



### RESEARCH ARTICLE

#### IS MY STETHOSCOPE HARMLESS? : OPERATING ROOM STETHOSCOPES UNDER MICROSCOPES

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#### Abstract

Medical equipment especially stethoscopes, are increasingly responsible for healthcare-associated infections. The objective of our work is to establish the prevalence of bacteria carried by stethoscopes among anesthesia doctors in the operating room of the Mohammed V Military Teaching Hospital. This was a prospective prevalence study carried out over a period of 2 months on 10 stethoscopes showing that 90% of the stethoscopes collected were infected. The average number of CFU / membrane was estimated at  $3.1 \times 10^4$ . This number has clearly been reduced 172 times after disinfection. This study suggests that awareness and the use of hydro alcoholic solutions to disinfect stethoscopes can significantly reduce bacterial carriage and infections.

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#### Introduction:-

Healthcare-associated infection is a major health problem responsible for a high morbidity and mortality, antibiotic resistance and expensive health bill[1,2].

Hospitals normally supposed to provide care, paradoxically can also be a source of infections, especially among the elderly, new-borns, transplant recipients and immunocompromised patients. Up to 32% of healthcare-associated infections can be avoided[3].

A 2013 systematic review demonstrated that medical personnel play a critical role in the transmission of healthcare-associated illnesses. Another study of 1022 cases of healthcare-associated infections incriminated medical materials and equipment as the main source of agents responsible for healthcare-associated infections[4].

Invented two centuries ago by René Laennec, 85% of stethoscopes are contaminated by pathogenic bacteria. This can be explained by the daily and multidisciplinary use of this essential tool especially in the operating room[5].

The stethoscope must be then considered as an extension of the doctor's hand and therefore hygiene care must be applied to it.

The objective of our work is to establish the prevalence of bacteria carried by stethoscopes among anesthesia doctors in the operating room of the Mohammed V Military Teaching Hospital and to demonstrate the impact of disinfection on bacterial carriage.

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**Materials and Methods:-****Period, type and location of the study:**

This is a prospective study of 10 stethoscopes carried out between November and December 2021 in the operating room in collaboration with the research and biosafety laboratory - P3- of the Mohammed V Military Teaching Hospital.

**Inclusion criteria:**

Doctors of anesthesia department working in the central operating room of the Mohammed V Military Instruction Hospital of Rabat: Residents, specialists and professors.

**Methodology:-**

Each participant fills out a form sheet labelled by number and a code (to remain anonymous). The stethoscope is first sampled using a sterile swab before any disinfection (Fig. 1). The swab is inoculated directly into a non-selective BCP (Bromocresol Purple) medium and a Chapman (Mannitol salt agar) medium (Fig. 2 and 3).



Figure 1:- Stethoscopesampling.



Figure 2:- Seedingmethod.



**Figure 3:-** Chapman and BCP medium.

The stethoscope is then disinfected using a hydro-alcoholic solution. A second sample is taken 10 to 15 minutes later (Fig. 4).

Incubation is done in the proofer at 37°C for 24h extended to 48h if the colonies grown at 24 h are small, not allowing good identification (Fig. 5).

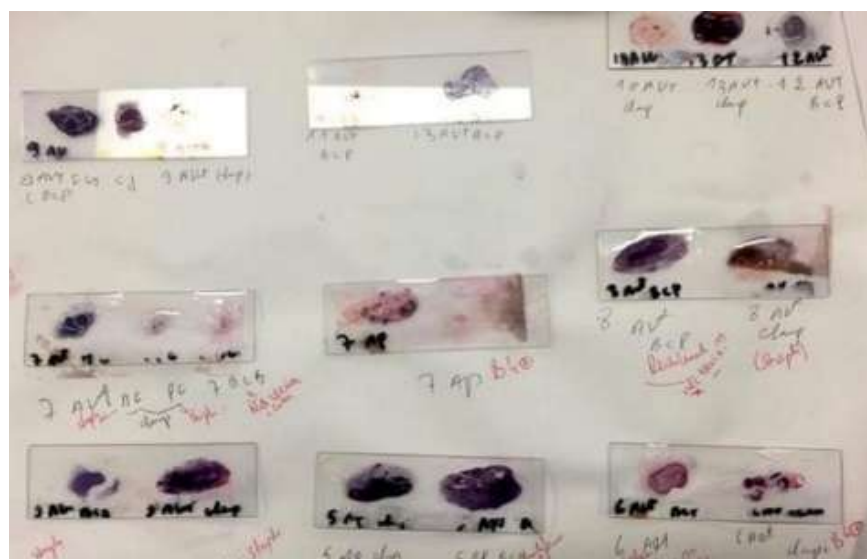
The identification of bacteria is carried out according to conventional methods based on the morphology of the colonies, the data of the Gram stain (Fig. 6), as well as their Biochemical characteristics: Catalase, DNase.....(Fig. 7).



