ORIGINAL RESEARCH PAPER
Volume - 10 | Issue - 12 | December - 2021 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

EXPOSURE INCIDENTS OF COVID -19 AND CLUSTER INFECTIONS IN A TERTIARY HOSPITAL DURING THE PANDEMIC

Community Medicine

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ABSTRACT

The COVID 19 pandemic has drastically affected India with ensuing mortality and morbidity . Transmission of infection in health care settings is a major area of concern as the possibility of cluster infections in non covid areas is high if infection prevention and control(IPC) activities are not adequate. An analysis of exposure incidents and risk of transmission in cluster infections is essential for containment of transmission in hospital settings .

Methods : Exposures to incident cases among HCW in non covid areas of the hospital from April 2020 to September 2020 were analysed. The primary contacts were traced, risk stratification and testing of both symptomatic and asymptomatic HCW done to investigate transmission. Cluster infections were investigated and risk of transmission among clusters identified .

Results : 332 incident cases and 22 clusters were reported from Non Covid areas of the institution during this time period . The attack rate for Covid infection among HCW primary contacts in non covid areas was 1.2%whereas it was 12.6% in clusters. Performing aerosol generating procedures (34.4%), taking duty together with colleagues (17.1%) and social interactions (23.3%) emerged as major exposure factors among those who tested positive in clusters. Use of mask was significantly associated with reduction in risk of Covid infection even in clusters(OR 0.29) .Wearing N95 mask (OR=0.51), Gloves (OR=0.57), face-shield (OR=0.51)and practicing hand hygiene (OR=0.53) after patient interaction emerged as protective factors against COVID infection among HCW.

Conclusion: Clusters in health care settings are high risk environments wherein transmission can occur rapidly even with low risk exposures. Extensive screening and testing of patients, caregivers and HCW is the key to prevent clusters in health care settings . Added to this strict adherence to IPC guidelines by HCW in health care settings will go a long way in preventing transmission.

KEYWORDS

Exposure incidents, hospital Cluster infections , COVID 19)

INTRODUCTION:

The Corona Virus disease, 2019 (COVID 19) which was detected in Wuhan - China initially became a global pandemic and continues to cause considerable morbidity and mortality. India witnessed its second wave of the pandemic in which hospitalizations due to COVID 19 overwhelmed the health infrastructure all over the country. Transmission of infection among hospital staff and inpatients remains a risk as health care facilities act as a major setting for transmission for COVID19.

Even during the early days of the pandemic China had estimated that 44% of its SARS COV -2 infections were hospital acquired (1). The potential for health care transmission of SARS-CoV-2 was demonstrated in a case study from St Augustine's Hospital in, South Africa, where a a single unsuspected case of SARS-CoV-2 led to six major clusters of infections involving 80 health care staff members and 39 patients,15 of whom died (2). To reduce patient load and exposure to COVID 19 in health settings, hospitals all over the world have discouraged elective patient visits (3). This led to hesitancy to seek medical care for non COVID and emergency conditions which may have resulted in increased morbidity and mortality.

Exposure to incident cases of COVID 19 in health care settings if undetected may result in cluster infections as has been seen in the St Augustine Hospital incident(2) and delivering routine health care for non COVID conditions during the pandemic has become a major challenge.Tertiary institutions like ours see a lot of footfalls in terms of out patients and inpatients and congenial conditions for transmission and cluster infections can exist due to multiple introductions of COVID Infection in non COVID areas.

An understanding of exposure incidents to COVID infection in such settings and the related risk factors are critical for mitigating cluster infections and to define policies for appropriate Infection Prevention and Control (IPC).

METHODOLOGY:

Our institution is a tertiary care hospital in the public sector and is one of the designated COVID Hospitals for the district. During the pandemic it caters to both COVID and non COVID cases. Infection prevention and Control practices were strengthened and universal masking was instituted in the hospital from the beginning of the pandemic. The reporting of incident COVID cases in non COVID areas of the hospital was made mandatory and contact tracing and risk stratification of HCW contacts was done as per GoI Guidelines (4).For the purpose of the study incident cases over a period of six months from 1st April 2020 to 30thSeptember 2020 from non covid patient care areas were analysed. HCW contacts with exposure to incident cases were traced and telephonically interviewed for type and duration of contact and personal protection used and categorized as high and low risk contacts. High risk contacts were quarantined and tested for SARS CoV -2 after 7 days of last contact or if symptomatic during the quarantine period. Low risk contacts were asked to self monitor for symptoms and tested if symptomatic or after 7 days of last contact(4).

