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Knowledge, Attitude and Practice of IIUM Kuantan Students on the Transmission of Microorganisms via Lift Buttons

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ABSTRACT

The coronavirus disease (COVID-19) outbreak has heightened global concerns about virus transmission through shared public facilities. People increasingly avoid touching public surfaces like doorknobs, trolley handles, and lift buttons to prevent microorganism transmission via direct contact with fomites. In multi-storied buildings, lift buttons are among the most frequently touched surfaces. This study focused on the knowledge, attitude, and practice (KAP) of students at IIUM Kuantan regarding microorganism transmission via lift buttons. The aim was to assess the KAP levels among students and identify factors influencing these outcomes. Additionally, the study analysed the correlation between the three domains and suggested solutions to reduce microorganism transmission. A cross-sectional study was conducted among 172 IIUM Kuantan students using standardized questionnaires. A scoring system graded the KAP scores. Knowledge about microorganism transmission was assessed with ten true or false questions, attitudes were evaluated using ten statements on a five-point Likert scale, and practices were measured through ten statements on a four-point Likert scale. Descriptive and inferential statistics were applied to analyse the data. Results indicated that 70% of the students had good knowledge, 72% had good attitudes, and 74% demonstrated moderate practices. Factors influencing these results included age and year of study. The study found a positive correlation between knowledge and attitude, while no correlation was observed between knowledge and practice or attitude and practice. Suggested measures to curb transmission included implementing voice recognition systems in lifts and providing hand sanitizers inside and outside lifts. This study effectively increased students' awareness of microorganism transmission via lift buttons and promoted proper practices to reduce such transmissions.

1. Introduction

Microorganisms, including viruses, bacteria, fungi, and protozoa, are ubiquitous in shared areas frequently used by many people, such as lift buttons, doorknobs, trolley handles, and sinks [1]. Bacterial colonization in these areas is a primary concern, as it leads to infectious diseases in humans. Transmission of these microorganisms occurs through direct contact and environmental reservoirs

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like water, food, and fomites [2]. High-touch surfaces have significant potential to harbour and spread pathogens within communities and buildings [3].

Studies have shown substantial contamination on public transport surfaces, such as handrails and seats. A study in Washington D.C. found 67% of metro rail system samples contaminated with bacteria, highlighting the risk of pathogen transmission in public areas [4]. Similarly, a Midwestern university study identified *Staphylococcus aureus* on doorknobs, indicating human interaction with inanimate objects as a source of bacterial transmission in crowded institutions [5]. Research in Mecca city identified various contaminated public surfaces, with the highest bacterial counts found on supermarket child seats and refrigerated water taps [1]. While a study conducted by Kandel *et al.,* [6] depicted that, in healthcare settings, lift buttons pose a higher risk of microbial colonization compared to toilet surfaces, contributing to nosocomial infections if not properly sanitized. Other than that, a study at Isfahan University found 100% of lift buttons contaminated with both Gram-positive and Gram-negative bacteria [3].

At IIUM Kuantan, previous studies by Danial [7] and Te [8] on bacterial contamination of lift buttons in student dormitories revealed a significant presence of microorganisms, with high contamination rates in lifts of Mahallah Khalid Al-Walid (95.5%) and Mahallah Fatimah Az-Zahra (92%). Given that all buildings on this healthcare campus are multi-storied, the frequent use of lifts exposed users to various pathogens concentrated on lift buttons. These findings underscore the need for effective cleaning and disinfection protocols in high-touch areas to mitigate pathogen spread. Effective disinfection involves removing pathogenic microorganisms from surfaces, excluding resistant bacterial spores. Common disinfectants include quaternary ammonium compounds, chlorine compounds, alcohols, and hydrogen peroxide, each with specific uses and efficacy levels. Factors influencing disinfection effectiveness include microbial load, surface type, and disinfectant concentration and exposure.

The COVID-19 pandemic has heightened awareness of microorganism transmission through fomites, emphasizing the need for regular disinfection of high-touch surfaces in public and healthcare settings [9]. Various studies have highlighted the importance of hand hygiene and surface disinfection to prevent infection spread [10-12]. Implementing rigorous cleaning schedules and disinfection protocols, along with public education, can help reduce pathogen transmission and protect public health. Although many studies have identified microorganisms on lift buttons, there is a lack of literature examining the knowledge, attitude, and practice (KAP) of individuals regarding this issue and how to mitigate microorganism transmission in public areas. It is expected that sociodemographic factors play essential roles in influencing KAP among the general population and IIUM Kuantan students specifically. Knowledge and attitude significantly impact practices, which in turn determine the effectiveness of measures to prevent microorganism transmission via lift buttons.

This study focused on the KAP regarding microorganism transmission via lift buttons among students at IIUM Kuantan, Pahang. The study aimed to determine the level of KAP on microorganism transmission via lift buttons among students at IIUM Kuantan, Pahang; identify the factors associated with the KAP of microorganism transmission via lift buttons; examine the correlation between KAP and microorganism transmission; and identify practical solutions for preventing and reducing microorganism transmission via lift buttons.

2. Methodology

2.1 Study Ethics and Design

Ethical approval for this study was obtained from the Kulliyyah Postgraduate and Research Committee (KPGRC), Kulliyyah of Allied Health Sciences, followed by approval from the IIUM Research Ethical Committee (IREC) under reference no: IIUM/504/14/11/2/IREC 2020-BS (KAHS). All

respondent information was kept private and confidential. This cross-sectional study examined the knowledge, attitude, and practice (KAP) of microorganism transmission via lift buttons in a specific population at a single point of time. The setting of this study was in IIUM Kuantan, Pahang from February to May 2020.

