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Knowledge, attitude, and practice about air-borne infection control guidelines: A cross-sectional study among residents doctors of tertiary care hospital in central India

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ABSTRACT

Background: Adherence to National Airborne Infection Control Guidelines (NAIC) by health-care facilities is an effective way of reducing the spread of air-borne infections such as H1N1, drug-resistant tuberculosis, and COVID-19 disease. **Aims and Objectives:** This study aims to assess the gaps in knowledge, attitude, implementation, and satisfaction regarding resources availability of NAIC among postgraduate resident doctors. **Materials and Methods:** Across-sectional study was conducted from December 2019 to February 2021 at a medical college in central India. Total 301 interns, postgraduates, and senior residents in surgery and medicine allied clinical departments were included by convenient sampling method. A pre-designed, self-administered questionnaire was used to assess knowledge, attitude, and practice (KAP) and their satisfaction with available resources regarding NAIC. The data collected were tabulated and were analyzed using descriptive test and comparison of means by Analysis of variance test. **Results:** Almost 95%, 77%, and 74% of study participants were having adequate KAP on NAIC, respectively. Sixty-one percent participants were satisfied with the resources availability in their work area. Statistically significant association was observed between participants age, designation with their KAP score ($P<0.05$) and between gender and essential resources provided in the hospital. There was an existence of difference between study participants mean KAP score and essential resources score with statistically significance ($P<0.05$). **Conclusion:** The overall KAP was adequate, but there was a gap that exists between knowledge, practice, and satisfaction for availability of essential resources. The study findings were useful for healthcare workers in designing interventions to improve the adherence toward the NAIC guidelines and also to benchmark evaluation of interventions.

Key words: KAP; Healthcare workers; National air-borne infection control guidelines; Resources

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INTRODUCTION

Infections acquired in health-care settings or Health Care-Associated Infections (HCAIs) are the most frequent adverse event in health-care delivery worldwide, among which airborne infections play a major role in transmitting the disease among Health Care Professionals(HCP).[1] As per the World Health Organization (WHO) "Airborne transmission of infectious agents refers to the transmission of disease caused by the dissemination of droplet nuclei that remain infectious when suspended in air over long distance and time."[1]

Acute respiratory infections are airborne infections which are the common disease patients admitted in hospitals in need of healthcare. Health-care settings are more

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vulnerable places for the spread of airborne infections. The aerosolized particles generated from the patients, contaminated articles which contain droplets(around 100 mm size) are dispersed through air current and infect the susceptible host.[2] Most of the infected particles remain suspended in the air and spreads the disease from patient to patient when the distance between the susceptible person and source comes together. Similarly, when the distance between source and susceptible person increases, the rate of transmission will get reduced, which prevents the spread of the disease.[3,4]

Airborne infection also increases when there is inadequate or poor ventilation in the hospital. In such places, the air particles remain suspended for a longer time which is in favor of further transmission of infection to the susceptible persons or newly admitted patients in the hospital.[3,4] The control and prevention of airborne infection transmission are not simple in healthcare settings; it requires the control of ventilation with the use of specified systems, use of personalized protective equipment, and basic infection control measures.[5]

In recent years, COVID-19 was also added to the list which is spread mainly through airborne routes. Mode of transmission of COVID-19 is mainly through close contact with infected people or through aerosolized spread of respiratory droplets. Transmission of COVID-19 is higher when the susceptible persons have close contact (within a meter) with an infected person who has symptoms of COVID-19.[6]

Apart from patients, waste generated during patient management, several surgical, and medical procedures also generates aerosolized infectious particles. Most of the airborne particles are produced during the examination of the respiratory tract, these include intubation, endotracheal suctioning, bronchoscopy, resuscitation, sputum induction, lung surgery, BIPAP, CPAP, and nebulizer therapy.[7] Proper care and preventive measures must be taken into account while performing the procedures and handling the patient to avoid air-borne infection.

