department had some growth, succeeded by Emergency (75%) and Pediatrics (62.5%). The difference across the departments was significant (p=0.006).* ***Conclusion:*** *There is a vast gap between the knowledge and the practice regarding hand hygiene and stethoscope hygiene among physicians. This can easily be regarded as a blind spot for hospital acquired infection. Strict national guideline and institutional protocol should be implemented to resolve this potential risk.*

Key-words: *Healthcare associated infection, Physician, stethoscope, hand, knowledge, attitude, practice, hospital.*

Number of Tables: 04; Number of Figures: 04; Number of References: 32; Number of Correspondences: 04.

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Received: *05 October 2025* ***Accepted revised version:*** *20 December 2025*

Introduction:

Non-communicable disease has taken over the lead to cause most human demise at the invent of the antibiotics[1]. The development of antibiotic has been through phases of progressive inventions (the golden era), plateau and now at a decline[2]. As the invention has become limited, our reliance on the effectiveness of current available antibiotic has become even more palpable. Thus, anti-microbial resistance (AMR) is now a global threat to initiate the dreadful post antibiotic era. It took only 40 years from the discovery of first antibiotic discovery in 1928 to the development of first antibiotic resistance in 1968[3]. In a report published in 2019, the World Health Organization (WHO) had provided the shocking data of 70,000,00 annual death globally by antibiotic resistant organisms[4]. Moreover, 35% of bacteria are already resistant to current lot of antibiotics4. If antibiotic resistance continues to grow at a current speed, WHO estimates 10 million death a year caused by resistant organisms by 2050[4]! Much initiatives have already been in place to combat the situation or at least to delay the catastrophe including pharmacovigilance, antibiotic stewardship, clinical audit, legislation etc. Unfortunately, in countries like Bangladesh those actions are merely implemented in practice. The socioeconomic and legal framework is conducive to antibiotic abuse. Majority of Bangladeshi still resides in rural area where they primarily rely on the traditional healer for their daily healthcare needs. Rampant use of antibiotics by village quacks, self- prescription of antibiotics, easy purchase from pharmacy without any need of any prescription, wide disparity of quality among pharmaceutical companies all lead to the resurgence of antibiotic resistance. Previous studies had shown that, in Bangladesh 92 % drugs dispensed at pharmacy are sold without any prescription[5]. Moreover, 37.02% antibiotic purchase happens without any doctor's prescription[6]. Apart from this community issues, hospital related factors also come into play to add layers in this complicated scenario. Lack of proper ward hygiene, unsuitable inter-bed distance, improper sterilization technique, lack of sufficient manpower etc. have kept many resource-constrained healthcare institute at a high risk for healthcare associated infection. Health care associated infection (HAI) can be defined as infection acquired by patient at least 48 hours after getting admitted into or within 30 days of getting discharged from a healthcare facility[7]. The subsets of healthcare associated infection includes catheter associated infection (CAUTI), central line associated blood stream infection (CLABSI), Hospital acquired pneumonia (HAP) that can be either non-ventilator (NV-HAP) or Ventilator associated (VAP) and surgical site infection (SSI)[8]. Studies had revealed that among hundred admitted patients 7 patients in high income and 10 patients in emerging countries contracts healthcare associated infection[9]. Systematic review and meta-analysis on south east Asian situation of healthcare associated infection had concluded that, the prevalence of HAI in this part of the globe is 9.1%[10]. Unfortunately, specific data on national prevalence is lacking in our country. Recently in July 2025, world health organization (WHO) had a meeting with Bangladesh Medical University (BMU) to set up a national model for infection prevention and control[11]. Change must start from within and not all these issues can be dealt with by the physicians. The current study aimed to focus on the physician's part of nosocomial infection and the means to improve that. In western setting, hand hygiene and stethoscope cleanliness is regarded as a routine procedure. Unfortunately, the practice is much limited in our country. We tried to bring forth how much doctors know and are aware of their own hand and stethoscope as a vector of nosocomial infection and what microbial load can be found in those areas.