2.2 Study Population

The study population comprised students of IIUM Kuantan. The sample size was calculated using the single proportion formula, considering a 10% dropout rate, as recommended by Basir *et al.,* [13]. The minimum required sample size was 171, with a final sample size of 188 to account for non-responses. The calculation is written in Eq. (1):

Sample size,

$$n = [Z_{\alpha/2} / \Delta]^2 p(1-p) \quad (1)$$

$$n = [1.96/0.06]^2\ 0.2(1-\ 0.2)$$

n = 171+10% non-response rate

n = 188

where,

$Z_{\alpha/2}$ = 1.96 (for 95% confidence interval)

Δ = 0.06 (precision)

p = 0.20 (proportion in population)

2.3 Sampling Method & Inclusion and Exclusion Criteria

A convenience sampling method was employed, targeting male and female students of IIUM Kuantan, preferably those residing in campus dormitories (mahallah). This non-probability sampling method selected the most readily available participants. Participants included in the study were students who had used lifts in multi-storied campus buildings at least once in the past year and who could understand English or Malay for survey purposes. Students on study leave, internships, or living off-campus were excluded from the study.

2.4 Questionnaire Design and Modification

2.4.1 Questionnaire design

The questionnaire used in this study was modified from Basir *et al.,* [13]. The questionnaire design involved identifying the study domain, specifically the KAP of IIUM Kuantan Campus students concerning microorganism transmission via lift buttons. Following the Guideline for Conducting a Knowledge, Attitude, and Practice (KAP) Study by Kaliyaperumal [14], the question preparation process was carried out in stages. This involved reviewing questionnaires from previous studies, brainstorming key items to be assessed, and constructing new questions and statements based on the revised items. An additional section of questions was also constructed in section five. Among the constructed open-ended questions focused on suggestions on how to develop innovation of the lift without the need to touch buttons and some preventive measures related in this matter. The answers in this section were not scored but were considered for this study instead. The questionnaire comprised five sections:

i. Section 1: Collected sociodemographic data.
ii. Section 2: Assessed knowledge with 10 true/false/not sure questions.
iii. Section 3: Evaluated attitudes using a Likert scale from "strongly disagree" to "strongly agree."
iv. Section 4: Measured practices with 10 Likert-scale questions from "never" to "always".
v. Section 5: Included open-ended questions for suggestions on lift innovation and preventive measures.

2.4.2 Content validation

The modified questionnaire was validated by three experts in Microbiology and Biostatistics to ensure clarity, relevance, and accuracy. Ensuring content validity was a key focus, confirming that the modified questionnaire accurately measured the intended topic by covering all relevant aspects, ensuring each question was meaningful, and maintaining alignment with the research objectives. Later, a pilot study was conducted to identify potential issues and refine the research instruments before the main study. Expert reviews helped ensure no key elements were missed, preventing incomplete or inaccurate data collection.

2.5 Data Collection

Data were collected using self-administered questionnaires distributed via email and Google Forms to IIUM Kuantan students. Participation was voluntary, and participants were informed they could withdraw at any time. Written informed consent was obtained, and no time limit was imposed for completing the questionnaires.

2.6 Data Analysis

Data were entered and analysed using the Statistical Package for Social Sciences (SPSS). Normality checks were conducted prior to performing any statistical analyses. The scoring system for assessing knowledge, attitude, and practice (KAP) towards microorganism transmission among IIUM Kuantan students categorizes the total scores as follows:

i. Good: A score of 20-28 for knowledge, 35-50 for attitude, and 28-40 for practice, corresponding to 70% or more of the total score.
ii. Moderate: A score of 15-19 for knowledge, 26-34 for attitude, and 21-27 for practice, corresponding to 51-69% of the total score.
iii. Poor: A score of 0-14 for knowledge, 10-25 for attitude, and 10-20 for practice, corresponding to 50% or less of the total score.

For each item within the KAP categories:

i. Knowledge: Correct statements are scored as 2 points for "True," 1 point for "Not sure," and 0 points for "False." For false statements, the scoring is reversed, with 2 points for "False," 1 point for "Not sure," and 0 points for "True."
ii. Attitude: Positive statements are scored on a scale from 5 points for "Strongly agree" to 1 point for "Strongly disagree." Negative statements are scored in reverse, with 5 points for "Strongly disagree" and 1 point for "Strongly agree."
iii. Practice: Positive statements are scored from 4 points for "Always" to 1 point for "Never." Negative statements are scored in reverse, with 4 points for "Never" and 1 point for "Always.

This scoring system was adapted with slight modifications from the study by Basir *et al.,* [13].

3. Results and Discussion

3.1 Sociodemographic Characteristics of the Respondents

This study included 172 students from IIUM Kuantan who participated in the survey. The sociodemographic profile of respondents is presented in Table 1. The majority resided in Mahallah Fatimah Az-Zahra (MFZ), while the fewest were from Mahallah Ummu Kalthum (MUK). All participants in MFZ were female students from the Kulliyyah of Allied Health Sciences (KAHS), Kulliyyah of Pharmacy (KOP), Kulliyyah of Science (KOS), and Kulliyyah of Nursing (KON), while MUK housed students from the Kulliyyah of Medicine (KOM) and Kulliyyah of Dentistry (KOD). All male participants resided in Mahallah Khalid Al Walid (MKAW). Regarding lift usage, participants were asked about the buttons they most frequently touched, with the "open" and "close" buttons being the most reported, followed by the "up" and "down" call buttons. Additionally, 73.3% of participants did not engage in lab-related activities during the semester, while those who did, primarily participated in laboratory practical. The elements from the sociodemographic section were used to analyse associations and correlations with the outcomes of the students' KAP. The survey on students' dormitory aimed to explore whether different programmes led to varying outcomes in the students' KAP.