To reduce the risk of airborne infection in health-care settings, the WHO, Centre for Disease Control and Prevention, and International Union of Tuberculosis and Lung Disease have released guidelines regarding the control of airborne infection in both developed and developing nations.[3,5] India has developed its own guidelines also for airborne infection control. These guidelines mainly focuses on preventing the spread of Tuberculosis including the drug resistant TB, but is equally useful for other airborne infections like H1N1 infections.[8] As the healthcare workers(HCWs) often serve as vectors for HCAIs, their role requires serious consideration in the implementation of infection control strategies to prevent HCAIs.[9] Despite the wide promotion of standard precautions and issue of many guidelines at the health-care settings worldwide the level of knowledge, attitude, and practice (KAP) of infection control among HCP remains substantially low.[10-14] Various studies also have reported poor implementation of infection control guidelines mainly due to structural, administrative, and behavioral factors.[15-19] Hence,this study was done to assess the knowledge, attitude, and implementation of National Airborne Infection Control guidelines 2010(India) among the post-graduate residents of various departments and also to assess the gaps in the implementation of the National airborne infection control guidelines in a tertiary care hospital in Jabalpur.

Aims and objectives

The aim of this study was to assess the knowledge, attitude, and implementation of national airborne infection control guidelines 2010(India) among the resident doctors. Finding the gaps in implementation of the National airborne infection control guidelines in a tertiary care hospital located in Jabalpur, India was the objective of the study.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at a medical college in Jabalpur between December 2019 and May 2021. Ethical approval for this study was obtained from ethical committee of Netaji Subhash Chandra Bose Medical College, Jabalpur in a meeting held on 17 December 2019. Ethical approval number for this study is IEC/2021/629. The sample size for this study was determined to be 210 with a confidence interval of 95% and an error of 5% calculated using Cochran's formula. Sample size $n = Z^2pq/d^2$, where Z is 1.96 at 95%, "p" is proportion, "q" is 1-p, and d is the error at 5%.

The sampling technique utilized was simple random sampling. After obtaining institutional ethical committee clearance, this study was conducted among 301 participants including Compulsory rotatory residential Internship (CRRI), postgraduate residents and senior resident doctors working at various clinical departments. Postgraduates and senior residents of non-clinical departments having no or minimal interaction with the patients were excluded due to the low risk of airborne infections.

A pre-designed and pre-tested questionnaire was framed with help of an expert group in the field of infection control in the hospital, based on the National Airborne Infection Control 2010 guidelines.[8] The reliability assessment of the questionnaire was done and has a

Cronbach's alpha value of 0.668. This Self-administrable questionnaire was used to collect information from the participants after obtaining their informed consent. This questionnaire consists of 40 items and 4 sections. Each section was established for KAP and satisfaction level on National Airborne Infection Control respectively. Correct answer assigned for 1 mark. Scoring of the KAP questions was categorized into adequate (if score was more than 5) and inadequate (if score was ≤5). Satisfaction level scores were categorized as satisfied (>5) and not satisfied (≤5).

Data were entered in spreadsheet and analysis was done using SPSS version 20.0 (Armonk, NY: IBM Corp). Categorical variables were expressed in frequency and percentage, while the continuous variables were expressed in Mean and Standard deviation. Difference between the mean KAP and resources scores in different groups was analyzed using Analysis of variance test. P≤0.05 was considered to be statistically significant.

RESULTS

A total of 301 study participants were included in the study.

The maximum number of study participants were between the age group of 26 and 30 years and the mean age of the study participants was 26.5±2.29 years. Around 59% of the participants were from the surgery allied department and 65% of them are having experience of 1 year of post MBBS (Table 1).

About 96% of study participants have undergone atleast a single workshop or training session on air-borne infection control guidelines in the past.

