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Microbial Contamination on Elevator Buttons: A Three-Site Study in Tripoli Libya

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ABSTRACT

This study emphasizes the significance of surface hygiene and the impact of microbial contaminants on infections acquired in healthcare settings and the community. Elevator buttons have been identified worldwide as high-risk surfaces that can harbor bacteria, fungi, and, in certain instances, multidrug-resistant organisms.

This study aimed to examine microbial contamination on interior elevator buttons at different places such as clinics, hospitals, and markets, at Tripoli, Libya, and to offer reference data for elevator disinfection and sanitation management to reduce community-related infections.

A total of 20 elevator button samples were collected using sterile swabs and cultured on selective media including Blood Agar, Mannitol Salt Agar, MacConkey Agar, and Sabouraud Dextrose Agar. Bacterial isolates were identified using the BD Phoenix™ system, while fungi were identified microscopically with Lactophenol Cotton Blue staining. Microbial growth was detected across almost all sampled buttons, with variations between clinical and non-clinical settings.

Clinics showed both bacterial and fungal contamination on the surface of their elevators, while private clinics presented predominantly bacterial growth. Market elevators displayed mixed contamination, with fungi dominating lower-floor buttons. Identified bacteria included *Staphylococcus epidermidis, Staphylococcus hominis, Acinetobacter baumannii, Pseudomonas Pseudoalcaligenes, and Bacillus cereus,* while fungal isolates included *Aspergillus and Penicillium* species. Several isolates are known opportunistic pathogens and exhibit multi-drug resistance. It can be concluded that elevator buttons in Tripoli are consistently contaminated with bacteria and fungi, including clinically significant resistant organisms, indicating that routine cleaning alone is insufficient and improved infection control strategies are urgently needed.

Key words*-Elevator buttons; Surface hygiene; Microbial contamination; Multidrug-resistant microorganisms; Healthcare-associated Infection.*

INTRODUCTION

Surface contamination remains a major concern in healthcare, industrial, and community settings where surface integrity directly affects safety and performance. A «clean» surface lacks universally accepted criteria and is context-dependent, defined by the absence of unintended foreign substances including particulates, residues, or microbial agents that compromise function or safety. In pharmaceutical and healthcare environments, contamination can jeopardize sterility, efficacy, and patient outcomes, necessitating strict control to meet regulatory standards such as ICH Q7.[1]

Microbial contaminants, including bacteria, fungi, viruses, and protozoa, are a primary form of contamination and spread through physical contact, aerosols, shared tools, or improper handling.[2] Healthcare facilities are particularly vulnerable due to high microbial loads and frequent contact with inanimate surfaces. Surface-adherent microorganisms often form biofilms that enhance persistence and resistance to cleaning.[3] Initial microbial adhesion is influenced by surface properties such as moisture, hydrophobicity, and electrostatic charge, while deposited organisms may later re-aerosolize or transfer via hand contact.[4]

High-touch surfaces are recognized reservoirs for nosocomial and community-acquired pathogens. Elevator buttons are consistently reported as high-risk due to frequent contact by diverse users without hand hygiene.[5] Previous studies have recovered coagulase-negative staphylococci, *Staphylococcus aureus* including MRSA, *Escherichia coli, Klebsiella* spp, *Acinetobacter baumannii, Pseudomonas* spp, and fungi such as *Aspergillus* and *Candida* from button surfaces, with contamination rates of 40–80% depending on location and cleaning frequency.[5] Such organisms can persist for days and contribute to the propagation of drug-resistant strains.[6]

Environmental and behavioral factors modulate contamination levels. Non-porous materials like stainless

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steel harbor fewer microbes than plastics, while elevated humidity promotes bacterial and fungal survival. Frequent contact, poor hand hygiene, and irregular disinfection further increase microbial load and transmission risk.[7] Despite this, elevator buttons are often overlooked in routine cleaning protocols, particularly in non-clinical settings such as markets and commercial buildings.[8]

Given their role in cross-contamination, improved control strategies are required. Emerging solutions include touchless haptic or gesture-based button systems and embedded 265 nm UVC-LED disinfection to reduce contact and provide on-demand germicidal activity. Antimicrobial coatings containing copper or silver ions offer passive, continuous reduction of surface bioburden between cleanings.[9]

However, data on microbial contamination of elevator buttons in Tripoli and their contribution to community-related infections remain limited. Therefore, the aim of this study was to assess the microbial contamination of interior elevator buttons in clinics, hospitals, and markets, identify the predominant bacterial and fungal isolates, and provide reference data to support disinfection and sanitation management for reducing community-related infections.

MATERIALS AND METHODS

Study Design and Sampling Sites

A descriptive study was conducted to evaluate microbial contamination of interior elevator buttons in Tripoli, Libya, during March 2024. Samples were obtained from selected hospitals, clinics, and markets. Sites were chosen based on high daily foot traffic and unrestricted public access.

Sample Collection

Twenty elevator buttons, including up, down, and numbered panels, were sampled using sterile cotton swabs moistened with sterile 0.9% saline. Each button surface was swabbed thoroughly for 10 s, and swabs were immediately placed in sterile tubes for transport to the laboratory within 2 hours of collection.

