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PATIENT SAFETY MEASURES IN HEALTH CARE: KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS DROPLET AND AIRBORNE ISOLATION PRECAUTIONS AMONGST MEDICAL STUDENTS AT OMAN MEDICAL COLLEGE

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ABSTRACT

Introduction: Microorganisms carried by the airborne route can be widely dispersed by air currents and may become inhaled by a susceptible host in the same room or over a long distance. The purpose of this study was to obtain comprehensive information about the knowledge, attitude, and practices in regard to airborne infection related precautions among the undergraduate students. **Methods:** A cross sectional study was carried out at Oman Medical College. Data was collected using a structured self-filled questionnaire. Students in 4th, 5th, 6th and 7th year were invited to participate using simple random sampling technique. Survey questionnaire comprised of series of questions covering knowledge of droplet air borne infection, infections spread through inhalation, hand washing and airborne germ transmission and regarding role of personal protective equipment's in airborne germ transmission. Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20. **Results:** A total of 175 students participated, of which 94.3% were female, 58.3% were clinical students and 41.7% were non-clinical students. Majority of participants (92.6%) believed that airborne germs are transmitted as very small particles by air currents and more than two third (74.9%) of the participants think airborne infections spread by droplet nuclei. One quarter think typhoid fever spread through inhalation of contaminated air and 83.5% gave positive responses about tuberculosis spread through air, 46.9% of participants believed measles and 33.7% chickenpox infection spread through inhalation of contaminated air. More than half of the participants think that airborne germ transmission can be prevented by environmental disinfection (63.4%) and by avoiding personal items sharing (65.1%). Nearly two third of study participant think that adherence to cough etiquette (74.9%) and standard precautions include hand hygiene (81.1%) can prevent airborne germ transmission, there was significant difference in the responses of clinical (mean rank score 79.4) and non-clinical (mean rank score 99.9) participant's responses (p-0.006). More than two third of the participants disclosed that gown, mask, and head caps provides protective barriers against infection (88%) and PPE should be used when there is an anticipated contact with blood and body fluids of a suspected or confirmed source of infection (78.3%). **Conclusion:** Medical students have acceptable level of general knowledge towards droplet and airborne isolation precautions. This study indicated a need for greater awareness regarding aerosols and about the spread of droplet infections and isolation precaution.

KEYWORDS: Droplet and airborne isolation, airborne infection, medical students, knowledge and perception.

INTRODUCTION

Airborne transmission refers to infectious agents that are spread via droplet nuclei (residue from evaporated droplets) containing infective microorganisms.[1] Diseases that are commonly spread by coughing or sneezing include bacterial meningitis, chickenpox, common cold, influenza, mumps, strep throat, tuberculosis, measles, rubella, whooping cough, SARS and leprosy. Airborne droplet nuclei develop when the fluid of pathogenic droplets (1-5 µm in size; micrometer = one-thousandth of a millimeter) evaporates.[3-4] Droplet transmission occurs when respiratory droplets generated via coughing, sneezing or talking contact susceptible mucosal surfaces, such as the eyes, nose or mouth.

Transmission may also occur indirectly via contact with contaminated fomites with hands and then mucosal surfaces.[5-6] Some ways to prevent airborne diseases include washing hands, using appropriate hand disinfection, getting regular immunizations against diseases believed to be locally present, wearing a respirator and limiting time spent in the presence of any patient likely to be a source of infection.[7-8] Gloves are used to prevent contamination of healthcare personnel hands when anticipating direct contact with blood or body fluids, mucous membranes, non-intact skin and other potentially infectious material; having direct contact with patients who are colonized or infected with pathogens transmitted by the contact route e.g., VRE, MRSA, RSV.[9]

The infection control measures among the health care professionals and an educational program on isolation precautions can further enhance the level of knowledge and practices reducing the infection transmission risks. This is imperative for practicing professionals to adapt proper infection control measures to protect both themselves and their patients.[10] Modern changes in undergraduate curriculum and medical training requires students direct patient contact from an early stage of their training the need for a more structured model for the teaching and assessment of infection control. The purpose of this study is to obtain comprehensive information about the knowledge, attitude, and practices in regard to airborne infection related precautions among the undergraduate students.

METHODOLOGY

This is a cross sectional study, conducted at Oman Medical College in relation to the knowledge, attitude, and practices regarding airborne infection related precautions among undergraduate medical students. A favorable ethical opinion was obtained from institutional ethics board. Students in 4th, 5th, 6th and 7th year were invited to participate using simple random sampling technique. Data was collected using a self-filled questionnaire. Survey instrument made after literature search and reviewed and agreed after several brain storming sessions will be used. Validation of questionnaire on small group (pilot) was performed. Two trained research assistants assisted principal investigator in data collection. After research assistant's communication with all participants explaining the importance and objective of the study and after taking informed consent, participants were requested to respond anonymously to written questions.