Table 1: Frequency distribution of study participants baseline characteristics (n=301)

Demographic variables	Frequency (%)
Age (in years)	
≤25	104 (34.6)
26–30	177 (58.8)
>30	20 (6.6)
Gender	
Male/Female	177 (59)/124 (41)
Department	
Medicine allied/Surgery allied	123 (40.9)/178 (59.1)
Designation	
CRRI	79 (26.2)
1st year post graduate	99 (32.9)
2nd year post graduate	87 (28.9)
3rd year post graduate	20 (6.6)
Senior resident	16 (5.4)
Year of Experience after MBBS	
More than 1 year	67 (22.2)
One year	195 (64.8)
No experience	39 (13)

More than 90% of the study participants were having adequate knowledge on air-borne infection control, features of N-95 mask and knowledge on adequate air exchange and minimum of air-change per hour at OPD's as per 2010 airborne infection control guidelines; as their total score on the knowledge domain of questionnaire was 5 or more than 5. Almost 96% of participants were aware that seating arrangements at outpatient departments were also important to maintain the safe environment as shown in Table 2.

More than 80% of the study participants had a good attitude on educating patients on cough etiquette, screening of patients to identify the respiratory ailments and their role in implementing air-borne infection control in hospital setting depicted in Table 3.

About three fourth of the study participants were adequately practicing the guidelines and nearly 80% of the participants were practicing hand wash technique before and after examination regularly. Nearly 78% of participants were discarding the biomedical waste in correct color-coded bins and regularly use personal protective kits in both OT and minor OT. Other measures of practice are shown in Table 4.

Table 2: Frequency distribution of study participants Knowledge on National airborne disease control guidelines

Questions	Knowledge level n (%)= Correct responses out of 301
In N 95 respirator – what does n stand for?	290 (96)
Minimum size of particles that n95 should block?	284 (94)
Minimum gap between two patient beds as per NAICG?	265 (88)
As per airborne infection control guidelines which is first line defense in reducing risk of transmission ofrespiratory pathogens?	269 (89)
As per 2010 airborne infection control guidelines, which is preferred mode for ensuring adequate air exchange?	274 (91)
As per 2010 airborne infection control guidelines, what is minimum air change per hour at outpatient department?	265 (88)
What is the correct setting arrangement for patient andhealth care worker?	289 (96)
Ultraviolet Germicidal Irradiation is maximal germicidal at a wave length?	279 (93)
Infectious solid waste should be sterilized at what temperature?	265 (88)

n: denotes the number of participants out of 301 who answered the particular question correctly

Table 3: Frequency distribution of study participant's attitude on National airborne infection control guideline

Questions	Attitude level n(%)=Correct responses out of 301
Attitude on educating patients with symptoms of cough, about cough etiquette	250 (83)
Attitude on educating patients about proper disposal of sputum as per guidelines	264 (88)
Whether screening of patients to identify persons with respiratory ailments followed?	236 (78)
Is segregation of respiratory symptomatic done or not at your OPD?	234 (77)
Whether fast tracking of respiratory suspect and cases to the front of line to expedite their receipt of services in facility done?	243 (80)
Whether patients with TB suspect have been kept in airborne precautionroom?	229 (76)
Do you believe as PG resident you can play major role in airborne infection control?	260 (86)
Do you regularly consider screen patients with 2 weeks cough for suspect TB?	195 (65)
Have you counselled the patient about mode of spread of respiratory infection particularly tuberculosis?	278 (92)
Have you spread information about airborne infection control among family members and friends of patients?	184 (61)

n: denotes the number of participants out of 301 who answered the particular question correctly

Table 4: Frequency distribution of study participant's practice of National air-borne infection control guideline

