A STUDY ON COVID19 VACCINE ACCEPTANCE AMONG RESIDENT UNDERGRADUATES OF THE UNIVERSITY OF BENIN, EDO STATE

BY

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CERTIFICATION

This is to certify that this work was successfully carried out by Osazemen Erhunmwunsee, department of clinical pharmacy, faculty of pharmacy, University of Benin, Benin City in partial fulfillment of the requirement for the Doctor of Pharmacy (Pharm.D) degree of the University of Benin, Benin City, Edo state, Nigeria

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Dedication

This work is dedicated to God almighty, my creator for his unfailing love towards me and to my parents for always seeing the wonder in me. I love you dada and momma.

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I am eternally grateful to God almighty who; in his infinite mercies have brought me this far and also my unlimited source of inspiration throughout my sojourn in pharmacy school.

To my parents, Chief and Mrs. E. Erhunmwunsee for their constant and unwavering love, support and prayers, not only during my college years but my entire life.

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ABSTRACT

Background: More than a year on from the emergence of COVID-19 in China in December 2019, it is expected that the COVID-19 pandemic will continue to impose enormous burdens of morbidity and mortality while severely disrupting economies and reducing GDP worldwide. Acceptance of the newly developed COVID-19 vaccine by the general public particularly in colleges and universities where rate of transmission is high is important for normalcy to return to campuses. The aim of this study is to explore the perception and acceptance of the COVID-19 vaccines among resident undergraduates of University of Benin, Edo state.

Method: The research is a descriptive one and a quantitative survey based approach was adopted using a 30 item questionnaire that was self structured and collected information on demographics, knowledge levels of COVID-19 and COVID19 vaccines, vaccine coverage and willingness to take the COVID19 vaccine. The questionnaires were administered in person to the respondents. Descriptive statistics on frequency distributions and percentage was used to analyze the responses. Data was analyzed using SPSS**.**

Results: There are 333 respondents of which 164 are males and 169 females. Knowledge levels are relatively high as indicated of almost 100% on COVID19 and 99.4% on their vaccines. Results also indicate low COVID19 vaccination coverage of 3.9% of which 44.3% of respondents indicates refusal to take the vaccine.

Conclusion: Low covid19 vaccination coverage with high refusal of respondents on acceptance of the vaccine. There is need to increase awareness on the covid19 vaccine as this will increase vaccination uptake and promote coverage in the university.

Chapter one

1.1 Introduction

Disease and illnesses have plagued humanity since the earliest days and intermittent outbreaks of infectious diseases have had profound and lasting effects on societies throughout history. There have been recorded processions of pandemics that each shaped our history and our society, inclusive of shaping the very basic principles of modern health sciences.

The world is more crowded and interconnected than ever before with increasing rate of human and animal interactions providing a growing opportunity for such epidemics like malaria, tuberculosis, leprosy, influenza, smallpox, and others to spread, re-assort, and rapidly adapt. There have been many significant pandemics recorded in human history, and the pandemic related crises have had enormous negative impacts on health, economies, and even threatened national security in the world.

1.2 Background

More than a year on from the emergence of COVID-19 in China in December 2019, there have been more than 137 million confirmed cases of COVID-19 and nearly 3 million deaths worldwide (WHO 2021). A variety of public health measures have been implemented by many countries in trying to prevent the spread of the virus (WHO, 2020). The global efforts to lessen the effects of the pandemic, and to reduce its health and socio-economic impact, rely to a large extent on the preventive efforts (Tanne et al., 2020). For most countries, the development of a safe and effective vaccination for COVID-19 is seen as the long-term solution to the COVID-19 pandemic. A critical step in extinguishing the pandemic will be vaccination of a high proportion of the population but