Cluster containment measures were implemented in the hospital ward reporting a cluster infection. The COVID positive case was shifted to isolation ward. The rest of the patients in the effected ward were placed under observation and tested for SARS CoV 2 after 7 days of last contact or if symptomatic during the observation period. No further patient admissions were allowed to this ward. The health care providers in the ward were to observe strict IPC measures and adequate PPE. The ward was disinfected prior to further intake of patients.

Operational definitions:

Incident case: A positive case of COVID 19 (either HCW or patient or caregiver) from Non COVID patient care area of the institution.

Exposure incident: An exposure incident is a situation when the eye, mouth, mucous membranes, or even non-intact skin comes into contact with blood or other potentially infectious material(5). In the case of Covid due to the highly infectious nature of the disease this may be taken as exposure to Covid positive individual for the purpose of this study. ***Hospital Cluster of COVID 19:*** A hospital cluster was defined as two or more positive cases of COVID 19 in the same Non Covid patient care area during the same time(6)either among HCW, patients or caregivers. All the members in the cluster were subjected to COVID testing for identification of cases.

Statistical Analysis

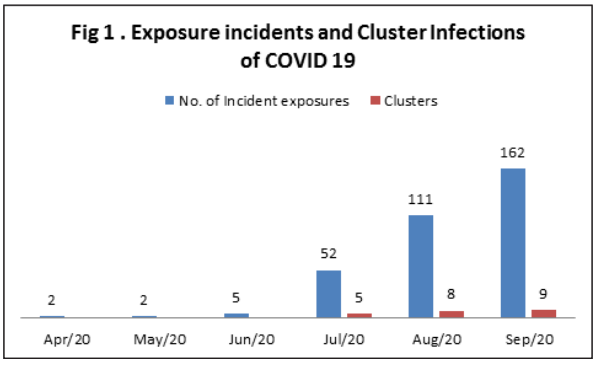
Statistical analysis was performed with PASW version 25.0 (IBM, Armonk, NY, USA) software . Continuous variables were analyzed using mean, median, standard deviation and interquartile range. Qualitative variables were analyzed using proportion and 95% CI. Risk was determined by calculation of Odds ratio. Chi-square test was used to find out the statistical significance. p- value of less than 0.05 is taken as significant.

RESULTS:

Description of Exposure incidents in non Covid patient care areas : During the six month period there were 332 incident cases of COVID 19 from the non COVID patient care areas of the hospital with cases increasing from the month of April to September 2020 peaking during the month of September 2020(Fig 1). There were 3312 exposure incidents (primary contacts) for HCW to these incident cases. Of the 3312 HCW primary contacts 678 had high risk exposures and were quarantined. On follow up and COVID testing with RTPCR, 36 (5.3%) of them tested positive for COVID 19. Of the 2564 with low risk exposures 4 (0.1%) tested positive for COVID 19. The overall attack rate of COVID among HCW primary contacts was 1.2%(Table 1).

Table 1 . Risk of COVID infection among HCW in Non COVID areas and in Clusters

Risk stratification of HCW	Non COVID areas		Clusters		ODDS RATIO (HR Vs LR exposures In clusters)	P - VALUE
	Primary contacts	COVID Positive	Primary contacts	COVID Positive		
High Risk	678	36(5.3%)	105	28 (26.7%)	3.291 (1.952-5.485)	0.000002
Low Risk	2564	4 (0.1%)	564	56 (10%)		
Total	**3312**	**40(1.2%)**	**669**	**84(12.6%)**		



Description of clusters: During the study period, there were 22 clusters of COVID 19 infection from the non COVID areas of the institution, maximum clusters seen during the month of September. Larger clusters occurred during the months of July and August 2020 with September seeing smaller clusters (Fig 2). 804 primary contacts from the 22 clusters were placed under surveillance for COVID19 of which 219 (27.2%) tested positive. Of the 219 who tested positive for COVID 19 in the various clusters 84(38.4%) were HCW, 86 (39.3%) patients and 49 (22.4%) caregivers (Fig 3). Of the 84 HCW, 37(13.6%) were doctors, 23 (11.7%) were nurses and 12.% other nursing staff.

