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A cross-sectional study of the microbial profile of Health workers hands in Meknes Hospital

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Abstract: Background: Despite recent advancements in medicine and fundamental research, infectious diseases caused by transmissible pathogens such as bacteria, viruses, and eukaryotes remain a significant challenge for scientists and clinicians. Restrictions on the prompt and precise identification of diseases and the rise in antibiotic resistance worsen these difficulties.
Objective: The present study aimed to investigate the contamination of healthcare workers' hands working in different departments of Meknes hospital, Morocco, as well as to examine the ability of hydroalcoholic solutions to eradicate different isolated pathogenic microbes. Materials and Methods: This cross-sectional study was carried out over a period of 60 days between July 2022 and August 2022. The samples were directly collected and analyzed at the laboratory of bacteriology. The bacteriological study was performed in the hands of 130 volunteer healthcare workers. Results: The treatment of results revealed that the positivity rate was 97.85%, and the identification of germs indicated that they belonged to a high polymorphism population. We separated 19,184 (CFU) colony-forming units from the samples taken from 260 hands. The average number of colony-forming units (CFU) was 74 CFUs/hand of the nursing staff. The bacteriological study resulted in the identification of: 6557 colonies of *Staphylococcus aureus*; 7342 colonies of Staphylococcus with Dance negative; 286 colonies of *Escherichia coli*; 1026 colonies of *Klebsiella pneumonia*; 1023 colonies of *Acinetobacter* spp, 272 colonies of *Pseudomonas* spp and 2678 colonies of yeasts and molds. The hands of healthcare personnel carry several pathogenic microorganisms. Conclusion: Handwashing and disinfection using hydro-alcoholic solutions are important for preventing harmful microbe transmission among healthcare workers and patients.

Keywords: Healthcare workers, microbial profile, hydro-alcoholic solution, infectious diseases

Introduction

Infectious diseases pose a serious challenge to human health, causing morbidity and mortality, and they are heavily weighted on healthcare systems in terms of cost. In the last two decades, the appearance of several outbreaks of infectious diseases has amplified considerable threats to public health. Infectious disease transmission is highly dependent on diverse factors, including patient-associated factors and pathogenic microbe-related factors [1–3]. In addition, healthcare workers (HCWs) may be considered an inadvertent interface between patients and healthcare setting [4,5]. HCWs are permanently exposed to different pathogenic agents in different hospital departments, indicating a potential risk of developing infectious illness [6]. Therefore, HCWs could be the main factor of infectious disease dissemination [1]. They serve as vectors of many pathogenic microbes, including viruses and bacteria [7].

HCW hand hygiene plays a pivotal role in preventing the transmission of infectious diseases. Therefore, hand hygiene is the primary preventive measure against the spread of HCW-associated infectious diseases [8]. Psychologically grounded hand hygiene interventions are the effective approaches that are highly associated with HCW compliance, improve patient care quality and limit the transmission of infectious diseases [9,10]. In this context, Allegranzi and Pittet demonstrated that the reduction of HCW-associated infections and hand hygiene were highly correlated with multimodal intervention approaches [8]. Pathogenic microbes can colonize HCW hands despite glove use [11]. Thus, hand hygiene is a permanent practice to prevent the transmission of pathogenic microbes to patients [11]. In addition, misuse of chemical agents for treating infectious diseases has been linked to the emergence of antibiotic resistance, which poses major health risks to humans.

Within this framework, the current study was undertaken to identify different bacteria that colonize HCW hands and evaluate the ability of hydroalcoholic solutions to inhibit microbial colonization and transmission to minimize infectious disease transmission.

Materials and Methods

Study design and setting

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The present cross-sectional study was conducted from July to August 2022 at Meknes hospital, Meknes, Morocco in collaboration with the different departments of the hospital, including the internal medicine, surgery, critical care, and laboratory departments.

Study population

The current study was conducted at the regional Hospital center in Meknes, Morocco. The study population consisted of hospital healthcare workers of the hospital. A total of 130 HCWs, including doctors or clinicians, nurses, technicians, and trainers who are working in all hospital departments, were selected after receiving a written consent statement from the participants to participate in this study. Employees who had direct patient contact experience at work were included in the study, whereas those who had no patient contact experience were excluded.