**Figure 4:-** Stethoscope disinfection.



**Figure 5:-** Incubation at 37°C.



**Figure 6:-** Gram stain.



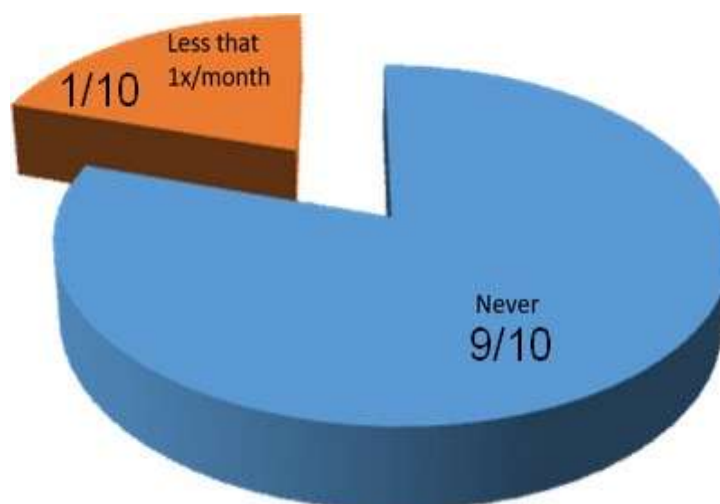
**Figure 7:-** Catalase and DNase reactions.

### Results:-

The use of the sampled stethoscopes was almost daily.

The average duration of use of the stethoscopes sampled is estimated at 87 months with extremes ranging from 1 month to 5 years.

90% of the stethoscopes collected have never been disinfected, only one doctor has already disinfected his stethoscope but less than once a month.



**Figure 8:-** Frequency of disinfection of stethoscopes.

The prevalence of bacterial carriage is estimated based on the number of colonies before and after disinfection. In total, 90% of stethoscopes were contaminated (9/10). The average number of CFU per membrane was  $3.1 \times 10^4$ .

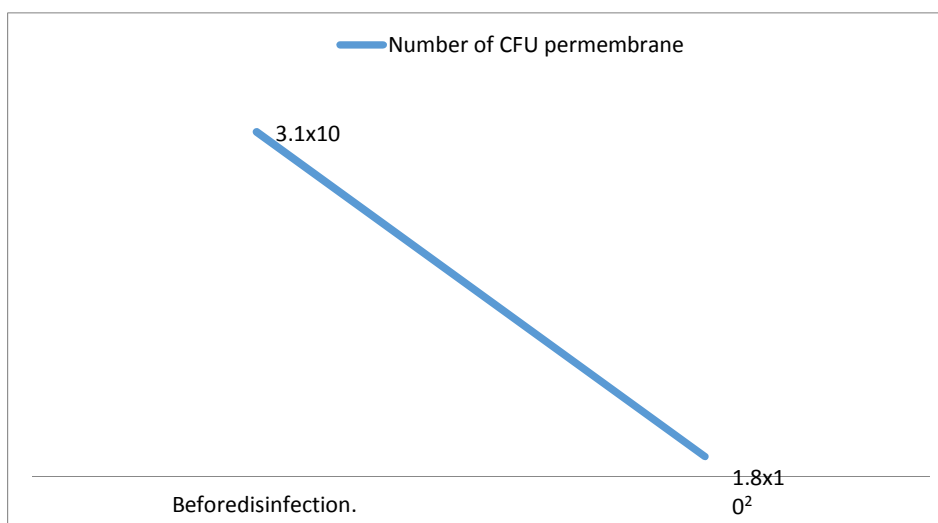
Stethoscope	Colonyformingunit (CFU	Bacteriaidentified
N°1	$2.1 \times 10^4$	Aureus staphylococcus
N°2	$6 \times 10^4$	Coagulase negative staphylococcus Neisseriaspp
N°3	$1.3 \times 10^4$	Aureus staphylococcus gram negativebacillus
N°4	$10^5$	Coagulase negative staphylococcus Aureus staphylococcus
N°5	$2 \times 10^3$	Gram negativebacillus Corynebacterium
N°6	$10^5$	Gram positive bacillus Corynebacterium
N°7	Sterile	Sterile
N°8	$10^3$	Neisseriaspp Gram negative bacillus
N°9	$5 \times 10^3$	Coagulase negative staphylococcus Neisseriaspp
N°10	$10^5$	aureus staphylococcus gram negativebacillus

**Table I:-** Identification and distribution of the different bacteria isolated on the sampled stethoscopes

5 of the 10 stethoscopes became sterile after disinfection with a hydro alcoholic solution.

The average number of CFU per membrane dropped significantly after disinfection.



**Figure 8:-** Evolution of bacterial carriage before and after disinfection.**Discussion:-**

The hospital environment as well as the medical staff are involved in the transmission of nosocomial infections[6–9].

