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## **Impact of public health interventions on COVID-19 control in Lahore**

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**Abstract**---Background: The COVID-19 pandemic has had a significant impact on public health, with governments and organizations implementing various interventions to control its spread. This study aimed to evaluate the impact of public health interventions on controlling the spread of COVID-19 in Lahore, Pakistan. Methods: Data on COVID-19 cases and public health interventions were collected from March 2020 to March 2022. The data were analyzed to evaluate the impact of each intervention on controlling the spread of COVID-19 in Lahore. Results: From March 2020 to March 2022, 6,710,142 COVID-19 tests were conducted in Lahore, with 518,393 cases testing positive for the virus. The contact tracing strategy involved tracing an average of 6.83 contacts per positive case in 2020, which increased over the year, and an average of 6.80 contacts per positive case in 2021, with a decrease in the second quarter of the year. The cordoning-off strategy was used to contain the spread of COVID-19 in over 340 areas of Lahore. Shutdowns of non-essential businesses and schools, guidelines for social distancing, and the use of PPE were also effective in reducing the transmission of COVID-19. The vaccination drive reached a large portion of the population, with 11,490,267 individuals vaccinated up to the 1st quarter of 2022. Conclusion: The implementation of various public health interventions has been effective in controlling the spread of COVID-19 in Lahore. Further research is needed to assess the long-term impact of these interventions and to identify best practices for future pandemic response efforts.

**Keywords**---COVID-19, Lahore, public health interventions, contact tracing, vaccination drive.

## **Introduction**

The COVID-19 pandemic has had a profound impact on public health, economies, and societies worldwide <sup>1</sup>. Governments have been implementing various measures to curb the spread of the virus, including quarantine measures, contact tracing, and testing <sup>2, 3</sup>. In Pakistan, the government has also implemented a range of measures to control the spread of the virus, including restrictions on public gatherings and the closure of non-essential businesses<sup>4, 5</sup>. Lahore, the second-largest city in Pakistan and the capital of Punjab, has been significantly affected by the pandemic <sup>6, 7</sup>. To control the spread of the disease, a range of public health interventions were implemented in Lahore, such as the establishment of isolation wards, contact tracing teams, and quarantine facilities. Despite these interventions, there is still a need for a better understanding of the dynamics of the disease and the effectiveness of the public health interventions used to control it <sup>8-10</sup>.

This study aims to evaluate the effectiveness of public health interventions implemented in Lahore to control the spread of COVID-19. The study will analyze the Lahore government's response to the pandemic and identify lessons learned and recommendations for future public health emergencies. The evaluation of the effectiveness of public health interventions implemented in Lahore is critical for controlling the spread of the virus and minimizing its impact on public health and the economy. Additionally, the study will highlight the importance of ongoing monitoring and evaluation of public health interventions to ensure their effectiveness in controlling the spread of infectious diseases. This study will provide a comprehensive understanding of the dynamics of COVID-19 in Lahore and the effectiveness of public health interventions implemented to control its spread. The findings will be relevant to policymakers, public health officials, and researchers involved in designing and implementing public health interventions to control the spread of infectious diseases. Moreover, this study will contribute to the development of culturally appropriate interventions that can effectively address social and cultural barriers to compliance with public health guidelines.

## **Material and Methods**

This study used secondary quantitative data obtained from the office of the Deputy Commissioner / Administrator District Health Authority in Lahore. Before data collection, the study received approval from the Institutional Review Board and Deputy Commissioner Lahore. The population of the study comprised confirmed COVID-19 patients residing in the Lahore district. A convenience sampling technique was used to select the sample. The inclusion criteria for the sample were confirmed COVID-19 patients of any age and gender, who tested positive on the PCR test and were residents of the Lahore district. The exclusion criterion was patients confirmed through clinical diagnosis but did not undergo PCR confirmatory test. The daily records data from March 2020 to March 2022 were obtained from the office of the Deputy Commissioner/Administrator of the District Health Authority in Lahore every month using a predefined proforma. The data were analyzed to evaluate the effectiveness of public health interventions implemented in Lahore to control the spread of COVID-19.

