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Research Article

# Investigation of Bacterial and Fungal Contamination of Timex Machines in Hospitals Affiliated to Babol University of Medical Sciences

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## Abstract

***Background:*** Due to daily contact with the hands of many employees, timex machines are likely to be infected with various microorganisms, and as a result, employees and personnel can unintentionally transfer many bacterial and fungal agents to each other through their hands and cause the spread of diseases. Therefore, this study investigated the types of bacterial and fungal contamination of timex machines in hospitals affiliated with Babol University of Medical Sciences.

***Methods:*** This research is a cross-sectional descriptive study. By referring to the hospitals affiliated to the Babol University of Medical Sciences, using sterile swabs that were moistened with sterile physiological serum, sampling was done from the surfaces of the timex machines and on the blood agar culture medium to identify bacterial contamination and Saburo dextrose agar for fungal contamination was cultured.

***Results:*** In this study, 120 samples were taken from the timex machines in hospitals, all the samples were positive for bacterial contamination, and in all the samples, the Staphylococcus genus was grown, of which 77.30% related to Staphylocoagulase negative species and 22.69% related s *Staphylococcus aureus* strain. Bacillus bacteria were also detected in 11.26% of the samples. Also, 8.33% of the fungal samples were positive for fungal contamination and the strains were Candida albicans species.

***Conclusion:*** According to the results obtained from the culture samples taken from the surface of timex machines in the studied hospitals, pathogenic bacterial and fungal contaminations were found on them, which can cause and spread microbial and fungal diseases among employees and other members of society. Therefore, to prevent and control related diseases, continuous and daily disinfection of these machines is recommended.

***Keywords:*** Bacteria, Fungi, Contamination, Hospital, Babol, Timex machines.

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## Introduction

Hospitals need accurate and advanced machines to better control employees, especially their timely attendance at work and their departure. These machines reduce additional costs related to paying wages during hours when employees are not working. These machines also eliminate intentional and unintentional attendance errors. One of the types of attendance machines is fingerprint machines. Since each person has a unique fingerprint, these machines are one of the most reliable ways to identify a person. Many studies have shown that one of the most common ways of transmitting bacterial and fungal diseases in hospitals is through the hands of employees. Due to the contact of these people's hands with timex machines, these machines are considered a potential reservoir for the transmission of pathogenic agents in the hospital staff [1-4]. Disease-causing agents can be transmitted by timex machines, computers, and mobile phones through human hands. These contaminated machines can easily act as potential reservoirs of infection and infect users who use this equipment .When another user comes into contact with these contaminated machines, bacterial and fungal agents on the surfaces of these machines can easily cause them to become contaminated. An infected person can also act as a new reservoir of pathogenic microorganisms, causing contamination of people and other public facilities [5, 6].

Pathogenic microorganisms can survive on various surfaces for long periods of time, from a few hours to several months. If these pathogens survive on the surfaces for a long time, they may be able to act as reservoirs of the disease for a longer period of time and thus cause more people to be infected with the disease [4, 7]. Among the bacteria and fungi that can survive on human hands for a long time and use them as a shelter and cause the transmission of pathogens are *Escherichia coli*, Enterococcus, *Staphylococcus aureus*, *Aspergillus*, and *Penicillium*. Maintaining good hygiene and proper hand washing by healthcare personnel, including surgeons, nurses, and other hospital staff, is very effective in preventing the spread of the disease [8, 9]. Also, keeping surfaces clean is one of the factors that can play a role in reducing the rate of infection and its transmission [10-12].

Transmission of various bacterial and fungal infections through timex machines in health care centers is vitally important. Due to lack of a study on the contamination caused by timex machines in Iran, this study was carried out for the determination of the status of bacterial and fungal diseases in fingerprint time attendance machines in hospitals affiliated with the Babol University of Medical Sciences in 1403.

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## Methods

This study aimed to determine the status of bacterial and fungal contamination of Timex machines in hospitals affiliated with the Babol University of Medical Sciences and was conducted for 8 months from January 2023 to August 2024. Sampling was carried out from the Timex machines of 5 hospitals affiliated with the Babol University of Medical Sciences according to Table 1, and 12 times sampling were taken from each hospital, a total of 120 samples were taken from the Timex machines. By attending hospitals affiliated with the Babol University of Medical Sciences and using sterile swabs moistened with sterile physiological serum, samples were taken from the surfaces of the timex machines and cultured on blood agar and Sabouraud dextrose agar in the faculty's microbiology laboratory and the mycology laboratory of Babol Medical School.