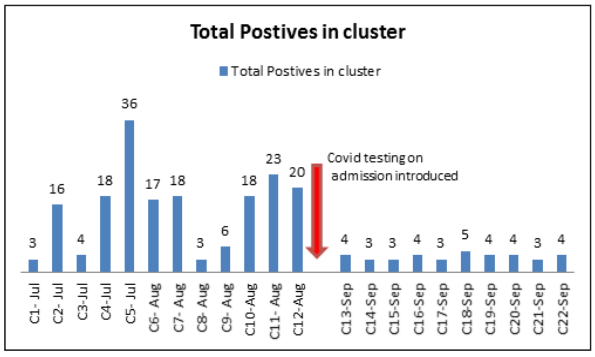
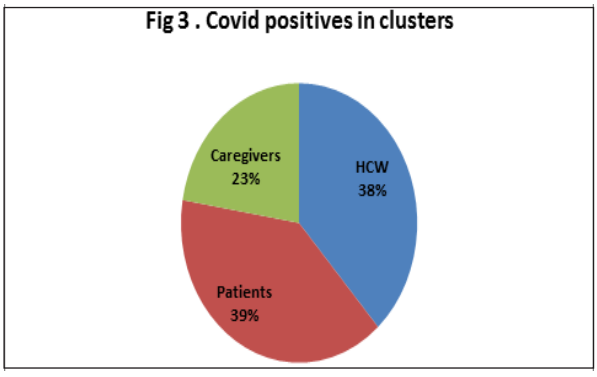


Fig 2.Monthwise COVID Positives in Clusters



Of the 804 primary contacts 669 were HCW, risk stratification of whom yielded 105 high risk exposures of which 26.7% tested positive compared to a smaller number (10%)of low risk exposures also testing positive(OR=3.2 , 95%CI= 1.95-5.48)(Table 1). When compared with the attack rate among HCW primary contacts in Non COVID areas (1.2%) the attack rate in clusters was high (12.6 %) (Table1)

Patient care activities like performing aerosol generating procedures 11(34.4%) emerged as a major exposure factor among HCW who tested positive in the clusters (Table 2) .Social interactions 17 (23.3%) among colleagues during break time and while having food together resulting in breach in personal protection in the high risk environment of clusters is an area of concern. A small percentage of the HCW were infected from community contact (household members, travel in public transport, attending social gatherings etc.).

Table 2: Exposure History of HCWs in the Cluster

EXPOSURE history of HCW	COVID STATUS		TOTAL
	POSITIVE	NEGATIVE	
Aerosol generating procedures	11 (34.4%)	21 (65.6%)	32 (100)
Routine activities	24 (7%)	318 (93%)	342(100)
Social interaction	17 (23.3%)	56 (76.7%)	73 (100)
Duty together	24 (17.1%)	116(82.9%)	140(100)
No direct contact	2 (2.6%)	74 (97.4%)	76 (100)
Community	6 (100%)	0	6 (100)
Total	84 (12.6%)	585(87.4%)	669(100)

Males were at a higher risk of becoming COVID positive in the clusters when compared to females (OR 2.23: 95% CI 1.62-3.07, p<.001).Personal protective measures like use of mask was observed to afford a reduction in risk of COVID infection even in clusters(OR 0.29) .Wearing N95 mask (OR0.51), Gloves (OR0.57), face-shield (OR=0.51)and practicing hand hygiene(OR 0.53) after patient interaction were significant protective factors against COVID infection among HCW($p<0.05$) (Table 3)