Table 1
Sociodemographic data of respondents (*n* = 172)

Characteristics	Frequency	Percentage (%)
Age		
18 years old and below	0	0
19 – 21 years old	66	38.4
22 – 24 years old	106	61.6
25 years old and above	0	0
Gender		
Male	35	20.3
Female	137	79.7
Kulliyyah		
KAHS[a]	82	47.7
KOP[b]	18	10.5
KOS[c]	43	25.0
KOD[d]	3	1.7
KON[e]	15	8.7
KOM[f]	11	6.4
Mahallah		
MKAW[g]	35	20.3
MFZ[h]	117	68.0
MUK[i]	20	11.6
Use of lift in mahallah		
Yes	144	83.7
No	28	16.3
Most likely touched buttons		
Up/down	109	63.7
Open/Close	125	73.1
LG[j]	19	11.1
1	68	39.8
2	2	1.2
3	25	14.6
4	40	23.4
5	17	9.9
6	36	21.1

7	20	11.7
8	17	9.9
9	20	11.7
Alarm button	1	0.6
Emergency phone button	0	9.4
Involvement in lab work		
Yes	46	26.7
No	126	73.3
Type of lab work(s) involved		
Clinical attachment/practicum	8	17
Laboratory practical	36	76.6
Research project	14	29.8

a = Kulliyyah of Allied Health Sciences
b = Kulliyyah of Pharmacy
c = Kulliyyah of Science
d = Kulliyyah of Dentistry
e = Kulliyyah of Nursing
f = Kulliyyah of Medicine
g =Mahallah Khalid Al-Walid
h = Mahallah Fatimah Az-Zahra
i = Mahallah Ummu Kalthum
j = Lower Ground

3.2 KAP Regarding Microorganism Transmission via Lift Buttons

Table 2 shows the survey results indicated that most students (*n* = 172) at IIUM Kuantan demonstrated good knowledge of microorganism transmission via lift buttons, with 69.8% scoring well in this area. Similarly, 71.5% of participants exhibited positive attitudes towards microorganism transmission. However, when it came to practice, most respondents showed only moderate practices, with only 11.6% achieving a good practice score.

Majority of students have moderate or good knowledge which might be influenced by the participants' background of study where they were commonly exposed to knowledge involving microorganisms in their study field in the science-based educational institution.

In addition, the outbreak of novel disease, COVID-19 when the survey was conducted has also led to more exposure on the respondents' level of awareness regarding the spread and transmission of pathogens which concurrently reflected in their decent knowledge level. Availability of sources of information regarding the disease can be easily acquired such as through the social media, television, and newspaper. This has resulted in the increment in knowledge level of the students.

In analysing the attitude of IIUM Kuantan students on this subject, it is proven that more than half (71.5%) have good attitude, 23.3% of moderate attitude, and 5.25% achieved poor attitude level regarding the transmission of microorganism through lift buttons. This result is noticeably higher than a similar KAP study done on health care workers about the spread of infections via fomites in Pakistan, in which 20.1% of the respondents presented poor attitude [15].

Table 2
Categories of knowledge, attitude, and practice scores regarding microorganisms transmission via lift buttons (*n* = 172)

Category	Frequency	Percentage (%)
Knowledge		
Good (≥70%)	120	69.8
Moderate (51% – 69%)	51	29.7
Poor (≤50%)	1	0.6
Attitude		
Good (≥70%)	123	71.5
Moderate (51% – 69%)	40	23.3
Poor (≤50%)	9	5.2
Practice		
Good (≥70%)	20	11.6
Moderate (51% – 69%)	128	74.4
Poor (≤50%)	24	14.0

3.2.1 Knowledge regarding microorganism transmission

Table 3 presents the distribution of students' responses to the knowledge statements on microorganism transmission. Most students correctly answered statements 1, 2, 3, 4, 7, 8, and 9, particularly on general microorganism knowledge. However, statements 5 and 6 saw fewer correct responses. Notably, while most participants were aware that objects like doorknobs, phones, and lift buttons could transmit microorganisms, around one-third (33.1%) were unsure about the potential harm posed by stethoscopes. Overall, 69.8% of participants possessed good knowledge, 29.7% had moderate knowledge, and only 0.6% showed poor knowledge. This high level of knowledge may be attributed to the students' educational background in science, as well as increased awareness due to the COVID-19 pandemic.

For the initial knowledge statements, nearly all students correctly identified the general facts about microorganisms and the risk of cross-contamination from using lifts. About half were able to correctly assess the risk of lift buttons compared to toilet surfaces, with some choosing incorrect or unsure answers. This finding aligns with Kandel *et al.,* [6] who reported higher colonization prevalence on lift buttons than toilet surfaces. Statement 5 saw only 21.5% of students answering correctly, with over 50% believing that cross-contamination is more likely in hospitals than public places. However, Thapaliya *et al.,* [5] found similar contamination rates in both settings. Additionally, 65% of students were uncertain about the survival time of bacteria on dry surfaces, despite research by Kramer *et al.,* [16] showing that most bacteria can live for months on such surfaces.

The survey also assessed students' knowledge of hand hygiene, including the effectiveness of hand sanitizer versus soap and water, and the ideal alcohol concentration in hand sanitizer. Previous study by Ariyaratne *et al.,* [17] has shown low KAP scores in hand hygiene among medical students, a trend also observed in countries like India, China, and Brazil (as cited in Alotaibi *et al.,* [18]). However, the Coronavirus-19 pandemic crisis might have heightened students' awareness of proper hand hygiene practices. When asked to identify items that could act as fomites, most students answered correctly, except for the stethoscope. Less than half recognized it as a fomite, though Rao *et al.,* [19] confirmed that stethoscopes, frequently in contact with infected skin, can indeed promote pathogen transmission.