Questions	Practice Level n (%)=Correct responses out of 301
Practice on hand hygiene before and after examination	230 (76)
Practice on steps of hand wash technique regularly	250 (83)
Practice on proper disposal of biomedical & general waste in correct colour coded dustbin in hospital	234 (78)
Do you use n95 respirators in high risk setting like MDR TB ward and bronchoscopy/endoscopy/isolation wards?	240 (80)
Do you visit OT or minor OT with proper personal protective equipment as per guidelines?	220 (73)
Whether regular monitoring of proper natural ventilation in wards is done as per recommendation of guidelines?	186 (62)
Are there adequate display sign boards, requesting patient and family members with acute febrile illness to maintain respiratory hygiene?	174 (58)
Is there adequate cleaning and disinfection of patient bed at periodic intervals?	260 (86)
Are you actively involved in implementing cough hygiene practice among patients?	180 (60)
Proper disposal of respiratory secretions in ICU settings done or not?	258 (86)

n: denotes the number of participants out of 301 who answered the particular question correctly

About 61% of the study participants were satisfied with needed resources being provided in their hospital, almost 94% of participants agreed that they are getting infection control supplies such as disposal surgical masks, gloves, and gowns from hospital and 88% were using 70% of alcohol-based hand wash as shown in Table 5.

Almost half of the participants feel that there is adequate airborne infection control training program in hospital. The overall KAP on air-borne infection control guidelines among study participants were above 75% as can be implied from Figure 1.

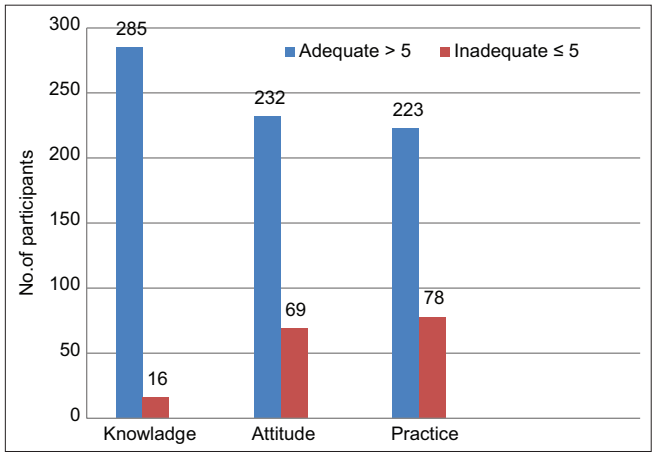

Figure 1: Frequency distribution overall KAP score of study participants on National airborne infection control guideline (Bar) (n=301)

There was an association between study participants age and designation with their KAP score (P<0.05). Post MBBS year of experience was associated and statistically significant with knowledge and resource score with P<0.05 and association found between department with attitude, practice, and resource score with statistically significant (P<0.05). There was a statistically significant difference found between knowledge and resource score with designation (P<0.05) and post MBBS year of experience with knowledge and significant difference found between attitude and resource score (P<0.05). There was a statistically significant (P<0.05) difference between

resource score with knowledge and practice as shown in Table 6.

Table 5: Frequency distribution of study participant's satisfaction level on provided resources in working hospital

Questions	Correct responses, n(%)=Correct responses out of 301)
Whether ventilation in all area especially OPD waiting area meet airborne infection control guidelines?	260 (86)
Whether infection control supplies like masks, gloves and gowns are provided to you at wards?	284 (94)
Is there adequate facility for disposal of surgical masks?	286 (95)
Have wards been provided with soap/70% alcohol-based hand wash?	264 (88)
Is there adequate isolation room for patient with suspected and confirmed highly infectious disease?	259 (86)
Is there ultraviolet germicidal irradiation available in high-risk areas inyour place of work?	242 (80)
Is there n95 respirators provided in high-risk areas?	199 (66)
Whether adequate mask provided to patient suffering from respiratory infection?	291 (97)
Is there adequate airborne infection control training programme in hospital?	175 (58)
Passive surveillance of TB/other nosocomial infection is done among health care workers by authorities?	290 (96)

n: denotes the number of participants out of 301 who answered the particular question correctly

DISCUSSION

The present study was a hospital-based study conducted to assess the gaps in available resources, knowledge, attitude, and implementation of national air-borne infection control guidelines by postgraduate residents of various departments in a medical college conducted over a period of around 1 year and 8 months. This study showed overall good adherence to infection control guideline. There was acceptable compliance and attitude toward NAIC.

