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Original Research Article

Inter-state cross border superspreading event of SARS-CoV2 in Central India, May 2020

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ABSTRACT

Background: During the mid-weeks of May 2020, a superspreading event occurred in a town of Central India, where breaking bread together led to an outburst of COVID-19 cases. This led to a sudden increase of the daily average number of cases later on in the month.
Methods: An epidemiological investigation was done to investigate the cause. Process of the epidemic investigation done has been described under three parts namely - Case finding, Contact tracing, Public health response.
Results: Our epidemiological investigation and contact tracing of the index case confirmed a superspreading event of COVID-19 which occurred due to multiple social gatherings during mid weeks of May 2020. It was estimated that 118 cases belonged to G0 and 94 cases belonged to G1 generation of the index case.
Conclusions: Most likely source of infection to the index case was from the guests who came for a social gathering on May 11, 2020 (lockdown 3) from a village across the border in Rajasthan, a high COVID-19 prevalent zone (Orange) to a low COVID-19 prevalent zone (Green).

Keywords: Epidemic investigation, Cross-border spread, Public health response, Contact tracing, Neemuch Outbreak, COVID appropriate behaviour

INTRODUCTION

Given the prolonged unpredictable nature of the current coronavirus disease 2019 (COVID-19) pandemic and the fact that India is currently having the second largest number of confirmed cases of COVID-19 in the world, there is a long way ahead in returning to normalcy. Since there is no specific effective treatment (complete cure) available for population against COVID-19 till date, and vaccine coverage is yet to have full-fledged effectiveness, the major interventional strategies to counter the current situation of COVID-19 pandemic still revolves around the phase of "disease transmission" in the natural history of this disease. In other words, the prime objective currently aims at reduction in the reproductive number (R0) through effective public health interventions. Various means through which this outcome may be achieved can broadly be classified as-

Those which require minimal community participation, largely depending on the availability and involvement of public health workforce example- Early detection of the cases in the community through contact tracing programs and

Those requiring significant community engagement example- Behavioral change communication / risk communication (wearing of masks, maintaining physical distancing, respiratory etiquette, hand sanitization etc).

Effectiveness of contact tracing depends on two dimensions namely- completeness (vastness of tracing contacts – number of contacts traced per positive case), time (early detection of cases including asymptomatic, followed by early isolation/quarantine). Published literature suggest that in certain scenarios around 10 to 20 percent of infected people can be responsible for 80 to 90 percent of COVID-19 transmission, and many people barely transmit the disease.[1-4] This phenomenon is based on the concept of "Super spreading". A super spreader is defined as "an individual who is highly contagious and capable of transmitting a communicable disease to an unusually large number of uninfected individuals".[5] Superspreading happens in two contexts- biological – The super spreader is in the stage of high transmission and is shedding huge quantities of infectious particles (symptomatic/asymptomatic), event – close contact of an infected individual with many people for sufficient period of time (>15 minutes in COVID-19) as in case of a mass gathering for respiratory illnesses.[6]

Throughout the history of infectious diseases there have been many famous 'super spreader' incidents such as Mary Mallon popularly known as Typhoid Mary who single handily infected 51 individuals of which 3 succumbed to the disease. In 1992, super-spreader event of Minnesota bar contributed to 35% of the disease burden of tuberculosis.[7] Ebola haemorrhagic fever outbreak in Kikwit, Congo (1995) was a superspreading event which witnessed high fatality.[8] Superspreading events of COVID-19 transmission in family gatherings have been well documented.[9] A similar event occurred in a town of Central India, where breaking bread together led to an outburst of COVID-19 cases. Neemuch (Nimach), a district in the Malwa region of the Indian state of Madhya Pradesh, shares its north-eastern border with state of Rajasthan. On May 18, 2020, a person Y, 65 years male, referred from a private practitioner came to the District Hospital, Neemuch with severe breathlessness and fever. History revealed that he was also a known case of hypertension (on medication). Suspecting a case of COVID-19, he was admitted by the health authorities in an isolation ward reserved for Severe Acute Respiratory Illness (SARI) and microbiological sampling for the same was followed by. The sample was reported positive for COVID-19 the next day and simultaneously the district public health authorities were notified. On May 20, 2020, an epidemiological investigation was started, and contact tracing was done with an aim to understand the source of infection and if there was any outbreak of COVID-19 in the community.

