ORIGINAL RESEARCH

Assessment of Transmission Dynamics of COVID-19 Infection *via* Contact tracing in a Dental Center of a Tertiary Care Hospital

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Abstract

Introduction: Contact tracing is an essential public health tool, which includes prompt and rapid identification of potentially infected individuals before the emergence of severe symptoms.

Objective: The objective of this cross-sectional analysis was to highlight a targeted prevention strategy for the spread of disease by monitoring rigorous contact tracing.

Study design: A retrospective cross-sectional analysis.

Study setting: Tertiary care hospital.

Patients/participants: Health care workers of a tertiary care hospital.

Methodology: An analysis of information provided in the contact tracing of 30 diagnosed coronavirus disease 2019 (COVID-19) positive patients was done in the present study. The study duration ranged from April to December 2020 and was conducted among the diagnosed COVID-19-positive patients of the Center for Dental Education and Research (CDER), All India Institute of Medical Sciences (AIIMS), New Delhi. Ethical approval was obtained from the Institutional Ethics Committee (IEC-1079/06.11.2020). The retrospective contact tracing was done for a period of 48 hours prior to the time of diagnosis or the time of first reported symptoms, whichever was earlier, by a trained medical professional.

Results: Fever (76.7%) was the most common symptom found at the time of diagnosis among the cases. It was found that the high-risk contacts (20%) were more susceptible to developing a COVID-19 infection compared to their low-risk counterparts (2%).

Conclusion: Aggressive contact tracing, when done right, is tremendously effective in containing an outbreak. Overstretched contact tracing can clearly diminish the possibility of the creation of a hot spot.

Keywords: Coronavirus disease 2019, Contact tracing, Infection control, Prevention, Tertiary hospital.

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Introduction

The ongoing COVID-19 pandemic has impacted >200 countries, caused about 550,218,992 confirmed cases, and resulted in nearly 6,343,783 deaths, as reported by the World Health Organization.[1] India has witnessed a total of 4,35,85,554 cases with 5,25,343 fatalities from 30th January 2020 to 6th January 2020.[2] The high-level of transmissibility and pathogenicity underpins the extent of seismic changes brought about by the betacoronavirus, globally.[3] The recent reopening of communities and readjustment of public social measures has resulted in enhanced social contacts when compared to the initiation phase of the pandemic in early 2020. Despite stringent preventive strategies and the impending vaccination drive, the vigilance practiced in the past 10 months cannot be halted abruptly. Contrarily, to ensure that the practices executed to curtail the spread of infection are implemented rigorously, the role of contact tracing is even more imperative than before.

Contact tracing is an essential public health tool, which includes prompt and rapid identification of potentially infected individuals before severe symptoms emerge, and it prevents a forward transmission of infection, thereby curtailing the establishment

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of secondary cases.[4–7] A contact is any person who had direct contact or was within 1 m for a minimum of 15 minutes with a person infected with the COVID-19 virus, even if the person with the confirmed infection did not have symptoms. Recently, the Centers for Disease Control and Prevention (CDC) has amended the definition of contact by including the definition of time of exposure "starting from 2 days before illness onset until the time the patient isolated."[8] In fact, systematically executed contact tracing and disciplined quarantine have been known to play important roles in COVID-19 infection spread control.[9] The role of contact tracing in mitigating the deleterious effect of the spread of infection to the vulnerable cohorts, as well as diminishing the more restrictive stay-at-home/lockdown measures, is immense. Aside from this, contact tracing also provides a unique chance to investigate the epidemiological traits of the disease.