Survey questionnaire comprised of four components. The first part of the questionnaire was about the Knowledge of droplet air borne infection; Second part of the questionnaire was about infections spread through inhalation of contaminated air. Third part was about hand washing and airborne germ transmission and the fourth part was comprised of set of questions regarding role of personal protective equipment's in airborne germ transmission. The format of all the responses was yes, no and don't know.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 for percentage, frequency and mean. Data was expressed in frequencies and percentages for questionnaire responses. Mann-Whitney test was used to compare differences between groups.

RESULTS

A total of 175 participants were enrolled in which 10 (5.7) were male and 165 (94.3) were female. Majority of the participants, 172 (98.3%) were aged between 20-25 years of age, 2 (1.1%) were aged less than 20 years and 1 (0.6%) was age above 25 years. Among all 102 (58.3%) were clinical students and 71 (41.7%) were non-clinical students.

Participants were asked multiple questions about their knowledge of droplet air borne infection, their responses were in yes, no and don't know. Majority of participants (92.6%) believed that airborne germs are transmitted as very small particles by air currents and more than two third (74.9%) of the participants think airborne infections spread by droplet nuclei (Table 1). More than half of the participants, identified that airborne infections spread by sharing of personal items and droplets are generated when an infected person talks. No significant statistical difference was observed between male (mean rank score 107.65) and female (mean rank score 86.81) response of participants involving perception regarding droplet air borne infection (p-0.204). Similarly, there was no significant difference (p-0.136) in the responses of clinical (mean rank score 83.2) and non-clinical participants (mean rank score 94.7).

Table 1. Knowledge of Droplet Air Borne Infection-n (%).

	Yes	No	Don't Know
Airborne germs are transmitted as very small particles by air currents	162 (92.6)	7 (4)	6 (3.4)
Airborne infections spread by Droplet nuclei	131 (74.9)	17 (9.7)	27 (15.4)
Airborne infections spread by Contact with mucous membrane and mucosal secretions of infected person	116 (66.3)	42 (24)	17 (9.7)
Airborne infections do not spread by Sharing of personal items	50 (28.6)	105 (60)	20 (11.4)
Droplets are generated when an infected person coughs and sneezes.	166 (94.9)	3 (1.7)	6 (3.4)
Droplets are not generated when an infected person talks	48 (27.4)	105 (60)	22 (12.6)

Droplets infectious agent are infectious particles of size less than 10um	61 (34.9)	22 (12.6)	91 (52.6)
Droplet nuclei are infectious particles of size less than 5um	52 (29.7)	23 (13.1)	100 (57.1)
Endotracheal intubation spreads air borne infection	76 (43.4)	57 (32.6)	42 (24)
Suctioning and Cardiopulmonary resuscitation spreads air borne infection	65 (37.1)	53 (30.3)	57 (32.6)

Study participants were asked about four different infectious diseases spread through inhalation of contaminated air. One quarter of the cohort think typhoid fever spread through inhalation of contaminated air and 83.5% gave positive responses about tuberculosis spread through air. Similarly, less than half (46.9%) of participants believed measles and 33.7% thijnk chickenpox infection spread through inhalation of contaminated air (Figure 1). No significant statistical difference was observed between male (mean rank score 79.4) and female (mean rank score 88.52) response of participants involving perception regarding droplet air borne infection (p-0.573). Similarly, there was no significant difference (p-0.87) observed in the responses of clinical (mean rank score 87.5) and non-clinical participants (mean rank score 88.7).

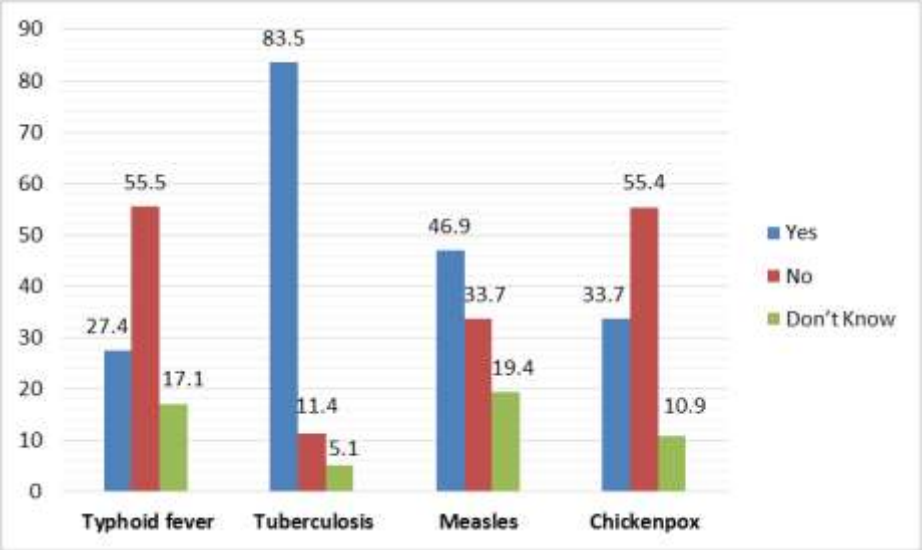

Figure 1: Infections Spread through Inhalation of Contaminated Air.