Sample preparation

The samples were collected by lightly applying the ends of the five fingers of the hand of the volunteer to a plate of agar medium (Mueller-Hinton) without wiping the hands prior to taking samples. The samples were taken before and after disinfection with an antiseptic solution (hydroalcoholic solution 70%), i.e. 4 samples per person.

Contact with the agar was 10 s per hand. Each Petri dish was labeled, and data were collected (name of nursing staff, category, sex, age, department). The samples were directly transferred to the microbiology laboratory and incubated in an oven at 37°C for 24 h. The results were recorded as colony forming units (CFU). The identification of bacteria and their pathogenicity were carried out according to the methods of classical bacteriology.

Microbial identification

The identification of microbial strains detected in all samples performed according to the protocol previously described by Istenes et al. to determine methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant Enterococcus (VRE), multidrug resistant Acinetobacter sp, E. coli, Klebsiella spp, Pseudomonas. Spp [12]. Then, coagulase assays were adopted to confirm MRSA-positive samples.

Antibiotic susceptibility testing

The preparation of the antibiogram was performed according to the disc diffusion method on Muller-Hinton agar medium following the recommendations of the Antibiogram Committee of the French Society of Microbiology version CA-SFM 2013 [3]. The antibiotics tested were amoxicillin-clavulanic acid (20/20µg), ceftazidime (30µg), vancomycin (30µg), and imipenem (10µg). For the phenotypic detection of MRSA, the antibiotic tested was cefoxitin (30 µg). Interpretation of the antibiogram was done after 18-24 hours of incubation at 37° C.

Statistical analysis

The mean ± SD values were utilized to express the results and the statistical analyses were conducted through ANOVA-two way using Graph Pad Prism 5 software [13].

Results and Discussion

Distribution of participants

A total of 130 voluntary participants were included in the present study, and their distribution was according to different hospital departments. The analysis of the obtained findings revealed that the participation rate was 30.95% (130/420). Concerning the distribution of participants, 30 HCWs were from the emergency department, 10 from the intensive care unit, 15 from the central operating room, 10 from the surgery department, 20 from the pediatrics department, 15 from the pneumology department, 18 from the internal medicine department, 7 from the neurology department, and 5 from the neurosurgery department. It is evident that women represented the highest proportion of participants, with a percentage of 56%. Moreover, 44% of all participants were men. The age of the subjects ranged from 23 to 56 years.

Hand rate contamination of healthcare workers

Figure 1 presents the results of rate contamination of HCW hands. In total, 260 samples were collected and analyzed. Results revealed that 97.85% (254/260) of the samples were positive for bacterial/fungal growth, indicating that the hands were infected. In contrast, 2.15% of the samples were negative.

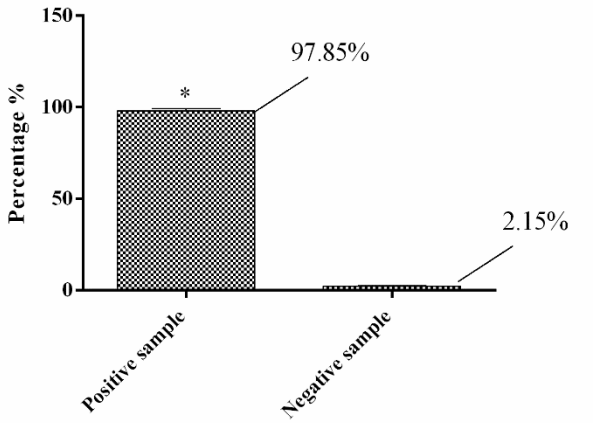

Figure (1): Hand rate contamination of healthcare workers.

Distribution of Petri dishes according to colony count

Figure 2 presents the results of colony counting. The analysis of the obtained outcomes showed that the total number of CFUs was 19,184, with an average of 74 CFUs per hand. It can be clearly seen that 60% of the samples contained some CFUs comprising between 30 and 300 CFU/petri dish. There was no significant difference between dishes counting less than 30CFU/ petri dish or more than 300 CFU/petri dish (p>0.05).

