Original Research Article

Are healthcare workers safe? Facility assessment of airborne infection control measures in public hospitals of Kerala

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ABSTRACT

Background: Nosocomial transmission of airborne infection is a major peril to health care providing community and has been linked to poor adherence to airborne infection control practices. The present study was conducted to assess the gaps in health care facilities and practices for prevention and control of transmission of air borne infections among healthcare workers in government district level hospitals of Kerala.

Methods: A cross sectional survey including observation was done in 24 facilities. The tool for the survey and the check list for observation were developed based on national airborne infection control guidelines and assessment tool for prevention and control of infection by centre for disease control. The data were analysed using IBM SPSS version 23.

Results: The functioning of airborne infection control system was found to be suboptimal in most of the institutions. Implementation of environmental control measures was poor when compared to administrative control and personal protection measures. Adequate ventilation was not present in more than half of the institutions (60%). All institutions had infection control committees in place but were not functioning well. Personal protective equipment's were not available at point of use in more than half of the institutions (62.5%). Out of the 16 self-reported hospital acquired respiratory infections among the staff, pulmonary tuberculosis was predominant.

Conclusions: Several barriers were identified at different levels for prevention and control of airborne infections among healthcare workers. The findings reinforce the need to implement strict guidelines to prevent occupation induced airborne infections among health workers in public health system.

Keywords: Nosocomial, Occupation induced, Secondary care hospitals, Tuberculosis

INTRODUCTION

Globally airborne infections remain an occupational risk for healthcare workers.[1-5] Reports of infectious outbreaks such as influenza, H1N1, drug-susceptible and multidrug-resistant tuberculosis among healthcare workers are alarming. Most of them can be attributed to poor adherence to infection control practices.[6,7] However in developing countries like India, there is no data to project the magnitude of this important public health problem. During May 2018, State of Kerala witnessed an outbreak of Nipahvirus (NiV) infection in Kozhikode district which resulted in death of 17 persons out of the 19 infected. Two healthcare personals who were directly involved in care of NiV patients got infected; one survived and the other succumbed to death.[8,9] This scenario has triggered the necessity of a proactive health care system, not only for the beneficiaries but also for the healthcare providing community.

Even though there are guidelines available at national and state level to curb airborne infections in hospitals, there is

no mechanism at present to ensure its adherence. The efforts made by the public health wing of Kerala health services in containing the infection during Nipah outbreak were exemplary. However it exposes the existing gaps in the infection control measures followed by the health facilities in public sector.

METHODS

The sample frame for the study had 35 secondary care hospitals including 18 General Hospitals (GH) and 17 District Hospitals (DH). General hospitals and district hospitals are the secondary care centres coming under the public health system in Kerala. One each of DH and GH from 14 districts were selected for the survey. The districts in which there were more than one GH and DH, the selection was done by lottery method. Thus a total of 28 facilities were included in the study out of which only 24 facilities were surveyed for lack of consent.

Secondary hospitals including GH/DH under government of Kerala were included in the study, private hospitals and Taluk hospitals which is of secondary type were excluded from the study.

A questionnaire was developed based on "National Airborne Infection Control Guidelines" and "Infection prevention and control assessment tool" for hospitals prepared by Centre for Disease Control and Prevention (CDC).[10-12] Content validity of the tool was checked by seven subject experts and was piloted before data collection.

Nurses with research experience working under National Health Mission in different secondary hospitals were selected for data collection. They were given unified and standard training before data collection. As part of training they were briefed on study protocol, air borne infection control guidelines, and application of survey tool and checklist.

A cross sectional survey including facility level survey and direct observations were conducted in the selected institutions. Either Medical superintendents or Nursing superintendents were interviewed to gather information. Data collectors visited the outpatient and inpatient facilities of Emergency, General Medicine, Pediatrics, and pulmonology departments, laboratories and intensive care units (ICU) to observe the facilities and record the details based on a checklist. Minutes of the meetings and documents on infection control available at the hospitals were verified to corroborate the details on trainings and infection control meetings and activities. The questionnaire included facility level characteristics, average patient load, managerial and administrative control measures like education and training of staff, spacing between beds, functional status of infection control committees, infection control plans, availability of resources, environmental control measures like modes of ventilation, availability of personal protection equipment's, provision of preventive health check-up for staff and frequency of cleaning of hospital equipments.