Table 3
Responses on knowledge regarding microorganism transmission (*n* = 172)

No.	Statements	True N (%)	False N (%)	Not sure N (%)
1.	Bacteria is classified as one of six major types of microorganisms.	**150 (87.2)**	5 (2.9)	17 (9.9)
2.	Pathogen can be defined as an organism that can cause disease to its host.	**159 (92.4)**	0	13 (7.6)
3.	Cross-contamination can happen if someone touches lift button.	**159 (92.4)**	0	13 (7.6)
4.	Lift buttons have lower risk to harbour microorganism as compared to toilet surfaces (e.g., door handles, toilet seat, and toilet flush handle).	51 (29.7)	**76 (44.2)**	45 (26.2)
5.	Cross-contamination highly occurs on surfaces of healthcare-related building (e.g., hospital) than public settings (e.g., supermarket).	97 (56.4)	**37 (21.5)**	38 (22.1)
6.	Most species of bacteria can only persist for two weeks on dry inanimate surfaces.	45 (26.2)	**15 (8.7)**	112 (65.1)
7.	Most viruses from the respiratory tract, such as *corona*virus*, influenza* virus*, SARS,* or *rhino*virus, can survive on dry inanimate surfaces for one to seven days.	**92 (53.5)**	16 (6.3)	64 (37.2)
8.	Hand sanitizer has the same effectiveness on reducing the number of microorganisms on hand as compared to soap and water	71 (41.3)	**77 (44.8)**	24 (14.0)
9.	Hand sanitizer must contain at least 60% alcohol concentration to ensure its effectiveness in removing microorganisms.	**101 (58.7)**	46 (26.7)	25 (14.5)
10.	Below listed item(s) can be potentially categorized as fomite (Fomite: inanimate object that serves as a mechanism of transfer for infectious agents between hosts.)			
	a) Doorknob	**169 (98.3)**	0	3 (1.7)
	b) Handphone	**150 (87.2)**	9 (5.2)	13 (7.6)
	c) Lift button	**171 (99.4)**	0	1 (0.6)
	d) Stethoscope	**83 (48.3)**	32 (18.6)	57 (33.1)
	e) Faucet	**105 (61.0)**	9 (5.2)	58 (33.7)

Note. Correct answers are in bold

3.2.2 Attitude regarding microorganism transmission

Table 4 presents the distribution of participants' attitudes toward microorganism transmission, scored on a Likert scale from ‘strongly disagree’ to ‘strongly agree.’ The statements evaluated students' perceptions of microorganism-related harm, responsibility for hand hygiene, and prevention of transmission via lift buttons. Most students' responses closely matched expected outcomes, indicating a generally positive attitude. However, 49.5% believed hand cleaning was necessary only after touching high-contact surfaces, deviating from the expected response. Additionally, 39.5% were neutral about whether the microbial load on hands correlates with that on lift buttons. The remaining statements largely aligned with expected attitudes on hand and lift button hygiene. Most participants recognized the potential harm posed by microorganisms on lift buttons, particularly in healthcare settings. For instance, Kassir and Nawas [20] pointed out that coagulase-negative *Staphylococcus* spp. and *Staphylococcus aureus* are among the organisms that were mostly isolated from lift buttons which are dangerous in health care settings as they might especially inflict harm to immunocompromised person. Whereas more than half of the respondents also believed that microorganisms could survive on lift buttons even the surface appeared to be dry. Lift button, though appeared to be dry, have always been misjudged as not being able to harbour microorganisms. As a matter of fact, the surfaces of no pores might act as a better colonization spot for bacteria as compared to other surfaces due to their non-porous nature [21].

Table 4
Responses on attitude statements regarding microorganism transmission (*n* = 172)

No.	Statement	Strongly disagree N (%)	Disagree N (%)	Neither agree nor disagree N (%)	Agree N (%)	Strongly agree N (%)
1.	I am aware that microorganisms are present on the lift buttons, but they are not harmful.	**18 (10.5)**	54 (31.4)	43 (25.0)	47 (27.3)	10 (5.8)
2.	I believe that microorganisms are present on the lift buttons but cannot be transmitted to another human.	**47 (27.3)**	89 (51.7)	24 (14.0)	7 (4.1)	5 (2.9)
3.	I believe that microorganisms cannot survive on lift buttons due to the dry surface of the buttons.	**36 (20.9)**	77 (44.8)	42 (24.4)	13 (7.6)	4 (2.3)
4.	I believe that indirect transmission of microorganism by touching the lift buttons is not as severe as direct transmission such as person-to-person contact.	13 (7.6)	41 (23.8)	33 (19.2)	64 (37.2)	**21 (12.2)**
5.	I know that touching lift button using laboratory gloved hand is an improper action.	12 (7.0)	13 (7.6)	32 (18.6)	54 (31.4)	**61 (35.5)**
6.	I should only clean my hands after touching public surfaces (e.g., shopping cart handle).	**29 (16.9)**	48 (27.9)	10 (5.8)	45 (26.2)	40 (23.3)
7.	I believe that the microbial load on hand is proportional to the microbial load transmitted from lift buttons.	15 (8.7)	32 (18.6)	68 (39.5)	44 (25.6)	**13 (7.6)**
8.	I know that frequent hand cleaning using alcohol wipes/hand sanitizers/soap and water before and after touching the lift buttons will reduce the occurrence of microorganisms.	10 (5.8)	2 (1.2)	9 (5.2)	60 (34.9)	**91 (52.9)**
9.	I believe that lift buttons should be cleaned on a regular basis.	11 (6.4)	0	14 (8.1)	61 (35.5)	**86 (50.0)**
10.	I believe that putting hand sanitizers/hand rubs outside and inside the lift is a good approach in preventing the transmission of microorganisms.	12 (7.0)	0	7 (4.1)	49 (28.5)	**104 (60.5)**

Note. Expected answers are in bold.