its success strongly relies on the acceptance of vaccines among various populations including young adults (Lazarus et al 2021). Thus, huge efforts by the scientific community and the pharmaceutical industry backed by the governments' support were directed towards developing efficacious and safe vaccines for Sars-CoV-2(Conte et al 2020). This effort was manifested by the approval of several vaccines for the emergency use in addition to more than sixty vaccine candidates in clinical trials. Moreover, more than one hundred and seventy COVID-19 vaccine candidates are in the pre-clinical phase (WHO 2021). Utility of vaccine campaign to control corona virus 2019 is not merely dependent on the vaccine efficacy and safety. Vaccine acceptance among the general public and health care workers appear to have a decisive role in the successful control of the pandemic. In studies conducted, there has been large variability in covid-19 vaccine acceptance rates with east and south East Asia having relatively higher rates than in other continents. This includes more than 90% acceptance rates in Indonesia, Malaysia and one study from china (Wang et al 2020; Harapan, et al 2020; Wong, et al 2020). Another survey on the general public in china reported vaccine acceptance rate of 79.8% (Lazarus, et al 2020) while the lowest covid-19 vaccine acceptance rate among the general public in the region was reported in Singapore (67.9%)(Lazarus, et al 2020). The relatively high rates of vaccines acceptance in the region were attributed to strong trust in government and stronger confidence in vaccine safety and efficacy. A survey conducted in Russia using the Russian registered sputnik V vaccine recorded a percentage of 26 agreeing to participate in the free mass vaccination of the population with the vaccine, which was produced in Russia. The share of respondents who certainly did not want to receive the vaccine in the near future was recorded at over 60percent (Statista 2021). These variations across demographic groups in several studies can also be seen in studies conducted in on undergraduates in several parts of the world. More recently, several studies emerged examining college students' attitude toward and intent to receive the covid-19 vaccine. Two studies from Italy

show that a high percentage of college students expressed intent to vaccinate (Barello, et al. 2020, Postorino, et al 2021). Among a sample of college students in South Carolina, higher acceptance of covid-19 vaccine was significantly associated with increased trust levels in mass media, health agencies, scientists, and pharmaceutical companies. Also in another study it appears that the intent to get vaccinated for covid-19 is lower among younger adults (Pew research center 2021). This is no surprise as vaccine hesitancy was a significant issue even before covid-19(Dube, et al 2014).

In order to build trust in COVID 19 vaccination efforts, addressing the scope of vaccine acceptance in developing countries like Nigeria becomes important. In schools and colleges; where there are high chances of transmission, it becomes important that awareness on the virus should be carried out in all the faculties.

1.3 Significance of the study

Vaccine acceptance among the general public and health care workers appear to have a decisive role in the successful control of the pandemic. In order to build trust in COVID 19 vaccination efforts, addressing the scope of vaccine acceptance in developing countries like Nigeria becomes important. In schools and colleges; where there are high chances of transmission, it becomes important that awareness on the virus should be carried out in all the faculties particularly residents of densely populated hostels where greater risk of transmission due to relaxed strict precautionary measures. There is need for the university, government and other stakeholders to understand students' response in the face of this public health emergency and develop good policies that will enhance adherence to preventive measures. Colleges and universities are recommended to reach out to the appropriate public health authority to be included in the planning and distribution of vaccine for students and other campus community members to prevent students from spreading the virus. Younger individuals may believe that covid-19 poses less serious threat to themselves than

other age groups as a result yielding higher covid-19 vaccine hesitancy hence the reason for this study.

1.4 What is a pandemic?

According to Wikipedia, a pandemic is an epidemic of an infectious disease that has spread across a large region, for instance multiple continents or worldwide, affecting a great number of people. This does not include endemic diseases whose numbers of infected people are stable as they occur simultaneously in large regions of the globe rather than being spread worldwide. A pandemic is an epidemic occurring on a scale that crosses international boundaries, usually affecting people on a worldwide scale (Portal et al. 2008). They are well known for their world wide spread and their ability to cause sickness and death while disrupting the social economic situation of many countries. In a long succession throughout history, pandemic outbreaks have decimated societies, determined outcomes of wars, wiped out entire populations but also paradoxically, cleared the way for innovations and advances in sciences (including medicine and public health), economy, and political systems (Scheidel 2017).

1.5 History of some notable pandemics

Many pandemics have occurred throughout the history of mankind. This occurred regularly throughout history with plague, small pox, cholera and Spanish flu being the longest lasting, repetitive and large numbers of human death causing pandemics. The mechanism by which cross species transmission of infectious pathogens occurs involves zoonotic transmission from animals to humans and its rate has increased dramatically with increased globalization. There have been some notable outbreaks that took place in history which have great impact on civilization including the black death of the fourteenth century, the Spanish flu of 1918 and more recent outbreaks of the twenty first century including SARS, Ebola and COVID19.

The plague: There have been three notable plagues in human history; the plague of Justinian, the Black Death and plague of Athens caused by *Yersinia Pestis* bacteria which are transmitted by fleas.

Plague of Athens (430 to 426 BC): During the Peloponnesian war, the plague which originated in Ethiopia spread throughout Egypt and Greece as a result of wartime overcrowding killing tens of thousands. The cause of the plague has not been clearly determined, initial symptoms included headaches, conjunctivitis, body rash and fever. Victims would generally die by the seventh or eighth day thus preventing a wider spread of the plague.