Materials and Methods:

This cross-sectional study was conducted in Ad-din Sakina Women's Medical College (ASWMC), Jashore from July to September 2025. We had collected data from four departments namely Medicine, Paediatrics, Emergency and Obstetrics and gyanecology based on stratified sampling. We had collected 3 sets of data from 70 physicians from those departments: a structured questionnaire evaluating the awareness level and practical implementation of hand and stethoscope hygiene as a potential risk of hospital acquired infection and a paired stethoscope-hand smear sample. The questionnaire that we had used in this study contained nine questions, three from each domain of knowledge, attitude and practice of hand and stethoscope hygiene among physicians. Although the questionnaire was formulated in Likert style short responses, it was later quantitatively scored for the ease of statistical inference. Informed written consent from the participants and clearance from institutional review board were collected. Identities of participants was completely anonymous and each participant was given a code. Data analysis was done using Statistical package for social science (SPSS) version 30. Statistical inference was drawn on the premise of 95% confidence interval and 5% margin of error and result was expressed as mean ӟ SD as appropriate. P value of <0.05 was considered to be statistically significant.

Specimen collection technique:

Hand swab:

The hand swabs were collected by the subject his/her self. Swab were collected by using a sterile rayon-tipped wooden swab stick. All samples were processed without any delay after collection .

Stethoscope swab:

The stethoscope swabs were collected by the subject his/her self. Swab were collected by using a sterile rayon-tipped wooden swab stick. All samples were processed without any delay after collection .

Sample transportation:

After collection swab stick placed in the sterile tube and cap securely with sterile cotton and transported to the laboratory.

Laboratory procedure:

Gram staining: One smear was prepared on a glass slide by mixing a single isolated colony with one drop of normal saline and another smear directly from the swab. Then, Gram staining was performed according to the method and examined under an oil immersion lens.

Isolation and identification of organism:

Isolation:

Isolation was done by inoculating the samples onto CLED and Macconkey agar media as soon as possible after collection. Inoculated Petri dishes were then incubated at 35-37°C for 24 hours aerobically. A smear was also made from growth on media and Gram stain preparations were performed.

Identification:

All the isolates were identified by a characteristic colony. All suspected colonies were identified by standard microbiological methods, including Gram staining, oxidase test and biochemical test.

Antimicrobial susceptibility testing:

Susceptibility to antimicrobial agents:

Susceptibility to antimicrobial agents, namely Amikacin (30mcg), Amoxycillin (25µg), Azithromycin (15mcg), Cefaclor (25µg), Cefotaxime (30µg), Cefoxitin (30µg), Ceftazidime (30µg), Ceftriaxone(30mcg), Cefuroxime(30µg), Trimethoprim(30µg), Cephradine (25mcg), Ciprofloxacin (5mcg), Doxycycline (30µg), Gentamicin (10mcg), Imipenem (10µg), Levofloxacin (5µg), Ofloxacin (5µg), Meropenem (10µg), Netilmicin (30µg), Colistin (50mcg) for the isolated from hand swabs and stethoscope swabs was determined by the disk diffusion method according to CLSI, 2024 following the Modified Kirby-Bauer technique.

Disk diffusion method:

Media used: Mueller-Hinton Agar.

Preparation of the inoculum: The inoculum was prepared by picking five distinct colonies of approximately 1 mm in diameter from a 24-hour-old culture of isolated species. The suspension was prepared in 3.0 ml of sterile saline (aqueous 0.45% NaCl, pH 4.5 to 7.0). A mixed homogenous suspension was made by vortexing for 15 seconds, and turbidity was adjusted to 0.5 McFarland standard.

Inoculation of test plates: Within 15 minutes after adjusting the turbidity of the inoculum suspension, a sterile cotton swab was dipped into the suspension. The swab was rotated several times and pressed firmly against the inside wall of the tube above the fluid level. The dried surface of a sterile Mueller-Hinton agar plate was inoculated by evenly streaking the swab over the entire agar surface three times, rotating the plate approximately 60° each time to ensure an even distribution of inoculum. Then, the rim of the agar plate was streaked. The inoculated agar plate was allowed to dry for 5-15 minutes with the lid in place.

Antimicrobial disc placement and incubation: Antimicrobial discs were stored in refrigerators at 2°C-6°C. Before used antibiotics discs keep out from refrigerators and wait 30 minutes and placed onto the surface of the inoculated agar plate 15 mm from the edge of the plate and 25 mm apart from one disc to another from center to center. 12 discs in 150mm agar plate and more than or equal 5 discs in 100mm agar plate. The inoculated agar plates were inverted and placed in an incubator at 35°C (±2°C) within 15 minutes after the discs were applied. The reading of plates was taken after 20 to 24 hours of incubation. The zone diameter was measured to the nearest whole millimeter at the point at which there was a prominent reduction in growth.

