# COVID-19 VACCINE BREAKTHROUGH INFECTIONS AMONG HEALTH CARE WORKERS AND SUPPORT STAFF OF MILITARY INSTITUTES IN PAKISTAN – AN UPDATE

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## ABSTRACT

***Objective:*** To measure incidence, disease severity and outcome of COVID-19 Vaccine Breakthrough Infections among Health Care Workers (HCWs) and Support Staff completely vaccinated with Sinopharm Vaccine.

***Study Design:*** Prospective cohort study.

***Place and Duration of Study:*** All Military Health facilities of Pakistan reporting COVID-19 cases post vaccination, from Jul to Sep 2021.

***Methodology:*** Established Surveillance Mechanism for getting post vaccination COVID-19 cases from various health care settings of Pakistan Army enabled the collection of data on prescribed data forms. Among HCWs and support staff vaccinated with both doses or single dose regimen of COVID-19 vaccine; those who developed COVID-19 infection ≥14 days post 2nd dose were included in the study. Total 327 participants from 1st Jul till 30th September 2021 fulfilled the criteria and data pertaining to them was further analyzed.

***Results:*** Mean age of the participants was 32.38 ± 9.18 years. Males were 73.4% and 26.6% were females. Median duration from 2nd dose to development of vaccine breakthrough infection was 133 days (Inter Quartile Range: 55 days). Asymptomatic /mild infections were reported among 97.9% and only 1.5% had moderate disease. However, 0.6% reported severe/critical disease and required ventilator support. Most 79.2% breakthrough infections ocuured almost more than 3 months completion of vaccination and only 20.8% developed it before three months. Among all, 99.4% recovered completely while 0.4% couldn't survive the complications associated with COVID-19. There was no significant statistical association of job category with disease severity ($p$>0.05)

***Conclusion:*** Vaccines still remain a powerful tool in war against COVID-19. No vaccine has yet to be found 100% effective against all variants of concern (VoCs) however less severe disease and mortality was observed after vaccination. Waning immunity after three months needs administration of booster dose of vaccine to HCWs and support staff working in a highly exposed environment of health facilities.

**Keywords:** COVID-19, Health Care Workers, Vaccine, and Vaccine Break Through Infections.

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## INTRODUCTION

Despite intense scientific and political efforts, COVID-19 Pandemic continues to effect the lives of millions of people across the globe.[1] The emergency authorization of first COVID vaccine in December 2020 followed by reports of sustained and marked decrease in COVID incidence observed in some countries was a ray of hope for return to normalcy.[2,3]. However, the rising breakthrough infections observed among countries with high vaccination coverage indicate that the journey is far from over.[4,5]. There exists a need to characterize the breakthrough infections to improve our understanding of the impact of vaccines in real life settings particularly among health care workers.[6,7]. Whereas m RNA vaccines being used in high income countries have been studied considerably, data on experience with use of other types of vaccines including inactivated, viral vector and protein subunit vaccines remains deficient.[8] These vaccines are being used in over 60 countries of the world.[9,10] Pakistan's COVID-19 vaccination drive also relies largely on non-m RNA vaccines but very limited data has been published on the actual experience with these vaccines.[9]

In Jun 2021, we reported pre-specified interim analysis of breakthrough infections among the largest cohort of health care workers of Pakistan Armed Forces.[11] However, the results were limited due to the short duration of follow up. Therefore, the study was continued and on 31 Oct, the data was locked to allow second analysis; results of which are being shared in this article. The strengths of the study are a large sample size, geographical diversity of participants, high vaccination coverage, mandatory routine reporting of COVID cases and vaccinations in the entire study pop-

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ulation, and close follow up of cases on key outcomes like hospitalization, ventilation and death.

**Operational Definitions**

***Support Staff:*** All the staff who is not directly involved in patient care but have a great role in maintain the hospital activities to go smoothly like ayas, sanitary workers, ambulance drivers, ward boys, stretcher bearers, administrative clerks, etc.

***Asymptomatic/Mild Disease:*** No symptoms or flu like symptoms including temperature, loss of smell or taste, mild or no cough. The patients do not complain of any kind of breathing difficulty on normal household activity. Most asymptomatic cases have mild disease.

***Moderate Disease:*** Lower respiratory illness on imaging or clinical assessment with SpO2 ≥ 94% on room air at sea level.

***Severe:*** Patients with SpO2 <94% on room air at sea level, a respiratory rate >30 breaths/min, PaO2/FiO2 <300 mmHg or lung infiltrates >50%.

***Critical Disease:*** Patients have acute respiratory distress syndrome, septic shock, cardiac dysfunction, exaggerated inflammatory response which may lead to multi-organ failure.

***Recovery:*** Any person who becomes COVID-19 PCR negative and is either clinically free of all symptoms or joins back at work after a period of 10 days sick leave.