Antonine plague (165 to 180 AD): This occurred during the reign of Marcus Aurelius of Rome. It was caused by small pox brought by soldiers returning from Seleucia affecting Asia Minor, Egypt, Greece and Italy.

Plague of Cyprian (251 to 266 AD): It was said to have killed about 5000 people within a day.

Plague of Justin Ian (541 to 750 AD): Also called bubonic plague which eliminated quarter to a half of the world's population causing Europe to drop by around 50% of its population.

Black Death (1331 to 1353): it was one of the most devastating epidemics in human history killing tens of millions of Europeans (DeWitte. 2014).

Cholera: It is a fatal disease of the gastrointestinal tract caused by water borne pathogen *Vibro Cholera*. This pandemic emerged during the period of increasing globalization resulting from technological progress in transportation. There were five major pandemics of cholera spreading to other continents during the 19^{th} and 20^{th} centuries. It was during the fifth pandemic that Robert Koch isolated the bacillus cholera creating an understanding of the importance of clean water in preventing its transmission.

Influenza: Influenza viruses are single stranded RNA viruses belonging to the *orthomyxoviridae* family. They can be distinguished in types A, B, C, and D of which type A viruses are the only ones capable of causing a pandemic. The Russian flu was the first well described pandemic occurring between 1889 and 1893. It was caused by an H3N8 virus causing an estimated 1million death worldwide. The Spanish flu (1918 to 1920) was the first true global pandemic that occurred in the era of modern medicine, affecting half a billion people. It was a category of influenza pandemic caused by H1N1 strain subtype of the deadly influenza virus. The Asian flu of a new subtype H2N2 strain was first identified in china in late February 1957 causing about two million deaths due to respiratory diseases.

Ebola outbreak (2014 to 2016): The Ebola virus disease (EVD), formerly known as Ebola hemorrhagic fever which first appeared in 1976 is caused by the Ebola virus from the family Filoviridae. It is introduced into the human population through close contact with the blood, secretion, organs or other bodily fluids of infected animals like fruit bats, chimpanzees, gorillas and it causes an acute, serious illness. The name Ebola was gotten as a result of its outbreak in a village near the Ebola River. The 2014-2016 outbreak in West Africa was the largest outbreak since the virus was discovered in 1976 starting in guinea and moving across to Sierra Leone and Liberia.

Zika (2015-2016): Zika virus is a mosquito-borne dormant virus found in rhesus monkeys. The virus was first identified in Brazil in 2015 and found to be transmitted sexually. It causes fever, joint pain, headaches and pinkish rash similar to dengue fever. This mild course was of less concern in public health until it was discovered to cause Guillain-Barre syndrome in adults and severe microcephalia in unborn children of infected mothers.

Coronaviruses: Coronaviruses are a group of related RNA virus causing disease. The name was coined from the Latin word “corona” by scientists; June Almeida and David Tyrell due to its crown shape. They cause mild to lethal respiratory tract infections including the common cold and lethal infections caused by SARS, MERS and COVID-19. The earliest reports of a corona virus infection in animals occurred in the late 1920s, when an acute respiratory infection of domesticated chickens emerged in North America (Estola 1970). The virus was then known as infectious bronchitis virus (IBV). In the 1960s, it was discovered in human but couldn’t be cultivated unlike the rhinoviruses, adenoviruses and other common cold viruses. A new method was developed by Tyrrell and Bynoe which successfully cultivated the novel virus. The novel virus when inoculated intranasal caused a cold and can be inactivated by ether. The IBV-like novel cold viruses were shown to be morphologically related to the mouse hepatitis virus later renamed coronavirus due to their morphological appearance. Other human coronaviruses like SARS-CoV in 2003, HCoV NL63 in 2003, HCoV HKU1 in 2004, MERS-CoV in 2013, and SARS-CoV-2 in 2019 have been identified. Many human coronaviruses have their origin in bats as the human coronavirus NL63 shared a common ancestor with a bat coronavirus (ARCoV.2). coronavirus include four genera i.e. alpha-, beta-, gamma-, and delta-coronaviruses(masters and Perlman, 2013). The beta-coronaviruses includes three highly pathogenic viruses which are severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and SARS-CoV-2 that induce severe pneumonia in humans. These human coronaviruses produces diseases commonly called SARS, MERS and COVID 19 respectively. The severe acute respiratory syndrome is caused by the SARS Corona virus (SARS-CoV) and it was the first outbreak to get public attention in the twenty first century due to its 10% global mortality rate. The outbreak which originated from bats affected mainly china, Hong Kong and other countries including Canada and was contained due to the vigilance of the public health system. In September