Culture and Isolation

Swab samples were inoculated onto selective and differential media to facilitate microbial growth and preliminary differentiation. The following media were used: Blood Agar for general bacterial cultivation and hemolysis patterns; Mannitol Salt Agar for isolation of *Staphylococcus* gram positive spp, MacConkey Agar for gram-negative enteric bacteria, Sabouraud Dextrose Agar for fungal recovery, and Thioglycollate broth to enhance growth of fastidious organisms (Figure 1). Bacterial plates were incubated aerobically at 37 ± 1°C for 24–48 h, while fungal plates were incubated at 25–28°C for 3–5 days.

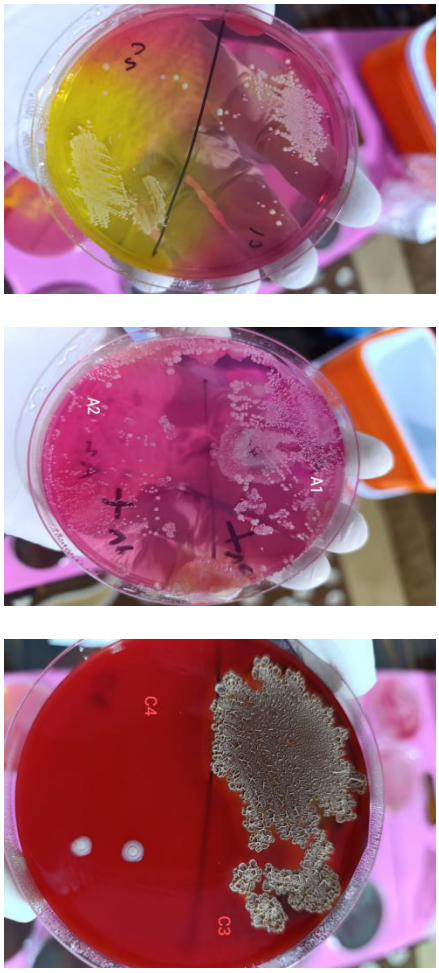

Figure 1: Different types of culture media

Identification of Isolates

Initial characterization of bacterial isolates was performed by Gram staining to distinguish gram-positive from gram-negative organisms. Fungal isolates were identified based on colony morphology and microscopic examination using Lactophenol Cotton Blue preparations.

Bacterial identification and antimicrobial susceptibility testing were carried out using the BD Phoenix™ 50 automated system, which provides biochemical profiling and rapid results. The automated method was complemented by conventional culture techniques to allow detection of organisms not covered by system panels and to confirm key findings. All tests were performed in duplicate to ensure reproducibility.

Data Recording

Colony characteristics, Gram reaction, and identification results were recorded for each isolate. The prevalence of bacterial and fungal contamination was calculated per sampling site, and isolates were categorized by genus and species when possible.

RESULTS

Microbial growth was detected on 19 of 20 sampled

elevator buttons (95%). Mixed contamination with both bacteria and fungi was the most common pattern, occurring in 45% of samples, followed by bacterial contamination alone in 40% and fungal contamination alone in 15%.

In hospital Elevator 1 (A), buttons A1, A2, and A4 yielded mixed bacterial and fungal growth, A5 showed bacterial growth only, and A3 showed fungal growth only. In hospital Elevator 2 (B), mixed growth was recovered from buttons B1, B2, B3, and B5, while B4 showed bacterial growth only (Table 1).

Table 1: Microbial contamination results of hospital elevators (A & B)

Buttons	Elevator A	Elevator B
open in the outside	Fungal and bacterial growth A1	fungal and bacterial growth B1
close in the inside	Fungal and bacterial growth A2	fungal and bacterial growth B2
the floor	Fungal growth A3	fungal and bacterial growth B3
the forth	Fungal and bacterial growth A4	bacterial growth B4
alarm	bacterial growth A5	fungal and bacterial growth B5

A=Sample from the hospital; B= Sample from the hospital

1=Open in the outside; 2 =Close in the inside; 3=The floor; 4=The forth; 5= Alarm

For the private clinic Elevator 3 (C), bacterial growth was observed on buttons C1, C2, C4, and C5, with fungal growth alone detected on C3 (Table 2).

Table 2: Microbial contamination of buttons at clinic elevators

Button	Elevator C
Open in the outside	bacterial growth C1
Close in the inside	bacterial growth C2
The floor	fungal and bacterial growth C3
The forth	bacterial growth C4
Alarm	bacterial growth C5

C= Sample from the private clinic

In market Elevator 4 (D), bacterial growth was present on D1 and D2, fungal growth on D3, and mixed contamination on D4 and D5 (Table 3),

Table 3: Microbial contamination of buttons at market elevator

Buttons	Elevator D
Open in the outside	fungal and bacterial growth D1
Close in the inside	fungal and bacterial growth D2
The floor	fungal growth D3
The forth	bacterial growth D4
Alarm	bacterial growth D5

D= Sample from the market- Most of elevator samples showed mixed microbial contamination 45% (fungal and bacterial contamination), followed by a bacterial contamination (40%), and fungal contamination only (15%)(Table 4).