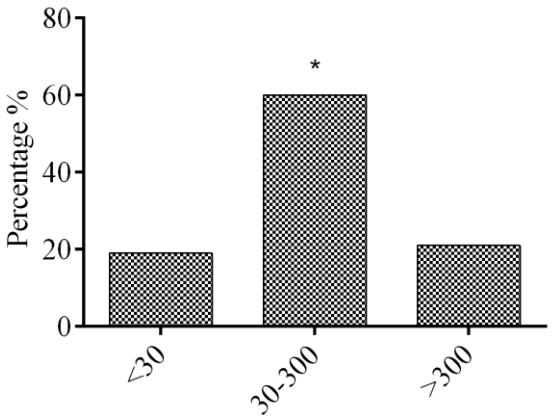

Figure (2): Distribution of Petri dishes according to colony count.

Frequency of different germs detected in various samples under study.

The results of identifying the different microbial strains detected in the various samples are depicted in Figure 3. It is worth noting that the predominant bacterial species reported were: Coagulase-negative *Staphylococcus*, which was the most isolated bacterium with a frequency of 38.27%, followed by *Staphylococcus aureus* with a percentage of 34.18%, *Klebsiella pneumonia* (5.35%), *Escherichia coli* (1.46%), *Pseudomonas* spp (1.42%), and *Acinetobacter* spp (0.64%). Whereas, yeast and molds represent a percentage of 17.08% (Figure 3).

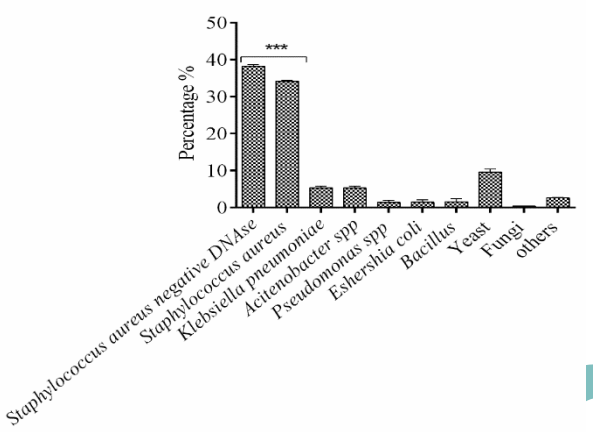

Figure (3): Frequency of different germs detected in various samples under study.

Microbial sensitivity

The antibiotic resistance profiles of the different microbial strains detected are presented in Table 1. The study of antibiotic resistance focused on Staphylococci and Gram-negative bacilli using amoxicillin-clavulanic acid, cefoxitin, ceftazidime, vancomycin and imipenem. The analysis of the obtained results showed that 30% of S. aureus isolates are methicillin-resistant (MRSA). Enterobacteriaceae (*Klebsiella pneumonia* and *Escherichia coli*) are resistant to the association amoxicillin-clavulanic acid, and 56% of them are resistant to ceftazidime. Pseudomonas spp and Acinetobacter spp strains were 72% and 100% resistant to ceftazidime, respectively. Whereas, imipenem and vancomycin have no effect on different bacterial strains under study.

Table (1): Antibiotic resistance phenotypes of isolated strains in %.

Germes	FOX	VAN	AMC	CAZ	IMP
S.aureus DNase negative	15% R	100 %S	-	-	-
S. aureus	32 %R	100%S	-	-	-
E. coli	-	-	100% R	52 % R of which 30 % BLSE	100 %S
Acenitobacter. spp	-	-	-	100 % R	100%S
Klebsiella spp	-	-	100% R	60%R	100% S
Pseudomonas. spp	-	-	-	72%R	100% S

Effect of hydro-alcoholic solutions

The results of the application of hydroalcoholic solution before sample collection Regarding the effectiveness of the hydro-alcoholic solution 70%, we took 10 samples after rubbing the hands with the hydro-alcoholic solution and then drying (time of friction and drying is 30 seconds). The analysis of the cultures showed a positivity rate equal to zero, i.e. a manual carry rate of 0%.