Interpretation of disk diffusion method: The zone of inhibition around the discs was recorded and interpreted as susceptible (S), susceptible dose-dependent (S-DD) and resistant (R). The interpretative zone diameters of antimicrobial agents are given below.

Interpretation of antimicrobial susceptibility testing by disk diffusion method

Disc content (µg)	Zone diameter in mm		
	Sensitive (S)	Susceptible dose-dependent (S-DD)	Resistant (R)
Amikacin (30mcg)	≥20	17-19	≤16
Amoxycilin (25µg)	≥18	14-17	≤13
Azithromycin (15mcg)	≥15	13-14	≤12
Cefotaxime (30µg)	≥26	23-25	≤22
Cefoxitin (30µg)	≥18	15-17	≤14
Ceftazidime (30µg)	≥21	18-20	≤17
Ceftriaxone(30mcg)	≥23	20-22	≤19
Cefuroxime(30µg)	≥23	15-22	≤14
Trimethoprim(30µg)	≥16	11-15	≤10
Cephradine (25mcg)	≥18	13-17	≤12
Ciprofloxacin (5mcg)	≥26	22-25	≤21
Doxycycline (30µg)	≥14	11-13	≤10
Gentamicin (10mcg)	≥18	15-17	≤14
Imipenem (10µg)	≥23	20-22	≤19
Levofloxacin (5µg)	≥21	17-20	≤16
Ofloxacin (5µg)	≥16	13-15	≤12
Meropenem (10µg)	≥23	20-22	≤19
Netilmicin (30µg)	≥15	13-14	≤12
Colistin (50mcg)	12	-	≤10

Results:

Most of our participants were female (75.7%) and graduate physicians (65.7%). Major discipline like Medicine (28.6%), Surgery (24.3%) and Ob-gyn (24.3%) contributed to comparable number of respondents. 47 out of 70 physicians were from the age group 25-35 years (67.1%).

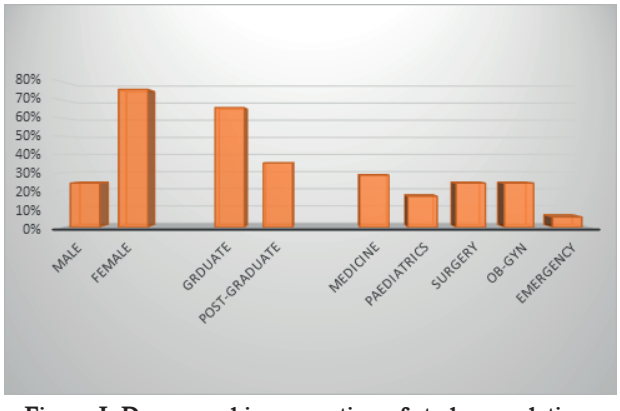

Figure I: Demographic proportion of study population

Participants had shown excellent knowledge regarding the hand and stethoscope hygiene and their potential role in causing healthcare associated infection. In the three out of nine questions dedicated to assess their knowledge 90% or more physicians could answer correctly. Unfortunately, the same could not be said in attitude domain. As for example, 71.4% mistakenly believed that, time and work pressure

justifies skipping the standard hygiene practice anyway. In their defense, it was also reported that, departmental logistic support was not sufficient according to majority consensus for practicing the hygiene protocol. When it comes to practice, more than 80% physicians did not clean their hand before every patient conduct. More than 60% doctors had reported to clean their stethoscope diaphraghm "rarely"! Hexisol was found to be the most frequently used cleaning solution by participants.

Table I: Knowledge, attitude and practice of hygiene among respondents

Alcohol based hand rub is effective to clean most pathogen	Yes 63 (90%)	No 4 (5.7%)	Don't know 3 (4.3%)	
Stethoscope can have MRSA and other important pathogens	Yes 69 (98.6%)	No 0 (0%)	Don't know 1 (1.4%)	
Hand hygiene is required before and after every patient contact	Yes 68 (97.1%)	No 0 (0%)	Don't know 2 (2.9%)	
Consistent hand & stethoscope hygiene significantly reduces nosocomial infection risk	Agree 63 (90%)	Disagree 4 (5.7%)	Neutral 3 (4.3%)	
Time and work pressure makes it acceptable not to practice consistent hand and stethoscope hygiene	Agree 50 (71.4%)	Disagree 19 (27.1%)	Neutral 1 (1.4%)	
My department provides sufficient facilities for proper hand and stethoscope hygiene	Agree 15 (21.4%)	Disagree 54 (77.1%)	Neutral 1 (1.4%)	
How often do you clean your stethoscope diaphragm?	Daily 7 (10%)	Weekly 7 (10%)	Randomly 13 (18.6%)	Rarely 43 (61.4%)
How frequently you clean your hands?	Before every patient 13 (18.6%)	After every round 28 (40%)	After visible soiling 28 (40%)	Rarely 1 (1.4%)
Which method do you use to cleanse your hands and stethoscope?	Hexisol 40 (57.1%)	Spirit 26 (37.1%)	Alcohol rub 1 (1.4%)	Others 3 (4.3%)

