

Review article

# The Effect of Vaccines on Vaccinated and Unvaccinated Patients Hospitalized for COVID-19

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## Abstract

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is an exceedingly transmissible and pathogenic RNA virus from the subfamily Orthocoronavirinae. It has caused a worldwide pandemic; consequently, a pandemic of "Acute respiratory disease", known internationally as "COVID-19". A disease capable of causing lethal or long-term complications, such as liver and kidney impairment, adverse heart problems, and severe blood clots leading to pulmonary embolism or strokes. A disease that predominantly constitutes a threat to humanity. An infection of a fully vaccinated person is given a term referred to as a "Vaccine breakthrough infection"; thus, fully vaccinated people may still be infected if they live in areas with considerable or high transmission of COVID-19. Research has shown that vaccines prevent serious symptoms if a breakthrough infection develops. This study aims to discover and show the effect of different vaccines on those hospitalized for COVID-19. Repeated observations and examinations were conducted on the same individuals to detect any changes that might occur over some time. Patients were divided into two categories (vaccinated and unvaccinated) and were checked clinically using various medical devices. Results were extraordinarily remarkable, as they disclosed that vaccinations are greatly associated with better clinical outcomes, in terms of shorter hospital stays and better oxygen saturation when compared with those who have not been vaccinated. The unvaccinated patients add up to 85% of the total admission; the vaccinated amassed only 14%. The total number of deaths for COVID-19 patients in Mitiga's Preventive Medical Hospital was less than 25%. 81% of the dead patients were not vaccinated. The conclusions indicate that vaccination impacts the morbidity and mortality of those individuals admitted for COVID-19. On these terms, it is recommended that the ministries of health and other health organizations worldwide increase awareness of the superiority and importance of coronavirus vaccines. This research is limited and does not cover the prosperity of patients after being discharged.

**Keywords:** Vaccine Breakthrough Infection, Hospitalization, Morbidity, Mortality.

## Introduction

"Vaccines save lives", that's what most people say. A treatment for COVID-19 has not yet been established. Nevertheless, an array of approaches to prevent this disease have been made. Vaccines are a great example and one of the most effective approaches in defending against this pandemic. However, do COVID-19 vaccines prompt hospitalization? Are they inefficient? The answer is "NO". Numerous COVID-19 vaccine studies have been conducted concerning the efficacy of vaccines for COVID-19. These studies show the occurrence of breakthrough infections and the effect of vaccines on them [1,2]. Although the correlation between COVID-19 vaccines and vaccine breakthrough infections has been studied thoroughly, inadequate attention has been paid to the effect of different vaccine types on the morbidity and mortality of the Libyan population. This study aspires to answer the following question: How do different vaccine types affect the morbidity and mortality of those hospitalized in Mitiga's Preventive Medical Hospital? It was hypothesized that individuals with underlying conditions, old age, or inappropriate vaccine stratagem increase the chances of vaccine breakthrough infection. This research begins by analyzing the methods used to create this paper, the results, and the findings; then goes on to give possible reasons and interpretations of the results.

## Material and Methods

### *Study design*

This longitudinal study was conducted between December 1, 2021, and March 1, 2022; utilizing Mitiga's preventive Medical Hospital data. We abstracted data on total hospitalized COVID-19 cases, vaccine types, admissions to the ICU, and deaths in the capital of Libya (Tripoli). The primary objective was to compare the total COVID-19 cases hospitalized and deaths in vaccinated versus unvaccinated patients over three months (Dec 2021 - Mar 2022).

### *Materials*

The EDAN's Patient monitor (model: iM60) was used to measure the patients' vital signs by the hospital's nurses or a medical professional. We hourly measured each admitted patient's oxygen saturation, blood pressure, heart rate, temperature, urine output, and random blood sugar. Daily, the patient's health was monitored with medical laboratory test information {such as CBC, ABG, CRP, LFT, UEC, D. Dimer 2, serum Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup>} and physically examined. Electrocardiographs, medical ultrasonography, X-ray scans, and HRCT scans helped us closely examine and regulate the patients' underlying conditions throughout this disease.