Discussion

Historically, infectious diseases have been considered the most feared plagues worldwide. They have demonstrated their ability to traverse entire continents under suitable conditions within weeks or months [14]. Several factors have been implicated in the emergence and widespread of infectious diseases, including climatic changes, human demographics, technological developments, human behavior, and disrespect of public health measures [14]. In light of this, the present work was undertaken to examine the efficiency of hydroalcoholic disinfectants and to determine different microbial strains that colonize healthcare worker hands, as well as their resistance to several antibiotics. The findings revealed that most of HCW hands were infected (97.85%). *Staphylococcus* and *Staphylococcus aureus* were the most common bacterial strains isolated from HCW hands with a percentage of 72.45%. All microbes were resistant to at least two antibiotics, with a resistant percentage varying between 15% and 100% (Table 2). The obtained results were in high concordance with those reported by several authors [15–17]. It has been found that HCW hands are colonized at least by 1 pathogenic microbe [15]. Munoz-Price et al. found that 86% of samples collected from HCW hands were infected by *S. aureus*, *Anicetobacter* spp, and enterococci [16].

Flouchi et al. found that 83% of the samples collected were infected. The authors claimed that the most contaminated services were men's and women's surgeries [18].

Hand hygiene plays an important role in diminishing the transmission of infectious diseases [15]. The authors found that after wound care and treatment, the hands sampled were contaminated with at least 1 pathogenic microbe [15]. Different pathogenic strains were detected during patient encounters in HCW hands, including MRSA, vancomycin-resistant *Enterococcus*, *Acinetobacter*, and *Clostridium difficile* [15]. The same findings were found in the current study. Whereas, Monistrol et al. reported that *Enterobacteriaceae*, *Pseudomonas* spp. and methicillin-

sensitive *Staphylococcus aureus* dominated the pathogenic microbes detected in HCW hands [17]. The ability of bacteria, viruses, and fungi to survive antimicrobial medications introduced into their environment is known as antimicrobial resistance. Acquired resistance emerges when the strains develop different strategies, including mutations that confer resistance to chemical agents [19]. The irresponsible use of antibiotics has led to wide spread of resistant microorganisms worldwide [20]. the immunological condition of the patient is closely connected with the severity and incidence of the infection [19].

The highest percentage of microbial contamination in different hand samples could be explained by a lack of respect for hygienic protocols, as previously demonstrated by Akoua-Koffi [21]. Concerning the impact of hydroalcoholic solutions on hand contamination, it worth noting that disinfectants play an important role in reducing pathogen microbe transmission. Furthermore, Bnigham et al. discovered that wearing gloves during the patient encounters could play a pivotal role in minimizing pathogen transmission [15]. Moreover, Minstrol et al. concluded that a multimodal hand hygiene strategy could play a pivotal role in reducing the risk factors and the probability of HCW hand contamination [17].

Hands of HCWs are considered the main vectors of multidrug resistance organisms, such as *Pseudomonas aeruginosa, Acinetobacter baumannii*, and vancomycin resistant Enterococcus [22]. Hand hygiene could be of crucial importance in reducing infectious disease transmission. To implement effective disinfection techniques, further experiments are required to identify various contaminated surfaces and medical devices.

Conclusion

In the present study, the examination of different samples collected from HCW hands revealed that the HCW hands were contaminated with different pathogenic microorganisms. The antibiogram revealed that the identified bacteria were resistant to at least one standard chemical agent. Hygiene hands should be of paramount importance to reduce the manual transmission of pathogenic bacteria. Therefore, hand disinfection must be performed before and after each patient interaction. This requires making the equipment necessary for its realization available to the staff.

Ethics approval and consent to participate

Complete written informed consent was obtained from the participants for the publication of this study

Consent for publication

Not applicable

Availability of data and materials

The manuscript has no associated data.

Author's contribution

Najia El Hamzaoui: Conceptualization, writing-original draft, data curation, formal analysis, investigation, methodology; Samira Jaouhar; Anjoud Harmouzi; Mohammed Sbitti: Writing review & editing.

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Conflicts of interest

The authors declare that they have no relevant financial or non-financial interests to disclose

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