## METHODOLOGY

It was a prospective cohort study conducted among health care workers and support staff working at various military health care settings in Pakistan. This study was approved by the Ethical Committee of Armed Forces Postgraduate Institute Rawalpindi, in accordance with National Research Committee and Helsinki Declaration. All the health care workers and support staff who were vaccinated against COVID-19 vaccine with two doses or single dose regimen of Sinopharm/Sinovac were followed. Surveillance system was already in place and mechanisms were developed for getting the data on prescribed data forms. The data was received from health settings on weekly basis including information on age, gender, job category, and date of first and second dose of vaccine, date of getting COVID-19 positive, disease severity and outcome of disease. Outcome was measured in terms of complete recovery from disease or mortality.

**Inclusion Criteria:** All HCWs and support staff working in a Military Health Care setting, vaccinated with both doses of COVID-19 vaccince and COVID-19 PCR positive upto two weeks after second dose of vaccination.

**Exclusion Criteria:** HCWs COVID-19 PCR positive who didn't receive any kind of vaccincation or got COVID-19 PCR positive after first dose or less than two weeks after second dose of vacination.

COVID-19 vaccination was started among health care workers on priority in Feb 2021. The results of data regarding health care workers who developed breakthrough infections till 30th June 2021 was published in August 2021.[11] However the data was gathered constantly till 30th Sep 2021 and further 327 health care workers and support staff developed breakthrough infections. Their data was analyzed and results were made part of this study. The whole process is described in Figure-1.

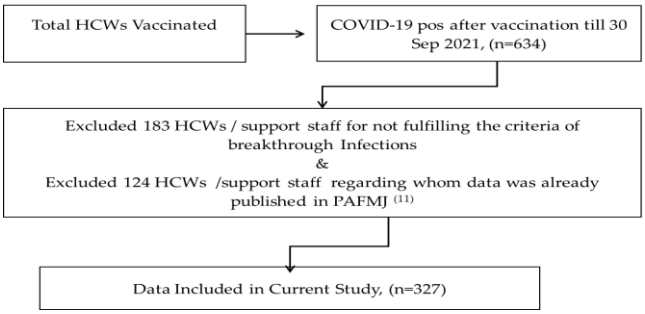


**Figure-1: The diagrammatic illustration regarding participants' inclusion in the study.**

## RESULTS

To date HCWs/Support staff have been completely vaccinated against COVID-19. Among full vaccinated HCWs/support staff 634 developed COVID-19 infection post vaccination. As per the definition of breakthrough infections 183 didn't fulfill the criteria and were excluded from the study. Data on 124 HCWs /Support staff has already being published as they developed breakthrough infection till end of June. Data on remaining 327 HCWs is being analyzed Figure-2.

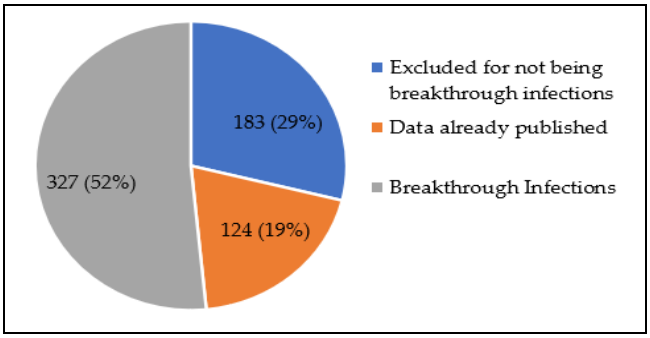


**Figure-2: Data on Post Vaccination Cases among HCWs /Support staff.**

Mean age of the cases was 32.38 ± 9.18 years (range: 18-58 years). Among all the cases doctors were 108 (33%), nursing staff 37 (11.3%), paramedics 62 (19%) and support staff 120 (36.7%). When the participants were inquired about history of exposure and getting tested, 9 (2.7%) said they had close contact (without PPEs) with COVID-19 cases in hospital while majority 318 (97.3%) were tested because they had COVID-19 like symptoms despite they were following personal protection measures at work place.

Median duration from receiving 2nd dose of vaccine and getting COVID-19 positive was 133 days with Inter Quartile Range (IQR) of 55 days (Q1: 98, Q2: 133, Q3: 153).

Severity of disease is the determinant of outcome and it was seen that among all the participants 320 (97.9%) had asymptomatic/mild infection, 5 (1.5%) had moderate infection while 2 (0.6%) developed severe/critical disease. As far as outcome was concerned, which is the corner stone of any intervention, 325 (99.4%) recovered completely from disease while 2 (0.6%) couldn't survive as a result of the complications of disease. The Overall incidence of Breakthrough COVID-19 disease among health care workers and support staff was 7 cases per 1000. The results are shown in Table-I.