Air-borne infections are common in health-care settings. There is a need to follow the proper protocol to control the rate of transmission of the airborne infections. Ministry of health and family welfare, Government of India recommends that all the health-care settings should adhere to the NAIC. All the HCP in health-care settings should be trained to get adequate knowledge on airborne infection control guidelines. The present study assessed the knowledge on personal protective measures, environmental measures including air exchange rate, arrangements of seating, display of sign boards, and education to the patients. Overall, it was observed that around 95% of the study participants have adequate knowledge on NAIC, whereas 5% had inadequate knowledge.

Similar studies conducted by various investigators[20-25] reported that the HCPs had adequate knowledge on infection control guidelines, whereas study conducted by Geberemariyam BS et al.[26] in Ethiopia and Raj A et al.[27] in Kerala,India showed that only <40% of the HCP had adequate knowledge. These variations may be due

Table 6: Difference between study participants mean KAP score on National airborne infection control guidelines with Designation (Academic year), Department and Year of experience post MBBS

Variables (Designation)	Knowledge score (n=301) (Mean±SD)	P-value	Attitude score (n=301) (Mean±SD)	P-value	Practice score (n=301) (Mean±SD)	P-value	Resource score(n=301) (Mean±SD)	P-value
CRRI	4.43±1.31		6.81±1.64		5.81±2.10	0.49	5.06±1.61	
1st year post graduate	4.78±1.22	<0.001*	6.21±1.43	0.477	5.87±1.61		5.35±1.56	0.008*
2nd year post graduate	4.89±1.42		6.08±1.67		6.35±1.50		4.81±1.34	
3rd year post graduate	4.8±1.39		6.55±1.73		5.95±2.18		5.40±1.69	
Senior resident	7.87±1.07		7.81±0.96		7.86±0.99		6.48±1.92	
More than 1 year experience	6.10±1.91	<0.001*	6.82±1.67	0.67	6.86±1.64	0.12	5.74±1.86	0.16
One year year experience	4.64±1.24		6.69±1.0		6.10±1.91		4.94±1.53	
Less than 1 year Experience	4.74±1.31		6.10±1.22		5.85±1.67		5.02±1.20	
Medicine allied speiciality	5.71±1.93	0.66	6.91±1.69	0.014*	6.55±1.89	0.79	5.25±1.96	0.02*
Surgery allied speciality	5.53±1.76		6.46±1.49		6.52±1.59		5.64±1.53	

*P<0.05 statistically significant, determined by using Analysis of variance test

to geographical variations and periodic training sessions conducted in the health-care settings.

The attitudes of the study participants were assessed based on screening and segregation of respiratory suspects, personal protective measures and their responsibility in airborne infection control. The present study reported that more than three-fourth of the study participants were having positive attitude towards guidelines. Similar findings were reported in the studies conducted in Ethiopia, Vietnam, and at India [20,23-24,27-28] This shows that the HCP have positive attitude towards airborne infection control in their workplace, irrespective of the geographical difference.

HCWs and also patients have a greater risk of airborne infections. Since, it is difficult to eliminate the reservoirs and susceptible hosts in the health-care settings; implementation of measures to eliminate the mode of transmission plays a pivotal role. In the present study, almost three-fourth of study participants (74%) have reported that their departments had adequately implemented the guidelines. Similar to this study findings, few studies conducted in India, Vietnam, and Ethiopia also showed good practice on implementing the airborne infection control guidelines in their workplace settings.[20,24,27-28] This shows the HCP wish to strictly adhere to the protocol to prevent the airborne transmission of disease in the hospital.