The study was submitted to Ethics committee for expedited review and got approval on 12th June 2018. Adequate permissions were obtained from the Director of Health Services, superintendents of selected facilities and consent was received from study subjects

The quantitative data were numerically coded and entered in Microsoft Excel 2007 and statistical analysis was performed using IBM SPSS version 23. Frequencies, percentages and mean with standard deviations were used to summarize the characteristics of designated hospitals and infection control implementation measures.

RESULTS

Among selected 24 public healthcare facilities, eight (33.8%) facilities were selected from northern Kerala, nine (37.5%) from Central Kerala and seven (29.2%) from southern Kerala. The characteristics of the health facilities were studied (Table 1).

More than half of the selected facilities (60%) had bed strength ranging from 200 to 500 with an average of 296.79±151.65. The average daily outpatient (OP) load of selected institutions was 1504±769.73 with minimum 574 OPS and the inpatient (IP) load was 109.42±112.2 ranges with minimum 14 IP admissions.

Three institutions were NABH/NABL accredited which is a marker of quality. One institution had received Kayakalpam award which is an honour given to public health facilities for high levels of cleanliness, hygiene and infection control measures.

Airborne infection control measures were assessed under three domains namely administrative control, environmental control and personal protection measures. For administrative control measures, all institutions had infection control committees in place. Even though the committee is supposed to conduct monthly meetings for review of infection control measures, only 13 institutions (54%) were found to conduct regular monthly meetings. A staff nurse specifically trained for infection control held the overall responsibility of infection control in all the hospitals. However in most of the institutions they were unable to execute their responsibility because of their routine work load. Less than half of the institutions (45.8%) had no infection control policy, but had an infection control plan (42.7%). None of the institutions had any system to educate the patients and caregivers on infection control except the intermittent lecture classes / display of charts conducted by nursing students as part of their curriculum.

No regular training was conducted for healthcare workers on infection control in any of the hospitals. Around 42% of doctors, 37% of staff nurses, 21% of Nursing

Assistants and hospital Attendants, 12% of Pharmacists and Lab Technicians received some training on infection control in last two years. Only negligible proportion (6%) of office attendants and part time sweepers received any such training.

Table 1: Details of diagnostic facilities present in the selected health facilities.

	N (%)
Diagnostic facilities available	
Radiology department	24 (100)
Integrated counselling and testing centre (ICTC)	22 (91.7)
Designated microscopy centre	19 (79.2)
Sputum collection area	15 (62.5)
PFT room	9 (37.5)
Bronchoscope suites	8 (33)
Special facilities available	
ART centre	9 (37.5)
Culture and DST laboratory	5 (20.8)
TB ward	5 (20.8)
Air borne precaution room	3 (12.5)
MDR TB Ward	2 (8.3)

Table 2: Details of environmental control measures.

Variables	Number of institutions with adequate measures in OP		Number of institutions with adequate measures in IP	
	Yes N (%)	No N (%)	Yes N (%)	No N (%)
Natural ventilation	11 (45.8)	13 (54.2)	14 (10)	58.3 (41.7)
Cross ventilation	10 (41.7)	14 (58.3)	8 (16)	33.3 (66.7)
Mixed mode ventilation	9 (37.5)	15 (62.5)	10 (14)	41.7 (58.3)
Openings constitute 20% of floor area	10 (41.7)	14 (58.3)	17 (7)	(70.8) (29.2)

More than half of the institutions reported shortage of cleaning staff (55%) and lack of funds (62.5%) for purchase of cleaning equipments and lotions. The average amount spent by the hospitals was around Rs 40,848 per month which was insufficient to meet their needs.

Regarding environment control measures, it was observed that more than 50% of the institution's outpatient department (OPD) lack natural ventilation. Cross and mixed mode ventilation was also not sufficient in most of the outpatient and inpatient departments (Table 2). Patients were not aligned in the direction of airflow in most (66.7%) of the OPDs and IPDs, which may increase the probability for cross infections. The available window and door openings for cross ventilation were often found

blocked by keeping tables and cupboards in those spaces. Sputum collection areas were often located indoors in a congested area without proper ventilation. Majority of the institutions (75%) did not have any facility for isolation of patients with airborne infections such as MDR TB and H1N1. Standardised bed to bed space was not maintained in majority of the IPDs (80%). It was observed that two to three patients shared a single bed. Laboratories were not adequately ventilated nor provided with exhaust fans.

The frequency of and method of cleaning of hospital equipments and furniture was assessed (Table 3). Damp dusting is the preferred method of cleaning surfaces as this won't generate dust movement. However it was found that only seven institutions (29%) followed damp dusting. Four institutions (16.7%) are still following dry dusting method which is not at all recommended at this point of time.

