ORIGINAL ARTICLE

Airborne Infection Control measures among Government and Private Health Facilities in a hilly district of North India

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ABSTRACT
Introduction: Guidelines for Airborne Infection Control in Health Care Settings were published in the 2010 to reduce Airborne Infections in health service providers and visitors to health facilities. **Objectives:** To evaluate healthcare facilities regarding implementation of Guidelines for Airborne Infection Control in Health Care Settings. **Methods:** An analytic, cross- sectional, health care facility-based study in the district Solan of Himachal Pradesh. A total 53 health care facilities from both public and private sectors were assessed and compared. **Results:** The implementation of these guidelines was unsatisfactory. Government health care facilities were better implementing the guidelines, compared to the private sector. **Conclusion:** The guidelines are over a decade old and implementation is not optimal. Efforts and emphasis are required to be put into implementation of these guidelines in health care facilities. An update of policy with stringent penalties are advocated for better compliance in the private sector.

KEYWORDS
Airborne, Infection, Aic, Control, Guideline

INTRODUCTION

Airborne infections refer to a range of illnesses that result from the transmission of microorganisms through the air. These diseases can be caused by various pathogens, such as bacteria, viruses, and fungi, and they have significant clinical implications.(1) Aerobiology encompasses the examination of mechanisms involved in the dispersion of microorganisms through the atmosphere, facilitating their movement between different geographic regions and the transmission of diseases through the aerosolized route.(2) The recent COVID-19 pandemic has brought focus back again on transmission and control of infections that are transmitted through air, particularly in enclosed settings of a hospital.

A bioaerosol refers to a suspension of biological substances in the air. These bioaerosols can consist of bacterial cells, fragments of cells, spores and hyphae of fungi, viruses, as well as by-products produced through microbial metabolism. Bioaerosols can be generated by various natural processes,

such as respiration, communication through speech, forceful exhalation during sneezing, vocalization like singing, and notably, forceful expulsion during coughing.(3)Most respiratory droplets have a diameter smaller than 100 µm, and these droplets quickly evaporate in the nearby surroundings, transforming into tiny particles called droplet nuclei. These droplet nuclei can remain suspended in the air or be carried away by airflow.(4-7)

Health care workers are at the risk of acquiring more than 15 types of air borne infections.(8) The SARS COV-2 spreads through droplet nuclei that can remain suspended in air for than three hours and upto four metres.(9)The transmission of tuberculosis within healthcare facilities poses a significant public health concern. Individuals working in hospitals, in-patients, or people visiting out-patient departments face the potential risk of infection.(10-11)In order to mitigate the risk of tuberculosis (TB) cross-infection among immune-suppressed Human Immunodeficiency Virus (HIV) patients, the Government of India formulated "Guidelines for Airborne Infection Control in Health Care Settings" in 2010. These guidelines were subsequently incorporated into HIV-TB collaborative initiatives and intended for implementation across all healthcare settings. The guidelines encompassed targeted policies tailored to the prevention and control of tuberculosis within healthcare settings. Although these guidelines were intended to prevent spread of Tuberculosis in HIV positive patients, they can play a crucial role in preventing the transmission of other airborne infections. However, over the past one decade, there has been a lack of comprehensive evaluation regarding the implementation of these guidelines and their impact on reducing nosocomial airborne infections.

Aims and Objectives: To evaluate healthcare facilities regarding implementation of airborne infection control (AIC) practices and adherence to the guidelines set forth in the Guidelines for Airborne Infection Control in Health Care Settings 2010.

MATERIAL & METHODS

This study was conducted in the health care facilities in District Solan in Himachal Pradesh both from public sector and private sector.

Study Type, Design, Settings and Duration: It is an analytic, cross- sectional, health care facility-based study which was carried out for duration of 12 months from Jun 2021 to May 2022.

Inclusion Criteria: We tried to cover all the health facilities in this hilly district Prior permission for assessment of health facilities was obtained from Directorate of Health Safety & Regulation (DHSR) Himachal Pradesh. A list of registered health facilities was obtained from the Office of Chief Medical Officer of District Solan. In this study primary health centres, community health centres, civil hospitals (run by state), district hospital, private hospitals & nursing homes (providing inpatient services),were included in the study.

Exclusion Criteria: Establishments providing only out-patient services, diagnostic services like laboratories and radiology centres were excluded.