Nearly two third of the participants think that patients with airborne infections should be isolated in special room and 90.3% believe that patients with airborne infections should wear mask during transport. In the questionnaire, participants were asked set of questions regarding prevention of airborne germ transmission. More than half of the participants think that airborne germ transmission can be prevented by environmental disinfection (63.4%) and by avoiding personal items sharing (65.1%). Nearly two third of study participant think that adherence to cough etiquette (74.9%) and standard precautions include hand hygiene (81.1%) can prevent airborne germ transmission (Table 2). This study results revealed that no significant statistical difference was observed between male (mean rank score 83.10) and female (mean rank score 88.30) responses of participants involving prevention of airborne germ transmission (p-0.751). On the contrary, there was significant difference in the responses of clinical (mean rank score 79.15) and non-clinical (mean rank score 100.36) participant's responses (p-0.006).

Table 2: Prevention of Airborne Germ Transmission.

	Yes	**No**	**Don't Know**
Environmental disinfection	111 (63.4)	28 (16)	36 (20.6)
Avoid sharing personal items	114 (65.1)	48 (27.4)	13 (7.4)
Adherence to cough etiquette	131 (74.9)	14 (8)	30 (17.1)
Standard precautions include hand hygiene	142 (81.1)	20 (11.4)	13 (7.4)
Standard precautions include use of personal protective equipment	133 (76)	12 (6.9)	30 (17.1)
The minimum distance with others to prevent transmission of airborne particles is 6 feet	56 (32)	34 (19.4)	85 (48.6)
The minimum distance with others to prevent transmission of airborne particles is 3 feet	38 (21.7)	43 (24.6)	94 (53.7)

Table 3 shows the answers of participants regarding hand washing and airborne germ transmission. Majority of study participants indicated that hand washing minimizes microorganisms acquired on the hands if soiled (85.7%) and standard hand washing includes washing of both hands and wrists (89.1%). More than two third (75.4%) participants disagreed to use of gloves replaces the need for hand washing and agreed that hand washing is indicated after removal of gloves (84.6%) and hand washing is needed with patients with respiratory infection (89.7). Study results revealed that no significant statistical difference was observed between male (mean rank score 84.2) and female (mean rank score 88.23) responses of participants involving prevention of airborne germ transmission (p-0.801). On the contrary, there was significant difference in the responses of clinical (mean rank score 79.4) and non-clinical (mean rank score 99.9) participant's responses (p-0.006).

Table 3: Hand Washing and Airborne Germ Transmission.

	Yes	No	Don't Know
Hand washing minimizes microorganisms acquired on the hands if soiled	150 (85.7)	11 (6.3)	14 (8)
Standard hand washing includes washing of both hands and wrists	156 (89.1)	13 (7.4)	6 (3.4)
Alcohol hand rub substitutes hand washing even if the hands are soiled	64 (36.6)	81 (46.3)	30 (17.1)
Use of gloves replaces the need for hand washing	25 (14.3)	132 (75.4)	18 (10.3)
Hand washing is indicated after removal of gloves	148 (84.6)	14 (8)	13 (7.4)
Hand washing is needed with patients with respiratory infection	157 (89.7)	9 (5.1)	9 (5.1)

Participants were asked about airborne germ transmission and personal protective equipment. More than two third of the participants disclosed that gown, mask, and head caps provides protective barriers against infection (88%) and PPE should be used when there is an anticipated contact with blood and body fluids of a suspected or confirmed source of infection (78.3%). 79.4% of the participants disagreed to the statement, gloves and masks can be re-used after proper cleaning (table 4). Study results revealed that no significant statistical difference was observed between male (mean rank score 115.8) and female (mean rank score 86.32) responses of participants involving prevention of airborne germ transmission (p-0.07). Similarly, there was no significant difference in the responses of clinical (mean rank score 86.6) and non-clinical (mean rank score 89.87) participant's responses (p-0.676).

Table 4: Airborne Germ Transmission and Personal Protective Equipment.