## Results

To control the COVID-19 pandemic, several interventions were implemented, including COVID-19 testing, contact tracing, travel restrictions, shutdowns of non-essential businesses and schools, guidelines for social distancing, personal protective equipment (PPE), effective communication, cordoning-off strategies, vaccination drives, strategies for healthcare capacity, and support for vulnerable populations. From March 2020 to March 2022, a total of 6,710,142 COVID-19 tests were conducted in Lahore. Out of these, 518,393 cases tested positive for the virus, with a total of 70,309 positive cases in 2020, 155,396 positive cases in 2021, and 33,470 positive cases in 2022. The contact tracing strategy involved tracing the contacts of individuals who tested positive for the virus and isolating or quarantining them to prevent further transmission. In 2020, an average of 6.83 contacts were traced per positive case, with a continued increase in the average number of contacts traced per positive case over the year. In 2021, an average of 6.80 contacts were traced per positive case, with a decrease in the average number of contacts traced per positive case in the second quarter of the year. In 2022, only data for the first quarter was available, with an average of 6.19 contacts traced per positive case. Overall, a total of 1,743,937 contacts were traced from 518,393 positive cases over three years, with an average of 3.36 contacts traced per positive case (Table-1).

Authorities in Lahore implemented aeroplane, train and road travel restrictions on specific regions and monitored the situation to ensure the measures were effective in controlling the spread of COVID-19. The Civil Aviation Authority (CAA) categorized countries into three categories - A, B, and C - and imposed a complete travel ban on category C countries. The SOPs were developed to screen travellers for COVID-19 symptoms and prevent the spread of the virus. Shutdowns of non-essential businesses, and schools, and encouraging employers to have their employees work from home have been key strategies. Governments have also provided guidelines for people to maintain a safe distance from each other in public spaces, including wearing masks, washing hands frequently, and maintaining a distance of at least six feet from others. The use of personal protective equipment (PPE) like face masks has played a significant role in reducing the transmission of COVID-19. Wearing face masks can help reduce the spread of droplets containing the virus, but proper usage is crucial.

Effective communication with the public was one of the most important strategies used. Regular updates on the current situation and the number of cases were crucial in keeping the public informed. The public needed to be made aware of the latest developments and the measures being taken to address the crisis. This was done through various channels such as media releases, press conferences, and online platforms, providing clear and concise information that was easy to understand. The cordoning-off strategy was used to contain the spread of COVID-19 in over 340 areas of Lahore. Physical barriers were established around high-risk areas to limit the movement of people in and out, and testing and quarantine measures were implemented for those entering or leaving these areas. The strategy involved identifying areas with high numbers of cases using data analysis. The areas that were cordoned off in Lahore due to the highest number of COVID patients were DHAs with 7456 cases (18.44%), Cantt with 4823 cases

(11.93%), Johar Town with 4198 cases (10.38%), Model Town with 3250 cases (8.04%), and Gulberg with 2487 cases (6.15%) (Table-2).

Vaccinations started in Lahore in March 2021, with 103,231 people receiving the vaccine. The number of vaccinations increased significantly in April and May, reaching a total of 812,805 and 1,360,755, respectively. Vaccination numbers gradually decreased in the following months before increasing again in February 2022, with 1,531,716 people receiving the vaccine. The vaccination drive was divided into several categories and facilities, with a total of 11,490,267 individuals vaccinated up to the 1st quarter of 2022. The largest percentage of vaccinations (37.55%) were administered through mobile vaccination units, with a total of 4,314,067 vaccinations administered in various Union Councils. Covid Vaccination Centers accounted for 34.89% of vaccinations, while other facilities accounted for 10.04%, 6.87%, and 7.17%. The data shows that the vaccination drive was successful in reaching a large portion of the population, and the use of mobile vaccination units was a significant factor in this success.

To prevent the collapse of healthcare systems, a strategy for healthcare capacity was developed, which included increasing the number of hospital beds, hiring more staff, providing training to existing staff, and setting up triage centres. The strategy was informed by guidelines from the World Health Organization (WHO) and the Ministry of National Health Services and covered eleven domains, including incident management, surge capacity, infection prevention and control, case management, human resource, continuity of essential health services, surveillance, communication, point of entry, laboratory services, and logistics and essential support services. To address vulnerable populations, strategies such as providing food and financial assistance, disseminating information about the virus, providing access to testing and resources, addressing specific needs of marginalized communities, and providing psychological support have been implemented. These strategies aim to reduce the spread of the virus and ensure that vulnerable populations have access to the resources they need to protect themselves and cope with the impacts of the pandemic.