2012, the Middle East Respiratory Syndrome MERS-CoV was identified to have emerged in humans from bats through camels as their intermediate host in Saudi Arabia. Infected individuals present mild to severe pulmonary diseases, renal dysfunction including fever, chills, non productive cough, athralgia and myalgia which worsen in older patients with co-morbidities. The SARS-CoV-2 pandemic which occurs in early December 2019 was caused by the SARS-CoV-2. The disease also referred to as COVID-19 was first reported in china. Symptoms includes most commonly fever, dry cough, shortness of breath, fatigue, headache, and complications like pneumonia, acute liver injury, cardiac injury, acute kidney injury and neurological manifestations.

1.6 stages of cross species disease transmission

The emergence of human diseases occurred when an established animal pathogen switched hosts into humans and subsequently transmitted within the human populations. This process of cross species transmission of pathogens involves several stages from stage 1 where it only exclusively infect animals into stage 5 where it exclusively infects humans.

Stage 1: A microbe only present in animal but has not been transmitted to humans under natural conditions (excluding modern technologies that aids transfer of microbes). In this stage, most animal pathogens are not transmitted to humans. Examples: most malarial plasmodia tend to be specific to one host species or to closely related group of host species.

Stage 2: An animal pathogen which is been transmitted to human under natural conditions. It involves primary infection from animals to humans but not between humans (secondary infection). Examples: rabies and West Nile viruses. As the existing host population increases with increase in fraction of the existing population infected and the frequency of encounters between an individual of the existing host(donor) and of the new host, the probability per unit time (p) of infection of an individual of a new host species(new recipient) will then increase.

Stage 3: An animal pathogen which undergoes secondary transmission between humans results in occasional outbreak that soon dies out. This human outbreak is often triggered by primary infection. Transmission often results in few victims yet a transition to stage 4 would lead to a devastating global impact. Examples: Ebola and monkey pox viruses.

Stage 4: the pathogen can be transmitted to infecting humans by primary transmission from the animal host. Secondary transmission occurs via long sequences between humans without animal host involvement. Examples influenza, cholera and typhus

Stage 5: a pathogen that is exclusive to humans only. This can occur in either of the two ways: an ancestral pathogen that is already present in the common ancestor of chimpanzee and humans could have co-speciated long ago; or else an animal pathogen could have colonized humans more recently and evolved into a specialized human pathogen (Wolfe, et al 2007).

Cross host exposures are an important step in transference to new hosts, and some host switching events are likely prevented because of limited contact between pathogens and potential new hosts. Factors that control the risk of zoonotic transmission may include the animal species that host the pathogen, nature of interaction between animal and human and the frequency of these interactions.

1.7 viral infections

A viral infection occurs as a result of a pathogenic virus entering and replicating in the human body system, prompting the immune system which acts as the body defense system to fight back. Their symptoms are similar to bacterial infections and can include body aches, ear pain, running nose, nasal congestion, sore throat, cough, fever, headache, nausea and vomiting. For most viral infections, treatments can only help with symptoms but it is left for the body immune system to be able to fight off the virus. A few notable examples that have gained the attention of the public

health community and the population at large includes Ebola, SARS, Influenza, Zika, Yellow fever, Human immune deficiency virus, Human Papiloma virus and the recent SARS-nCoV-2. Viruses are considered the most abundant biological entity on the planet and their cure is yet to be found but vaccines can help prevent their spreads.

1.8 COVID 19; a viral infection.

1.8.1 Overview

17 years after the 2003 epidemic of severe acute respiratory syndrome (SARS), the SARS-CoV-2 was isolated from bronchoalveolar lavage of several patients with unknown origin pneumonia in Wuhan city, China (Zhu et al. 2019). On november17, 2019, a 55-year old individual from Hubei province, china may have been the first person to have contracted the disease. On December 2019, doctors noted cases in Wuhan, china after authorities suspected a virus stemmed from something cold at a wet market in the city (Li et al., 2020). Following the first case in November 17, about five new cases were reported every day and by December 15, the total infections reached 27. On December 27, the head of the respiratory department at Hubei provincial hospital, DR. Zhang Jixian, after treating a pneumonia cluster of unknown cause reported to Wuhan Jianghan CDC in china that a novel coronavirus was causing the disease and it has infected more than 180 individuals at present. On 30 December 2019, a test reported addressed to Wuhan central hospital, from a company capitalBio Medlab, stated that there was an erroneous positive result for SARS causing a group of doctors at Wuhan central hospital to alert their colleagues and relevant hospital authorities of the result. Eight of those doctors, including Li Wenliang (who was also punished on Jan 3) (The guardian 2020) were later admonished by the police for spreading false rumors and another Dr Ai Fen was reprimanded for raising the alarm(Kuo 2020). The Wuhan municipal health commission made the first public announcement of the outbreak triggering an investigation. The