	Yes	No	Don't Know
Gown, masks and head caps provides protective barriers against infection	154 (88)	11 (6.3)	10 (5.7)
PPE should be used when there is an anticipated contact with blood and body fluids of a suspected or confirmed source of infection	137 (78.3)	13 (7.4)	25 (14.3)
Use of PPE eliminates risk of acquiring occupational infections	120 (68.6)	32 (18.3)	23 (13.1)
Gloves and masks can be re-used after proper cleaning	26 (14.9)	139 (79.4)	10 (5.7)
Used PPE are to be discarded through regular municipal disposal systems	94 (53.7)	41 (23.4)	40 (22.9)
Gloves should be changed between different procedures on the same patient	112 (64)	45 (25.7)	18 (10.3)
Used needles should be recapped after use to prevent injuries	103 (58.9)	55 (31.4)	17 (9.7)

Study participants were asked if the questionnaire help them in improving their knowledge about air borne infections. 109 (62.3%) agreed, 33 (18.9%) were disagreed and 33 (18.9%) didn't answer.

DISCUSSION

Droplet transmission occurs when respiratory droplets generated via coughing, sneezing or talking contact susceptible mucosal surfaces, such as the eyes, nose or mouth. Transmission may also occur indirectly via contact with contaminated fomites with hands and then mucosal surfaces. Some ways to prevent airborne diseases include washing hands, using appropriate hand disinfection.[11]

The general knowledge level regarding infection is adequate in medical students in this study(Table I). Majority of participants believed that airborne germs are transmitted as very small particles by air currents and more than two third of the participants think airborne infections spread by droplet nuclei (Fig I). Literature reports same findings regarding infection control knowledge. Although the students had good knowledge and attitudes regarding infection control, the compliance

and practice levels regarding the same were low. Such findings highlight the necessity of continued infection-control education of Saudi dental students.[12-13]

In this study the participants did not have adequate knowledge regarding specific infection spread. One quarter think typhoid fever spread through inhalation of contaminated air but majority gave positive responses about tuberculosis spread through air. Similarly, less than half of participants believed measles and chickenpox infection spread through inhalation of contaminated air(Fig I). One study reports in adequate knowledge levels regarding infection practices were not adequate among the participants, particularly regarding hand hygiene methods. These findings suggest the need to consider strengthening training regarding infection prevention practices to reduce the morbidity.[14-15]

More than half of the participants in our study think that airborne germ transmission can be prevented by environmental disinfection and by avoiding personal items sharing. Nearly two third of study participant think that adherence to cough etiquette and standard precautions include hand hygiene can prevent airborne germ transmission (Table 2). The knowledge levels regarding infection practices were not adequate among the participants, particularly regarding hand hygiene methods. Failure to comply with hand hygiene is considered the leading cause of health care-associated infections, contributes to the spread of multi-resistant organisms, and is recognized as a significant contributor to outbreaks of infection.[16]

All health care workers should routinely use appropriate barrier precautions to prevent skin and mucous membrane exposure during contact with any patient's blood or body fluids that require universal precautions (Table 3). Gloves should be worn for touching blood and body fluids requiring universal precautions, mucous membranes, or non-intact skin of all patients, and for handling items or surfaces soiled with blood or body fluids to which universal precautions apply Gloves should be changed after contact with each patient with appropriate hand washing.[17]

More than two third of the participants in this study disclosed that gown, mask, and head caps provides protective barriers against infection should be used when there is an anticipated contact with blood and body fluids of a suspected or confirmed source of infection, there was significant difference in the responses of clinical (mean rank score 79.4) and non-clinical (mean rank score 99.9) participant's responses (p-0.006) (Table 4). Literature reports that medical students can make a unique and important contribution to hospital infection control.[18]

One study suggests that knowledge of transmission routes and a positive attitude toward infection control measures to induce acceptable compliance is mandatory.[19] Literature reports that hand hygiene, sharp management, and personal protective equipment reflecting insufficient and ineffective instructions received by medical students through the current curriculum posing them vulnerable to health facilities related infections. Proper curricular reform and training are required to protect students and their patients.[20]

For adherence to hand hygiene practice a hospital-wide multifaceted program aiming at clinicians and students education, adoption of alcohol based hand rubs as a primary formulation, and encouraging role modeling of junior practitioners by senior practitioners can help improve compliance to hand hygiene.[21-22]

Study participants acknowledged that the questionnaire helped them in improving their knowledge about air borne infections. Although student's general knowledge was adequate but specific knowledge needs more training during undergraduate program.

CONCLUSION

Medical students have acceptable level of general knowledge towards droplet and airborne isolation precautions. This study indicated a need for greater awareness regarding aerosols and about the spread of droplet infections and isolation precaution. Medical students can make a valuable and important contribution to hospital infection control if they are trained appropriately. Medical students have direct patient contact from an early stage of their training, the need for a more structured model for the teaching and assessment of infection control. The infection control measures among the health care professionals and an educational program on isolation precautions can further enhance the level of knowledge and practices reducing the infection transmission risks.

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