No statistically significant difference was found across the three domains between genders, different age groups and academic strata except knowledge which was significantly lower among graduate physicians (p=0.004).

Table II: Mean knowledge, attitude and practice score across different subgroups

Variables	Domain specific score		
Gender	**Knowledge**	**Attitude**	**Practice**
Male	8.88±0.332	7.71±0.92	4.71±1.4
Female	8.77±0.577	7.77±.869	4.36±1.54
P Value	*0.111*	*0.445*	*0.617*
Age group			
25-35	8.81±0.537	7.66±0.962	4.34±1.44
36-45	8.74±0.562	8±0.667	4.58±1.77
46-55	9±0.00	7.75±0.5	5±0.816
P Value	0.657	0.365	0.639
Academic qualification			
Graduate	8.74±0.612	7.76±0.899	4.39±1.48
Pos-graduate	8.92±0.282	7.75±0.847	4.54±1.58
P Value	*0.004*	*0.781*	*0.721*

66% collected sample swab was culture positive. The commonest bacteria isolated was E.coli (55%) followed by Pseudomonas and Klebsiella.

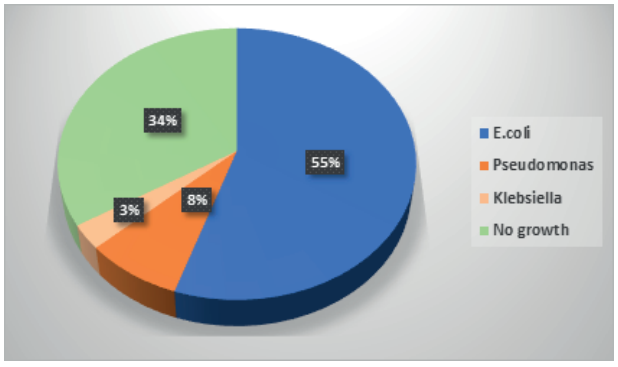

Figure II: Bacteriological profile of sample swab

80% E.coli and 100% Klebsiella isolates was found from the samples of the female participants. On the other hand, most (82.6%) of the culture negative samples also belonged to female participants. The gender difference across the organism species was found to be significant statistically (P= 0.002). Graduates had more E.coli (64%) and Post-graduates more Pseudomonas (63.6%) and they had same amount of klebsiella isolates from their respective samples. These differences were significant (p= 0.001). All the klebsiella positive isolates were collected from Surgery department and no pseudomonas was found in the samples of Ob-gyn and Emergency department. Culture positivity among different departments varied significantly (p=0.002). No significant difference was found in age groups (p=0.819) and sample types (p=0.895).

Table III: Proportion of organisms in various study subgroup

Variable	Categories	E.coli	Pseudomon	Klebsiella	No Growt	P value
Gender	Male	15(20%)	7(63.6%)	0(0%)	8(17.4%%	0.002
	Female	60(80%)	4(36.4%)	4(100%)	38(82.6%)	
Age group	25-35	35 (77.8%)	3 (60%)	2 (50%)	15 (75%)	0.819
	36-45	8 (17.8%)	2 (40%)	2 (50%)	4 (20%)	
	46-55	2 (4.4%)	0 (0%)	0 (50%)	1 (5%)	
Academic qualification	Graduate	48(64%)	4 (36.4%)	2 (50%)	34 (73.9%)	0.001
	Pos-graduate	27 (36%)	7 (63.6%)	2 (50%)	12 (26.1%)	
Departments	Medicine	29 (38.7%)	5 (45.4%)	0 (0%)	4 (8.7%)	