WHO on January 1 launched an investigation after learning of the cluster of viral pneumonia in Wuhan. A report published by WHO concluded that human spillover via an intermediate animal host was the most likely explanation having originated in a bat and somehow hopped to another animal possibly pangolin which then passed it on to humans through the food supply chain. This epidemic has spread very quickly, and by February 15, 2020, the virus had reached 26 countries resulting in 51,857 laboratory confirmed infections and 1669 deaths, with nearly all infections and deaths occurring in china (WHO 2021). On 30th January 2020, WHO declared it as a public health concern of which on march 11, it was declared a pandemic. In early and mid-January 2020, the virus spread to other Chinese provinces, helped by the Chinese New Year migration and Wuhan being a transport hub and major rail interchange (WHO China 2020). On 20 January, china reported nearly 140 new cases in one day, including two people in Beijing and one in Shenzhen (france24tv 2020).During this period, 6,174 people had already developed symptoms by 20 January with most on diagnosis testing positive for the virus later (Zhonghua et al 2020). This prompt china to impose drastic measures in response to the outbreak (including lockdowns and face mask mandates) and one of the first country to bring the outbreak under control. On March 31, 2020, the national health commission (NHC) in china announced that it would begin reporting the infection number of symptom-free individuals who tested positive for coronavirus. On April 17, 2020, fatalities increased by 50 percent on revision. By the end of March, more than 80,000 people had been infected in china (about 50,000 in Wuhan) and more than 4600(about 3870 in Wuhan) deaths were recorded as being due to covid-19. After quarantine measures were implemented, the country reported no new local coronavirus COVID-19 transmission for the first time on March 18, 2020. By May 16, 2021, the novel coronavirus sars-cov-2 had infected around 102,700 people and killed 4,846 in the country. Shengai is currently the region with the highest active cases in china. . Coronavirus are a large family of Zoonotic viruses that cause illness

ranging from the common cold to severe respiratory diseases. The infection can be transmitted through large droplets or aerosols predominantly via respiratory transmission involving human to human and less commonly by contact with infected surfaces. This human to human transmission occurs due to close contact with an infected person, exposed to coughing, sneezing, respiratory droplets or aerosols which can penetrate the human body predominately the lungs via inhalation through the nose or mouth (Phan et al., 2020). The infected patients exhibited pneumonia symptoms with a diffused alveolar injury which lead to acute respiratory distress syndrome (ARDS). Symptoms occur following an incubation period of roughly 5 days with the period from the onset of symptoms to death ranged from 6 to 41 days. This period is dependent of on the age of the patient and status of the patient's immune system (Wang et al., 2020). Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. Most common symptoms are fever, dry cough, tiredness headache, and loss of taste or smell. Serious symptoms include difficulty breathing or shortness of breath, chest pain or pressure and loss of speech or movement (WHO 2021).

1.8.2 Identification of the COVID19 virus

All human coronaviruses have animal origins, namely, natural hosts. Bats must have been the natural hosts of HCoV-229E, SARSCoV, HCoV-NL63, and MERS-CoV (Su et al. 2016; Forni et.al 2017; Tao et al. 2017). SARS-CoV-2 sequenced at the early stage of the COVID-19 outbreak only shares 79.6% sequence identity with SARS-CoV through early full-length genomic comparisons. However, it is highly identical (96.2%) at the whole-genome level to Bat-CoV RaTG13, which was previously detected in *Rhinolophus affinis* from Yunnan Province, over 1500