Bacterial samples were cultured in the Microbiology Laboratory of the School of Health and fungal samples were cultured in the Mycology Laboratory of the School of Medicine at Babol University of Medical Sciences on blood agar and Sabouraud dextrose agar, respectively. Blood agar culture medium was placed in a 37°C incubator for 24 hours to grow bacteria. Then microscopic observations and final diagnostic tests were performed. Diagnostic tests including catalase and coagulase were performed on the isolated strains [13]. Also, to identify fungi, samples were cultured on Sabouraud dextrose agar medium. Then, from the colonies grown on the SC medium, a single colony was taken and cultured on Candida chrome agar medium, incubated at 35°C for 48 hours, and differentiated based on colony color. According to the instructions of Chrome Agar (Chrome Agar Candida Company, made in France), Candida albicans (green), Candida tropicalis (metallic blue), Candida cruzi (velvet pink), and the remaining species were seen as white to purple [14]. Performing the catalase and the coagulase test, the Growth of Staphylococcus aureus and the Growth of Candida albicans are shown in figures 1 to 4.

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**Table 1. The number of samples from timex machines of the hospitals studied.**

| Hospitals | Number of Samples | | | | | | Number of samples | |
|---|---|---|---|---|---|---|---|---|
| | Winter | | Spring | | Summer | | Bacteria | Fungi |
| | Bacteria | Fungi | Bacteria | Fungi | Bacteria | Fungi | | |
| Shahid Rajaie | 4 | 4 | 4 | 4 | 4 | 4 | 12 | 12 |
| Ayatollah Rouhani | 4 | 4 | 4 | 4 | 4 | 4 | 12 | 12 |
| Shahid Yahyaneghad | 4 | 4 | 4 | 4 | 4 | 4 | 12 | 12 |
| Shahid Beheshti | 4 | 4 | 4 | 4 | 4 | 4 | 12 | 12 |
| Amirkola Children's | 4 | 4 | 4 | 4 | 4 | 4 | 12 | 12 |
| Total of samples | | | | | | | 60 | 60 |