METHODS

It is a routine epidemiological investigation and contact tracing activity of the index case conducted suspecting an outbreak of COVID-19 in Jawad, Neemuch (Madhya Pradesh) during May – June 2020. As per the information received from the district health authorities, the district epidemiologist started an epidemiological investigation on May 20, 2020. Our study considered RT-PCR positive patients as a confirmed case of COVID-19. Process of the current epidemic investigation in has been divided into three parts, as follows: Case finding, contact tracing, public health response.

Case finding

The epidemiologist elicited a detailed medical history of the case Y (index case) admitted in the district hospital, Neemuch and conducted a detailed interview to collect the relevant epidemiological data (time, place and person). The district Rapid Response Team (RRT) was informed and contact tracing of all the primary contacts was initiated.

Contact tracing

With the help of RRT, household and community contact tracing was done for all those who encountered the index case in the previous 14 days. Relevant information was gathered from the family members and other sources during the process through face-to-face interviews. Throat swab was taken from all the primary contacts of the index case (irrespective of symptomatology) and sent for RT-PCR testing.

Public health response

Inter-state cross border spread of COVID-19 was suspected during investigation of the outbreak. We compiled the details of inter-state co-ordination mechanism, response of the district health and administrative authorities during the outbreak, as well as public health preparedness and response activities.

Statistical analysis

Utilizing the pre-existing district epidemiological data on COVID-19 and the data obtained through contact tracing, we compiled all the important findings and then calculated the number of cases attributed to the probable superspreading event. An epidemic curve was drawn for the month of May-June 2021 and further analysis of the outbreak was done.

Since the investigation was a part of regular public health emergency response, ethical permission was not taken for this study.

RESULTS

Case finding

During the epidemiological investigation, it was learnt that on May 11, 2020, a social gathering was held in the house of a Councillor residing in Ward 8 of Momin Mohalla, Jawad town, Neemuch. There were 87 local invitees and few guests who were invited from villages of Nimbahera town, Chittorgarh district of Rajasthan (Annexure). Around 10 to 12 guests from across the border (MP-Rajasthan border) came to the gathering in their private vehicles. They stayed in Momin Mohalla for a day or two and returned to Nimbahera. On May 12, 2020, one of the hosts, person Y complained of fever and sore throat. His first point of healthcare contact was a private practitioner. As the person Y's symptoms deteriorated, he consulted 2 other private practitioners during the next three days. On May 18, since the fever did not subside and the severity of breathlessness increased, he was referred to the district hospital. Sample collection of the index case was done on May 19 and the result was declared on May 20, 2020. The index case was isolated the same day as declaration of the result and contact tracing was started (Figure 1). Duration of exposure could not be ascertained but it is suspected that there were multiple gatherings with the same attendees in the household.

Table 1: Details of primary contacts of index case (n=223).

S. No.	Primary contacts	No. (%)
1.	**Family members**	83 (37.2)
2.	**Co-workers of Case Y**	42 (18.8)
3.	**Private practitioners whom case Y visited**	3 (1.4)
4.	**Others**	94 (42.2)
Total		223 (100)

Contact tracing

Out of the 223 primary contacts traced (Table 1), nearly 52% (118) were found positive. Most of the contacts were asymptomatic while they were isolated. Distribution of COVID-19 positive primary contacts according to age and gender has been shown in Table 2. The overall mean age of positive contacts was 32.1 years, mean age among females was 29.2 years and was 35.5 years among males.

All the three private practitioners tested negative. It was also found that among the patients attended by them in last 14 days, they had even treated 7 members of the family of Case F, all of them were eventually tested COVID-19 positive on contact tracing and were isolated. Family members were in the state of denial when the epidemiologists visited the site during investigation. Most of the information was gathered from the other sources of witness from the surrounding areas.