Many students acknowledged the risk of indirect transmission of microorganisms, though less severe than direct contact. They also recognized that using contaminated laboratory gloves on lift buttons could lead to cross-contamination, as gloves can harbour high bacterial loads after lab tasks which agrees with Yadav *et al.,* [22]. Finally, most students agreed that frequent hand cleaning and the availability of hand sanitizers in and around lifts could reduce microorganism transmission. This aligns with the study conducted by Assadian *et al.,* [23], which emphasized that regular disinfection of lift buttons, as recommended by the WHO, is widely supported, underscoring the importance of maintaining hygiene in public spaces.

3.2.3 Practice regarding microorganism transmission

Table 5 presents that 75% of students reported always touching lift buttons with bare hands, contrary to recommended practices. The habit increases the risk of cross-contamination and the spread of pathogens. Bare hands can carry and transfer pathogens to multiple surfaces, highlighting the importance of preventive actions to reduce contamination risk. Chowdhury *et al.,* [24] acknowledged that bare hands may act as vehicles, carrying large number of pathogens including bacteria and later transferring them to multiple fomites. Although the invention of lifts as of today

require people to touch the buttons, preventive actions must be taken to reduce the risk of cross-contamination among the users. Additionally, only 3.5% of students minimized contact by using objects like pen caps, toothpicks, or elbows to press the buttons, which is recommended to prevent pathogen transmission. Another positive finding was that 91.9% of respondents removed their gloves after lab work before using the lifts, effectively preventing microorganism transmission. Furthermore, more than half of the students avoided pressing lift buttons multiple times or held the buttons for too long, which helps reduce the potential spread of microorganisms. However, practices related to hand hygiene before and after using lifts were not widely adopted, with less than 10% of participants regularly practicing this. The unfamiliarity with such practices might indicate that adopting new hygiene habits, such as frequent hand hygiene, requires time and gradual transition from lower to higher levels of practice.

Table 5
Responses on practice regarding microorganism transmission (*n* = 172)

No.	Statement	Never N (%)	Seldom N (%)	Often N (%)	Always N (%)
1.	I use lift every day to go to other floors in a week.	4 (2.3)	43 (25.0)	43 (25.0)	**82 (47.7)**
2.	Instead of lift, I use stairs each day in a week.	14 (8.1)	91 (52.9)	43 (25.0)	**24 (14.0)**
3.	I touch lift buttons with bare hands.	**1 (0.6)**	9 (5.2)	33 (19.2)	129 (75.0)
4.	I minimize contact with lift buttons by using other objects to press them (e.g., elbow, cotton bud, toothpick).	57 (33.1)	88 (51.2)	21 (12.2)	**6 (3.5)**
5.	After working in the lab, I keep wearing the gloves when touching lift buttons.	**158 (91.9)**	12 (7.0)	0	2 (1.2)
6.	I press the lift buttons many times to make it operates faster.	**25 (14.5)**	69 (40.1)	42 (24.4)	36 (20.9)
7.	I let the doors to open or close automatically without using the open/close buttons on the lift panel.	20 (11.6)	118 (68.8)	27 (15.7)	**7 (4.1)**
8.	I only touch the lift buttons for a moment without holding them on for too long.	3 (1.7)	55 (32.0)	68 (39.5)	**46 (26.7)**
9.	I clean my hands using alcohol wipes/hand sanitizers/soap and water before touching the lift buttons.	73 (42.4)	77 (44.8)	13 (7.6)	**9 (5.2)**
10.	I clean my hands using alcohol wipes/hand sanitizers/soap and water after touching the lift buttons.	56 (32.6)	82 (47.7)	21 (12.2)	**13 (7.6)**

Note. Expected answers are in bold.

3.3 Association of Sociodemographic Factors with KAP on Microorganism Transmission

The main factors that influenced the outcome in this study were the socio-demographic variables of the respondents, namely age group and year of study. Parametric tests for age groups were performed either Independent *t*-test or one-way ANOVA after normality assumptions for parametric tests were met. Meanwhile, the association of those sociodemographic factors with attitude and the practice scores of the students were revealed through non-parametric tests such as Mann-Whitney *U* test and Kruskal-Wallis test as normality assumption of the data for each variable was not met.

Referring to Table 6, total knowledge scores on microorganism transmission between age groups of 19 to 21 and 22 to 24 differ significantly as the *p*-value is less than 0.05. Concurrently, the *p*-value for different years of study is also less than 0.05 which indicates that at least one pair from the groups has significant difference in mean of knowledge score. To determine this, post-hoc comparisons using the Tukey HSD test was performed as being illustrated in Table 7. It is shown that the mean knowledge score for Year 1 students (M = 68.72, SD = 9.48) was significantly different from all Year 2

(*M* = 75.19, *SD* = 8.71), Year 3 (*M* = 74.96, *SD* = 9.40), and Year 4 students (*M* = 76.79, *SD* = 11.18). This suggests that older students, who are mostly in their senior undergraduate years, have more exposure to knowledge about microorganisms compared to younger age groups. This finding aligns with Sharif and Obaidat [25], which supports the notion that higher educational levels contribute to higher knowledge scores as cited in Yusoff [26].

