



**ORIGINAL RESEARCH PAPER**

**Epidemiology**

**IMPACT OF VACCINATION ON COVID INFECTION IN HEALTH CARE WORKERS IN WESTERN ZONE OF INDIAN RAILWAYS**

**KEY WORDS:** Post vaccination, Healthcare workers, COVID-19 infection, Delta plus variant, Prevalence, Disease severity

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**ABSTRACT**  
 Healthcare workers (HCWs) are highly exposed to SARS-CoV-2 infection. HCWs are also likely source of infection of their family members .COVID-19 Vaccination programs started during December 2020 in several countries and prioritized healthcare workers (HCWs). The vaccination campaign coincided with the second surge of COVID cases in Western part of India. This study assess the prevalence of COVID19 infection and disease severity in vaccinated HCWs. Prevalence of SARS-CoV-2 cases was 6.3% of vaccinated HCWs. Most infection cases occurred within two weeks of the first vaccine dose. Out of total HCWs 87.4% were mild, 11.1% were moderate, and 1.5% were severe cases. This study stresses on early identification of asymptomatic carriers in vaccinated individuals. Even vaccinated HCWs might spread the infection leading to hospital outbreaks. With the emergence of newer strains of Covid 19 and amid the rising cases of Delta variant across the globe, adequate infection control practices like masking, social distancing, appropriate PPE and hand sanitization and vaccination are mandatory. However, disease severity is milder post vaccination. It is important to distinguish symptoms of side effects post vaccination from COVID infection even in vaccinated HCW in pandemic.

**INTRODUCTION:**  
 The novel coronavirus 2019 (COVID-19) continues to be a significant health issue worldwide. Infection caused by severe acute respiratory syndrome coronavirus-2 (SARS CoV-2) may be associated with a wide range of disease patterns ranging from mild to life threatening pneumonia and multiorgan dysfunction syndrome.[1] It was declared a pandemic by WHO on March 10, 2020 [2]. Health-care workers (HCWs) are Amongst the highest population at the risk of exposure to the disease.[3]

mutations at these sites may have increased replication, which leads to higher viral loads and increased transmission of these strains.[7,8] The Delta Plus variant – also known as B.1.617.2.1 or AY.1 – is different from delta variant because it contains a new mutation in the spike protein-K417N. Delta Plus variant have three characteristics: increased transmissibility, stronger binding to receptors of lung cells (suggesting easier entry into human cells), and a potential reduction in response to monoclonal antibodies (so that they may be less responsive to lifesaving monoclonal antibody treatments).[9]

Several variants of the SARS CoV-2 have been reported in India during January to April 2021: (SARSCoV-2-B.1.1.7 (alpha variant, United Kingdom), B.1.351 (beta variant, South Africa), B.1.617.2 (delta) variant, B.1.1.28 (Brazil P1, P2)).[4,5] The B.1.617.2 (delta) variant of the SARS-CoV-2, was detected across the globe and most of which have been reported from India, starting in mid-April 2021 and a notable increase in cases seen in the United Kingdom.[6] The delta variant is characterized by the mutations in the spike protein T19R, Δ157-158, L452R, T478K, D614G, P681R, and D950N. These mutations may affect immune responses and it appears that

COVID-19 Vaccination programs started during December 2020 in several countries and prioritized healthcare workers (HCWs).[10] Two vaccines that have been granted emergency use authorization by the Central Drugs Standard Control Organization (CDSCO) in India are Covishield (AstraZeneca's vaccine manufactured by Serum Institute of India) and Covaxin (manufactured by Bharat Biotech Limited).[11] Recently the Indian government granted emergency use approval (EUA) to US-based pharma company Moderna vaccine and SputnikV created by Gamaleya Institute in Moscow.[12] The vaccination campaign

coincided with a second surge of COVID cases. Surveillance is one of the significant phases in controlling viral diseases, which can be achieved either by active or passive approaches.

Western railway covers most parts of Gujrat, western parts of Madhya Pradesh and Maharashtra. The Medical department of western railway provides comprehensive health care i.e. Administrative, Curative, Preventive and Promotive services. These services are provided at three levels i.e. Health units (Primary Health Care- basic Health Care), Sub divisional, Divisional Hospitals, Workshop Hospital (Secondary Health Care- speciality health care) and Zonal Hospital (Tertiary Health Care- speciality & super speciality health care). The beneficiaries include serving railway employees and their family members and dependents, retired railway employees, their family members and dependents and certain other categories of staff such as contractors, labour, vendors, licensed porters etc. numbering 5.5 Lakhs.