### *Participants*

The sample encompassed 454 patients with different ages {varying from 16y old to 104y old}, genders, ethnicities {Libyan, Egyptian, Sudanese, Algerian, Moroccan, Somalis, and Filipinos}, and medical histories. Ethics approval was gained during the inscription of the required data. As the study depended on the cooperation of the family members or the participated patients themselves. Individuals were admitted to the hospital for COVID-19 if the oxygen saturation reads below 90% on room air, with a positive RT-PCR or rapid antigen test. People have also been admitted if their oxygen saturation was above 90% and tested positive for COVID-19, with underlying conditions (DM, DKA, MI, COPD, Asthma, Hyperkalemia) that may raise the risk of severe illness. Individuals are admitted if their oxygen saturation is below 90% and a negative RT-PCR or rapid antigen test, but with a family member testing positive for COVID-19. The patients were only discharged from the hospital after testing negative for RT-PCR or rapid antigen test; with an oxygen saturation above 92% on room air. The data regarding the vaccinated patients were gathered during clinical audits. All the information concerning vaccination, the number of doses, the time of the most recent vaccine, and the type of vaccine were documented on the patients' files and in our data collecting form. This data was only authenticated if a vaccine card of the patient was brought if not, the data was renounced and was not enrolled. Other information such as underlying conditions, age, and sex were also documented. Some of these patients were cases of "vaccine breakthrough infection" and were admitted to the hospital for COVID-19. In Mitiga's Preventive Medical Hospital, individuals that bear COVID-19 undergo clinical audits. In the audits, we record the patient's vital signs, underlying conditions, medications they're taking, and other related information. Patients are then admitted for COVID-19.

### *Experimental procedure*

To begin, admitted patients were asked if they were vaccinated against COVID-19, if so, then a vaccination card or a printed photograph of the card was asked for. Once information concerning the vaccinated patient was brought, a data collecting form was filled with the patient's information. If a patient wasn't vaccinated, then only the data concerning vaccination wasn't filled; he/she was enrolled under unvaccinated participants. In consideration that this is a longitudinal study, information was collected until the participant was either discharged or passed away.

## Results

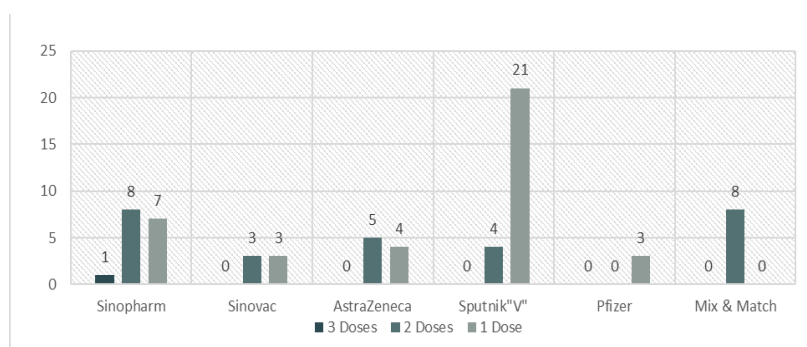
Approximately 2 million people received 1 dose in Libya, and 1 million received 2 doses [3]. The overall vaccinated accounts for about 15% of the whole population. Between December, 1st 2021, and March, 1st 2022, a total of 454 patients were admitted to Mitiga's Preventive Medical Hospital for COVID-19. 85% CI {387 patients} of those admitted were unvaccinated, while the vaccinated amassed to only 14% CI {67 patients}. The death toll for COVID-19 patients in Mitiga's Preventive Medical Hospital was less than 25% CI {104 patients}. 81% CI {85 patients} of the dead patients were unvaccinated.

### *Unvaccinated*

A total of 387 unvaccinated patients were enrolled, and 178 patients were transferred or admitted as I.C.U. patients. The average length of stay {ALOS} in the hospital for unvaccinated patients near 26 days CI {25.67}.

### **Sinopharm**

The Sinopharm vaccine is a type of inactivated vaccine [4]. The virus in the following vaccine is killed by heat, disinfectants, UV, or  $\gamma$ -radiation. Unlike a live vaccine, the virus loses its capability to replicate and cause disease even in immunodeficient individuals. The downside of this vaccine type is that one dose merely fortifies the immune system; protection is achieved only after multiple doses {After the 2nd or 3rd dose} [5,6]. A total of 16 patients vaccinated with Sinopharm were enrolled. 1/16 patients received 3 doses, 8/16 patients received 2 doses, and 7/16 patients received 1 dose of Sinopharm {Figure 1}. For patients who were vaccinated with Sinopharm, the average time interval between the latest vaccine and COVID-19 infection is about 57 days {Two months}. For Sinopharm, 7/16 patients were transferred or admitted as I.C.U. patients (4 vaccinated once, and 3 vaccinated twice); two lost their lives in the I.C.U. and the rest were discharged. The ALOS for patients vaccinated with Sinopharm and admitted to the hospital for COVID-19 was about 10 days CI {9.75}. The total deaths add up to 5/16 patients.



