

## ORIGINAL ARTICLE

## SHISHA -THE HAZARDOUS PASTIME: MICROBIAL INVESTIGATION OF SHISHA APPARATUS IN PUBLIC CAFÉS IN THE UAE

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## ABSTRACT

*This study aims to examine the risk of bacterial and fungal transmission through frequent or repeated usage of the same water pipe by different smokers in public café shops. A total of 110 samples were extracted from different parts of used shisha apparatuses. These samples were collected from different cafes in seven cities in the UAE in the time period between Nov. 2016 and Feb. 2017. In all 110 samples, the bacterial and fungal strains were examined at Canadian university Dubai laboratories using standard protocols for culturing, isolating and identifying microorganisms. Later on, the samples were sent to Iranian hospital Dubai to examine the resistance of isolated bacteria to common antibiotics. Statistical analysis was conducted using quantitative data analysis and figures were expressed in percentage for clearer conclusion. Five bacterial strains were detected which are; Pseudomonas putida; Staphylococcus saprophyticus; Micrococcus luteus; Bacillus cereus and Providencia alcalifaciens (See table 2). One of the most important findings of the current study is the isolated bacteria Staphylococcus saprophyticus which showed methicillin resistance. Shisha smoking is a public health issue and could be a carrier of pathogens for smokers. There is a need for further assessments to address the impact of the sharp increase of Shisha smoking among specific populations especially in the Gulf countries (GCC) and among the female segment of society.*

**Keywords:** Shisha apparatus; Pathogens; Antibiotic sensitivity; Carrier of Pathogen; Public Health

## INTRODUCTION

‘Shisha’, ‘Hookah’ or ‘Water Pipe’ smoking is a practice which is part of the traditional habits of the ancient civilizations that subsisted in this region. It consists of syrupy tobacco mixed with molasses and vegetable glycerol as moisturizer and specific flavors like fruits or mint added to it. The smoking apparatus consists of different pieces including a smoke chamber, a bowl, a pipe and a hose. In Contrary to ancient lore and common beliefs, smoking shisha generates numerous toxicants known to cause cancers, respiratory and heart diseases<sup>1,2,3</sup>. With reference to the world health organization report (WHO) on the global tobacco epidemic (2017), the number of smokers in the UAE is frightening<sup>4</sup>. Approximately 30% of the entire population is addicted to some sort of smoking. Around 16% and 8% of the youth of the UAE (male and female respectively) are also shisha smokers<sup>5</sup>. Café shops in general are not following the hygienic standards and thus guest health is vulnerable. In addition to that, the UAE community shows a higher risk of respiratory diseases compared to other countries in the same region ( I.e. The UAE vs. Iran)<sup>6</sup>.

A study of the UAE population estimated that 8.6% of males and 11.8% of female young adults (20-44 years) are currently living with asthma<sup>7</sup>. Two Arabic

countries (Jordan and Lebanon) also ranked globally within the top 20 countries for tobacco consumption<sup>8</sup>. This data reinforces the need to carry out more research on the water pipe usage and related health issues. It is well known that water pipe smoking is associated with many health risks much like cigarette smoking<sup>9,10,11</sup>. However, contrary to cigarette smoking, water pipe smoking is not well addressed in the literature.

The main objective of the current study is to examine the risk of bacterial and fungal transmission through frequent or repeated usage of the same water pipe by different smokers in public café shops.

The main hypothesis of this study is that “there may be a microbial existence inside the water pipe which could be contagious”. We hypothesized this after our personal observation of some shisha smokers who tend to have frequent throat infections - compared to non-shisha smokers. We have also noticed that, the same water pipe is used by different people without any cleaning or hygienic precautions, especially in lower end Café shops.