Data Collection: All health facilities were approached (total 56 in the district with in-patients wards/rooms) and then a written consent was obtained from Officers-in-Charge for collecting the required information. Data was collected using proposed airborne infection risk assessment tool which was based on NAIC guidelines. The content validation of this tool was done by experts in the field of Tuberculosis and Epidemiology. Interviews with in-charge/authorized person of facilities were undertaken about implementation of NAIC guidelines after obtaining providing participant information sheet and obtaining informed consent. There were three main domains in the tool as per NAIC guidelines viz. administrative control, environmental control and personal protection measures for air borne infection control.

Working Definition: Health facilities were defined as per the definition given in the Clinical Establishment Act i.e. “a hospital, maternity home, nursing home, dispensary, clinic, sanatorium or an institution by whatever name called that offers services, facilities requiring diagnosis, treatment or care for

illness, injury, deformity, abnormality or pregnancy in any recognized system of medicine established and administered or maintained by any person or body of persons, whether incorporated or not." Government health facilities were those run and administered by State or Union Government and Private health facilities were those run by individuals, trusts or non-governmental organizations.

Data analysis: The statistical analysis was carried out using SPSS 25.0. For qualitative variables, fraction of total and percentages were calculated. Chi-square test was used to compare two qualitative groups. A p value of <0.05 was considered as significant.

Ethical Consideration: Ethical clearance was obtained prior to commencement of data collection from the Institutional Ethical Committee at MMMCH, Solan. All care was taken to avoid interference with patient care activities in the facilities.

RESULTS

Total 53 health facilities were covered under the study of which 31(58.5%) were government and 22 (41.5%) in private sector. Table 1 shows the distribution of government and private health facilities. Among the private health facilities internal medicine,s urgery, maternity homes and nursing homes (single specialty) were predominant. Hospital staff and number of outpatients departments were more in government facilities as compare to private health facilities. In the government facilities, there were 24 DOT centres (providing directly observed treatment to tuberculosis patients) as compared to only one DOT centre in private sector. Tuberculosis smear microscopy diagnostic facility was not available in private facilities and tuberculosis patients were not being managed in indoor wards of any of the private health facilities. No separate Chest/Tuberculosis Ward in either government or private facilities was reported.

Table1: Distribution of health facilities among government and private sectors

Variable	Sub-domain	Number	Percentage
Government	Civil hospital	05	9.4
	Community health centre (CHC)	07	13.2
	ESI	02	3.8
	Primary health centre (PHC)	16	30.2
	District hospital (RH)	1	1.9
Private		22	41.5
Total		53	100

As seen in Table 2, the majority (>70%) of health facility managers were aware about the NAIC guidelines, yet the actual practice of control measures was lacking in both government and private sectors. Infection control committees were in place in most of the government facilities and there was a significant difference in conduct of infection control committee meetings among the government and private facilities. Likewise, a plan for infection control was available in half of the government facilities, compared to just one private health facility having an infection control plan. Both government and private facilities performed poorly, in terms of, risk assessment for airborne infections, routine surveillance for nosocomial infections and presence of policy for screening or restricting visitors. Only six government facilities had done a reassessment of their infection control policies and procedures.

Table 2: Administrative Airborne Infection Control measure in govt and private hospitals.

Indicator	Govt. (n=31)		Private (n=22)		p -value
	N	%	N	%	
Facilities with IC committees in place	26	83.87	15	68.18	0.179
IC committee meetings held in the last 3 months	23	74.19	0	0	0.000
Health facility IC plan available in written form	16	51.61	1	4.55	.000*
Facility risk assessment for airborne infections conducted	9	29.03	5	22.73	0.608
Routine surveillance for nosocomial infections performed	3	9.68	2	9.09	0.943
Periodic IC training for the hospital staffs	16	51.61	12	54.55	.833
Periodic assessment on infection prevention practices	14	45.16	1	4.55	0.001*

Indicator	Govt. (n=31)		Private (n=22)		p -value
	N	%	N	%	
Hospital familiar with the Ministry of Health and Family Welfare AIC guidelines	24	77.42	16	72.73	0.696
Policy for screening and restricting family/visitors with illnesses	7	22.58	0	0	.017*
Reassessment of infection prevention policies and procedures (annual)	6	19.35	0	0	.028*

In the out-patient departments (OPDs) IEC material on cough hygiene was present in more than half of the facilities, and around 70% facilities provided face masks to respiratory symptomatic patients, probably post COVID-19 pandemic. (Table 3) In the OPDs, adequate cross-ventilation was present in half of the government facilities and one-fourth of the private facilities. The government facilities though performing poorly, were significantly better than private facilities in terms of, display of IEC materials, segregation of patients with respiratory symptoms and separate waiting areas for patients with respiratory symptoms. Air-borne infection control measures were absent in out-patient departments of almost all of the private facilities.