**Aims:**

1. To assess the prevalence of COVID19 infection in vaccinated HCWs
2. To study post vaccination disease severity in HCWs.
3. To study coverage of COVID 19 vaccination program by western railway.

**Material and Methods:**

This is a retrospective cross sectional cohort study conducted in Health Care workers of Western Zone of Indian Railways. INDIA launched a vaccination campaign in early January 2021, and HCWs of the study center received Covishield vaccine. SARS-CoV 2 cases in HCWs were detected by real time reverse transcriptase polymerase chain reaction (rRT-PCR) and rapid antigen test (RAT). Testing was done for symptomatic cases, asymptomatic HCWs for workplace exposure as part of contact tracing, out state travel and as per request. Vaccinated HCWs who were infected with COVID from February till June 2021 are included in this study. A telephonic survey was done to collect data about dates of vaccination of first and second dose, Date of positive report, symptoms, severity and hospitalization.

**RESULT:**

Out of total 2314 HCWs of Western Railway, 2140 (92.48%) HCWs were vaccinated from February till June 2021 (Chart 1). Full dose of vaccination was completed by 38.2% (817/2140) HCWs while 61.8% (1323/2140) had taken only one dose (Chart 2). Total HCWs infected with COVID-19 after vaccination was 135. Of the total 2314 HCWs, 174 had not received vaccination. Prevalence of SARS-CoV-2 infection amongst vaccinated HCWs was 6.3%. Percentage of infection in HCW who took a single dose was 7.7% and 4% in cases receiving both vaccine doses (Table 1, Chart 2). Cases occurring within 15 days from initial dose of vaccination were 60.7% (82/135) and 39.3% (53/135) cases occurred after 15 days of vaccination (Table 2, Chart 3). Cases managed at home isolation were 82.9% and 17.1% were admitted in hospital for treatment (Table 3, Chart 4). 87.4% of the infected HCWs had Mild disease, 11.1% had moderate disease. There were two severe cases (1.5%), out of which one succumbed to infection (Table 4, Chart 5).

**Table 1: Percentage (%) of infected HCW after receiving vaccination**

Vaccine dose	Total HCW receiving	Positive cases after	Percentage (%) of infected HCW after
1st dose	1323	102	7.7%
2nd dose	817	33	4%
Not vaccinated	174		

**Table 2: HCWs Characteristics Stratified by Vaccination-to-Diagnosis Timing**

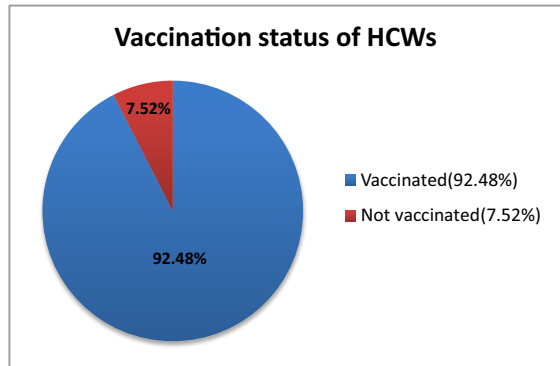
<15 days of vaccination	>15 days of vaccination
60.7% (82/135)	39.3% (53/135)

**Table 3: HCWs requiring home isolation and in hospital treatment**

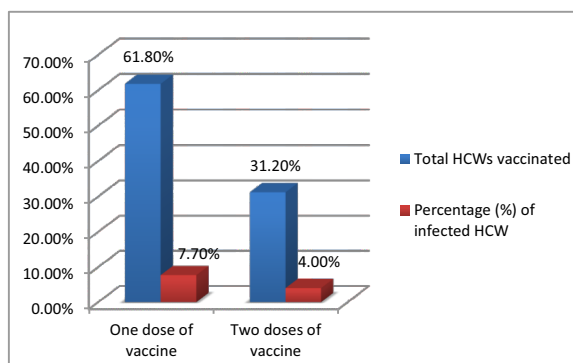
Home isolation	112	82.9%
Hospitalization	23	17.1%
Total	135	100%

**Table 4: Categorization of HCWs according to disease severity**

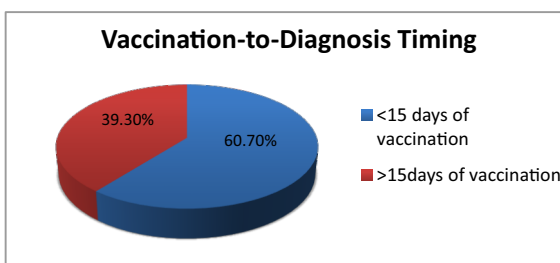
Mild	118 (87.4%)
Moderate	15 (11.1%)
Severe	02 (1.5%)
Total	135