km from Wuhan (Zhou et al. 2020). Bats are likely reservoir hosts for SARS-CoV-2; however, whether Bat-CoV RaTG13 directly jumped to humans or transmits to intermediate hosts to facilitate animal-to-human transmission remains inconclusive. No intermediate host sample was obtained by scientists in an initial cluster of infections of the Huanan Seafood and Wildlife Market in Wuhan, where the sale of wild animals may be the source of zoonotic infection. Furthermore, the earliest three patients with symptom onset had no known history of exposure to the Huanan market (Huang et al. 2020). The CDC and a Canadian laboratory identified the SARS genome in April, 2003. Scientists at Erasmus University in Rotterdam, the Netherlands demonstrated that the SARS coronavirus fulfilled Koch's postulates thereby confirming it as the causative agent. In the experiments, macaques infected with the virus developed the same symptoms as human SARS victims. In late May 2003, studies from samples of wild animals sold as food in the local market in Guangdong, China, found the SARS coronavirus could be isolated from masked palm civets (Paguma sp.), but the animals did not always show clinical signs. The preliminary conclusion was the SARS virus crossed the xenographic barrier from palm civet to humans, and more than 10,000 masked palm civets were killed in Guangdong Province. Virus was also later found in raccoon dogs (Nyctereuteus sp.), ferret badgers (Melogale spp.), and domestic cats. In 2005, two studies identified a number of SARS-like coronaviruses in Chinese bats. Phylogenetic analysis of these viruses indicated a high probability that SARS coronavirus originated in bats and spread to humans either directly or through animals held in Chinese markets (Lam et al. 2020). The bats did not show any visible signs of disease, but are the likely natural reservoirs of SARS-like coronaviruses. In late 2006, scientists from the Chinese Centre for Disease Control and Prevention of Hong Kong University and the Guangzhou Centre for Disease Control and Prevention established a genetic link between the SARS coronavirus appearing in civets and humans, bearing out claims that the disease had jumped across species.

1.8.3 Global distribution of covid-19

Following the discovery of the virus in china, tension rose in china and other countries of which the first confirm cases outside china was witnessed in Thailand, South Korea, Japan and even a few western countries. On January 13 in Thailand, the ministry of public health reported the first imported case of laboratory confirmed covid-19. After that, surges in cases of covid-19 in Italy, Japan, and Iran also heightened fears that the world is on the brink of a pandemic. Experts points to the sharp rise of the number of cases in South Korea from 30 to 204 within four days interval. In Iran, 18 cases were confirmed with four deaths raising source of concern having exported two cases within 36 hours of announcing it had found two patients a traveler from Canada and another from Lebanon tested positive after returning home from Iran. In addition, over 213 countries and territories have reported at least a case of COVID-19 infection. The Americas region has the highest number of reported cases while Western pacific region has the least number of COVID-19 infections. This was much concern suggesting transmission will be far more wide spread than the official numbers would indicate. Therefore the WHO increased the assessment of the risk of spread and Impact of COVID-19 to very high at the global level

Table 1: Number of confirmed COVID-19 cases as of 23rd July 2021, according to region.

Region	Confirmed cases	Total death
Globally	190,860,860	4,101,414
Africa	5,212,918	137,518
Americas	75,085,849	1,967,351
Eastern Mediterranean	11, 890, 644	227,375
Europe	58,219,039	1,205,773
South-East Asia	36,968,057	531,741
Western Pacific	4,060,268	60,675

Who health emergency dashboard (2021)

Asia was the center of the initial outbreak that spread from china in early 2020, but the number of cases and deaths there was initially lower than in Europe and North America. However, the recent surge in cases in India and elsewhere is changing the picture. In India, the official death toll is approaching 400,000 while it has recorded more than 30million cases- second only to the US. In Latin America, Brazil has recorded 18.4 million cases and more than 513,000 deaths – the world's second highest official death toll. Experts say they are concerned that the situation could worsen as winter sets in. Peru now has the fifth highest toll in the world with more than 190,000 deaths, but the highest number of deaths by population size- nearly 600 deaths for every 100,000 people. Columbia, Argentina and Chile have also seen recent surges in cases. Several European countries have also seen spikes in covid-19 cases in recent months. But the number of daily infections has slowed in most of the worst affected countries, and the overall trend is downward. Vaccine rollouts across the European Union have been problematic. There have been delays to deliveries and concerns over the safety of the oxford-AstraZeneca vaccine, which a number of countries have withdrawn from use or restricted to certain age groups. The US has recorded more than 33 million cases and over 600,000 deaths – the highest figures in the world. However, daily cases and deaths in the US have both now fallen, as they have in Canada, where the death rate is far lower than its neighbor's. Several countries in the Middle East have had severe outbreaks of the virus, with Iran and Iraq seeing the highest numbers of deaths. Australia and New Zealand have been praised for their response to the pandemic, with both countries having seen comparatively fewer deaths. But there is new concern in Australia where cases of the delta variant of covid-19 have been detected across the country. Elsewhere in the region, Papua New Guinea saw a recent spike in infections, taking total cases there to more than 17,000. Africa has recorded more than 5.4 million cases and more than 140,000 deaths – but the true extent of the pandemic in many African countries is not known as testing rates are low. South Africa, with more than 1.9 million cases and about 60,000

deaths, is the worst affected country on the continent, according to official figures. Morocco has recorded over 500,000 cases and Tunisia, Ethiopia and Egypt have all seen more than 250,000 cases (BBC NEWS 2021)

Table 2: Key figures for the most impacted countries worldwide as of 19th July 2021.