More than half of the institutions (60%) had adequate supply of hand hygiene materials such as alcohol based hand rubs and paper towels, personal protective equipments such as gloves, boots, masks, gowns, goggles and other protective equipments based on their needs. N95 masks were not available for health workers at point of use in 13 institutions. However, those institutions which stocked N 95 masks started doing it only after the Nipah outbreak. Few institutions (30%) have started providing protective equipments like mask/gloves to patients with respiratory symptoms and their care givers; a welcome change noticed after the Nipah outbreak. Majority of the institutions (N 20; 83%) did not conduct any pre-employment medical examination. Vaccines against diseases such as Hepatitis B and Tetanus were provided free of cost only for permanent staff completely ignoring the contract staff in 15 institutions (62.5%).

Table 3: Frequency of cleaning of medical equipment.

Equipments	After every use N (%)	Daily N (%)	Alternate days N (%)
Nebulisation mask and tubings	24 (100)	-	-
Oxygen delivery devices	18 (75)	2 (8.3)	4 (16.7)
Humidifiers	6 (25)	13 (54.2)	2 (8.3)
Ventilator tubings	14 (58.3)	1 (4.2)	9 (37.5)
NIV Mask	13 (54.2)	-	8 (33.3)
Bag valve mask unit	18 (75)	-	1 (4.2)
Assistive devices	7 (29.2)	7 (29.2)	1 (4.2)
Furniture	6 (25)	5 (20.8)	2 (8.3)

Most of the health facilities (N 19; 79%) did not have a system for alerting the employees about the probability of cross infections.
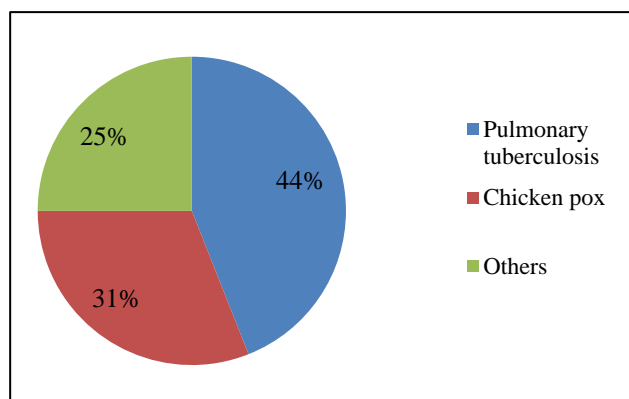

Figure 1: Types of respiratory events reported among health care workers.

Figure 2: Overcrowded OP.

Figure 3: Crowded IP wards.

About 16 cases of respiratory infections were reported among health workers in last one year out of which 7 were pulmonary tuberculosis (TB) reported by staff nurses (Figure 1).

DISCUSSION

Containment of Nipah outbreak was a great accomplishment for the health department of Kerala state. The state initiated intensive measures with the help of central government and international organizations to control the outbreak. Adoption of universal precaution, early suspicion, detection, isolation, treatment, and surveillance of confirmed cases with involvement of community, LSG and other departments enabled the state to declare free of NiV infection. Despite the success in controlling Nipah outbreak, air borne infections remain a major occupational peril for healthcare workers in Kerala. Inadequate infection control strategies in the institutions are one of the reasons to be blamed.[5,14] Adherence to infection control guidelines is crucial for both patients' and worker's safety.[15] The institutions need to scale up with emphasis on integration of airborne infection control practices into existing health system activities.

The current study used facility level survey and observations to understand the measures adopted by healthcare institutions to control nosocomial transmission of airborne infections. The study identified several lacunas in the implementation of airborne infection control measures at district level secondary care hospitals in the public sector of Kerala. The secondary care hospitals at district level belong to the second tier of three tier health system in the State. The services available in the public secondary hospitals are free of cost. Persons belonging to low socioeconomic status, who cannot bear the high cost of treatment available in the private hospitals, are greatly dependent on the government hospitals.[16] This study identified that majority of such institutions were overloaded with patients with more than 700 OPDs daily.

In general, the airborne infection controls in the hospitals are implemented through a three pronged approach namely administrative, environmental, and personal protection measures.[9,10] Administrative control measures mainly aims to reduce potential opportunities of exposure of susceptible individuals to infectious patients. The present study identified several gaps in the implementation of administrative control measures. Even though the hospitals had infection control plan and policies, most of them were not complete and up to date. It appears that the administrators do not consider this as a priority among their innumerable day to day activities.

