## Research Article

# Incidence of COVID-19 Infection in Nurses and their Families: A Prospective Cohort Study in Lahore

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**Abstract**

**Background:** Nurses, as frontline workers, are at a higher risk of contracting COVID19 and serve as a potential source of transmitting this infection to their family members. Estimating risk in this population is critical for controlling the rate of secondary attack rate among their families.

**Objective:** To measure the incidence of COVID-19 in nurses and their families with associated risk factors for transmission of infection.

**Methods:** A prospective cohort study was conducted in Akhtar Saeed Medical and Dental college, Lahore and associated three hospitals. A cohort of 176 nurses was identified in March 2020 by using non-probability convenience sampling technique and was followed till September 2021. During this tenure of one and a half year, incidence was observed by following the cohort and using a self-structured questionnaire. With SPSS 23, Chi square test was applied and p value of < 0.05 was considered significant.

**Results:** In a cohort of 176 nurses, followed for one and a half year, incidence of COVID-19 was 37(21%). Secondary attack rate among household members of these nurses was 3%. A significant association was observed between the nursing staff and exposure to their family members (p = 0.002). Vaccination rate in nurses at the start of the study was only 26%. Nurses who worked directly with COVID-19 patients reported high incidence (p = 0.009). Nurses who used Personal protective equipment (PPE) were less affected (p = 0.003). Nurses with comorbidities showed higher incidence (p =0.02). Rate of psychological distress was high (p =0.007).

**Conclusion:** Incidence of COVID-19 among nurses was 21% with secondary attack rate of 3% in families. Protective use of N 95 mask and comorbidities were associated with incidence.

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**Keywords** | Incidence, COVID-19, Nurses, Families, Secondary attack rate

## Introduction:

The outbreak of COVID-19 first emerged in Wuhan, Hubei Province, China, in December 2019 and the World Health Organization announced it as a public health emergency of global concern on January 30, 2020.[1] Coronavirus is spreading globally with 267,865,289 confirmed cases of COVID-19 and 5,285,888 deaths as per reported to WHO on 7th December, 2021.[2] Glo-

bally people of all nations, races, and socio-economic groups are affected but the health of healthcare workers is dramatically challenged.[3]

It has been estimated that in year 2020 almost 90,000 healthcare workers from all over world have been COVID positive and greater than 600 nurses have lost their lives.[4] According to regional analysis, a study in Wuhan showed that on March 26th 2020, total confirmed

cases among healthcare workers (HCW's) were 50006 out of which 52.06% were nurses while rest of them were doctors (33.62%) and other paramedical staff (14.33%).[5]

According to an Iranian study, COVID-19 has infected at least 90,000 healthcare workers until June 5th, 2020 and more than 260 nurses have died as a result of the pandemic.[6] As of June 29, 2021, Pakistan had reported a total of 0.95 million confirmed cases of COVID-19.[7] In Pakistan more than 440 cases have been reported in frontline healthcare workers out of which 8 confirmed cases reported death in different provinces by 2020. Out of these 440,67(15.2%) were nurses, 216(49%) were doctors and 161(36.5%) were other healthcare workers[4] and the number is still increasing.

Several risk factors responsible for COVID-19 spread among healthcare workers are inadequate availability of personal protective equipment, work overload, poor infection prevention practices and pre-existing comorbidities, unavailability of diagnostic tests, exposure to infected patients and asymptomatic carriers.[8] Number of healthcare workers affected by COVID-19 is constantly increasing. This creates a lot of stress on nurses and their families.[4]

Healthcare providers should be carefully monitored from time to time because if they are infected, they can transmit it to their colleagues, healthy patients and family members.[9]

Nurses play a critical role in the treatment of COVID-19 patients and are more susceptible to infection. There is scarcity of literature on the incidence of COVID-19 among Pakistani Nurses. The objective of the study is to measure the frequency of COVID-19 infection in nurses and their families and associated risk factors for transmission of infection.