Countries	Confirmed cases	Active infections	Deaths	Recoveries
World	191,230,672	12,941,642	4,105,847	174,183,183
USA	34,963,907	4,962,571	624,746	29,376,590
India	31,144,229	421,632	414,141	30,308,456
Brazil	19,376,574	810,800	542,262	18,023,512
Russia	5,958,133	468,483	148,419	5,341,231
France	5,867,730	97,200	111,472	5,659,058
Turkey	5,529,719	92,578	50,554	5,386,587
United kingdom	5,433,939	908,281	128,708	4,396,950
Argentina	4,756,378	260,134	101,549	4,394,695
Columbia	4,639,466	133,882	116,307	4,389,277
Italy	4,287,458	46,113	127,867	4,113,478

Statista (2021)

1.8.4 Covid-19 in Africa

The first confirmed case of COVID-19 infection in Africa was imported from Europe into Egypt on 24th February 2020. The confirmed case was identified when on contact screening investigation of an index case on a business trip to china via cairo. This happened seven weeks after the beginning of the outbreak in wuhan, china (who 2020). Although, there had been delay in the spread of the disease, africa has experienced their own fair share of rise in the number of cases. According to the Africa Centers for Disease Control and Prevention (CDC) as of 7 am GMT 13th July 2020, a total of 594,955 COVID-19 infections had been reported with 13,246 deaths has been

reported in 54 African countries. The majority of the cases were in Southern Africa with a total of 63, 206 cases (64%), closely followed by North Africa with 14,968 cases (15%), West Africa 11,502 cases (12%), East Africa 5,032 cases (5%). The least number of reported cases was in the Central Africa region with a total of 4,611 cases (5%). The most affected countries in the WHO African Region include; South Africa (250,687), Nigeria (31,323), Ghana (23,834), Algeria (18,712) Morocco (15,542), Cameroon (14,916), Cote d'Ivoire (12,502), Sudan (10,250) Kenya (9,726) and Senegal (8,014). These countries account for about 82% of the cases reported in the African region (WHO African Region 2021). Since the first case was detected in Egypt on the 14th day of February 2020, the number of cases in Africa has been on a steady rise, though has remained lower than the rest of the world. With over 1.3 billion people and a weak health system plagued by lack of healthcare infrastructure and shortages of health manpower, limited access to social protection and low health literacy, the public health measures implemented at the start of the pandemic was not sufficient to stop further progress of the virus in Africa or end the pandemic. However, the official numbers of the African continent are significantly lower than those of Europe, North America, South America, and Asia. Nevertheless, the infectious disease still managed to have its effects on several countries. South Africa had the highest number of deaths. Morocco and Tunisia, the second and third most affected in Africa, recorded 9,105 and 11,971 deaths, respectively, while Egypt registered even a higher number at 14,441 as of may 18, 2021. As of June, 2021, the number of confirmed covid-19 cases in Africa amounted to 5,363,727 which represented around 2.97% of the infections around the world. In the African continent, South Africa was the most drastically affected country with more than 1.87 million infections.

Table 3: Key figures of most impacted countries in Africa as of June 2021

Country	Confirmed cases	Active cases	Deaths	Recoveries
Total	5,363,727	510,799	140,040	4,712,888
South Africa	1,877,143	141,910	59,406	1,675,827
Morocco	528,180	3,885	9,265	515,030
Tunisia	395,362	38,135	14,406	342,598
Egypt	279,184	54,990	16,002	208,192
Ethiopia	275,601	13,876	4,296	257,429
Libya	191,660	11,369	3,185	177,106
Kenya	181,239	54,239	3,538	123,462
Nigeria	167,401	1,350	2,118	163,933
Zambia	140,620	22,867	1,855	115,898
Algeria	137,403	38,358	3,669	95,599

Statista (2021)