Although contact tracing has been an integral part of managing the COVID-19 crisis in India, its dynamics have been underplayed and not well understood in a dental setup. The risk of the spread of disease in a dental setup is excessively high, primarily due to the generation of aerosols.[3,8,10,11] Recent literature discloses that the highest infection potential amongst all health care professionals has been reported for primary dental service providers.[3,12,13] In the wake of the urgency of the pandemic CDC and the Ministry of Health and Family Welfare (India) have laid meticulous, evidence-based patient management practices and protocols for routine dental patients.[8,11] Despite rigorous implementation and execution of these guidelines, professionals working in dental setups cannot be alienated from the presence of the infection. By contrast, all the individuals involved in the operational activities of the dental setups can play an enormous role in creating a zone of a hot spot for the spread of the disease.[3] This can prove to be doubly malefic, whereby both the operators and the patients visiting the dental setups are predisposed to the risk of getting an infection.[3]

The end point of the pandemic cannot be predicted. Also, dental treatments, especially elective options, cannot be indefinitely postponed.[3] In the line of duty, while providing appropriate care to the patients as per their needs, it is imperative for dental professionals to be vigilant and cognizant about the chain of disease transmission through the operatory, irrespective of the level of care (primary, secondary, or tertiary). Although a few studies on the contact tracing have been reported in the literature, no study has enumerated the details of contact tracing in a dental setup. The current study attempts to fill the lacunae in the literature by assessing the transmission dynamics of COVID-19 infection *via* contact tracing in a dental center of a tertiary care hospital in a metropolitan city (New Delhi). The intent of this cross-sectional analysis was to highlight targeted prevention strategies for the spread of disease by monitoring rigorous contact tracing in all dental setups so that the dental professionals in the community can be a contributor to simmering down the pandemic in times to come.

Study Design

A retrospective cross-sectional analysis.

Study Setting and Patients/Participants

Coronavirus disease 2019 infected health care workers of a tertiary care hospital.

Methodology

The analysis was done on the basis of information provided in the contact tracing of 30 diagnosed COVID-19-positive patients. The study duration ranged from April to December 2020. It was conducted among the diagnosed COVID-19-positive patients of the CDER, AIIMS, New Delhi, India. The contact tracing was mandatory for all the diagnosed cases as per AIIMS, New Delhi Institute protocol. Ethical approval was obtained from the IEC-1079/06.11.2020. The definition of contact used in this study was any encounter with a person within a 2–3 m radius and face-to-face conversation for >2 minutes duration. The retrospective contact tracing was done for a period of 48 hours prior to the time of diagnosis or the time of first reported symptoms, whichever was earlier, by a trained medical professional. Each contact was traced once, either from infector to infectee (forward tracing) or from infectee to infector (backward tracing).

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The demographic details about family history, comorbidities, socioeconomic status (SES), and education were obtained from each diagnosed case telephonically. Also, the following details were recorded over the phone on a recall basis: a number of direct exposures; place of exposure; mode of exposure; duration of exposure; type of exposure involving interaction, examination, or any procedures done; personal protective equipment is worn, and social distancing followed. Details about the presence of both typical and atypical symptoms such as cough, cold, sore throat, fever, chills, fatigue, loss of appetite, diarrhea, other gastrointestinal (GI) symptoms, the new loss of taste or smell, shortness of breath, headache, and muscular pain were also collected. The contacts of the diagnosed cases were categorized into high-risk and low-risk on the basis of personal protection equipment, and social distancing followed during the contact. The statistical analysis was performed using the Statistical Package for Social Sciences Software.

Results

The sociodemographic details of COVID-19-positive cases and the place of exposure of their high-risk and low-risk contacts are summarized in Tables 1 and 2, respectively. Fever (76.7%) was the most common symptom found at the time of diagnosis among the cases (Table 3). It was found that the high-risk contacts (20%) were more susceptible to developing a COVID-19 infection compared to their low-risk counterparts (2%) (Table 4).