## Methods:

This is a prospective cohort study conducted with a cohort identification of 238 nurses, through non-probability, convenient sampling technique in Farooq Hospital West Wood Lahore, Akhtar Saeed Trust Teaching Hospital, Lahore and Farooq Hospital, Allama Iqbal Town Branch, Lahore. This cohort was identified on March 2020 and was followed till September 2021. Initially cohort consisted of 250 nurses but the final number of nurses remained in cohort was 176. Attrition

was observed due to non-willingness of participants to continue in research and change in vaccination status. Ethical approval of this research was taken from the Institutional review board of Akhtar Saeed Medical and Dental College, Lahore and Medical superintendents of the relevant hospitals before data collection from nurses. IRB letter number M-19/055/CM was originated to grant data collection to researchers. Before data collection, informed consent was taken from nurses in identified cohort. Data was collected by observations and interviews on self-structured questionnaire. This questionnaire was pretested through pilot study. The questionnaire comprised of three sections. The first section comprised of the sociodemographic information of nurses, which included age, sex, marital status, area of residence and family type of the participant nurses. The second section comprised of questions regarding Nurses' workplace, their access to PPE's contact with COVID19 patients, psychological distress faced during working in COVID wards, vaccination status, severity of COVID19 symptoms. In the third section, family members living in the same house as health care workers were asked about their vaccination status, contact history, onset of suspicious symptoms, comorbidities, treatment plan, hospitalization, and isolation status. Data was entered and analyzed in SPSS (Statistical Package for Social Sciences) version 23. Descriptive statistics like frequency and proportions were used for categorical variables. Mean and standard deviations were calculated for continuous variable. Data was presented in the form of frequency tables. Chi square test was applied and p value of less than 0.05 was considered significant. Secondary attack rate was calculated among relatives of nurses residing in the same place as these nurses. It was calculated as the total number of new cases emerging in household of nurses divided by the total number of households of these nurses. Primary cases were excluded from numerator and denominator both.

## Results:

The mean age of nurses in identified cohort was 26.4 ± 3.9 years. Majority of the participants 159(90%) were females. Those who belonged to nuclear family were 104 (59%). Incidence of COVID 19 was reported in 37(21%). Out of the total 176, 46(26%) got COVID vaccine, and maximum respondents 31(67.3%) had Sinopharm vaccine as shown in Table 1.

**Table 1:** *Sociodemographic Profile of Cohort of Nurses*

| Age | Frequency (n) | Percentage (%) |
|---|---|---|
| 20-30 years | 153 | 86.9 |
| 31-40 years | 21 | 11.9 |
| 41-50 years | 2 | 1.1 |
| **Gender** | | |
| Male | 17 | 9.7 |
| Female | 159 | 90.3 |
| **Type of family** | | |
| Nuclear | 104 | 59.1 |
| Extended | 72 | 40.9 |
| **Vaccination** | | |
| Yes | 46 | 26.1 |
| No | 130 | 73.9 |
| **Type** | | |
| Sinopharm | 31 | 67.3 |
| Sinovac | 15 | 32.6 |
| **Workplace** | | |
| Akhtar Saeed Trust Teaching Hospital | 44 | 25 |
| Westwood Branch | 84 | 47.7 |
| Iqbal Town Branch | 48 | 27.3 |
| **Unit** | | |
| ICU | 31 | 17.6 |
| COVID Isolation Ward | 6 | 3.4 |
| Emergency Unit | 34 | 19.3 |
| OPD | 13 | 7.4 |
| CCU | 12 | 6.8 |
| Any other Ward | 80 | 45.5 |

**Table 2:** *Bivariate Analysis to Assess Risk Factors Associated with COVID-19 in Nurses*

| Variables | Affected with COVID-19 | Not affected | Total | P-Value |
|---|---|---|---|---|
| **Vaccination Status** | | | | |
| Yes | 10(21.7%) | 36 (78.3%) | 46 | 0.89 |
| No | 27(20.7%) | 103 (79.2%) | 130 | |
| **Work with COVID-19 Patients** | | | | |
| Yes | 28(28%) | 72 (72%) | 100 | 0.00 |
| No | 9(11.8%) | 67 (88.2%) | 76 | |
| **Psychological Distress in COVID Ward** | | | | |
| Yes | 13(38.2%) | 21 (61.8%) | 34 | 0.00 |
| No | 15(22.7%) | 51 (77.3%) | 66 | |
| **Use N-95** | | | | |
| Yes | 32(26.4%) | 89 (73.6%) | 121 | 0.02 |
| No | 0(0%) | 5 (100%) | 5 | |
| **Comorbidities** | | | | |
| Yes | 8(40%) | 12 (60%) | 20 | 0.02 |
| No | 29(18.6%) | 127 (81.4%) | 156 | |
| **Diabetes** | | | | |
| Yes | 4(40%) | 6 (60%) | 10 | 0.02 |
| No | 33(24.8%) | 133 (75.2%) | 166 | |