Table 6
Comparison of total scores of KAP regarding microorganism transmission between different age groups and year of studies

Groups compared	N	Knowledge scores		Attitude scores		Practice scores	
		Mean (SD)[a]	*p*-value	Median[c]	*p*-value	Median[c]	*p*-value
Age group							
19 – 21 years old	66	71.4 (10.12)	0.005*	72	<0.001*	57.5	0.132
22 – 24 years old	106	75.78 (9.11)		76		60.0	
		Mean (SD)[b]		Median[d]	*p*-value	Median[d]	*p*-value
Year of study							
1	29	68.71 (9.48)	0.009*	72	0.001*	62.5	0.744
2	38	75.19 (8.71)		72		58.8	
3	87	74.96 (9.39)		74		60.0	
4	18	76.79 (11.18)		81		60.0	

*$p < .05$.
a: Comparison using Independent *t*-test
b: Comparison using one-way ANOVA test
c: Comparison using Mann-Whitney *U* test
d: Comparison using Kruskal-Wallis test

Attitude scores show a statistically significant difference between the 19- to 21-year-old age group (*Md* = 72, *n* = 66) and the 22- to 24-year-old age group (*Md* = 76, *n* = 106), *U* = 2380, *z* = -3.53, $p<0.05$, *r* = 0.27. The *r* value, which determines the effect size, is calculated using the formula stated in Eq. (2).

$r = z$ / square root of N where N = total number of cases (2)

Table 7
Post-hoc test using Tukey HSD to determine the pair in year of study with significant difference in mean of knowledge score

Year of study (I)	Year of study (J)	Mean difference (I-J)	*p*-value
1	2	-6.469	0.031*
	3	-6.240	0.013*
	4	-8.067	0.026*

*$p < .05$.
Note. The multiple comparisons in post-hoc tests showed significant difference between Year 1 and all other years hence explained the selection of Year 1 being compared with others in this table.

The obtained *r* value indicates a medium effect size for the attitude scores. As there is a significant difference between age groups, the direction of the difference is evident in the mean ranks, with the 22- to 24-year-old students having a higher mean rank (97.1) compared to the 19- to 21-year-old students (69.6).

Findings from Kruskal-Wallis test also portrays statistically significant difference across four different years of study with $\chi^2 = 16.19$, $p = 0.001$ ($p<0.05$). Year 4 students recorded the highest median score (*Md* = 81, *n* = 18) among other groups while both Year 1 (*Md* = 72, *n* = 29) and Year 2

(*Md* = 72, *n* = 38) had the lowest median scores. Year 3 (*Md* = 74, *n* = 87) achieved a median score between those of the other groups. In practice scores, no significant differences were found between age groups and years of study (p>0.05).

3.4 Relationship Between Knowledge, Attitude, And Practice of Microorganism Transmission Via Lift Buttons

The Spearman Rank Order Correlation analysis as showed in Table 8 revealed a significant positive association between knowledge and attitude towards microorganism transmission via lift buttons (p = 0.01, r_s = 0.195). However, this correlation was weak, explaining only 3.8% of the variance in attitude scores. No significant association were found between knowledge and practice (p = 0.574) as well as attitude and practice (p = 0.274). These findings suggest that while a higher level of knowledge may contribute to a more positive attitude, it has limited impact on actual practices.

Table 8
Correlation between total score of KAP towards microorganism transmission via lift buttons

Variable	r_s value	p-value
Knowledge and attitude	0.195	0.010*
Knowledge and practice	0.043	0.574
Attitude and practice	0.084	0.274

*p < .05.

3.5 Analysis of Open-Ended Questions

The open-ended questions in the last segment on the survey elicited a range of suggestions from participants regarding innovations for lift buttons and strategies to reduce microorganism transmission. The most popular suggestion for lift innovations as shown in Table 9 was the implementation of voice recognition systems (67.8%). Mohan *et al.,* [27] in his paper stated that this idea is feasible, as voice-operated intelligent lifts have recently been introduced in India. Such systems can interpret spoken commands and execute corresponding actions, eliminating the need to touch lift buttons. The second most common suggestion was the use of touch sensors (11.9%), similar to those found in gadgets, to replace traditional lift buttons. Another suggestion was the incorporation of foot pedals (7.1%), which have already been used in lifts at a shopping mall in Thailand to reduce COVID-19 transmission. This approach is considered more practical for campus lifts due to its lower cost compared to implementing advanced technologies. Additionally, some respondents proposed using QR codes and access cards (4.8% respectively) for lift operation, akin to hotel room key cards, or holographic buttons to replace physical ones. Shen [28] stated that although China has implemented holographic buttons as a touchless solution during the COVID-19 pandemic, this technology remains costly and is not widely adopted. In summary, while various innovative suggestions for lifts have been proposed, each should be carefully evaluated for practicality and suitability before implementation.

Table 9
Suggestions on innovation of lift without the need to touch buttons

Suggestion on innovation of lift	Total respondents who answered	Percentage of answer (%)
Voice recognition system	57	67.8
Touch sensor	10	11.9
Foot pedals	6	7.1
QR code / smartphone remote	4	4.8
Access card	4	4.8
Holographic buttons	3	3.6
Total	84	100.0

Referring to Table 10, more than half of participants suggested on practicing proper hand hygiene before and after using the lifts. This includes to provide hand sanitizers outside and inside the lift as to encourage people on cleaning their hands while using the lift to reduce the concentration of pathogenic microorganisms on their hands as well as on lift button surfaces. Besides, 22 students suggested on cleaning the lift buttons frequently by using disinfectants while 21 responded on using other objects to press the buttons instead of using bare hands or fingers. The least suggestions received concerning this matter is to limit direct contact with the buttons such as reducing the duration of touch with the lift surfaces or assigning only a specific person to control the lift panels so the transmission of microorganisms can be controlled within smaller scope. Six respondents also suggested on increasing the awareness of harms that can be associated with microorganism transmission via lift buttons which indirectly can enhance the understanding of the users and reassuring them to practice measures in reducing the transmission of microorganisms. These findings highlight the need for innovative technologies and public health measures to mitigate the risk of microorganism transmission in lift environments.