Discussion

The present cross-sectional survey intended to evaluate the role of contact tracing in preventing the spread of COVID-19 infection. Klinkenberg et al. emphasized the importance of contact tracing for communicable diseases.[14] According to the authors, a delay in contact tracing may cause contactees in the chain emanating from a symptomatic infected to become symptomatic themselves before the tracing process reaches them. This leads to the initiation of a new tracing process of their own within the same cluster. Also, if the infection process is faster than the tracing process, the cluster size grows infinitely large, and tracing becomes ineffective. The contact tracing was mandatory for all the diagnosed cases as per AIIMS, New Delhi Institute protocol. The premise of tracing was to stratify contacts of index or primary cases into high and low-risk categories on the basis of personal protective protocols and social distancing practiced at the time of exposure.

Sociodemographic variables of the included COVID-19 confirmed cases had explained in Table 1. It was found that a greater number of males were contacted by the disease compared to females. The preponderance of infection in males is probably attributed to lifestyle choices, such as smoking, lack of implementation of responsible hygiene practices, and nonchalance to protection protocols by male members.[15] With respect to education, although the frequency of COVID-19-positive cases did not vary substantially among the different categories, there was a marginally high-level of frequency noted for those belonging to the postgraduation. This finding is contradictory to what has been observed in the general population, uninvolved with healthcare service delivery.[16] This is explained by the fact that those who belong to the group with advanced training are usually involved directly, on a firsthand basis, with the patients. It may also be probably due to the inclusion of postgraduate students who form a large part of the workforce of the tertiary care center. These student's frequent interaction at the institute or hostel mess and canteens augmenting the chain of transmission comparison of the frequency of index cases based on SES by using the modified Kuppuswamy scale (2020) revealed that the majority of index cases (66%) belonged to the middle-class (upper middle and lower middle). The majority of health care workers, including nurses, technicians, and postgraduate students, belong to the middle-class. This workforce comes in contact with the patients directly and at regular intervals, sometimes within close confines surmounting to the higher frequency of the observed finding. It could also be attributed to frequent professional interactions aside from those involved in primary patient care, such as small group physical education meetings. Additionally, easy accessibility of the testing center and a greater understanding of the disease within this cohort of individuals incentivized these individuals to get their testing done at the earliest. Those belonging to upper and lower-class categories have less direct interaction with suspects or the index cases, thereby resulting in a lesser frequency of COVID-19 among them. Similar trends were followed when the high-risk and low-risk contacts of index cases were analyzed for their SES status, revealing that majority of contacts (134/177) were from the middle-class ($p = 0.008$). Noticeably, the findings of this study, when compared to the population pools uninvolved with healthcare services, these findings are contradictory.[17] The divergent findings reveal that, on a general basis, precautions were well followed. However, the risks associated with professional interactions and personal profile has been a game changer in the outcome of the study.

The risk stratification of contacts based on the adoption of personal protection protocols and social distancing revealed that 80/177 (45.10%) were in the high-risk category, whereas 97/177 (54.90%) were in the low-risk category (Fig. 1). When they were

Table 1: Frequency distribution of sociodemographic variables of COVID-19-positive patients

Variables		*N*	*%*
Gender	Male	23	76.6%
	Female	7	23.3%
Education	12th or less	10	33.3%
	Graduate	9	30.0%
	Postgraduates	11	36.6%
Socioeconomic status (modified Kuppuswamy scale 2020)	Upper	4	13.3%
	Upper middle	12	40.0%
	Lower middle	8	26.6%
	Upper lower	6	20.0%
	Lower	0	0.0%
Occupation	Doctors	10	33.3%
	Nurses, hospital attendant, and technicians	13	43.3%
	Sanitary staff	2	6.6%
	Security/liftman	2	6.6%
	Administrative staff/data entry	3	10%
Family size (number of family members present in the family)	One	5	16.6%
	Two	5	16.6%
	Three	2	6.6%
	Four	8	26.6%
	>4	10	33.3%

Table 2: Place of exposure among high-risk and low-risk contacts of COVID-19-positive patients