	Paediatrics	6 (8%)	4 (36.4%)	0 (0%)	6 (13%)	
	Surgery	14 (18.7%)	2 (18.2%)	4 (100%)	16 (34.8%)	0.002
	Ob-Gyn	20 (26.7%)	0 (0%)	0 (0%)	18 (39.1%)	
	Emergency	6 (8%)	0 (0%)	0 (0%)	2 (4.3%)	
Sample type	Hand	37 (49.3%)	6 (54.5%)	2 (50%)	23 (50%)	0.895
	Stethoscope	38 (50.7%)	5 (45.5%)	2 (50%)	23 (50%)	

Numbers in parentheses indicates proportion within bacterial class

Table IV: Proportion of culture growth in various departments

Departments	Growth	No growth	P Value
Medicine	89.5%	10.5%	
Paediatrics	62.5%	37.5%	
Surgery	55.6%	44.4%	0.006
Ob-Gyn	52.6%	47.4%	
Emergency	75%	25%	

Overall, most of the samples isolated from the physicians working in the department of medicine was found to be culture positive (89.5%) and Ob-gyn had the highest (47.4%) culture negative samples. Emergency (75%) and Paediatrics (62.5%) followed Medicine in the culture positive ratio. The departmental differences were significant (P=0.006).

The antibiogram of the cultured organism shows that, E. coli was almost to 100% resistant to 30 % of tested antibiotics (Amoxycillin, Azithromycin, Cefaclor, cefuroxime, cephradine and colistin). Whereas, 20% of tested antibiotics was 100% resistant against Pseudomonas

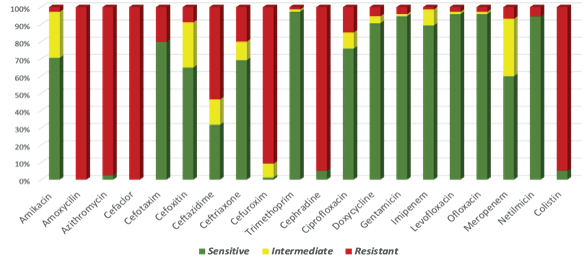

Figure III: Antibiogram of isolated E.coli

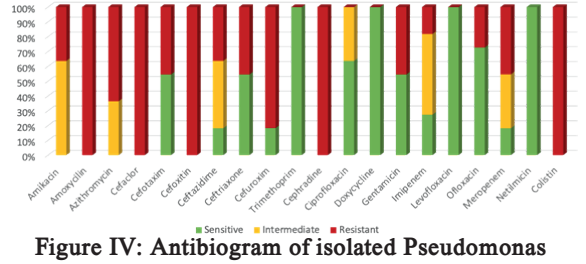

Figure IV: Antibiogram of isolated Pseudomonas

Amoxicillin, Cefaclor, Cefoxitin, cephradine and colistin was totally resistant against isolated pseudomonas. Azithromycine and cefuroxime were also mostly resistant. Whereas, Trimethoprim, Doxycycline, Levofloxacin and netilmicin were fully sensitive against pseudomonas.

Discussion:

This study provides a comprehensive evaluation of the bacterial contamination of physicians' hands and stethoscopes in relation to their knowledge, attitude, and practice (KAP) of hygiene in a tertiary teaching hospital. The findings highlight a critical discordance between knowledge and actual hygienic practices, with important microbiological and antimicrobial resistance implications. Patients get themselves admitted into in to the hospital in hope of getting better from their ailments. Unfortunately, sometimes they suffer from infection for getting themselves exposed to hospital environment. Hospital is a good reservoir of microbes that may contaminate medical personnel and their used instruments including stethoscope[12]. In the present study, the majority of participants were female (75.7%) and belonged to the 25–35-year age group, reflecting the current demographic structure of the physician workforce in many teaching hospitals across South Asia. Similar demographic distributions have been reported in studies from Bangladesh, India, and Nepal, where younger physicians and trainees constitute a significant proportion of clinical service providers[13,14]. The predominance of medicine, surgery, and obstetrics–gynecology as participating disciplines is also consistent with prior institutional KAP studies, given their high patient turnover and frequent use of stethoscopes[15]. Despite demonstrating excellent knowledge regarding hand and stethoscope hygiene—where more than 90% of respondents answered most knowledge-based questions correctly—attitude and practice were markedly suboptimal. This "knowledge–practice gap" has been repeatedly reported in both low- and high-income countries. Studies from India, Pakistan, and Ethiopia similarly reported high awareness but poor compliance with hand hygiene protocols, often attributed to workload, time constraints, and inadequate institutional support[16–18]. The finding that 71.4% of physicians believed time and work pressure justified skipping standard hygiene practices mirrors observations from WHO multicenter studies, where perceived time constraints were a major barrier to compliance[19]. In terms of practice, more than 80% of physicians in this study did not clean their hands before every patient encounter, and over 60% reported cleaning their stethoscope diaphragm only rarely. These findings are comparable to reports from Bangladesh and Nepal, where stethoscope disinfection rates ranged from 10% to 30% on a routine basis[13,20]. International studies from the United States and Europe have also demonstrated that stethoscopes are frequently overlooked as fomites, despite being classified as "non-critical medical devices" requiring regular decontamination[21]. Microbiological analysis revealed that 66% of collected swabs were culture positive, which is consistent with contamination rates reported globally, ranging from 55% to 85%[22–24]. Escherichia coli was the most commonly isolated organism (55%), followed by Pseudomonas and Klebsiella. Similar organism profiles have been reported in studies from India, Nigeria, and Iran, where Gram-negative bacilli predominated, reflecting fecal contamination and poor hand hygiene practices[16,23,25]. The isolation of E. coli from hands and stethoscopes is particularly concerning, as it underscores the potential for transmission of enteric pathogens in clinical settings. The study demonstrated statistically significant differences in bacterial isolation based on gender, academic status, and department. Although female