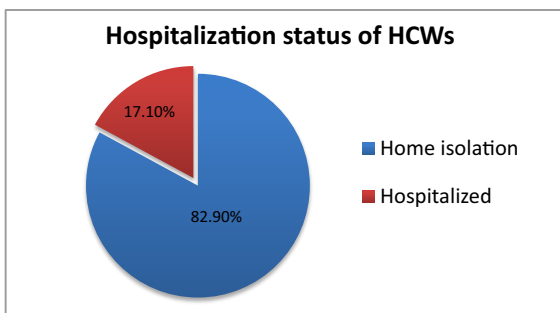
**Chart 1: Vaccination status of HCWs**



**Chart 2: Percentage (%) of infected HCW after receiving vaccination**

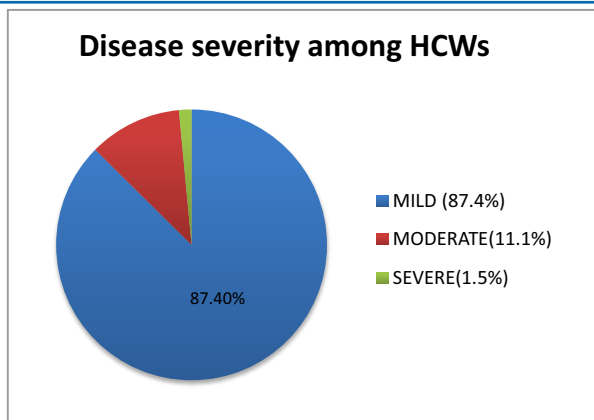


**Chart 3: HCWs Characteristics Stratified by Vaccination-to-Diagnosis Timing**



**Chart 4: HCWs requiring home isolation and in hospital treatment**

### Disease severity among HCWs



**Chart 5: Categorization of HCWs according to disease severity**

#### DISCUSSION:

Covid pandemic has adversely affected the health and economy globally. India has experienced a high rise in cases of Covid-19 since late March 2021, reaching more than 400,000 cases and approximately 4000 deaths reported each day in early May 2021.[6,13] SARS-CoV-2 is different from other known viruses due to multiple mutations on the sites of nonstructural proteins (NSP) 2 and 3, and the varying nature of virulence between different persons.[14] WHO has been tracking mutations and variants since the start of the COVID-19 outbreak. The global SARS-CoV-2 laboratory network includes a dedicated Virus Evolution Working Group, to detect new changes quickly and assess their possible impact. WHO has also established a SARS-CoV-2 Risk Monitoring and Evaluation Framework to identify, monitor and assess Covid variants of concern. It involves components like surveillance, research on variants of concern, and evaluation of the impact on diagnostics, therapeutics and vaccines.[15]

COVID-19 vaccination programs started during December 2020 in several countries, prioritizing higher risk groups including HCWs [10] Multiple mutant strains create challenges in the development of a universal vaccine. Designing a theranostic vaccine instead of a single shot to prevent multiple strains. Multiple vaccines are being developed globally. Different types of vaccine are: Live attenuated vaccines, inactivated vaccines, subunit vaccines, viral vector-based vaccines, and nucleic acid vaccines. Vaccine development is an extensive process with high chances of failure and even involves numerous challenges and safety issues to get accepted and approved.[14] Vaccines which are designed to elicit an IgG response, preventing the developing of COVID-19. However a local mucosal secretory IgA response as shown for anti-polio vaccination is required for protection against viral replication within the airways. Hence limited protection is offered by these vaccine[16,17] In India Covishield, Covaxin, Moderna and Sputnik V are the vaccines that have been granted emergency use authorization by the Central Drugs Standard Control Organization (CDSCO).[18]. It takes 2-3 weeks for adequate immune response after completion of the entire vaccination schedule.[11]

Post-vaccination breakthrough infection is defined as the contraction of a virus after being inoculated with a single or both doses of the vaccine. Post surveillance helps in identifying any unexpected adverse risk such as anaphylaxis, vaccine-strain systemic infection and vaccine-associated paralytic condition.[19] The first real-world case of positive PCR test in a HCW after full dose vaccination-induced immunity was reported in January in the United Kingdom in HCW after the Pfizer-BioNTech vaccine.[20] In a study done at hospital in Israel by Amit S et al, active and passive surveillance of vaccinated staff was conducted by using daily

health questionnaires, on-call infectious disease unit staff, and post-vaccination web-based questionnaires to identify and test symptomatic HCWs.[21]