	High-risk group		*Low-risk group*	
Place of contact	*N*	*%*	*N*	*%*
Workplace	15	18.75	84	86.60
Eateries/cafeteria/leisure activities	13	16.25	7	7.22
Home	52	65.00	6	6.18
Total	80	100	97	100

Table 3: Frequency distribution of various symptoms at the time of diagnosis in COVID-19-positive patients

Symptoms	*N*	*%*
Fever	23	76.7
Headache	4	13.3
Cough	5	1.7
Cold/runny nose	3	1.0
Sore throat	5	1.7
Gastrointestinal symptoms	2	0.7
Weakness	7	23.3
Body ache	6	2.0
Breathlessness	2	0.7
Asymptomatic	4	13.3

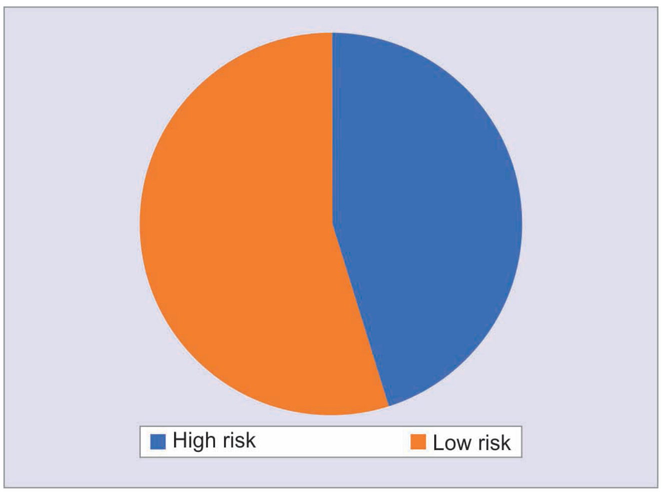

Fig. 1: Distribution of high-risk and low-risk contacts of COVID-19-positive patients

Table 4: Frequency distribution of odds of infection susceptibility among high-risk and low-risk contacts

Risk stratification of contacts	*Diagnosed positive*	*Diagnosed negative*	*Total*	*p-value*	*Relative risk*
High-risk	20 (25%)	60 (75%)	80 (100%)	<0.001	12.50
Low-risk	2 (2.0%)	95 (98%)	97 (100%)		