The Generation of index case (G0), identified by the positive primary contacts thus contain 118 COVID-19 cases. The next generation of cases (G1) occurred due to the secondary contacts who were also traced subsequently and isolated through the regular contact tracing program. Although, quantification of the exact number of cases in G1 (linked to the superspreading event) was not possible but a rough estimate was done as follows. Average number of cases per day, ever since the first case in Jawad (May 5) until the date of index case isolation (May 20) linked to this event was 3.3. Average number of cases per day for the next 20 days (6 days of Generation time/interval + 14 days of incubation period. May 20 – June 8) since the isolation of the index case was 14. Average number of cases per day for the next 10 days was 3.2 (similar to the daily average before the event). Literature review on previously published articles shows that the generation time/interval is above five days (5.2).[10,11] Generation interval is the time between the infection in one generation and the infection in next generation (The measure of how quickly an outbreak spreads). Total number of cases between May 20 - June 8 was 280. Considering the baseline daily average of COVID-19 cases in Jawad as 3.3, the expected number of cases in these 20 days was calculated to be 66. Hence, the rest 214 cases which were observed in excess to the expected cases based on the usual occurrence of the disease in that geographic area (Jawad) can be attributed to the superspreading event [Figure 1]. Since 118 of them belong to G0, it was estimated that 94 (214-118) cases belonged to G1.

Table 2: Distribution of COVID-19 positive primary contacts according to age and gender.

Age (in years)	Male (No, %)	Female (No, %)	Total (N, %)
≤10	6 (5.1)	11 (9.3)	17 (14.4)
11-20	7 (6)	9 (7.6)	16 (13.6)
21-30	8 (6.8)	15 (12.7)	23 (19.5)
31-40	14 (11.9)	14 (11.9)	28 (23.7)
41-50	7 (6)	8 (6.8)	15 (12.7)
51-60	8 (6.8)	2 (1.7)	10 (8.5)
>60	5 (4.2)	4 (3.4)	9 (7.6)
Total	55 (46.6)	63 (53.4)	118 (100)

Public health response

All the contacts of the index case were isolated in the designated quarantine facility where they were monitored for any spike in body temperatures and other COVID-19 related symptoms including cough, sore throat and diarrhoea. The asymptomatic contacts were discharged from the facility when none of them developed any symptoms suggestive of COVID within 7 days. The Symptomatic contacts were discharged once their other symptoms like cough, sore throat subsided and were afebrile for 3 days consecutively.