## METHODS

Samples were collected from different regions in the UAE, where shisha smoking is more prevalent and legally permitted. We visited 35 café shops; however, the investigators were able to extract samples from only 22 cafés. In these 13 failed attempts, the investigator was unsuccessful in extracting good samples in 3 cases and in the other 10 cases they were not given approvals to perform the procedures from Café owners. A total of 110 samples were collected from 22 cafés in 7 cities within the UAE. Five samples were collected per cafe. These samples were intentionally extracted from different parts of water pipe apparatus. The samples were taken from the smoke chamber, the water tank or bowl, pipe, hose and the mouth piece.

Each sample was isolated by using a sterile swab and then transferred to sterile broth on site. The samples were transported to the Canadian University Dubai (CUD) - School of Public Health and Health Science laboratories within 3-5 hours post extraction. The sample broth was incubated for 24 hours to identify the turbidity. The turbid samples were serial diluted and  $10^{-3}$  and  $10^{-4}$  dilutions were initially inoculated in Nutrient agar. The plates were incubated at  $37^{\circ}\text{C}$  for 24-36 hours. The colonies that developed were inoculated with different cultures such as Mc Conkey agar, Eosin Methylene blue agar, Nutrient agar, Lowenstein-Jensen medium (LJ), Blood agar, Chocolate agar for bacterial species isolation and then incubated at  $37^{\circ}\text{C}$  for 24-36 hours. The Medium was kept in an incubator for 4 weeks at  $37^{\circ}\text{C}$  to confirm the presence of *Mycobacterium tuberculosis*. Sabouraud's dextrose agar (SDA) is used for fungal identification and incubated at  $25^{\circ}\text{C}$  for 4-6 days.

After the bacterial growth appeared in a pure culture, gram staining was carried out. The gram nature of isolated species and their colony morphology was recorded. The colony was once again pure cultured and incubated for 24 hours to produce more viable colonies to undergo Biochemical tests. The viable colonies were subjected to biochemical tests using a BDXpert-ID -Phoenix machine at the central microbiology lab at Iranian Hospital -Dubai. The identified bacterial species were subjected to antibiotic drug resistance (MIC) tests using the BDXpert-ID- Phoenix- AST taxonomy machine.

## RESULTS

In the current research, wide spectrum of Cafés in the UAE - higher and lower end- was investigated. Shisha price may vary depends on the location and the luxury of the Café. In general, the cost for each Shisha was approximately 10- 50 \$.

The samples were collected from specified part of shisha apparatus. The extracted samples were subjected to microbial isolation. There were variations in the number of positive samples among these collected from different shisha sites in the UAE. For instance, out of 50 samples collected from Ajman and Dubai (25 samples each), A number of 16 and 12 positive samples were identified respectively. Out of 20 samples from Abu Dhabi, 13 of them showed positive microbial growth. Other cities (i.e. Fujairah, Al Ain, Umm Al Quwain and Ras Al Khaimah) showed positive microbial growth in 8,6,4,8 samples respectively out of 10 samples that were collected. Furthermore, Shisha tank seems to be the most contaminated part of the Shisha as the majority of bacteria isolated were obtained from shisha tank. Other 2 parts that seems to be even dominated with microbes are smoke chamber and shisha pipe. However, due to the fact that other parts of the shisha are replaced and discarded, the hose and mouth piece seem to have the least contaminations. In general, approximately 80% of samples isolated from Fujairah and Ras Al Khaima was found to be positive. While just less percentage 'around 60%' of positive samples were obtained from Dubai and Abu Dhabi.

The table 2 Illustrates the type of Positive pathogens isolated from each part of shisha apparatus with their location and sample reference number.

The Bacterial species isolated from each sample are **B1-** *Pseudomonas putida*, **B2-** *Micrococcus luteus*, **B3-** *Bacillus cereus*, **B4-** *Providencia alcalifaciens*, and **B5-** *Staphylococcus saprophyticus*.

Table 1: Number of positive samples obtained from each part of shisha apparatus X1-shisha tank, X2-Smoke chamber, X3-Pipe, X4-Hose, X5-Mouth piece.