**Figure 1.** The analogy between different vaccine types and the amount of dose each admitted patient received.

### **Sinovac**

Sinovac is a type of inactivated vaccine as well [7]. A total of 6 patients vaccinated with Sinovac were enrolled. 3/6 patients received 2 doses, and the remaining three patients received only 1 dose of Sinovac {Figure 1}. For patients who were vaccinated with Sinovac, the average time interval between the latest vaccine and COVID-19 infection is about 38 days {One month}. Regarding Sinovac, 4/6 patients were transferred or admitted as I.C.U. patients (3 vaccinated once, and 1 vaccinated twice); two lost their lives in the I.C.U. and the rest were discharged. Where ALOS for patients vaccinated with Sinovac and admitted to the hospital for COVID-19 was about 13 days CI {12.48}. The total deaths add up to 2/6 patients.

### **AstraZeneca**

AstraZeneca is a viral vector vaccine [8]. Similar to the mRNA vaccine, a viral vector vaccine doesn't use a virus, therefore it's replication-deficient and won't cause disease. This vaccine deposits genetic material in a viral vector; a different and modified version of a virus [5,6]. A total of 9 patients vaccinated with AstraZeneca were enrolled. 5/9 patients received 2 doses, and the remaining four patients received only 1 dose of AstraZeneca {Figure 1}. For patients who were vaccinated with AstraZeneca, the average time interval between the latest vaccine and COVID-19 infection is about 140 days {Five months}. As for AstraZeneca, 4/8 patients were transferred or admitted as I.C.U. patients (2 vaccinated once, and 2 vaccinated twice); one lost his life in the I.C.U. And the rest were discharged. Additionally, the ALOS for patients vaccinated with AstraZeneca and admitted to the hospital for COVID-19 was about 14 days CI {14}. The total deaths add up to 3/9 patients.

### **Sputnik "V"**

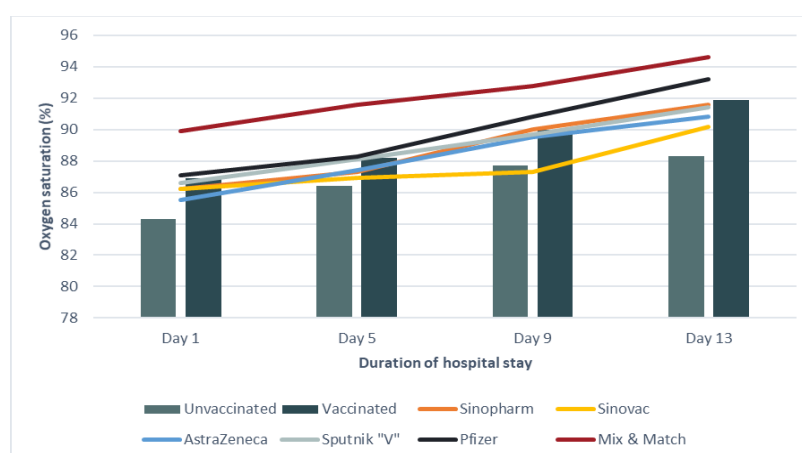
Sputnik "V" is a live-attenuated vaccine [9]. The virus in this vaccine is weakened, and its pathogenicity is abolished {long lasting compared to the Inactivated vaccine}, but its ability to replicate still stands. This type of vaccine usually doesn't cause disease, but if it does, the immune response to the disease is milder and similar to that fabricated by a natural infection [5,6]. A total of 25 patients vaccinated with Sputnik "V" were enrolled. 4/25 patients received 2 doses, and 21/25 patients received only 1 dose of Sputnik "V" {Figure 1}. For patients who were vaccinated with Sputnik "V", the average time interval between the latest vaccine and COVID-19 infection is about 143 days {Five months}. For Sputnik "V", 11/25 patients were transferred or admitted as I.C.U. patients (10 vaccinated once, and only 1 vaccinated twice); Seven lost their lives in the I.C.U. and the rest were discharged. And the

ALOS for patients vaccinated with Sputnik “V” and admitted to the hospital for COVID-19 was about 15 days CI {15.4}. The total deaths add up to 9/25 patients.