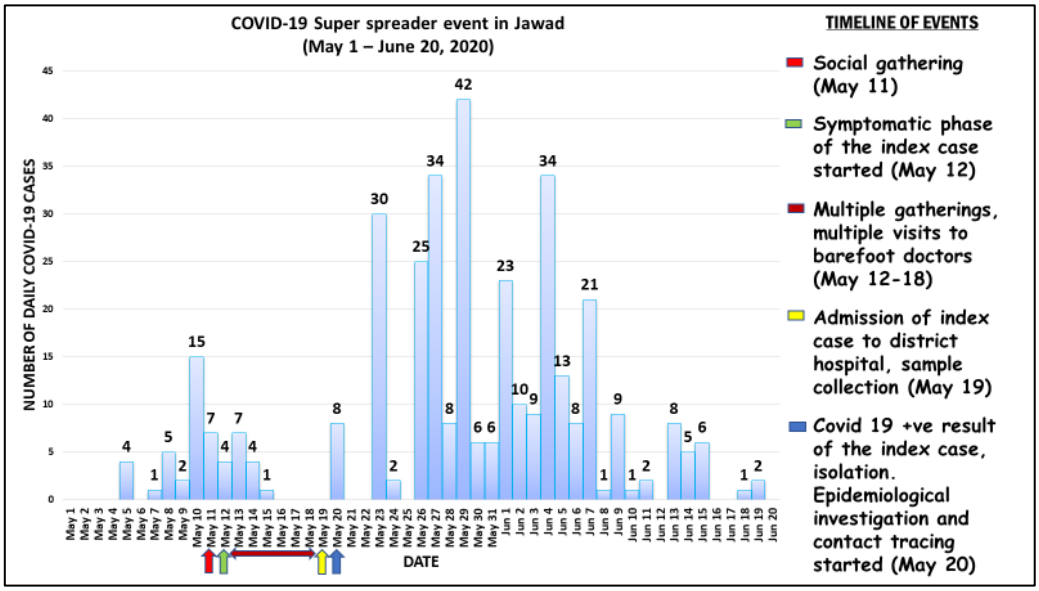

Figure 1: Daily number of cases in Jawad from May 1 – June 20, 2020 (The Epidemic curve).
Source of Data: Central Surveillance Unit, IDSP, NCDC, Delhi.

As sampling of primary contacts was being done, person F, who attended the social gathering on May 12 and is a neighbour of case Y, developed severe symptoms suggestive of COVID-19 and was referred to a tertiary care centre in Ujjain district of Madhya Pradesh, where she succumbed to the illness. Case F was a 70 year old female, a known case of diabetes and hypertension, who tested positive for COVID-19 posthumously. The Ujjain district health authorities informed Neemuch district health authorities regarding the same. While the case Y remained in the designated quarantine centre under observation who later recovered successfully, a similar epidemiological investigation was initiated for case F also. It was noted that there was a considerable overlap between the primary contacts of case F and case Y. All the 3 private practitioners were tested for COVID-19. The patients attended by them in last 14 days were also traced and tested according to guidelines. A surrounding area of 1km radius, containing 90 houses with population of 622 people was marked as a containment zone. There were 3 teams which visited the containment zone daily for the next 14 days and screened the residents for SARI through thermal screening and reported the COVID-19 symptoms. Cross notification to Nimbahera (Chittorgarh, Rajasthan) regarding the incident was done for taking necessary action. The incident happened while India was under Lockdown 3.0 and each district was assigned a colour tag (Red, Orange and Green) according to the severity of COVID-19 spread and different guidelines were issued by the Government of India for respective zones. During the phase of Lockdown 3, Chittorgarh district of Rajasthan was classified as Orange zone and Neemuch district of MP as Green zone.[12] As per the MHA guidelines, Inter-state travel and public/social gathering was not allowed not in any of the three zones. It was also advised that persons with co-morbidities, pregnant females, individuals above 65 years of age and children below 10 years shall stay home except for meeting essential requirements or for health purposes. Despite daily IEC activities regarding ILI/SARI a social gathering was held which led to an outbreak of COVID-19. It was also brought to notice that the breach of the Unlock 3 guidelines through interstate travel happened because the commuters used private vehicles through porous border where inter-state RTO check posts were not stationed. A notice was issued to the ward councillor by the Sub Judicial Magistrate for organizing the social gathering. An explanation was asked for disobedience, especially for violating the guidelines being a public representative. Epidemiological investigation also revealed that one of the reasons for amplification of the super spreading event was due to the delay in reporting by the private practitioners who failed to notify a case of suspected COVID-19. It was also noticed that all the thee of them who were consulted by the case Y were "Barefoot Doctors". Under section 188 CRPC, a FIR was lodged against them for not adhering to an order duly promulgated by a public servant.

DISCUSSION

Progression of an infectious epidemic depends on the number of cases generated by one generation of infected cohort producing the next generation by infecting the susceptible population. It is measured by the metric called Reproduction number (R0). Irrespective of the progress of an epidemic (on the rise or declining or stationary), the role of public health experts is to constantly focus on reducing the R0 value and bring it down to zero. In case of COVID-19 pandemic where there is lack of targeted pharmaceutical management and vaccines in the trial stages, it is quite important to tackle the issue more aggressively through public health interventions for limiting the spread and reducing mortality. Although multiple measures have been taken to reduce the R0 value