Table 3: Airborne infection control measures at outpatient department in govt and private health facilities

Indicator	Govt. (n=31)		Private (n=22)		p -value
	N	%	N	%	
Counselling on cough etiquette/hygiene practices in registration/waiting areas	19	61.29	12	54.55	0.623
IEC material on cough hygiene displayed/handed over to patients	9	29.03	1	4.55	0.025*
Provided masks to respiratory symptomatic at the reception area	22	70.97	15	68.18	0.828
Separate well-ventilated waiting area for respiratory symptomatic	9	29.03	1	4.55	.025*
Fast tracking of respiratory symptomatic	8	25.81	1	4.55	.042*
Segregation of respiratory symptomatic	9	29.03	0	0	.006*
Adequate cross ventilation available	16	51.61	5	22.73	.034*

In the domain of personal protection, practice of hand hygiene and sputum disposal was excellent (95%) in both the government and private health facilities, subsequent to the awareness brought about by the pandemic. However, usage of N95 respirator masks, proper disposal facilities for used masks and pre-employment medical examinations for respiratory conditions weregrossly inadequate both in private and government facilities. (Table 4) Availability and use of personal protective equipment was 100% in government facilities and significantly better than private facilities. Practices for air-borne infection control were also assessed in this study. Displaying signages at entrances, provision of tissues and space in patient waiting areas for infectious persons was inadequate in both Govt and private health facilities. None of the private health facilities had adequate space in patients waiting areas and overcrowding was observed. Significantly higher number of the government facilities were providing facemasks to coughing patients as compared to private facilities. (Table 5)

Table 4: Availability and usage of personal protective equipment (PPE) in govt and private health facilities

Indicator	Govt. (n=31)		Private (n=22)		p - value
	N	%	N	%	
Practice of hand hygiene among health workers	30	96.77	21	95.45	0.804
Availability of PPE's and use among health workers	31	100	17	77.27	0.005*
Provided N95 respirators at high-risk settings	29	93.55	14	63.64	0.006*
Usage of N95 respirators at high-risk settings	12	38.71	5	22.73	0.219

Indicator	Govt. (n=31)		Private (n=22)		p - value
	N	%	N	%	
Sputum disposal as per the BMW management plan	30	96.77	21	95.45	0.804
Proper disposal facilities for used surgical masks	15	48.39	13	59.09	0.442
Pre-employment medical examination among staffs for respiratory conditions	9	29.03	2	9.09	0.078

Table 5: Airborne Infection Control Practices

Indicator	Govt. (n=31)		Private(n=22)		p - value
	N	%	N	%	
Posting signs at entrances	11	35.48	3	13.64	0.075
Providing tissues and no-touch receptacles for disposal of tissues	5	16.13	4	18.18	0.845
Providing hand hygiene supplies in or near waiting areas	19	61.29	15	68.18	0.606
Offering facemasks to coughing patients and other symptomatic individuals upon entry to the facility	19	61.29	4	18.18	0.002*
Providing space in patient waiting areas (e.g., ED waiting room) and encouraging individuals with symptoms of respiratory infections to sit as far away from others as possible	8	25.81	0	0	0.010*

The last domain assessed was related to Infection control training. A training plan for infection control and bio-medical waste management was present in most of the facilities. However, in the past one year, only 40% of the government facilities and just one private facility had provided training in infection control practices to their staff. Availability of standardized training material on infection control for hospital staff was not available in half of the government and three-fourths of the government facilities (Table 6). Overall, the training activities were better in government facilities.

Table 6: Infection control training plan and activities in govt and private health facilities

Indicator	Govt. (n=31)		Private (n=22)		p-value
	N	%	N	%	
Staff training plan for Infection Control /or bio-medical waste in place	26	83.87	20	90.91	0.456
Availability of standardized training material on IC for staff available	18	58.06	6	27.27	0.026*
"Standard Precautions" is part of the training material	13	41.94	4	18.18	0.012*
IC Training of staff conducted in the past 12 months	13	41.94	1	4.55	0.002*
IC trainings conducted routinely	10	32.26	1	4.55	
IC training conducted as part of: Induction training / Special training	7	22.58	1	4.55	0.071

DISCUSSION

Over a decade has passed since the formulation and implementation of national air borne infection control guidelines. In our literature review, we could only find a handful of articles related to this topic and a couple of studies to assess the implementation status of the guidelines. The study was conceptualized during the peak of COVID-19 pandemic and our results show some improvement in the level of awareness about measures to prevent air-borne infections. We covered ~95% of the health facilities in the district. Our results point that more efforts are required to prevent the spread of air-borne infections at health care facilities. We made a comparison between the government and private health care facilities about the implementation of national air-borne infection control guidelines. The quality of air borne infection control in government health facilities was found to be better than private health care facilities in the district.