**Table 3:** *Bivariate Analysis to Assess Disease Pattern of COVID-19 in Nurses*

| Variables | Affected with COVID-19 | Not affected | Total | P-Value |
|---|---|---|---|---|
| **Test for COVID-19** | | | | 0.00 |
| Yes | 35(97.1%) | 1 (2.8%) | 36 | |
| No | 2(1.4%) | 138(98.6%) | 140 | |
| **Source of Infection** | | | | |
| Colleagues | 2(100%) | 0 (0%) | 2 | 0.00 |
| Patients | 33(100%) | 0 (0%) | 33 | |
| Friends | 2(100%) | 0 (0%) | 2 | |
| **Type of Test** | | | | |
| PCR | 13(100%) | 0 (0%) | 13 | 0.00 |
| Antibody/Serology Test | 7(100%) | 0 (0%) | 7 | |
| Chest Xray | 12(100%) | 0 (0%) | 12 | |
| HRCT | 4(100%) | 0 (0%) | 4 | |
| **Symptoms you noted in case of being infected with COVID-19** | | | | |
| Fever | 17 (100%) | 0 (0%) | 17 | 0.00 |
| Cough | 6 (100%) | 0 (0%) | 6 | |
| Sore Throat | 7 (100%) | 0 (0%) | 7 | |
| Fatigue | 2 (100%) | 0 (0%) | 2 | |
| Body Ache | 1 (100%) | 0 (0%) | 1 | |
| **Type of treatment in Symptomatic State** | | | | |
| Self-Medication | 14 (100%) | 0 (0%) | 14 | 0.00 |
| Doctor Recommendation | 17(100%) | 0 (0%) | 17 | |
| Others | 2(100%) | 0 (0%) | 2 | |
| **Severity of COVID-19 Symptoms** | | | | |
| Symptomless | 4 (100%) | 0 (0%) | 4 | 0.00 |
| Mild | 20 (100%) | 0 (0%) | 20 | |
| Moderate | 7 (100%) | 0 (0%) | 7 | |
| Severe | 6 (100%) | 0 (0%) | 6 | |
| **Most Affected System** | | | | |
| GIT | 4(100%) | 0 (0%) | 4 | 0.00 |
| Respiratory | 24(100%) | 0 (0%) | 24 | |
| Circulatory System | 9 (100%) | 0 (0%) | 9 | |
| **Isolation** | | | | |
| Yes | 21(100%) | 0 (0%) | 21 | 0.00 |
| NO | 16(100%) | 0 (0%) | 16 | |
| **Hospitalization** | | | | |
| Yes | 3(100%) | 0 (0%) | 3 | 0.00 |
| No | 34(100%) | 0 (0%) | 34 | |

Bivariate analysis showed that nurses got infection irrespective of their vaccination status (p= 0.89). Nurses who worked directly with COVID-19 patients had high incidence of disease (p=0.00). Psychologically stress was reported while working in COVID ward (p = 0.00). Use of N-95 mask played a significant role in prevention of disease (p =0.02). Comorbidities were seen in 20(11%) of the participants and majority 10(50%) reported diabetes (p =0.02) as evident in Table 2.

Bivariate analysis showed significant association with positivity of PCR test and patients as a source of infection. Fever was the most significant symptom. Maximum number of patients had mild symptoms and took doctor's advice for treatment. Most affected system was respiratory system as shown in Table 3.

Severity associated with COVID-19 infection was noticed in 6(16%) of the respondents and 3(8%) of them got hospitalized. Mean drop in oxygen level along with standard deviation was 87.3 ±11.01.

Mean number of family members residing at home was 6.45 ± 2.89. Total number of family members affected by COVID-19 were 35 and secondary attack rate was estimated by dividing the number of exposed persons developing disease within range of incubation period (n=35) by total number of exposed persons in households (n=1136) and multiplied by 100 and the calculated result was 3%. Mean number of family members with vaccination was 0.81 ±1.480 SD. Major comorbidity noticed in household members 7(58%) was hypertension.