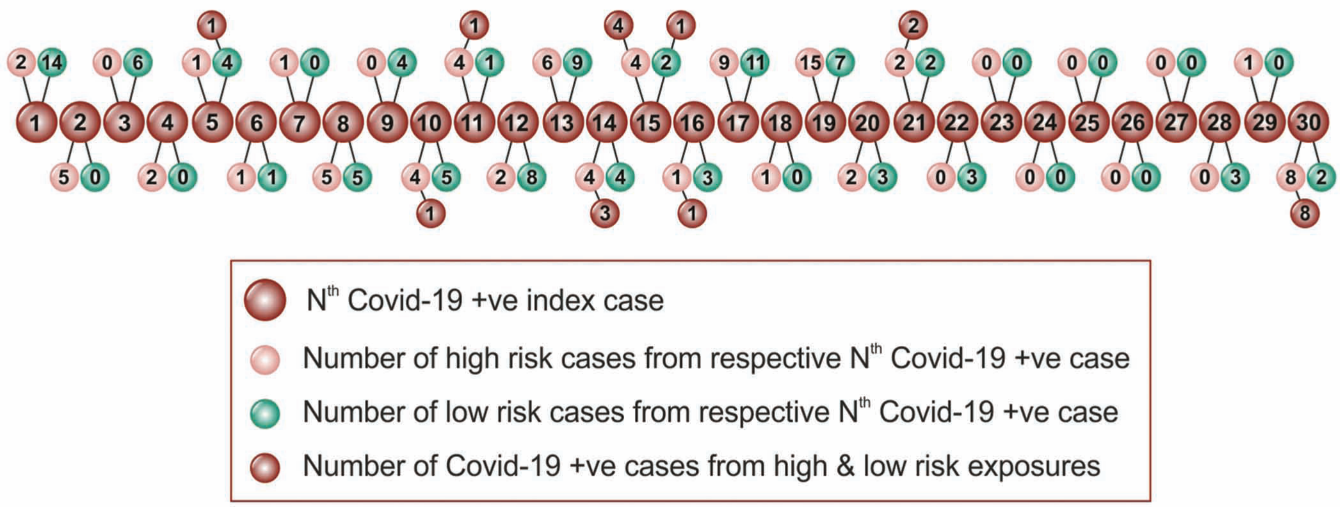

Fig. 2: Caterpillar plot showing transmission of infection *via* COVID-19-positive index cases

further assessed for a place of contact, it was found that majority of the high-risk contacts (52/80 or 65%) had their contact source from home whereas most (84/97 or 86.6%) among low-risk contact had exposure at the workplace (Table 2). The present study was carried out in a dental center of a tertiary care hospital. Consequently, those present at the workplace were aware of the precautions that need to be taken to prevent the spread of COVID-19 infection. This could be a reason why most of the contacts at the workplace were in the low-risk category. In contrast, the majority of contacts that occurred at home were of the high-risk category (52/58), as it is difficult to maintain the isolation among the family members. Although health care professionals are generally aware of disease transmission, execution of personal protection in a household is challenging domestic interactions within the confines of the household. The fact that family members are less protected at home and may or may not have the same level of awareness may be also contribute to a larger number of high-risk contacts at home.[18]

The confirmed COVID-19 cases were also recorded for their symptoms at the time of diagnosis (Table 3). It was found that fever was the most common symptom (76.7%), followed by weakness (23.3%). Headache was the other common symptom (13.3%). Cough, cold, sore throat, and GI disturbances were the other symptoms that were observed with relatively less frequency. The 4/30 cases were asymptomatic at the time of diagnosis and were undergone testing since they were high-risk contacts of the known cases. The confirmatory diagnosis of COVID-19 is made by microbial examination. Nevertheless, the delay in laboratory results and the possibility of false negative results in the early stages of the disease may jeopardize the intent of prompt isolation. The red flag symptoms, as reported by the patients, must be paid attention to in order to initiate the process of immediate quarantine and cap the spread of the disease without any delay.[19]

When assessed for the risk of disease transmission among the high and low-risk contacts, it was found that the relative risk of getting infected was higher among high-risk contacts (20/80) compared to low-risk contacts (2/97) with a relative risk of 12.50 (Table 4) ($p < 0.001$). Figure 2 with the caterpillar plot shows the chain of transmission of included 30 cases, and it is clearly evident that high-risk contacts have a higher likelihood of getting COVID-19 infection and should be isolated as early as possible. Thus, the findings of the present study necessitate the importance of contact tracing in preventing the transmission of COVID-19 and to break the chain of transmission. The research published in the United Kingdom had similar observations. It confirmed that the contact tracing strategy is likely to identify a sufficient proportion of infected individuals. This can further prevent the subsequent spread of infection. However, the ultimate success of contact tracing will depend on the rapid detection of cases and isolation of their contacts.[20] The study limitations could be the lack of implementation of multiple layers of contact tracing (second-order contacts or contacts of the contacts) and dependency on recall data.[21]

Conclusion

Hot spots or hyper-infected zones are plausible in a dental setup where excessive creation of aerosol is always anticipated. Aggressive contact tracing, when done right, is tremendously effective in containing an outbreak. Overstretched contact tracing can clearly diminish the possibility of the creation of a hot spot.

Clinical Implications

Extinguishing a pandemic requires a multipronged approach. The results of the study lucidly divulge the effectiveness of intense contact tracing and prompt isolation in curbing the creation of a hot spot in a tertiary dental health center in India, burgeoning with patients.

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