In the year 2013, Shrivastava SR et al(12), first published an article to create awareness about prevention of air-borne infections and its public health importance. However, it was not

until the year 2019 that an assessment report was published. Raj A et al1(3) conducted an assessment about the practices and adherence to the National Air Borne Infection Control Guidelines in 50 health facilities randomly selected from five districts in Kerala. Their results are similar to our results and they conclude that there is scope of improvement regarding implementation of air borne infection control guidelines. A mixed methods study was conducted by Kaushal P et al(14)among 13 health care facilities in Himachal Pradesh. They reported that the deficiencies in the implementation of airborne infection control measures were attributed to both the inadequate functioning of the healthcare system and individual factors. Talukdar R et al(15) have recently studied the implementation of these guidelines among primary and secondary level government facilities in Puducherry. Their results also show the deficiency in establishment of Infection Control Committees and barely minimal presence ofwritten air borne infection control plan.

There are three main domains for control of air borne infections. In administrative control for air borne infections we need to form infection control committees and create awareness and take consequent steps to tackle anti-microbial resistance. Practically they are not optimally performing especially in non-accredited hospitals. Success in implementing infection prevention practices hinges on the continual training, monitoring, and improvement of existing resources.(16)Routine surveillance and periodic assessment for infection control the most neglected domains as per the results of our study. We need to ensure identification and segregation of patients with cough and other respiratory symptoms in outpatient departments and waiting areas to prevent cross infection.

The practice of hand-washing by health care workers was reported to be followed by most of them. Infrastructural needs like provision of hand wash facilities, signage at common areas and lack of space in patient waiting areas are also highlighted by the results of study and requires due emphasis. Lastly, the importance of trainings, demonstrations and their lack thereof cannot be ignored. These dimensions of the programme are getting neglected. Based on our study findings the recommendation to the planners is to provide the adequate budget for training and IEC activities for implementation of guidelines.

One likely source of bias is the Hawthorne Effect, in which responders could have changed their behavior/ answers during the time of interview. This is one possible limitation. The results may not be generalizable to the country because of different topography of the state and the level of health care services. COVID-19 pandemic is another variable which has positively effected our results (the availability of PPEs and N-95 masks, hand-washing practices).

These guidelines have been published over a decade ago and since, there have been many changes in the country viz. improved technology, availability of resources and advancement in knowledge about air borne infection transmission owing to the pandemic. Also, as our study highlights, there is no regulation over the private health facilities in implementation of infection control measures. Though, infection control is an important constituent of checklists in all the accreditation agencies, most of the hospitals, in the country are still not accredited. Therefore, policy makers can think about including infection control practices to be checked during initial licensing and renewals.

CONCLUSION

Our study highlights that the implementation of Guidelines for Airborne Infection Control in Health Care Settings has not been satisfactory. The situation is worse in private health facilities and more regulations in this regard are warranted. The study highlights the need for further evaluation and research guided revision of guidelines, which can be implemented across the country, thus preventing air borne infections, in patients and health care providers. The country is working towards elimination of tuberculosis and proper implementation of air-borne infection control measures is indispensable to achieve this target.

RECOMMENDATION

As per the study interpretation we need to have the proper robust policy for air borne infection control for health institutions and health service providers. Necessary regulatory measures especially in the private sector are required since the situation there needs to be strengthened. In medical education at Under Graduate and Post Graduate levels we need to emphasize these aspects.

LIMITATION OF THE STUDY

Due to Post COVID 19 pandemic the results were positively affected since health institutions and health service providers were regularly and more vigorously monitored. Thus results cannot be generalised.

RELEVANCE OF THE STUDY

In the light of NTEP, Covid-19 pandemic and rising trends of Anti Microbial Resistance, findings of the study become more relevant to policy makers, health managers, hospital administrators.

AUTHORS CONTRIBUTION

All authors have contributed equally.

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Nil.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DECLARATION OF GENERATIVE AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors haven't used any generative AI/ AI assisted technologies in the writing process.

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