1	Ajman 1	Sample ref.	Total	2	Dubai	Sample ref.	Total	3	Abudhabi	Sample ref.	Total	4	Fujairah	Sample ref.	Total	5	Al Ain	Sample ref.	Total										
	AJ 001	X1	1	DXB 001	X1	0	ABD 001	X1	1	FJ 001	X1	1	ALA 001	X1	1		X1	1											
		X2	1		X2	1		X2	1		X2	0		X2	0														
		X3	0		X3	0		X3	1		X3	1		X3	1														
		X4	1		X4	1		X4	1		X4	1		X4	0														
		X5	1		X5	1		X5	0		X5	1		X5	1														
	AJ 002	X1	1	DXB 002	X1	0	ABD 002	X1	1	FJ 002	X1	1	ALA 002	X1	1		X1	1											
		X2	1		X2	1		X2	1		X2	1		X2	1														
		X3	0		X3	0		X3	1		X3	0		X3	1														
		X4	0		X4	1		X4	0		X4	1		X4	0														
		X5	0		X5	1		X5	0		X5	1		X5	0														
	AJ 003	X1	0	DXB 003	X1	0	ABD 003	X1	1	Total Bacteria Positive		8	Total Bacteria Positive		6														
		X2	1		X2	0		UMQ 001	X2	0	6	Umm al-Quwain	Sample ref.	Total	7				Ras Al Khaima	Sample ref.	Total								
		X3	1		X3	0			X3	1												X3	1	RAK 001	X1	1			
		X4	0		X4	1			X4	0												X4	0				RAK 002	X2	1
		X5	0		X5	0			X5	1												X5	1						
	AJ 004	X1	1	DXB 004	X1	1	ABD 004	X1	1	UMQ 002	Sample ref.	Total	7	Ras Al Khaima	Sample ref.	Total													
		X2	1		X2	0		X2	0								X2	0	RAK 001	X4	1								
		X3	1		X3	0		X3	1								X3	1				RAK 002	X5	1					
		X4	1		X4	0		X4	0								X4	0							RAK 002	X1	1		
		X5	0		X5	1		X5	1								X5	1										RAK 002	X2
AJ 005	X1	1	DXB 005	X1	1	Total positive Bacteria		13	UMQ 002	Sample ref.	Total	7	Ras Al Khaima	Sample ref.	Total														
	X2	1		X2	0	UMQ 002	Sample ref.	Total								7	Ras Al Khaima	Sample ref.	Total										
	X3	1		X3	1															X3	1	X3	1	RAK 001	X1	1			
	X4	0		X4	0															X4	0	X4	0				RAK 002	X2	0
	X5	1		X5	1															X5	1	X5	1						
Total bacteria Positive		16	Total Bacteria Positive		12	Total Bacteria Positive		4	Total samples Positive		8																		

Table 2a: The number and type of bacteria isolated from each positive sample.