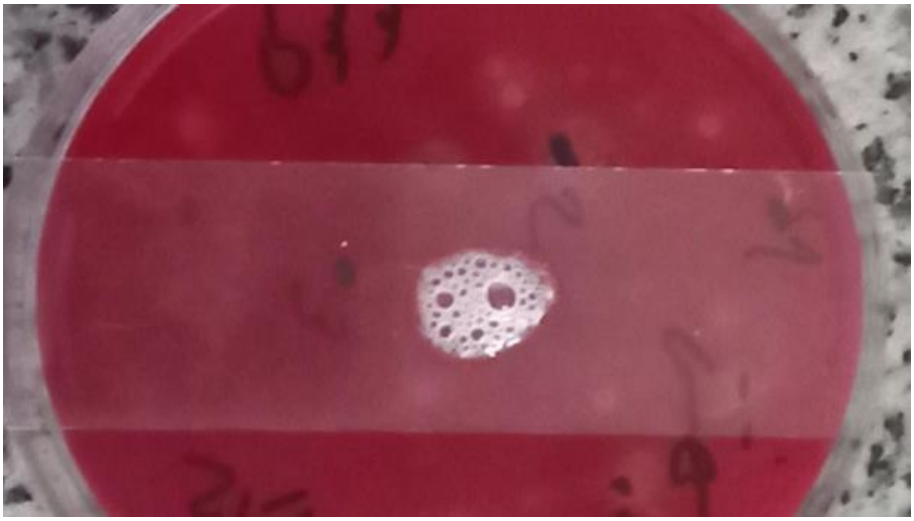

**Figure 1. Performing the catalase test.**

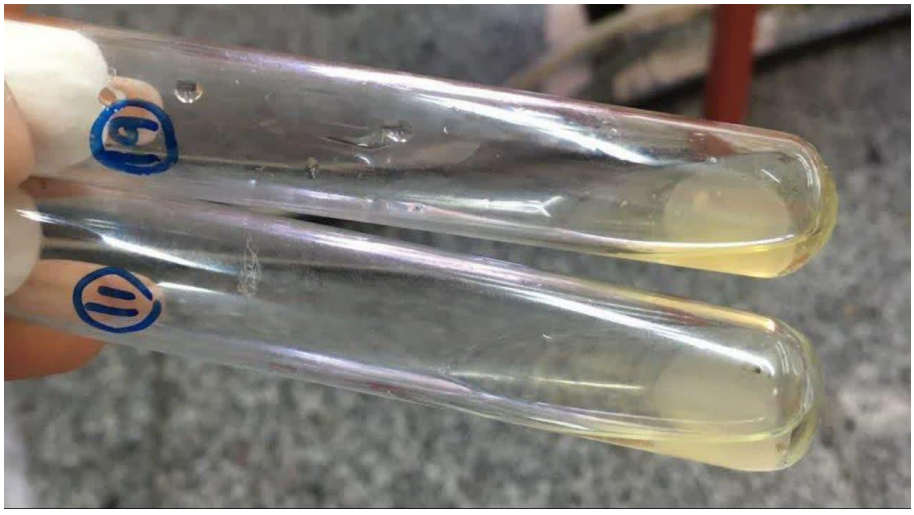

**Figure 2. Performing the coagulase test.**

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**Figure 3. Growth of Staphylococcus aureus on Mannitol Salt Agar medium.**

**Figure 4. Growth of Candida albicans on Candida Chrome agar medium.**

## Results

In this study, 60 fungal samples were cultured from the timex machines of the hospitals covered by the Babol University of Medical Sciences, of which 5 samples were positive equal to 8.33%, all of which belonged to Shahid Beheshti and Yahainejad hospitals. After culturing the infected fungal samples on Candida Chrome Agar, all samples were identified as *Candida albicans*. Also, all the bacterial samples taken from the timex machines of the hospitals covered by the Babol University of Medical Sciences were positive for contamination. All bacterial samples (100%) were infected with *Staphylococcus* and 11.26% were infected with Bacillus. Of the Staphylococcus strains, 77.30% were related to *Staphylococcus coagulase*-negative species and 22.70% were related to *Staphylococcus aureus* species. The percentage of microorganisms in the studied hospitals is shown in Table 2 and Figure 5.

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**Table 2. Percentage of microorganisms in each hospital studied.**

| Hospitals | Bacteria | | |
|---|---|---|---|
| | ***Staphylococcus aureus*** (%) | ***Coagulase-negative*** (%) | ***Bacillus*** (%) |
| Amirkola Children's | 21.48 | 78.52 | 1.40 |
| Shahid Rajaei | 18.67 | 81.33 | 0.00 |
| Ayatollah Rouhani | 27.12 | 72.88 | 4.21 |
| Shahid Yahyaneghad | 25.77 | 74.23 | 4.23 |
| Shahid Beheshti | 20.44 | 79.56 | 1.42 |