Table 3. Role of protective equipment in prevention of COVID 19 infection

PPE USED BY HCW	CATEGORY	COVID STATUS		OR (95% CI)	p-value
		POSITIVE	NEGATIVE		
Mask	Yes	67 (11%)	544 (89%)	0.297 (0.1598-0.552)	0.00005
	No	17 (29.3%)	41 (70.7%)		
Type Of Mask	N-95	43 (9.9%)	393 (90.1%)	0.5124 (0.323-0.8127)	0.00402
	Other masks	41 (17.6%)	192 (82.4%)		
Gloves	Yes	51 (10.6%)	428 (89.4%)	0.5669 (0.3527-0.9111)	0.01799
	No	33 (17.4%)	157 (82.6%)		
Face Shield	Yes	16 (8%)	184 (92%)	0.5128 (0.2895-0.9084)	0.02021
	No	68 (14.5%)	401 (85.5%)		
Hand Hygiene	Yes	41 (9.8%)	376 (90.2%)	0.53 (0.3346-0.8396)	0.006235
	No	43 (17%)	209 (83%)		

DISCUSSION:

Strategies for prevention of transmission of COVID 19 infection in healthcare settings is of paramount importance as these facilities are visited by patients who may have multiple co morbidities. Transmission among health care providers also impacts the quality of services provided due to depletion of the workforce due to COVID isolation and quarantine. With the increase in case load in the community a proportional increase in the incident cases and cluster infections were seen in our study as has been documented by Seidelmanetal (7). The pandemic peaked in Kerala during the months of September and October 2020 (first wave). The average number of cases were 1500 -2000 per day during August 2020 and 3000-6000 per day in September 2020(8). With the introduction of the COVID Rapid antigen screening test for patients and caregivers prior to admission in the institution the cluster size decreased.

Transmission of COVID 19 in health care facilities may occur resulting in cluster infection in non COVID patient care areas if the initial cases are undetected. The high rate of COVID positivity within clusters both for high risk as well as low risk exposures indicate that cluster infections are high risk environments with a high probability of contracting COVID infection both for HCW as well as patients and caregivers. Multiple exposures with COVID positive individuals during routine patient care and social interactions within the cluster increases the chance of transmission within the cluster(9). With opening up of all institutions the importance for containment strategies to prevent cluster infections in health care settings needs to be seriously addressed. Even though vaccination against COVID is effective in preventing severe infection it may not interrupt transmission of infection(10). Given this situation expanded testing of HCW, patients and caregivers is the key as high proportion of asymptomatic, pauci- symptomatic and pre-symptomatic infections may occur. Serial testing of patients and HCW allows prompt detection of cases who can be isolated immediately to prevent transmission.

Performance of aerosol generating procedures by HCW was also a risk factor for COVID in our study .Procedures like suction, intubation etc generate aerosols which remain suspended in the closed indoor environment of hospitals and may result in transmission in these areas resulting in increased transmission within closed spaces resulting in cluster infections .Several studies have demonstrated that transmission of SARS CoV 2 occurs not only by droplet (11,12) but also by airborne route wherein the droplets remain suspended in the environment especially closed spaces and may facilitate transmission even at distances of >2 m. Air conditioned rooms can propogate droplets and increase the transmission in these settings (13)

Males were at a higher risk of becoming COVID positive in the clusters when compared to females This finding is comparable to a study in US ,where COVID-19 infection risk was higher in men than in women (RR 1.11; 95%CI = 1.05 to 1.17) ($P < 0.001$) (14). This could be because social interactions and risk behavior are more among males.

Universal masking by health care providers prevents transmission to a great extent but breach may occur during refreshment breaks as in this study where a significant proportion of the infections among HCW occurred due to breach in routine universal masking.

The role of protective wear especially masks particularly N95 masks in prevention of transmission needs to be stressed not only among health care providers but also among patients and caregivers (15,16). Ensuring distancing during unmasked encounters especially during breaks among health care providers needs to be stressed.

CONCLUSION:

Incident exposures and Cluster infections in hospitals are proportional to the case load in the community but can be prevented. Clusters in health care settings are high risk environments wherein transmission can occur rapidly even with low risk exposures .Widespread transmission can be reduced by testing of patients, caregivers on admission to health facility and regular testing among symptomatic and asymptomatic HCW. Strict adherence to personal protective measures with caution taken to avoid breach, ensuring full PPE during aerosol generating procedures, adequate ventilation of indoor spaces will go a long way in reducing transmission inside health facilities and decrease cluster infections

Conflict of Interest: None

Ethical concerns: Permission has been obtained from the (GMCKKD/RP2020/IEC/455) Institutional Ethics Committee for the conduct of the study. Verbal consent from the subjects was obtained prior to the collection of data.

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