from time to time, there are few determinants impacting R0 which are often overlooked. One among them is the measure of "overdispersion".[13] Interestingly, recent studies on effectiveness of contact tracing during COVID-19 pandemic have shown that the R0 greatly depends on "overdispersion", which is the measure of variation of the spread of secondary cases (how even / uneven is the spread of disease transmission from one generation to the next).[14-17] Parameters such as viral load, presence or absence of symptoms, the day of symptom onset, knowledge and practice of respiratory etiquette, presence/absence of a person (infective/not) at that time (phase of the disease when shedding of the virus is high/low) in a particular place (in the crowd/in isolation) for a sufficient duration of contact period, coupled with practices of susceptible population (wearing masks, physical distancing, hand sanitization etc) all decide whether transmission of the virus happens or not. Due to many such parameters influencing disease transmission, there is a huge variation in the spread of transmission rates among individuals within a generation. Events / individuals showing high rates of disease transmission are known as super-spreaders. Given the unpredictable nature of such spread, and the fact that asymptomatic cases consume a large proportion of the seropositive cases, maximizing the extent of contact tracing followed by immediate isolation is the most effective strategy to minimize the effect of super-spreaders in progression of the current COVID-19 pandemic. This strategy used as a response in this case has helped curtailing the aftereffects (uncontrolled progression of disease transmission) of a superspreading event. Supporting the claim of asymptomatic transmission, there has been increasing literature evidence suggestive of the transmission of the SARS-COV-2 by asymptomatic individuals, especially adolescents.[18-20] Hence, vastness of contact tracing program is very much recommended since it shall address biological component of super-spreaders as well.

In the current outbreak, it is suspected that there was lack of COVID-19 Appropriate Behaviour (CAB) such as maintenance of physical distancing, usage of masks, proper hand sanitization practices etc and it was also informed that there were multiple gatherings for sufficient contact period (>10 minutes) necessary for spread of the virus. There was a glaring evidence of the ill ventilated housing structure which aided the spread. A similar outbreak was observed in the United States in June-July 2020. There had been a family gathering of 15 people from 4 different states. They stayed in close quarters for a duration of approximately 25 days without adhering to the preventive measures advised. An adolescent was suspected as the index case since she was the first to develop symptoms and 14 (93%) people tested positive among the attendees of the gathering.[21] In February-March 2020, the Chicago Department of Public Health (CDPH) reported a similar event cluster of COVID-19 due to a large multifamily gathering. There were 16 cases, out of which 3 succumbed to the disease. These cases & fatalities were attributed to two family gatherings, a funeral, and a birthday celebration. This report concluded that social distancing recommendations are intended to reduce SARS CoV-2 transmission.[16] The multiple exposure events reported here are similar to what was observed in our study. In a wedding event in Jordan (March2020) consisting of less than 400 people, father of the bride was suspected to be the index case for a COVID-19 outbreak after investigation. He had returned from Spain when pandemic was on the rise there, though he had no known history of exposure to a COVID-19 positive patient. Out of 350 wedding attendees, 76 turned positive for COVID.[22] Similar to this incident, it is suspected in our study that the most likely source of infection was from across the border.

Limitations

Though it is suspected that the infection spread to the index case of this superspreading event happened through the guests across the border, this cannot be ascertained because they could not be tracked. Contact tracing is purely based on memory; it may be that some amount of recall bias occurred.