Table 10
Suggestions on reducing the transmission of microorganisms while using lift

Suggestion on reducing the transmission of microorganism	Total respondents who answered	Percentage of answer (%)
Hand hygiene	74	57.4
Lift cleaning	22	17.0
Use another object to press button	21	16.3
Limiting contact	6	4.6
Increase awareness	6	4.6
Total	129	100

4. Future Recommendations

The overall findings of this study highlight several areas for improvement. One suggestion is to distribute questionnaires more evenly among students from different faculties and year groups to ensure more accurate and precise results. This approach will help produce normally distributed data and reduce the occurrence of outliers in future analyses. Additionally, the scope of the study could be expanded to include a more diverse population, such as staff, visitors or Kuantan community, which may benefit from increased awareness about the transmission of microorganisms on frequently touched surfaces. In addition to questionnaires, future research could include environmental sampling of frequently touched surfaces such as lift buttons, to directly measure microbial contamination levels. This could contribute to a broader understanding of environmental transmission risks, particularly on high-contact surfaces. Future study could also examine the potential of using technology, such as touchless systems or UV sterilization devices for lift buttons

and other high-touch surfaces, to mitigate transmission risks. It is hoped that this study will not only raise awareness within the campus community but also help reduce the transmission of pathogens via lift buttons, thereby supporting efforts to break the chain of infection.

5. Conclusions

The study found that most respondents demonstrated good knowledge (70%) and attitude (72%) towards microorganism transmission via lift buttons, but practice was only moderate (74%). Age and year of study were key factors influencing these outcomes, with older students and those in higher years of study showing better KAP levels. A positive correlation was found between knowledge and attitude, but not between other pairs. The study suggests implementing voice recognition systems in lifts and providing hand sanitizers to reduce microorganism transmission and promote hand hygiene among students.

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References

[1] Ashgar, Samy S., and Hamdy M. El-Said. "Pathogenic bacteria associated with different public environmental sites in Mecca city." Open Journal of Medical Microbiology 2, no. 4 (2012): 133–137. https://doi.org/10.4236/ojmm.2012.24020

[2] Kraay, Alicia NM, Michael AL Hayashi, Nancy Hernandez-Ceron, Ian H. Spicknall, Marisa C. Eisenberg, Rafael Meza, and Joseph NS Eisenberg. "Fomite-mediated transmission as a sufficient pathway: a comparative analysis across three viral pathogens." *BMC infectious diseases* 18 (2018): 1-13. https://doi.org/10.1186/s12879-018-3425-x

[3] Mohammadi, Amir, Afshin Ebrahimi, and Sepideh Nemati. "Bacterial and fungal contamination of elevator buttons in university schools of Isfahan University of Medical Sciences, Isfahan, Iran." *Health Scope* 5, no. 4 (2016). https://doi.org/10.17795/jhealthscope-34428

[4] Elsergany, Moetaz, Mayada Moussa, Amimul Ahsan, Athra Khalfan, and Abir Eissa. "Exploratory study of bacterial contamination of different surfaces in four shopping malls in Sharjah, UAE." *Journal of Environmental and Occupational Science* 4, no. 2 (2015): 101-5. https://doi.org/10.5455/jeos.20150611030039

[5] Thapaliya, Dipendra, Mohammed Taha, Mark R. Dalman, Jhalka Kadariya, and Tara C. Smith. "Environmental contamination with Staphylococcus aureus at a large, Midwestern university campus." *Science of the Total Environment* 599 (2017): 1363-1368. https://doi.org/10.1016/j.scitotenv.2017.05.080

[6] Kandel, Christopher E., Andrew E. Simor, and Donald A. Redelmeier. "Elevator buttons as unrecognized sources of bacterial colonization in hospitals." *Open Medicine* 8, no. 3 (2014): e81–e86.

[7] Danial, Nur Izzatul Husna Mohd. "Enumeration and identification of bacteria isolated from the lift buttons of Mahallah Ummu Kalthum, IIUM Kuantan." Kuantan: International Islamic University Malaysia (2019).

[8] Te, Nur Athirah Syahirah. "Enumeration and identification of selected bacteria isolated from the lift buttons of Mahallah Fatimah Az-Zahra In IIUM Kuantan." Kuantan: International Islamic University Malaysia (2019).

[9] Bartlett, Christopher, Jens Langsjoen, Qiuying Cheng, Alexandra V. Yingling, Myissa Weiss, Steven Bradfute, Douglas J. Perkins, and Ivy Hurwitz. "COVID-19 global pandemic planning: Presence of SARS-CoV-2 fomites in a university hospital setting." *Experimental Biology and Medicine* 246, no. 18 (2021): 2039-2045. https://doi.org/10.1177/15353702211024597

[10] Boyce, John M. "Current issues in hand hygiene." *American Journal of Infection Control* 51, no. 11 (2023): A35-A43. https://doi.org/10.1016/j.ajic.2023.02.003

[11] Albastaki, Abdulla, Matthew Olsen, Hanan Almulla, Rania Nassar, Syrine Boucherabine, Lobna Mohamed, Reem Almheiri et al. "Mobile phones as fomites for pathogenic microbes: A cross-sectional survey of perceptions and sanitization habits of health care workers in Dubai, United Arab Emirates." *Infection, Disease & Health* 28, no. 1 (2023): 19-26. https://doi.org/10.1016/j.idh.2022.07.001