**Table-I: Breakthrough Infection characteristics among the participants.**

| Variable | | n (%) |
|---|---|---|
| Mean age of the participants | | 32.38 ± 9.18 years |
| Gender Distribution | Males | 240 (73.4%) |
| | Females | 87 (26.6%) |
| Duration post 2nd dose of vaccine and getting breakthrough infection | Median Duration | 133 days (IQR 55 days) |
| | Cases who developed breakthrough infection in ≤90 days | 68 (20.8%) |
| | Cases who developed breakthrough infection in ≥90 days | 259 (79.2%) |
| Severity of disease | Asymptomatic/Mild | 320 (97.9%) |
| | Moderate | 5 (1.5%) |
| | Severe | 2 (0.6%) |
| Disease Outcome | Recovered | 325 (99.4%) |
| | Expired | 2 (0.6% |

When chi-square test of statistical significance was applied to find out association between the job category and severity of disease it was found to be insignificant ($p$<0.05).

**Table-II: Association between job category and disease severity among breakthrough infection cases.**

| Job Category | Disease Severity | | | Chi square/ $p$-value |
|---|---|---|---|---|
| | Mild | Moderate | Severe/ Critical | |
| Nursing Staff | 37 | 0 | 0 | $\chi^2$=9.485 $p$=0.148 |
| Doctors | 102 | 4 | 2 | |
| Paramedics | 62 | 0 | 0 | |
| Support Staff | 119 | 1 | 0 | |

## DISCUSSION

In a study conducted among HCWs in a tertiary care hospital of Italy.[12] A cohort of 3720 HCWs who were administered Pfizer vaccine, followed and found that 33 of them developed breakthrough infections making an overall incidence of 8.9 cases per 1000 while in our study it was highly comparable approximately 9.6 cases/1000. This incidence is also very close to the findings (7.3 cases/1000) shared by a Dutch study,[13] conducted at two tertiary health care facilities by following a cohort of 22,169 HCWs. However much contrary results were shared by an Indian study[14] reporting vaccine breakthrough cases up to 186.5/1000. The difference is of the locally manufactured Astra Zeneca by the Serum Institute of India.

A major advantage on our part was of the Chinese vaccines with a highly maintainable cold chain as compared to other vaccines that require storage at extremely low temperatures.[15] In a study reported in Israel, among cases of breakthrough infections, 46% were nursing staff, 26% support staff, 15% paramedics and 13% doctors while in ours study the highest proportion was of support staff being 37%, doctors 33% followed by paramedics 19% and nursing staff 11%. These proportions could vary depending upon the strength of HCWs and support staff on strength of the health facility and extent of involvement in COVID-19 cases management.[16] It has been documented in literature that full vaccination status reduces asymptomatic SARS-CoV-2 infection in health care workers.[17] Similar conclusions were made from our study where 97.9% of the infections were asymptomatic or mild and didn't require hospitalization with 0.6% mortality. Whereas in Netherland[13] all 100% reinfections were asymptomatic with 100% recovery/no mortality. This difference in outcome largely goes to the vaccine type being administered

In a study conducted at Kerala, South India the mean age of the HCWs with breakthrough infections was 31.9 ± 9.7 years very close to our findings 32.38 ± 9.18 years. and proportion of males being 73% while their proportion of females was 64%.[18]

The median duration of getting Breakthrough infections occurred after 69 days[18] and 37 days[19] indicating very poor response to the administered vaccines was observed in two separate studies. This may be due to any reason ranging from vaccine type to, maintaining cold chain and faulty administration technique. In our study this duration was 133 days which is almost >3 months, indicating waning effect of immunity requiring booster dose as discussed in literature.[20]

## CONCLUSION

Vaccines still remain a powerful tool in war against COVID-19. No vaccine has been found to be 100% effective yet against all variants of concern (VoCs) however less severe disease and mortality was observed after vaccination. Waning immunity after three months needs administration of booster dose of vaccine to HCWs and support staff working in a highly exposed environment of health facilities.

**Strengths**

- The biggest data of its kind on breakthrough infections among HCWs and support staff collected through well-established surveillance system
- Representative of the ethnic heterogeneity
- The existing infrastructure, functioning processes and swift implementation in the Armed Forces, allowed for effective data gathering and policy implementation
- Surveillance data usually exists as summary statistics however, one strength of our study is the availability of detailed individual patient data from multiple sites.
- No attrition of data set at any stage
- No vaccine refusals at any stage of vaccination campaign.

## LIMITATIONS OF STUDY

A national data base should be established to gather data from all health care settings to establish guidelines/recommendations for onward dissemination at national level.