physicians accounted for a higher proportion of E. coli and Klebsiella isolates, this likely reflects their numerical predominance in the study population rather than intrinsic gender-related risk, a finding also supported by previous studies that failed to demonstrate independent gender-based contamination risk after adjustment[26]. The higher prevalence of E. coli among graduate physicians and Pseudomonas among postgraduates may be related to differences in patient exposure, procedural frequency, and adherence to infection prevention protocols.

Department-wise variation in culture positivity was notable, with physicians from the medicine department showing the highest contamination rates, while obstetrics–gynecology had the highest proportion of culture-negative samples. Similar interdepartmental differences have been reported in studies from tertiary hospitals in India and Saudi Arabia, where internal medicine and emergency departments consistently showed higher contamination due to increased patient contact and workload[27,28]. The absence of Pseudomonas in obstetrics–gynecology and emergency samples in this study may reflect differences in patient profiles or localized infection control practices. The antimicrobial susceptibility pattern observed in this study raises serious concern. E. coli demonstrated near-complete resistance to approximately 30% of tested antibiotics, including commonly used agents such as amoxicillin and cephalosporins. Comparable resistance patterns have been reported in hospital-based contamination studies from South Asia, where indiscriminate antibiotic use and inadequate antimicrobial stewardship contribute to rising resistance[29,30]. Pseudomonas isolates showed complete resistance to multiple antibiotics, including colistin, which is alarming given its role as a last-resort drug. Similar resistance trends have been reported in studies from India and Iran, emphasizing the growing threat of multidrug-resistant organisms on healthcare workers' hands and equipment[25,31]. The finding that trimethoprim, doxycycline, levofloxacin, and netilmicin remained fully sensitive against Pseudomonas aligns with some regional antibiogram data but underscores the urgent need for continuous surveillance, as resistance patterns are known to evolve rapidly[32]. Overall, this study reinforces the role of physicians' hands and stethoscopes as significant reservoirs of potentially pathogenic and multidrug-resistant bacteria. The observed gap between knowledge and practice highlights the need for targeted behavioral interventions, continuous education, adequate logistical support, and strict enforcement of infection prevention and control policies. Regular monitoring of stethoscope hygiene, integration of alcohol-based disinfectants into routine practice, and institutional accountability mechanisms are essential to reduce healthcare-associated infections.

This study has some setback like a single institutional study, relatively small sample size, sampling bias could not be ruled out, cross-sectional nature of the study and self-reported practice.

Conclusion:

We conclude by reiterating the importance of hand and stethoscope hygiene practice and bringing the knowledge base into practical field to eliminate the chance of cross-contamination. Institute should come forward to make it a custom to clean hands and stethoscope and provide sufficient logistics to facilitate the practice. Regular clinical audit may inhibit the reluctance to adhere with the hygiene protocol.

Conflict of Interest: None.

Acknowledgement:

We are thankful to the honorable Principal, ASWMC to fund a large portion of the study. We are grateful to all of our colleagues at ASWMC who were kind enough to participate in this research.

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