## Discussion:

Results of this showed that incidence of COVID 19 was reported in 37 (21%) out of a cohort of 176 nurses. Another study conducted in Muscat, Oman reported that the majority of the health care workers affected with COVID-19 were nurses 77(38%).[10] Health care professionals, who have played a critical role in the response to COVID-19, maybe at a higher risk of contracting SARS COV-2 and then transferring it to their family, coworkers or both. According to current study the number of family members who got affected by COVID-19 were 35 with secondary attack rate of 3 % while another study showed (32.1%) of family members were IgG positive with Covid-19 infection.[11] A study in Italy showed that 33(9%) health care workers were believed to be the source of infection for family mem-

bers.[12]

Healthcare workers (HCW) are slated to be early recipients of SARS-CoV-2 vaccines due to increased risk of exposure to patients with COVID-19. Although nurses are front-line health workers, the vaccination status among them was inadequate 46(26.1%) only. Whereas a Chinese study found vaccination rate of nurses as 76.98%.[13] Results of this study showed that vaccination status was not associated with incidence of disease in nurses.

A significant association was found with incidence of COVID 19 in nurses with place of duty allocation. Another study conducted in Pakistan showed maximum number of cases in nurses working in emergency ward and isolation ward specific for COVID 19.[14]

Healthcare professionals and nurses experienced emotional stress in the fight against Covid-19 infection and 34(34%) of our respondents experienced it. A study conducted in Jordan revealed that 41% of nurses were psychologically affected by this pandemic.[15]

Results of this study showed use of personal protective equipment by 140(79.5%) of the nurses in identified cohort, another study conducted in Pakistan showed that 129(28%) of HCWS had adequate access to PPE.[14]

Majority of nurses 121 (96.03%) reported use of N 95 masks, which had significant for prevention of COVID 19 infection in this study. A study published in Critical care medicine in 2010 has already established the role in N95 masks in prevention of influenza and SAARS.[16]

A recent study conducted in Pakistan showed that disposable face masks were used by 263(78%) of the health care providers during their hospital working hours.[17]

In this study high incidence of COVID 19 was reported in nurses with associated comorbidities, particularly diabetes. A survey conducted in an Indian hospital where similar comorbidities in health care workers associated with SARSCov-2 infection were reported as hypertension in (49%), diabetes mellitus (47%) and (5%) with ischemic heart disease.[18]

According to results of this study 36(20.5%) of the individuals had their COVID-19 test, 35.1% preferred PCR. Another study reveals that 32.3% of the nurses, were detected positive with Covid-19 infection through PCR in a hospital-based study.[19]

Majority 33 (89.1%) of the nurses in this cohort got

infected from their patients. Depending upon the severity of COVID-19 symptoms respondents in this study experienced mild 20(54%), moderate 7(18%) and severe 6(16%) symptoms. Similar results were reported in a study conducted in Egypt where severe illness was reported only in 8(11%) of the nurses.[20] Upon participants systemic inquiry it was found that 24(64.8%) respondents experienced respiratory tract symptoms. These results are in line with the study findings conducted in Wuhan.[21]

In this study 3(8%) of the respondents required hospitalization depending upon the severity while another study conducted among symptomatic health care workers in Washington, only 6(3%) reported hospitalization related to COVID-19.[22]

Being a prospective cohort study with a long follow-up of one and a half year is a biggest strength of this study in which researchers observed the true incidence of infection among nurses. but a longer duration of follow-up forced change of variables noted during observations particularly the vaccination status of nurses to counteract this factor, analysis of incidence of infection was based on initial data obtained at the beginning of cohort identification. The initial cohort was 238 with attrition rate of 6.2% the data was analyzed only for 176 retained nurses. Another major limitation was that the cohort of nurses was identified on the basis of convenient sampling based on 3 associated hospitals of Akhtar Saeed Medical and Dental College to make follow-up easier. Despite of all the limitations, this study reflects data from 3 different hospitals of Lahore so results can be generalized.

## Conclusion:

Incidence of COVID-19 among nurses was 21% with secondary attack rate of 3% in families. Statistically significant association was observed between incidence of COVID-19 infection among nurses and protective use of PPEs, comorbidities and psychological stress faced during COVID-19.

**Ethical Approval:** Given
**Conflict of Interest:** The authors declare no conflict of interest.
**Funding Source:** None

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