1	Ajman 1	Sample ref.	B1	B2	B3	B4	B5	Total	2	Dubai	Sample ref.	B1	B2	B3	B4	B5	Total	3	Abudhabi	Sample ref.	B1	B2	B3	B4	B5	Total
	AJ 001	X1	1	0	0	1	0	2		DXB 001	X1	0	0	0	0	0	0	ABD 1	X1	1	1	0	1	0	3	
		X2	1	0	0	0	0	1			X2	0	0	0	0	1	1		X2	0	1	0	0	0	1	
		X3	0	0	0	0	0	0			X3	0	0	0	0	0	0		X3	1	0	0	0	0	0	1
		X4	1	0	1	0	1	3			X4	0	1	0	0	0	1		X4	1	0	1	0	0	0	2
		X5	0	0	1	0	0	1			X5	1	0	0	0	0	1		X5	0	0	0	0	0	0	0
	AJ 002	X1	0	0	0	1	0	1		DXB 002	X1	0	0	0	0	0	0	ABD 2	X1	1	0	1	0	1	3	
		X2	0	0	0	1	0	1			X2	0	0	1	1	0	2		X2	0	0	1	0	0	1	
		X3	0	0	0	0	0	0			X3	0	0	0	0	0	0		X3	0	1	0	1	0	2	
		X4	0	0	0	0	0	0			X4	0	1	0	0	0	1		X4	0	0	0	0	0	0	
		X5	0	0	0	0	0	0			X5	0	1	0	0	0	1		X5	0	0	0	0	0	0	0
	AJ 003	X1	0	0	0	0	0	0		DXB 003	X1	0	0	0	0	0	0	ABD 3	X1	1	0	1	1	0	3	
		X2	0	1	0	1	0	2			X2	0	0	0	0	0	0		X2	0	0	0	0	0	0	
		X3	1	0	0	1	0	2			X3	0	0	0	0	0	0		X3	0	1	0	0	0	1	
		X4	0	0	0	0	0	0			X4	0	1	0	1	0	2		X4	0	0	0	0	0	0	
		X5	0	0	0	0	0	0			X5	0	0	0	0	0	0		X5	0	0	1	0	0	1	
	AJ 004	X1	0	0	0	0	1	1		DXB 004	X1	0	1	0	0	1	2	ABD 4	X1	0	1	0	1	0	2	
		X2	0	0	1	0	0	1			X2	0	0	0	0	0	0		X2	0	0	0	0	0	0	
		X3	0	1	0	1	0	2			X3	0	0	0	0	0	0		X3	0	0	0	0	1	1	
		X4	1	0	0	0	0	1			X4	0	0	0	0	0	0		X4	0	0	0	0	0	0	
		X5	0	0	0	0	0	0			X5	0	1	0	0	0	1		X5	1	0	1	0	1	3	
	AJ 005	X1	0	1	0	0	0	1		DXB 005	X1	0	1	0	1	0	2	Total Bacteria positive								
		X2	1	0	1	0	0	2			X2	0	0	0	0	0	0			6	5	6	4	3	24	
		X3	0	0	1	0	0	1			X3	0	1	0	1	0	2									
		X4	0	0	0	0	0	0			X4	0	0	0	0	0	0									
		X5	1	0	0	0	1	2			X5	1	0	0	0	0	1									
Total bacteria		Positive	7	3	5	6	3	24	Total Bacteria		Positive	2	8	1	4	2	17									

Table 2b: The number and type of bacteria isolated from each positive sample.

4	Al Ain	Sample ref.	B1	B2	B3	B4	B5	Total	5	Ras Al Khaima	Sample ref.	B1	B2	B3	B4	B5	Total
	ALA 001	X1	1	0	0	1	0	2		RAK 001	X1	1	1	0	1	0	3
		X2	0	0	0	0	0	0			X2	1	0	1	1	1	4
		X3	0	1	0	0	1	2			X3	1	0	0	0	0	1
		X4	0	0	0	0	0	0			X4	0	1	0	1	0	2
		X5	0	1	0	0	1	2			X5	0	0	0	0	1	1
	ALA 002	X1	0	0	1	0	0	1		RAK 002	X1	0	0	0	1	0	1
		X2	1	0	0	1	0	2			X2	0	0	0	0	0	0
		X3	1	1	0	0	1	3			X3	0	0	1	0	0	1
		X4	0	0	0	0	0	0			X4	0	0	0	0	0	0
		X5	0	0	0	0	0	0			X5	1	0	0	0	0	1
Total Positive Bacteria			3	3	1	2	3	12	Total Positive Bacteria			4	4	2	5	3	18
6	Fujairah	Sample ref.	B1	B2	B3	B4	B5	Total	7	Umm al-Quwain	Sample ref.	B1	B2	B3	B4	B5	Total
	FJ 001	X1	0	1	0	1	0	2		UMQ 001	X1	1	0	1	0	1	3
		X2	0	0	0	0	0	0			X2	0	0	0	0	0	0
		X3	0	1	0	0	0	1			X3	0	0	0	0	0	0
		X4	1	0	1	0	0	2			X4	0	0	0	0	0	0
		X5	0	0	0	0	1	1			X5	0	0	0	0	0	0
	FJ 002	X1	1	0	0	0	0	1		UMQ 002	X1	1	0	1	0	0	2
		X2	0	0	0	0	0	0			X2	0	0	0	0	1	1
		X3	0	0	0	0	0	0			X3	0	0	0	0	0	0
		X4	1	0	0	0	1	2			X4	1	0	1	0	0	2
		X5	0	1	0	1	0	2			X5	0	0	0	0	0	0
Total Positive Bacteria			3	3	1	2	2	11	Total Positive Bacteria			3	0	3	0	2	8