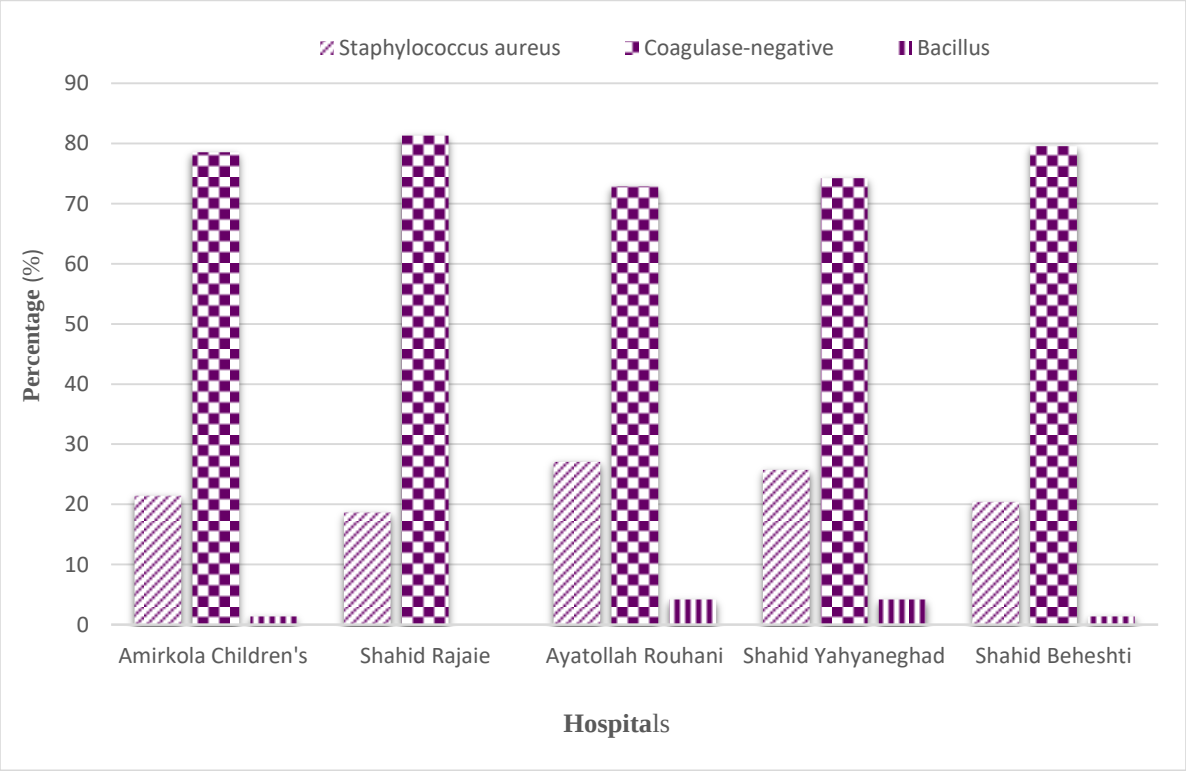


**Figure 5. The comparison of bacterial microorganisms on timex machines in the studied hospitals.**

## Discussion

The present study has shown the presence of contamination caused by Bacillus species and *Staphylococcus aureus* species, *Staphylococcus coagulase-negative* and fungal contamination caused by *Candida albicans* species on the surfaces of the timex machines in the investigated hospitals. Since these hospital pathogens can survive on inanimate surfaces for weeks therefore, timex machines can be the cause of the transmission of pathogens among



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employees and other members of the community. The difference in the amount of fungal and bacterial contamination in the studied hospitals can be related to the variety of hospital activities and the number of infectious beds in different hospitals.

In a research conducted by Aquino et al. in 2021 intending to determine multidrug-resistant bacteria isolated from an automated teller machine in Brazil, it showed that the most common bacteria isolated included Staphylococcus aureus, Enterococcus, and Staphylocoagulase negative species with 64, 22 and 14 percent, respectively(15). Also, in a 2016 study with the purpose of microbial community patterns associated with automated teller machine keypads in New York City, Bik et al. reported Staphylococcus aureus as the main component of skin and nasal microbiota(15, 16). The results of this research confirmed the presence of Candida albicans species in some timex machines of the studied hospitals. As, in research conducted by Yusha et al. in 2021 with the aim of Isolation of bacteria and fungi from personal and public mobile cellphones at Bayero University in Kano, Nigeria, Candida species were identified at the level of personal and public mobile phones (17).

Also, this study proved the presence of staphylocoagulase-negative species on the timex machines of the studied hospitals. In a research conducted in 2020 by Al Omani to Elucidation Practices of Mobile Phone Hygiene and Identification of the Microorganisms in Riyadh, Saudi Arabia, the predominant microorganism was coagulase-negative Staphylococcus species(18).

In addition, the present study has shown that 26.11% of the samples taken from the timex machines of the studied hospitals were contaminated with Bacillus. In 2017, in a research conducted by Vivekananda Annet Viveka with the aim of isolation and identification of common bacterial contaminants in mobile phones owned by veterinary undergraduate students at the University of Peradeniya, Kandy, Sri Lanka, 28.6 percent of the samples were reported to be infected with Bacillus(19) .

## Conclusions

Timex machines are among the equipment that are important in the transmission of pathogens through hands. Since pathogenic microorganisms can survive on surfaces for a long time from several hours to several months, they can play a role in the transmission of pathogenic agents (20). In this study, all the 120 samples taken from the surface of timex machines in hospitals covered by the Babol University of Medical Sciences were positive for bacterial contamination. 11.26% of the samples were infected with Bacillus and 100% of the samples were infected with Staphylococcus. Of the Staphylococcus samples, 77.30% were related to Staphylococcus aureus species, and 22.30% were related to Staphylococcus aureus species. Also, 8.33% of the fungal samples were positive for fungal contamination and the strains were Candida albicans species. According to the results of this study, it is very important to observe personal hygiene in the use of disinfectants and to observe environmental hygiene in the disinfection of public equipment. Also, the replacement of video identification machines instead of timex machines in organizations, especially in hospitals and health care centers, is very important in disease control.

## Declarations:

The study was carried out following approval from the Ethics Committee of the Babol University of Medical Sciences and obtaining written permission from the university (ethics code number IR.MUBABOL.REC.1402.163) and all ethical requirements were followed in all stages of the research.

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## Author's contribution:

Conceptualization: A.I.A., S.M.M.; Methodology: A.I.A., S.M.M.; E.F., M.T.A.; Sampling: S.F.M.; Laboratory Work: S.F.M., E.F., M.T.A.; Statistical analysis and investigation: A.I.A., S.M.M..; Writing - original draft preparation: S.F. M.; Writing - review and editing: A.I.A., S.M.M.

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## Consent for publication

Not applicable.

## Conflict of interest

The authors declare that they have no competing interests.

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