[12] Bruzaud, Jérôme, Jeanne Tarrade, Elena Celia, Thierry Darmanin, Elisabeth Taffin de Givenchy, Frédéric Guittard, Jean-Marie Herry, Morgan Guilbaud, and Marie-Noëlle Bellon-Fontaine. "The design of superhydrophobic stainless

steel surfaces by controlling nanostructures: A key parameter to reduce the implantation of pathogenic bacteria." *Materials Science and Engineering: C* 73 (2017): 40-47. https://doi.org/10.1016/j.msec.2016.11.115

[13] Basir, Nur Amalina Binti Abdul, Nor Azlina A. Rahman, and Mainul Haque. "Knowledge, attitude and practice regarding pertussis among a public university students in Malaysia." *Pesquisa Brasileira em Odontopediatria e Clínica Integrada* 20 (2020): e4993. https://doi.org/10.1590/pboci.2020.002

[14] Kaliyaperumal, K. I. E. C. "Guideline for conducting a knowledge, attitude and practice (KAP) study." *AECS illumination* 4, no. 1 (2004): 7.

[15] Aftab, Hassaan Bin, Bushra Zia, Mohammad Faizan Zahid, Ahmed Raheem, and Mohammad Asim Beg. "Knowledge, attitude, and practices of healthcare personnel regarding the transmission of pathogens via fomites at a tertiary care hospital in Karachi, Pakistan." In *Open forum infectious diseases*, vol. 3, no. 1, p. ofv208. Oxford University Press, 2016. https://doi.org/10.1093/ofid/ofv208

[16] Kramer, Axel, Ingeborg Schwebke, and Günter Kampf. "How long do nosocomial pathogens persist on inanimate surfaces? A systematic review." *BMC infectious diseases* 6 (2006): 1-8. https://doi.org/10.1186/1471-2334-6-130

[17] Ariyaratne, MHJD, Chinthika Gunasekara, Manjula Weerasekara, Jananie Kottahachchi, BP Kudavidanage, and Neluka Fernando. "Knowledge, attitudes and practices of hand hygiene among final year medical and nursing students at the University of Sri Jayewardenepura." *Sri Lankan Journal of Infectious Diseases* 3, no. 1 (2013): 15–25. https://doi.org/10.4038/sljid.v3i1.4761

[18] Alotaibi, Abdulaziz, Abdulrahman Algwaiz, Nawaf Alghamdi, Muhammad Almutairi, and Razique Anwer. "Knowledge, attitude, and practice of hand hygiene among clinical year medical students at Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia." *International Journal of Medical Research & Health Sciences* 8, no. 7 (2019): 134–141.

[19] Rao, Danish Ahmed, Aiysha Aman, Syed Muhammad Mubeen, and Ahmed Shah. "Bacterial contamination and stethoscope disinfection practices: a cross-sectional survey of healthcare workers in Karachi, Pakistan." *Tropical doctor* 47, no. 3 (2017): 226-230. https://doi.org/10.1177/0049475516686543

[20] Kassir, Ranim, and Tarek Nawas. "Elevator buttons: an unrealized potential health hazard." *International Journal of Academic Health and Medical Research* 2, no. 5 (2018): 1-5.

[21] Bean, B., B. M. Moore, B. Sterner, L. R. Peterson, D. N. Gerding, and H. H. Balfour Jr. "Survival of influenza viruses on environmental surfaces." *Journal of infectious diseases* 146, no. 1 (1982): 47-51. https://doi.org/10.1093/infdis/146.1.47

[22] Yadav, Dipak Kumar, Pushpa Kumari Shah, Shree Prasad Shah, and Amarendra Kumar Yadav. "The use of disposable gloves by general public during COVID-19 increases the risk of cross-contamination." *Asia Pacific Journal of Public Health* 32, no. 5 (2020): 289-291. https://doi.org/10.1177/1010539520932704

[23] Assadian, Ojan, Stephan Harbarth, Margreet Vos, Johannes K. Knobloch, Angel Asensio, and Andreas F. Widmer. "Practical recommendations for routine cleaning and disinfection procedures in healthcare institutions: a narrative review." *Journal of Hospital Infection* 113 (2021): 104-114. https://doi.org/10.1016/j.jhin.2021.03.010

[24] Chowdhury, D., Shamaila Tahir, Mark Legge, Honghua Hu, Tania Prvan, Khalid Johani, Greg S. Whiteley, T. O. Glasbey, Anand K. Deva, and Karen Vickery. "Transfer of dry surface biofilm in the healthcare environment: the role of healthcare workers' hands as vehicles." *Journal of Hospital Infection* 100, no. 3 (2018): e85-e90. https://doi.org/10.1016/j.jhin.2018.06.021

[25] Sharif, Labib, Mohammad M. Obaidat, and Mohammad-Raed Al-Dalalah. "Food hygiene knowledge, attitudes and practices of the food handlers in the military hospitals." *Food and Nutrition Sciences* 4, no. 3 (2013): 245-251. https://doi.org/10.4236/fns.2013.43033

[26] Yusoff, Muhamad Saiful Bahri. "ABC of content validation and content validity index calculation." *Education in medicine journal* 11, no. 2 (2019): 49-54. https://doi.org/10.21315/eimj2019.11.2.6

[27] Mohan, Thomas, K. Amrutha, Anjana Anil Kumar, Helen Johnson, and K. Silsha. "Voice operated intelligent lift." *International Research Journal of Engineering and Technology* 5, no. 6 (2018): 520–522.

[28] Shen, Xinmei. "Elevator in China Uses Holographic Buttons Amid Coronavirus Outbreak." *South China Morning Post*, March 6, 2020.