Out of five different bacterial species were isolated, the B1- *Pseudomonas putida* was found contaminated in 28 samples. The micrococcus *luteus* found in 26 samples. B3- *Bacillus cereus*, B4- *Providencia alcalifaciens*, B5- *Staphylococcus saprophyti* were found in contaminated in 19, 23 and 18 samples respectively.

Regarding the existence of bacteria in different parts of shisha apparatus, the isolated bacterial species were found highly contaminated at X1-shisha tank with around 35 samples. Followed by 21 samples from X3-Pipe, X2 - smoke chamber, 19 samples, X4-Hose, 14 samples and X5-mouth piece with 18 samples.

#### I. Antibiotic susceptibility test and Results

The Antibiotic susceptibility test showed that *Pseudomonas putida* was resistant to cefoxitin, ceftazidime, Ceftriaxone, Ampicillin, Amoxicillin-Clavulanate and Nitrofurantoin. *Providencia alcalifaciens* were resistant to cephalothin, Cefuroxime, Ceftazidime, Cefepime, Aztreonam, Ampicillin, Nitrofurantoin. The *Micrococcus luteus* bacterium was resistant to Imipenem, Cefoxitin, Cefotaxime, Ampicillin, Penicillin G, Oxacillin, Amoxicillin-Clavulanate, Erythromycin, Fusidic Acid.

### DISCUSSION

The main challenge which the research team faced throughout the data collection phase was to convince Café shop owners to give the approvals to carry out the sampling while the café is filled with customers. In addition to that, there was a logistic obstacle related to transferring the samples from different cities to the laboratory within strict timeframe (3- 5) Hours to avoid any cross contamination. There is very little published research about the diseases which could be acquired from common use of Shisha apparatuses, although Shisha is seen by public health professionals as a global tobacco epidemic<sup>2</sup>. It has been reported that sharing water-pipe mouth piece poses a serious risk of transmission of communicable diseases<sup>12,13</sup>.

From the 110 samples that we extracted and investigated, 67 samples were found to be contaminated with bacteria (see table 1). No fungal growth could be identified (see table 2). This figure shows that more than 60% of the investigated samples were contaminated with one or more species of bacteria (see table 2). Water pipe smoking is a social act, and in Arabic countries, two or more people frequently share the same shisha<sup>14,15</sup>. This behavior may put water pipe smokers at risk of sharing the same pathogens

through alternate use of the same shisha and increase the risk of transmitting the pathogens from an ill person to a healthy individual. To best of our knowledge, there are no updated figures about the numbers of shisha smokers among female fragment in the community in the UAE. Café Owners recognize that smoking shisha by women is socially negatively evaluated and they try to get around this by offering private booths that keep women unseen. One study carried out in KSA showed that the occurrence of smoking among female college students was 8.6%<sup>16</sup>. Which is more than four times that of males (2.0%) in the early eighties<sup>17</sup>. This indirectly increases the prevalence of women smoking in the UAE which has pushed the Dubai Health Authority to ban pregnant women from entering shisha cafes, regardless of whether or not they intend to smoke. The current research has confirmed that *S saprophyticus* existed in 16 samples of the shisha apparatuses. The *S saprophyticus* is an important cause of UTIs in young women<sup>18</sup>. It has been documented that water pipe tobacco usage by pregnant Arab women ranges between 4.0-8.7%<sup>19</sup>. It has also been reported that smoking one or more shisha per day during pregnancy is associated with at least 100 gm reduction of weight of smoker mothers. It is also associated with a higher risk of delivering low birth weight babies<sup>20, 21</sup>.