Their prevalence in European countries is estimated at 7% and of which 32% are preventable[10].

Despite the fact that uncritical medical equipment such as stethoscopes are repeatedly mentioned as potential vectors for the transmission of organisms, the role of these items in the transmission of nosocomial infections is not entirely clear. In theory, a contaminated stethoscope could transmit organisms to a patient's skin or an examiner's hands while acting as a true reservoir for further transmission if the stethoscope is left uncleaned.

The majority of studies investigating stethoscopes as carriers of microorganisms were observational, prospective, or cross-sectional studies.

**Stethoscope contamination rate:**

The average contamination rate of stethoscopes over 28 studies was 85.1%. (range 47-100)

The contamination rate of stethoscopes in our study was 90%. Six surveys quantified the contamination of stethoscopes by the average number of CFU per membrane, and gave values ranging from 27 to 132 CFU per membrane [11,12]

The French standardization association for hygiene suggests that the bacterial carriage of stethoscopes should be <5 CFU per cm<sup>2</sup> or <20 CFU per membrane [13]. Therefore, the stethoscopes were highly contaminated based on the average number of CFU per membrane in four of six studies in which contamination was quantified.

**Bacteria identified on the surface of stethoscopes Pathogenic or non-pathogenic? :**

The level at which microorganisms were identified varied considerably between studies, with predominance of skin flora and non-pathogenic bacteria (16 studies/22). Coagulase-negative Staphylococcus is the most identified species (in 97% of stethoscopes)[14].

One of the largest studies of 355 stethoscopes found that 85% of bacteria cultured from stethoscope membranes were non-pathogenic [13]. Non-pathogenic bacteria other than coagulase-negative staphylococci reported were:

Corynebacterium spp., Diphtheroids, Bacillus spp. And streptococci of the viridans group.

Potentially pathogenic bacteria were isolated in 30 out of 31 studies. However, they generally represent a small proportion compared to non-pathogenic germs. *Aureusstaphylococcus* was the most frequently isolated potential pathogen (27 of 31 studies) [15,16]. Other potentially pathogenic bacteria cultured from stethoscopes include: *Enterobacteriaceae* (*E.coli*, *K.pneumoniae*, *Enterobacter* spp.), *Acinetobacter* spp. *P.aeruginosa* and *Stenotrophomonasmaltophilia*.

#### **Bidirectional transfer between stethoscopes and skin**

Focusing on VRE contamination of pre-sterilized stethoscopes, a standard physical examination resulted in VRE contamination of stethoscopes in 31% of cases [17].

In the reverse direction, the potential for bacteria transfer from the stethoscope to the skin was suggested in an experiment involving the deliberate transfer of a quantity of  $10^6$  *Micrococcus luteus* to three pre-sterilized stethoscopes. The inoculated stethoscopes were applied to the pre-sterilized skin of the forearm for 3 seconds. Three subsequent forearm cultures gave respectively: 3, 15 and 9 CFU of *M. luteus*[18].

#### **Bacterial carriage of stethoscopes: can it cause infections?**

An investigation of a cluster of *K.pneumoniae* bloodstream infections in a neonatal intensive care unit (ICU) in 2003, showed that the outbreak strained from three stethoscopes [20].

In a similar investigation of an outbreak of extended-spectrum betalactamase-producing *K.pneumoniae* in a neonatal ICU, out of 30 environmental samples, the outbreak strain was cultured only from the dedicated stethoscope of an already infected child [21].

#### **Evaluation of stethoscope disinfection practices among healthcare professionals:**

Numerous studies have found that between 12% and 47% of healthcare professionals either never cleaned their stethoscope or only cleaned it once a year [15].

Results among paramedical professionals were more promising. All 44 physiotherapists cleaned their stethoscope at least once a day in one study [7]. In the same study, 17% of doctors and medical students had never cleaned their stethoscope.

In another study in which the stethoscope contamination rate was 92%, only 6% of students had ever disinfected their stethoscopes [22].

#### **Effect of disinfection of stethoscopes on bacterial carriage:**

Not surprisingly, contamination rates were lower among those who cleaned their stethoscopes more frequently [76].

The frequency of cleaning stethoscopes influenced the rate of MRSA contamination [14]. It was also found that 100% of stethoscopes were recontaminated if they were used to examine more than five patients after the last disinfection [23].

#### **Conclusion:-**

This study is one of the first carried out on a national scale, and is part of a large strategy carried out by the Mohammed V Military Hospital in Rabat to study the various potential sources of nosocomial diseases within the establishment. .

The results obtained are similar to literature studies, concluding that stethoscopes carry many bacterial colonies, from different species.

Rising awareness among medical and paramedical staffs of the significant pathogenic risk of stethoscopes and medical materials and their formal implication in the transmission of nosocomial infections may be a promising strategy to reduce incidence of healthcare-associated infections.

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