CONCLUSION

Neemuch reported its first case (four cases) of COVID-19 on May 5, 2020. In the first 15 days, it witnessed a total of 50 cases with a daily average of 3.3. In the next 20 days (while contact tracing of person Y was carried out), the town eventually witnessed 280 cases with a daily average of 14 followed by a gradual fall in daily new cases back to the earlier average. Our epidemiological investigation and contact tracing of the index case confirmed a superspreading event of COVID-19 which occurred due to multiple social gatherings during mid of May 2020. Most likely source of infection to the index case was from the guests who came for a social gathering on May 11, 2020 (lockdown 3) from Nimbahera, Rajasthan, a high COVID-19 prevalent zone (Orange) across the border to Jawad, a low COVID-19 prevalent zone (Green). Further, delay in seeking treatment & poor reporting on part of private practitioners amplified the amplitude of the superspreading event which prompts the need for more aggressive risk communication and behavioural change communication strategies, not only in the general public but also among the healthcare community.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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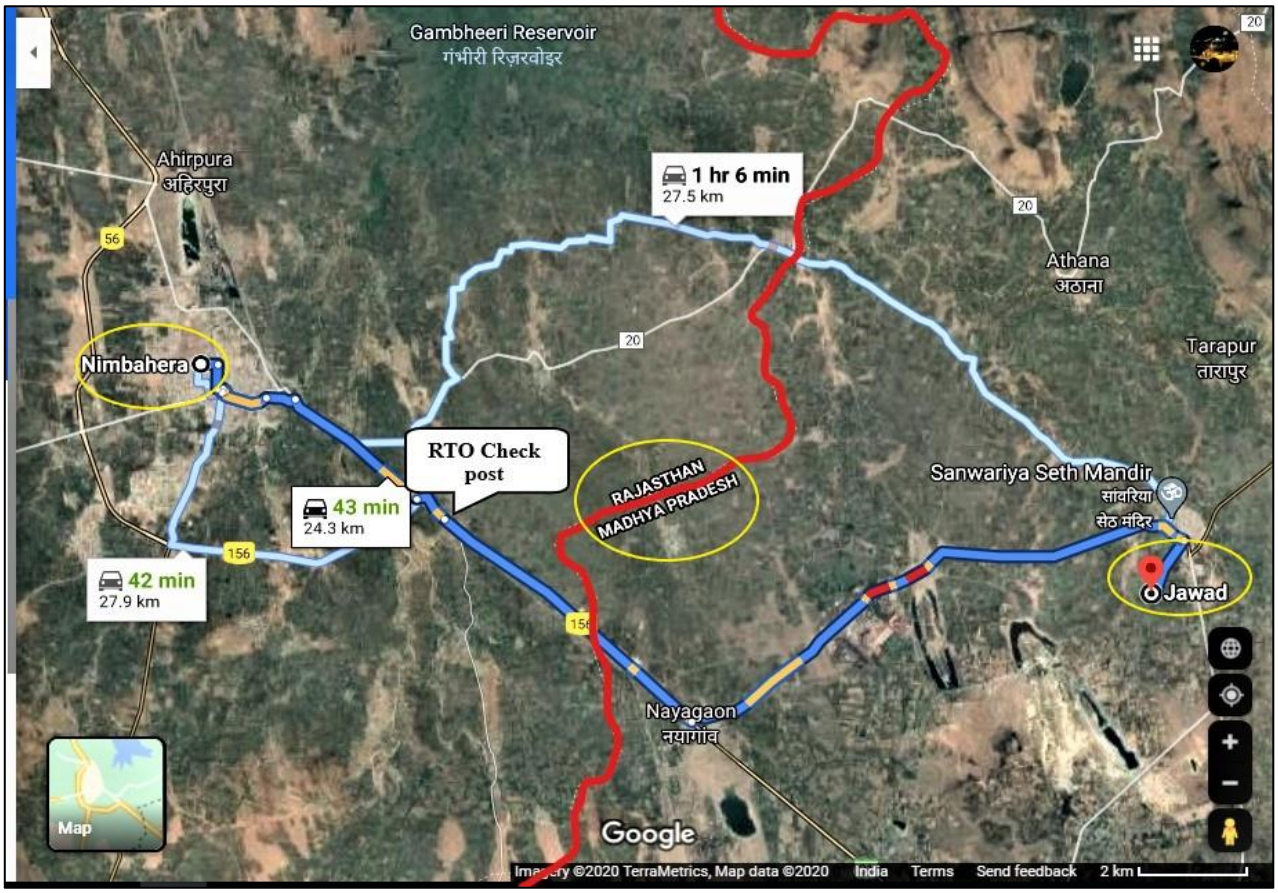
ANNEXURE

Map representing boarder of Rajasthan and Madhya Pradesh with distance marked between Nimbahera (Rajasthan) and Jawad (Madhya Pradesh).



Source: Google Maps.