Table 4: Type and percentage of microbial contamination

Type of contamination	Percent
fungal contamination	15%
bacterial contamination	40%
Mixed fungi and bacteria contamination	45%

- By using phoenix 50 the following bacterial strains were identified:(Table 5).

Table 5: Types of microbial strains

Location of the sample	No of elevator	Button number	Microbial strain
Hospital	***A***	*A1*	*Pantoea agglomerans, staphaylococcus epidermidis*
		A2	*Staphaylococcus hominis*
		A3	----------
		A4	*Pseudomonas Pseudoalcaligenes and Peanibacillus Alvei*
		A5	*Mannheimia heamolytica*
	B	*B1*	*Bacillus cereus*
		B2	*Paracoccus yeei*
		B3	*Mannheimia heamolytica*
		B4	*Mannheimia heamolytica*
		B5	*Niallia circulans*
Clinic	***C***	*C1*	*Staphaylococcus hominis*
		C2	*Staphaylococcus ureilyticus*
		C3	*Pantoea agglomerans*
		C4	*Priestia megaterium*
		C5	*Staphaylococcus epidermidis*
Market	***D***	*D1*	*Acinetobacter lwoffri/heamolytcus*
		D2	*Acinetobactor baumannii*
		D3	----------
		D4	*Staphaylococcus epidermidis*
		D5	*Staphaylococcus hominis*

Regarding fungal contamination, Microscopic examination using Lactophenol Cotton Blue revealed fungal isolates

belonging to *Aspergillus* spp. and *Penicillium* spp.

DISCUSSION

This study demonstrated widespread microbial contamination of elevator buttons across hospital, clinic, and market settings, confirming their role as reservoirs for potential pathogens and fomites for cross-contamination. Microbial growth was detected on 95% of sampled buttons, with mixed bacterial-fungal contamination most frequent (45%), followed by bacteria alone (40%) and fungi alone (15%).

Contamination patterns varied by location. Hospital elevators showed predominantly mixed growth, while private clinics had mainly bacterial contamination and markets exhibited mixed growth with fungi more common on lower-floor buttons. These differences likely reflect variations in user traffic, cleaning protocols, and environmental conditions. Notably, multidrug-resistant organisms were recovered from clinic A but absent in clinic B, suggesting inconsistent disinfection practices.

Isolated bacteria included commensal and opportunistic pathogens such as *Staphylococcus epidermidis, S. hominis, Acinetobacter baumannii, Pseudomonas pseudoalcaligenes, and Bacillus cereus.* Which were also reported as predominant opportunistic pathogens on elevator buttons in a Chinese hospital study. Several, particularly *A. baumannii and Pseudomonas* spp., are clinically significant due to nosocomial infection risk and multidrug resistance. Their presence on high-touch surfaces is concerning for immunocompromised individuals in healthcare settings. Less common isolates, including *Paracoccus yeei* and *Paenibacillus alvei*, further indicate the diverse microbial ecology of elevator buttons, consistent with global reports.

Fungal contaminants were primarily *Aspergillus* spp. and *Penicillium* spp. Although ubiquitous, these genera are clinically relevant for invasive mycoses in immunocompromised patients. Their detection reinforces the need to monitor fungal load in healthcare environments.

The recovery of multidrug-resistant *A. baumannii* and *Pseudomonas spp,* highlights the role of environmental surfaces as reservoirs for resistant strains. Recent metagenomic data show that intensive disinfection can reduce diversity yet select for disinfectant and antibiotic resistance genes on surfaces, implying that overuse of biocides may promote persistence of resistant organisms.[10] Material properties also influence contamination, studies indicate polyvinylidene chloride (PVDC) button covers reduce microbial residue, and contamination rebounds within hours after cleaning, especially on ground and door buttons.[11] Culture-independent analyses have revealed broader diversity and resistance gene pools on lift buttons, including efflux pumps and ABC transporters, underscoring adaptive capacity of surface microbiota.[12]

Overall, findings indicate that routine cleaning alone is insufficient. Enhanced infection control should combine frequent targeted disinfection, selection of low-retention surface materials or antimicrobial coatings, public hand-hygiene promotion, and periodic molecular surveillance to track resistance determinants. These measures are essential to limit transmission of opportunistic and multidrug-resistant organisms via high-touch surfaces in clinical and community settings.

CONCLUSION

Elevator buttons were consistently contaminated with diverse bacteria and fungi, including clinically significant pathogens such as *Acinetobacter baumannii, Pseudomonas spp.*, and *Staphylococcus spp*., several exhibiting multi-drug resistance. Fungal genera *Aspergillus* and *Penicillium* were also recovered. Contamination varied with location, surface material, and cleaning practices, reflecting the impact of environmental and behavioral factors. These results, consistent with international studies, confirm that elevator buttons act as reservoirs for environmental and resistant organisms. Routine cleaning alone is inadequate; effective infection control requires increased disinfection frequency, antimicrobial materials or PVDC coverings, and improved hand hygiene. Culture-based methods may underestimate microbial load and resistance, indicating that molecular approaches should be integrated into future surveillance.

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