The importance of infection control in the hospitals as part of overall quality improvement has to be highlighted through regular training of all category staff including housekeeping staff, administrators and security. Adherence to NAIC guidelines by the healthcare workers

can be ensured by routine monitoring and supervision. The infection control committee need to take some precautions and alert the staff to take safety measures if a patient with any of the infectious disease gets admitted in the hospital. This is possible only when there is a policy decision in this regard and a system in place. None of the hospitals had such a mechanism unless in the case of an outbreak or epidemic. As per the information shared by the Superintendents in the selected institutions, some of the employees were infected with airborne infections out of which pulmonary tuberculosis was frequent. Similar to some of the earlier studies, more cases of TB was reported among nurses who work in close contact with the patients.[29,30] There were no records in the hospital to substantiate the findings. Unless there is a routine surveillance and documentation system to report such events, nosocomial infections among healthcare workers will pose a great threat to the public healthcare system.[18]

Environmental control measures intend to minimize concentration of infectious particles present in the healthcare settings.[17] The most efficient and low cost method among the environmental control measures is to provide ventilation through open windows and doors. It was found that many institutions did not realise the importance of this simple method by the way the ventilation was enabled in different facilities. Similar to findings in other studies, the naturally available ventilation in some of the facilities was disrupted by faulty arrangement of furniture and rearrangement of the rooms by construction of cubicles and closure of doors and windows.[18,19] According to Indian Public Health Standards (IPHS) guidelines to prevent cross infection in an inpatient ward, minimum distance between beds should be at least 3.6 m.[21] Similar to findings in some of the earlier studies, the bed to bed space was not maintained in most of the institutions.[22] As per Kerala accreditation standards for Hospitals (KASH) and IPHS guidelines, isolation facilities should be available in all centres and number of beds in the isolation facility is suggested based on the bed strength of the hospital.[23,24] However isolation ward/facility was not available in most of the institutions. In most of the institutions, labs were functioning in make shift arrangements by constructing a cubicle in a hall or corridor without adequate natural or mechanical ventilation. The directive that sputum has to be collected outdoors or at least there should be an open window to prevent transmission of infection to others was ignored in most instances. The authorities have to be oriented on the importance of the environmental measures for airborne infection control through routine trainings. Inspection of environmental control measures in the hospital should be done routinely. Consultation with environmental engineers will be helpful during new construction as well as modification of old buildings. In short, physical design of a hospital is crucial to develop and implement infection control strategy.[20]

In general there was lack from the side of the administrators in providing vaccination to the staff for prevention of Hepatitis B and Tetanus infections. This is crucial for the safety of both patients and healthcare workers.[31] Support services for prevention of occupational hazards should be equitable, employee friendly and abide to NAIC guidelines. Use of personal protective measures including N95 masks by the healthcare workers was found to be better than that reported in previous studies.[18-22,26] The experience from Nipah has definitely contributed to the change in the attitude of the administrators in procuring and providing personal protective equipments to patients and healthcare workers.

To summarise, most of the institutions did not successfully implement administrative, environmental and personal protection measures to prevent the transmission of airborne infections.[22-25] Hospitals should be made compliant to national airborne infection control guidelines (NAIC) which is as an essential entity to prevent nosocomial transmission of airborne infections. Establishment of functional infection control committees, periodic infection control training for all hospital staffs and routine unbiased assessment of airborne infection prevention practises need to be done. Most of the barriers identified can be overcome by integrating airborne infection control principles into existing infection control training modules and provide routine training for all categories of staff and students. Low cost interventions in consultation with environmental engineers need to be developed to ensure compliance to airborne infection control. Providing counselling on cough etiquette/hygiene practices in waiting areas, displaying Information Education Communication (IEC) materials on cough hygiene, providing masks to respiratory symptomatic patients and their care givers at the reception area, fast-tracking facilities, and usage of N95 masks at high risk settings need to be ensured in all hospitals. These measures shall be included in the emergency preparedness plan for the hospital.

Statistical analysis of predictors linked with practice of infection control measures were not performed because of small sample size. Self-reported information on nosocomial infections by the healthcare workers could not be counter checked as there was no system to capture such events.

CONCLUSION

The study identified several lacunas in adherence to NAIC guidelines by the public district hospitals in the State. Airborne infection control strategies including establishment of low cost customized environmental measures, regular monitoring mechanism of infection control and implementation of managerial / administrative policy and procedures need to be strengthened to prevent airborne infection transmission. This should be one of the focal points of Kerala health system to ensure the security of the healthcare workers from hospital acquired airborne infections.

ACKNOWLEDGEMENTS

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