According to ICMR Director-General Dr Balram Bhargava the post-vaccination breakthrough infection rate in India for COVID-19 is not more than 0.04 percent. Among 11.6 crore recipients of Covishield, 17,145 (0.02 percent) tested positive after receiving the first dose and 5,014 (0.03 percent) were detected with the coronavirus infection after the second dose.[22] Saad-Roy et al, in their study discussed inevitable uncertainties facing vaccine rollout and they found that one-dose strategies generally reduce infections in the short term, while the long-term outcome depends on immune robustness.[23] Yadav PD et al study reported neutralization data in the broader B.1.617 variant category and suggested that convalescent serum samples from persons with Covid-19 and from recipients of the BBV152 vaccine (Covaxin) were able to neutralize variants in the B.1.617 lineage.[24]

In this study 92.48% HCWs were vaccinated, 817 (38.1%) HCWs received both doses. Other HCWs were not vaccinated because of medical conditions, allergies or some misconception about vaccination. The majority (60.7%) of infections occurred within first 2 weeks of the vaccination. HCWs testing positive after receiving both doses of vaccinations were 33 while 102 had positive test results after the first dose. Our results were concordant with Keehner J et al and Mary Van Beusekom. [25, 26] In a study of Bouton TC et al, the majority of post vaccination SARS-CoV-2 cases occur in the two weeks following the first dose.[27]

In our study vaccination prevalence was 6.3% (135/2140). Our results were concordant with the result of Thompson et al study, prevalence was 5.2% (205/3,950) [28] while discordant with study of Bouton et al having prevalence of 1.3% (96/7,109) infected HCWs who received at least one dose, 0.3% (17/5,913) HCWs given both doses.[27] And Amit S et al study showed 0.54% infection prevalence in vaccinated HCWs.[21] Multiple factors could be responsible for the higher Prevalence of Covid infection in our study compared to other studies. Most of the HCWs in this study were frontline HCWs working in COVID wards. The time period of study of prevalence of infection coincided with the second surge of Pandemic and a smaller number of study population in our study as compared to other studies.

As per WHO there should be a minimum criterion for any acceptable COVID-19 vaccine having clear demonstration of efficacy (on a population basis) ideally with ~50% point estimate". The efficacy can be assessed against severity of disease, and/or shedding/transmission" endpoints.[29] Covishield has completed its Phase III trials in the UK and the bridging trial in India. However, vaccine effectiveness against the disease and safety in a larger group of people over the duration of 1-2 years is not completed.[11] However our study describes real clinical scenarios during the early period of post vaccination. This is not an efficacy study.

The new delta plus variant cases reported in several states of India including Maharashtra, Kerala and other states.[30] Bernal JL et al found the absolute difference in vaccine effectiveness against symptomatic disease with one dose of vaccine with the delta variant as compared with the alpha variant. However, the differences in vaccine effectiveness after two doses were small.[31] Till now 42,78,82,261 total vaccination doses have been administered and still Indian population needs to be vaccinated totally as early as possible to be prepared for subsequent waves and new variants of Covid 19.

In our study most (87.4%) of the infected HCWs also had had Mild disease, and only two severe cases (1.5%), one of them

died due to infection. According to research study of Jeff Burgess Kris Hanning from University of Arizona Health Sciences, People who contract COVID-19 after vaccination are likely to have a lower viral load, have milder symptoms and experience a shorter infection time than those who are unvaccinated. However, breakthrough infections do occur, the level of infection and impact of the disease are significantly reduced.[32] The current COVID-19 vaccination drive is not really for controlling the spread, but to protect those who are likely to develop severe disease.[33] Our result was concordant with them.

Several new kinds of variants may emerge in the future as it will keep mutating. Large-scale vaccination is the most successful and cost-effective tool for the control or eradication of viral diseases. However vaccinated individuals might get infected and transmit the virus. Hence Infection control practices like masking, social distancing, appropriate PPE and hand sanitization and vaccination are mandatory.

**CONCLUSION:**

Ensuring the safety of HCWs by priority vaccination is essential to combat the pandemic Breakthrough infections can occur; however, disease severity is milder post vaccination. Early identification of asymptomatic carriers even in vaccinated individuals is important. Post-vaccination surveillance on a large scale is important as it helps to study unexpected adverse risks caused due to the vaccination process. Preparedness for emerging Covid variants, following Covid-19-appropriate behavior and large scale vaccination is need of time.

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