Table 1  
COVID-19 Testing in Lahore

Year	Number of Tests Conducted	Number of Positive Cases
2020	1,385,619	70,309
2021	3,538,262	155,396
2022	1,786,261	33,470
Total	6,710,142	518,393

Table 2  
Cordoning-Off Areas in Lahore

Area	Number of Cases	Percentage of Total Cases
DHAs	7,456	18.44%
Cantt	4,823	11.93%
Johar Town	4,198	10.38%

Model Town	3,250	8.04%
Gulberg	2,487	6.15%
Other Areas	35,179	54.06%
Total	57,393	100%

## Discussion

The present study emphasises the importance of various strategies in controlling the spread of COVID-19. These findings are consistent with the results of several other studies conducted in different countries. When comparing the statistics of Lahore with other countries in the region, it is evident that Lahore has had lower mortality rates and consistently high recovery rates <sup>11</sup>. For example, in 2021 Q2, Lahore had a mortality rate of 2.37%, while Afghanistan, India, and Iran had rates of 3.84%, 1.30%, and 1.64%, respectively. Similarly, Lahore had a high recovery rate of 99.33% in 2022, while Afghanistan had a recovery rate of 92.54% and India had a recovery rate of 96.71% in the same year. In terms of positive rates, Lahore had lower rates than Bangladesh and India overall, but higher rates than Sri Lanka and the UAE in certain quarters. For instance, in 2021 Q1, Lahore had a positive rate of 7.83%, while the UAE had a rate of 0.33%. However, Lahore had a lower positive rate than India in most quarters. It is also essential to note that Lahore's population size is significantly larger than some of the countries being compared to, such as Sri Lanka and the UAE. Therefore, this may impact the overall situation regarding the specific disease in Lahore. However, the data indicates that Lahore's strategies and interventions, such as effective communication, community engagement, and healthcare capacity building, have been successful in controlling the spread of COVID-19 and mitigating its impact on the population.

Several studies have highlighted the significance of various measures in managing the COVID-19 pandemic. For instance, Akter et al. (2022) <sup>12</sup> stressed the importance of community participation and capacity building for effective COVID-19 management. Similarly, Lupton and Lewis (2021) <sup>13</sup>, Ha et al. (2021) <sup>14</sup>, and Gilmore et al. (2020) <sup>15</sup> emphasized the relevance of clear communication, good data management, and regular reviews to ensure that policies and procedures are addressing the pandemic's challenges. Filip et al. (2022) <sup>16</sup> and Mallah et al. (2021) <sup>17</sup> highlighted the importance of screening individuals to stratify them into different risk levels and reduce the risk of transmission. Updating protocols and suspected case criteria regularly for optimal resource use and the best possible treatment was also deemed necessary, as mentioned in our study and Purssell et al. (2020)<sup>18</sup> and Thomas et al. (2020) <sup>19</sup>.

Various studies have underscored the significance of implementing infection prevention and control measures to ensure the safety of both patients and healthcare workers during the COVID-19 pandemic. Proper hand hygiene, eye protection, and the use of appropriate PPE, such as N95 respirators, have been emphasized as critical measures in preventing transmission. Additionally, the correct inspection, disinfection, and disposal of PPE, as well as ongoing education and training for healthcare workers, have been highlighted as essential in maintaining staff readiness and competency <sup>20, 21</sup>. Furthermore, studies have suggested that multidisciplinary peer-review processes following each operation

with COVID-19 patients can aid in process improvements and ensure that healthcare personnel and stakeholders are adequately briefed<sup>22, 23</sup>. The study had certain limitations i.e., one limitation of this study is that it is a retrospective analysis of data collected during the pandemic. As a result, it is subject to the limitations of observational studies and potential confounding variables. Additionally, the data collected in this study were from a single city and may not be generalizable to other areas. Finally, the study relied on publicly available data and may be subject to errors in data collection or reporting.

## **Conclusion**

The COVID-19 pandemic has presented a major challenge to the healthcare systems and public health infrastructure around the world. The situation in Lahore, Pakistan was no different. However, effective implementation of various public health interventions including testing, contact tracing, social distancing guidelines, PPE use, communication strategies, vaccination drives, and support for vulnerable populations, has shown promising results in controlling the spread of COVID-19. Continued efforts are needed to sustain these interventions and address any new challenges that may arise in the future. Additionally, ongoing research is necessary to assess the long-term impact of these interventions and identify best practices for future pandemic response efforts. Overall, the lessons learned from the COVID-19 pandemic will be invaluable in strengthening public health preparedness and response in the future.

## **Recommendations**

Based on the findings and limitations of this study, several recommendations can be made. Firstly, it is important to continue implementing and enforcing public health interventions, including COVID-19 testing, contact tracing, travel restrictions, social distancing, and the use of PPE. Additionally, there is a need to improve communication strategies to increase public awareness and adherence to these interventions. It is also important to continue the vaccination drive and ensure equitable access to vaccines for all populations, including vulnerable groups. Furthermore, there is a need to strengthen healthcare capacity, particularly in terms of increasing the number of hospital beds, ICU beds, and ventilators, as well as training healthcare workers in infection prevention and control measures. Finally, further research is needed to assess the long-term impact of these interventions and identify best practices for future pandemic response efforts.

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