### **Pfizer**

Pfizer is an mRNA vaccine [10]. This vaccine teaches the immune system to make antibodies that bind to the spike protein of SARS-CoV-2 through genetically engineered mRNA. The mRNA is enveloped by a coat of fat particles to protect and transmit it in “Dendritic cells” [5,6]. A total of 3 patients vaccinated with Pfizer were enrolled. The three patients received only 1 dose of Pfizer {Figure 1}. For patients who were vaccinated with Pfizer, the average time interval between the latest vaccine and COVID-19 infection is about 64 days {Two months}. Pfizer vaccinated patients were not transferred or admitted as an I.C.U. patient. No death was recorded for Pfizer. Finally, the ALOS for patients vaccinated with Pfizer and admitted to the hospital for COVID-19 is about 12 days CI {11.6}.

The average oxygen saturation of the overall vaccinated individuals ranges between 85% and 94%. While the average oxygen saturation of the overall unvaccinated individuals ranges between 78% and 91%. Figure 2 illustrates the progression of oxygen saturation throughout 13 days, to visualize the difference between those who have been vaccinated and those who haven't {see Figure 2}.



**Figure 2.** Comparing the oxygen saturation throughout the patients' stay in the hospital between the unvaccinated and vaccinated.

### **The "Mix and match" approach**

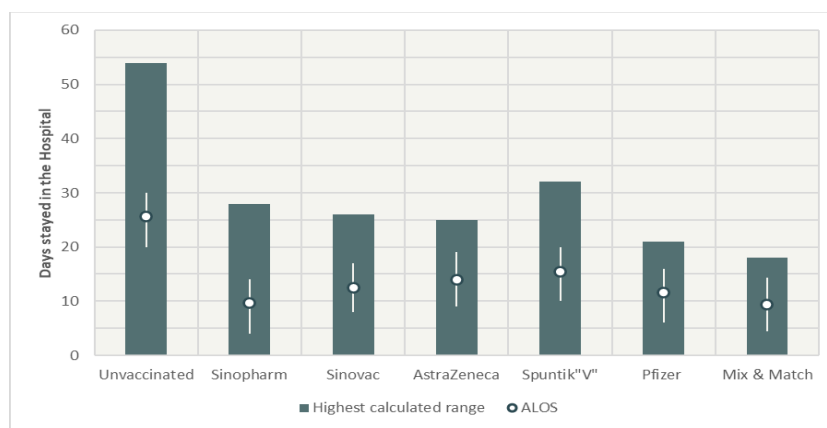
The heterologous prime-boost vaccine or "mix and match" approach is nothing new. This vaccination technique involves the vaccination of different vaccine types. It was tested in the 21st century on HIV vaccines and it showed tremendous potency [11,12]. Today, an identical attitude is being used for SARS-CoV-2.

### **Coalescence of Sinopharm and AstraZeneca**

Two patients were admitted with this vaccine mix for COVID-19. One of the two patients was a 55-year-old male with a known case of “Diabetes mellitus” and “Hypertension”; oxygen saturation didn't drop below 89% {was put on a poly mask with an 8L/hour flow rate}. He was vaccinated the second dose 7 months CI {212 days} before admission and was discharged after 8 days.

### **Coalescence of Sputnik “V” and AstraZeneca**

Three patients were admitted with this vaccine mix for COVID-19. One of the three patients was a 72-year-old male with a known case of “ischemic heart disease”, “Hypertension”; “Pleural effusion”, and “chronic kidney disease” on regular dialysis. Oxygen saturation didn't drop below 86% {was put on a poly mask with a 12L/hour flow rate}. He was vaccinated the second dose 4 months CI {122 days} before admission and was discharged after 13 days.



**Figure 3.** The relation between the types of vaccine, unvaccinated, and the average length of stay {ALOS} in the hospital.

#### ***Coalescence of Sputnik "V" and Sinopharm***

One patient was admitted with this mix for COVID-19. The patient was an 80-year-old female with a known case of "Bronchial asthma", "Hypertension", and "Acute kidney injury"; oxygen saturation didn't drop below 90% {on room air}. She was vaccinated the second dose 9 days before admission and was discharged after 9 days.

#### ***Coalescence of Sinovac and Sinopharm***

One patient was admitted with this mix for COVID-19. The patient was a 50-year-old male not a known case of any chronic illness; oxygen saturation didn't drop below 92% {was put on a nasal cannula with a 4L/hour flow rate}. He was vaccinated the second dose 4 months CI {126 days} before admission and was discharged after 5 days.

#### ***Coalescence of AstraZeneca and Pfizer***

Only one patient was admitted with this mix for COVID-19. The patient was a 93-year-old female with a known case of "Hypothyroidism" and "Hypertension". Oxygen saturation didn't drop below 92% {on room air}. She was vaccinated the second dose 5 months CI {164 days} before admission and was discharged after 4 days.