This study found 28 positive cases of *Pseudomonas putida* (see table 2). It is an opportunistic bacterium which is colonized in the lower respiratory tract. Previously, scientists considered *Pseudomonas putida* to be of low pathogenicity, however, over time this bacterium has been encountered as a significant human pathogen. *P. putida* can cause nosocomial infections, especially in immunocompromised patients. Moreover, *Micrococcus luteus* was found in 26 samples in this studies (see table 2). This bacterium exists in soil, dust, water and air, and as part of the normal flora of mammalian skin. This bacterium also colonizes the oral cavity and upper respiratory tract which could be seen as a reason for frequent sore throats and throat inflammation within shisha smokers<sup>22</sup>. A case control study carried out in Lebanon reported that the incidence of benign lesion of the vocal cords and vocal folds in the shisha smoking group is 21.5% with edema being the most common symptom presenting 16% of the time, followed by cysts presenting at 4.8% frequency<sup>23</sup>. *Bacillus cereus* was also found in 19 samples (see table 2). This bacterium causes two types of food-borne illnesses. One type is characterized by nausea, vomiting and abdominal cramps. The incubation period is 1 to 6 hours. The second type is manifested primarily by abdominal cramps and diarrhea following an incubation period of 8 to 16 hours<sup>24</sup>. The result of the current study confirms the existence of 23 cases

of *Providencia alcalifaciens* in the extracted samples (see table 2). While *Providencia* species mainly involve urinary tract inflammation, they are also associated with gastroenteritis<sup>25</sup>.

It is important to mention that 33% of pathogens were isolated from shisha tanks and the least number were isolated from the mouth piece (16 %). This could be explained by the way that Shisha works. Shisha smoke passes through the water pipe body, through the water in the bowl and is then carried out to the smoker. By this mechanism many pathogens may be pulled down to the bowl of water. While the least number of pathogens were identified in the disposable mouthpiece as there is no route here for cross contamination. The Antibiotic sensitivity level of each pathogen showed a high and broad level of resistivity to all major antibiotics<sup>26</sup>.

Some studies confirmed that cigarette smoking has no significant effect on the microbiota of oral sites and nasal cavity<sup>27</sup>. Microscopic organisms are able to respond to stimuli by switching the state from free-living - state to sessile mode in biofilms with advantageous of enhanced tolerance to many adverse conditions including antimicrobial agents<sup>28</sup>. Even though the isolated pathogens are opportunistic, the antibiotic resistivity ratio revealed its high pathogenicity impact which might infect to each shisha smoker.

To conclude, the current study raises a few important issues. First, aside from the well addressed harmful effects of smoking to human health, almost nothing has been mentioned in literature about the risk of the Shisha apparatus (itself) to smoker health. We were able to detect 5 strains of bacteria in all of the cafés that we investigated (see table 2). All of these bacteria are harmful with high antibiotic resistivity. The prices of these cafés were not a determinant factor. All cafés, both luxurious and lower - end, were found to be lacking in safety and hygienic precautions. Finally, it is clear that there is a need for further research to address the impact of the sharp increase of Shisha smoking among specific populations especially in the GCC and among the female segment of society.

#### ACKNOWLEDGEMENTS AND DECLARATIONS

The researchers were personally involved in the data collection, sampling and analyzing. In the current study there was no need for Ethical approval. The study was not designed to involve any human subject or require any clinical intervention or any human sampling. Samples were analyzed in the laboratories of Canadian university

Dubai and Iranian hospital Dubai by the researchers; hence it is a self-funded study.

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