Hospital-associated infection magnitude may be quite high in developing countries. The meticulous infection control measures may not be always feasible due to limited resources in the health sectors in these countries. Availability of resources plays a key role in implementation of air-borne infection control in any health-care settings. In the present study, satisfaction level of study participants on resources was measured by infrastructure provided for effective control of airborne diseases. Overall around 60% of the study participants had reported satisfaction on essential resources provided in their working area. This finding is similar to findings of studies conducted by Jain M et al.[20], Honarbakhsh M et al.[21], and Desta M et al.[24] This implies that the availability and satisfaction level on resources provided among HCP were satisfactory, irrespective of the geographical area.

There are varieties of factors that may contribute for increase in KAP of airborne infection control guidelines among HCP. In the present study, it was found that statistically significant association between the increase in overall KAP on air-borne infection control guidelines with age, designation, and post MBBS years of experience. The present study shows that younger age group (<25 years of age) have high KAP on airborne infection control guidelines. However, this variation may be due to reduced sample size in participants aged more than 30 years of age. The present study also found that increase in year of experience, designation with increase in KAP score. Similar observations were reported in Vietnam, Ethiopia, and Kerala.[24,27-28] This shows that healthcare professional with increasing years of experience and senior designation have great knowledge on airborne control measures, this may be due to periodic training given to them.

The mean KAP score on NAIC with designation and year of experience shows significant difference. The mean score (SD) on knowledge was high for senior residents doctors compared to CRRIs and postgraduate resident doctor, whereas no significant differences found in terms of designation with attitude and practice. Regarding years of experience, participants with more experience had good knowledge with significant differences with others whereas attitude and practice does not have any significant differences. Similar to this study finding, the study conducted by Jain M et al.[20] had reported that 77.9% of their subjects had adequate knowledge and found significant difference of knowledge in subjects with years of experience. That suggests that higher the work experience more the knowledge, and better practice of Airborne Infection Control guidelines. Similarly, Geberemariyam BS et al.[26] reported that increase in years of experience of >10 years had 3.41 (CI: 1.32–9.55) times odd of increase knowledge and practice compared to the participants with less experience. Assefa J et al.[23] had reported significant association (Adjusted Odds Ratio 1.52 [CI: 1.13–4.5)] with increase in years of experience and KAP on infection control implementation in the health sector.

Satisfaction on essential resources in health-care settings has great impact on KAP on airborne infection control. The present study shows significant difference in knowledge, practice on air-borne infection control with higher satisfaction level on availability of essential resources, whereas attitude does not have any significant difference on availability of essential resources satisfaction level, that is, the study participants were having good attitude toward air-borne infection control in order to prevent the spread of disease in the hospital irrespective of the essential resources availability.

Limitations of the study

This study has a limitation that it is a single centered study. Different clinical settings may have difference in KAP parameters as per geographical location and the type of clinical settings. If study finding are collaborated with multiple centers, it may yield a better picture of the airborne infection control measures implementation. Since the study is an subjective assessment, so it is not possible

to determine the respondents actual practices on air-borne infection control measures.

CONCLUSION

There was good adherence toward practice and compliance of attitude to infection control precautions. The participants with inadequate knowledge and practice reported low satisfaction level with essential resources availability in hospital. Hence, it shows that there was a gap that exists between knowledge, practice, and satisfaction for availability of essential resources. The need of periodic training to the health-care professionals to utilize the essential resources effectively can be suggested here to fill these gaps. This evaluation could provide information regarding the level at which changes in frequency of training sessions is required in the health-care professionals.

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HK- Data collection, Interpreted the results; reviewed the literature and manuscript preparation; **JKB-** Concept and design of the study, coordination; **AJ** - reviewed the literature and First draft of manuscript preparation; **VP**- Coordination, statistical analysis and interpretation, reviewed the literature; **BP**- Concept, Data interpretation, manuscript preparation and revision.

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