## RECOMMENDATIONS

Vaccine roll out should be more robust and inclusive to achieve 100% coverage of target population at national level. Booster dose should be admin-istered to HCWs and support staff as a priority group to safeguard this important national workforce.

**Conflict of Interest:** None.

**Author's Contribution**

SM: Results, SS: Concept, NB: Discussion, EM: Introduction, SN: Data review, AI: Data entry, SI: Overall review, MA: Bibliography.

## REFERENCES


1. Johns Hopkins University of Medicine. COVID-19 Map - Johns Hopkins Coronavirus Resource Center. 2020 [Internet]. Available at: https://coronavirus.jhu.edu/map.html (Accessed Nov 16, 2020).
2. Azar AM. Emergency Use Authorization Declaration. Published online. 2020 [Internet]. Available from: https://www.federalregister.gov/documents/2020/04/01/2020-06905/emergency-use-authorization-declaration
3. Impact and effectiveness of mRNA BNT162b2 vaccine against SARS-CoV-2 infections and COVID-19 cases, hospitalisations, and deaths following a nationwide vaccination campaign in Israel: an observational study using national surveillance data at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8099315/
4. COVID-19 Breakthrough infections and transmission risk: real-world data analyses from Germany's Largest Public Health Department (Cologne) at https://www.mdpi.com/2076-393X/ 9/11/1267/html
5. Worldometer- COVID-19 Pandemic: Country stats. 2021 [Online] Available at: https://www.worldometers.info/coronavirus/ country /germany/ (Accessed 16 Nov 2021)
6. Vaccination reduces need for emergency care in breakthrough COVID-19 infections: a multicenter cohort study. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8428472/
7. The Lancet. COVID-19: Protecting health-care workers. Lancet 2020; 395(10228): 922.
8. Tanriover MD, Doğanay HL, Akova M, Güner HR, Azap A, Akhan S, et al. Efficacy and safety of an inactivated whole-virion SARS-CoV-2 vaccine (CoronaVac): interim results of a double-blind, randomised, placebo-controlled, phase 3 trial in Turkey. Lancet 2021; 398(10296): 213-222.
9. Our World in Data. COVID-19 vaccine doses administered by manufacturer. 2021 [Internet] Available at: https://ourworldindata.org/grapher/covid-vaccine-doses-by-manufacturer? country=~AUT (Accessed 16 Nov 2021).
10. China's Vaccine Map: China's Vaccine Map: Countries using Chinese vaccines. 2021 [Internet] Available at: https://news. cgtn.com/news/2021-03-14/China-continues-to-contribute-to-global-vaccine-distribution-YCquwiznFK/index.html (Accessed 16 Nov 2021).
11. Maroof S, Bakht N, Saleem S, Nisar S, Rashid Z, Mansoor E, Iftikhar A. COVID-19 vaccine breakthrough infections among health care workers in military institutes of pakistan – till 30th June 2021. Pak Armed Forces Med J 2021; 71(4): 1471-75.
12. Rovida F, Cassaniti I, Paolucci S. SARS-CoV-2 vaccine break-through infections with the alpha variant are asymptomatic or mildly symptomatic among health care workers. Nat Commun 2021; 12: 6032.
13. Shamier MC, Tostmann A, Bogers S, de Wilde J, IJpelaar J, Kleij WA, et al. Virological characteristics of SARS-CoV-2 vaccine breakthrough infections in health care workers. MedRxiv. https://www.medrxiv.org/ content/ 10.1101/2021.08.20.21262158v1
14. Sabnis R, Patil A, Shete M, Rastogi AK. Break-through COVID-19 infection rate with Indian strain in single-center Healthcare Workers – A real world data. MedRxiv. https://doi.org/10.1101/2021.07.02.21258881
15. Baraniuk C. What do we know about China's covid-19 vaccines? Br Med J 2021; 373: n912.
16. Jung J, Sung H, Kim SH. COVID-19 Breakthrough Infections in Vaccinated Health Care Workers. N Engl J Med 2021; 385(17): 1629-1630.
17. Linsenmeyer K, Charness ME, O'Brien WJ, Strymish J, Doshi SJ, Ljaamo SK, et al. Vaccination status and the detection of SARS-CoV-2 infection in health care personnel under surveillance in long-term residential facilities. JAMA Netw Open 2021; 4(11): e2134229.
18. Jung J, Sung H, Kim SH. COVID-19 Breakthrough Infections in Vaccinated Health Care Workers. N Engl J Med 2021; 385(17): 1629-1630.
19. Jung J, Sung H, Kim SH. COVID-19 Breakthrough infections in vaccinated health care workers. N Engl J Med 2021; 385(17): 1629–31.
20. Goldberg Y, Mandel M, Yinon M, Bodenheimer O, Freedman L. Waning Immunity after the BNT162b2 Vaccine in Israel. N Engl J Med 2021; 385: e85.