The ALOS for patients vaccinated with a heterologous prime-boost vaccine is 9 days CI {9.4}; the average time interval between the latest vaccine and COVID-19 infection is around 194 days {6 months}. Out of the eight, only one patient was admitted to the I.C.U, and none died {see Figure 3}.

#### ***Adverse events***

Similar to other research, several adverse events during data collection were encountered. Primarily, some participating patients were discharged against medical advice {DAMA} by the family members; as this made it burdensome to accurately observe and collect the required data. Phone calls and video chats with collaborating family members were used as means to collect the remaining data required for these patients. However, several patients were excluded for not providing the necessary data and meeting the study criteria {21 patients}. The lung condition of both the patients (Vaccinated and unvaccinated) that died or were discharged after COVID-19 was collected, but due to the HRCT not always being applicable, missing data evolved, and the topic along with the data was repudiated.

#### **Discussion**

These results support the theory that vaccines play a crucial role in the morbidity and mortality of those infected with COVID-19 [3]. This analysis demonstrates a correlation between the time of vaccination and the point at which the vaccine breakthrough infection progressed. Keep in mind that different vaccines have different outcomes. Our data bear to reveal that Sinopharm protects the body for roughly 57 days. For Sinovac, protection lasts for about 38 days. AstraZeneca protects the body for roughly 140 days. Sputnik "V" has been shown to prevent this disease for about 143 days. Pfizer on the other hand has been shown to protect the body for about 64 days. Finally, the "mix and match" approach presented surprising outcomes, as they maintained the protection for approximately 194 days. Additionally, the data indicates that the average length of stay [ALOS] for the vaccinated patients {1 or 2 doses} was a lot less than for those who did not vaccinate. The same can be said about the significance of a COVID-19 patient being in a life-threatening situation and sent to the I.C.U. For instance, out of the overall admitted patients, about 46% CI {178} of

the unvaccinated patients were sent to the I.C.U., whereas the vaccinated patients only make up 6% CI {27} of the patients admitted to the I.C.U.

Surprisingly, the data suggests that the "mix and match" or heterologous prime-boost vaccines fabricate an enhanced and long-lasting response compared to a single vaccine regimen. Furthermore, this data evinces the efficacy of such coalescence by forging symptoms that were milder despite the underlying conditions. In line with the hypothesis, individuals that did not receive their second jab {patients who were vaccinated once} and did not properly complete their vaccine stratagem, decreased the immunization effect and increased the risk of COVID-19 infection, becoming severely ill, and entering the I.C.U. Of course, the risk increases if someone did not vaccinate at all.

SARS-CoV-2 is capable of making anyone seriously ill. However, for some individuals, the risk is higher. Old adults have a higher chance of getting seriously ill from COVID-19, consequently, increasing the chances of COVID-19 being fatal. According to the Center of Disease Control {CDC}, more than 81% of COVID-19 deaths happen over the age of 65 [13]. Likewise, a person's risk of severe illness elevates as the number of underlying medical conditions increases. Nonetheless, the experiment fortifies a new insight into the affiliation between vaccines and the morbidity and mortality rates of those with an increased risk of severe illness.

The results showcased how individuals who were presumed to become ill did not because they were vaccinated before the infection materialized. These results supplement existing evidence of past research conducted on vaccine breakthrough infections [3]; while these preceding researches fixated on the general effect of vaccines, these results demonstrate that vaccines can even protect those with serious underlying medical conditions. It is beyond the scope of this study to convey the cause of death in deceased patients (vaccinated or unvaccinated patients) and the well-being of those discharged. Further research is required to inaugurate whether the cause of death is a factor that's different between the vaccinated and unvaccinated patients, accompanied by supplementary research to establish whether post-COVID-19 complications {e.g., post-covid lung fibrosis} differ between the vaccinated and unvaccinated.

### Conclusion

Vaccines have been around for some time, moreover, they have had an eminent positive effect on peoples' health worldwide, and their values are evident in numerous applications. The future of disease prevention and one's well-being depends on vaccines' development, testing, and implementation. COVID-19 vaccines have validated their usefulness throughout this research, with different positive outcomes for different vaccine types and combinations. They have reduced the patients' hospital stay and symptoms and protected individuals with serious underlying conditions that generally elevate the morbidity rate when infected with COOVID-19. Vaccines are only a segment of a much-needed effort to battle and withstand this disease, but they are an important segment that can help make an impactful difference in our health.

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