1.8.5 First case of COVID19 in Nigeria

The Federal Ministry of Health has confirmed a coronavirus disease (COVID-19) case in Lagos State, Nigeria. The case, which was confirmed on the 27th of February 2020, is the first case to be reported in Nigeria since the beginning of the outbreak in China in January 2020. The index case is an Italian citizen who works in Nigeria and returned from Milan, Italy to Lagos, Nigeria on the 25th of February 2020. He was confirmed by the Virology Laboratory of the Lagos University Teaching Hospital, part of the Laboratory Network of the Nigeria Centre for Disease Control after falling ill and transferred to Lagos state bio-security facilities for isolation. Sixty persons who had contact with the index patient were isolated. On March 9, a second case was reported to be a Nigerian citizen who had contact with the index case. The second case was confirmed to have tested negative and no longer had the virus in his system. By 31 march, 139 cases and 2 deaths had been confirmed and suspected cases tracing rising to 6000. Nevertheless, the onset of covid-19

sent waves of panic across Nigeria which prompted the NCDC to activate a multi-sectoral national emergency operations center (EOC) to oversee the national response to COVID-19. By September, 4,840 cases and 99 deaths were reported, bringing the total number of confirmed cases and deaths to 58,848 and 1,112 respectively with active cases of 7,378 (Channelstv 2021). On December 10, the health minister said a second wave is imminent as a result of the rising number of cases detected in the country. This statement was made as a result of the country recording its highest daily number of covid19 cases on 17 December with 1145 new infection. A new variant, the B.1.1.7 variant was confirmed on 25 January after almost a month after the director of the African centers for disease control and prevention (CDC) during a conference in Addis Ababa announced a new coronavirus variant separate from the lineage of the UK and the South African lineages. As of April 2021, total number of confirmed cases rising to 165,110 after 2219 new cases. The death toll rose to 2063 with number of recovered patients increasing to 155,101, leaving 7,946 cases at the end of the month (NCDC 2021).

The Government of Nigeria, through the Federal Ministry of Health has been strengthening measures to ensure an outbreak in Nigeria is controlled and contained quickly. The multi-sectoral Coronavirus Preparedness Group led by the Nigeria Centre for Disease Control (NCDC) has immediately activated its national Emergency Operations Centre and will work closely with Health authorities of the 36 states of the federation in responding to these cases and implementing firm control measures.

Table 4: Number of confirmed COVID-19 cases confirmed by states as of 24th June 2021.

State	Confirmed cases	Cases on admission	No. of death
Lagos	59,516	545	456
FCT	19,887	516	166
Oyo	6,858	0	124
Edo	4,910	0	185
Delta	2,650	22	72
Rivers	7,318	37	101
Kano	4,001	7	110
Ogun	4,684	0	51
Kaduna	9,115	15	65
Katsina	2,110	21	34
Plateau	9,065	2	57
Ondo	3,471	38	65
Kwara	3,144	21	55
Osun	2,578	6	52
Enugu	2,464	0	29
Nasarawa	2,384	0	39
Gombe	2,080	4	44
Ebonyi	2,039	5	32
Akwa ibom	1,931	1	18
Anambra	1,909	64	19
Abia	1,693	2	22
Imo	1,661	0	37
Bauchi	1,549	0	17
Benue	1,366	15	24
Borno	1,344	1	38
Adamawa	1,134	4	32
Taraba	1,001	0	24
Niger	935	5	17
Bayelsa	906	1	26
Ekiti	877	3	11

Sokoto	775	0	28
Jigawa	533	5	16
Yobe	478	18	9
Kebbi	450	42	16
Cross river	402	0	18
Kogi	5	0	2
Zamfara	244	3	8
Total	167,532	1,429	2,119

NCDC(2021)

1.8.6 COVID19 variants of concern

The coronavirus disease 2019 SARS-CoV-2 is closest in structure to previously discovered SARS-CoV and MERS-CoV and also having 80% identity with SARS-CoV. Structurally, the crown like spikes on the surface of the virus may undergo changes which can be studied in other to help scientist understand how changes to the virus might affect rate of transmission and severity of symptoms. Genetic variants of sarscov2 have been emerging and circulating around the world throughout the COVID 19 pandemic. This is as a result of mutation occurring during replication of a viral strain resulting in new strains that maybe more contagious. Sometimes new variants emerge and disappear. Other times, new variants emerge and persist. In the United Kingdom, a new variant of sarscov-2 known as B.1.1.7(alpha variant) first emerged during September 2020 with a large number of mutations. In January 2021, scientist from UK reported evidence that suggests the alpha variant may be associated with an increased risk of death compared with other variant (Horby, et al 2021). By December 20, 2020, reported cases were seen in other countries including the US. Another variant of sarscov-2 known as beta variant (B.1.351) emerged in South Africa in October 2020 different from the alpha variant. It was observed to share some mutations with alpha variant and have been detected in multiple countries outside of South Africa. As at late December 2020, it

was the predominant variant in Zambia. In Brazil, the gamma variant (P.1) which is a branch off the B.1.1.28 lineage was first identified in four Brazilian travelers during a routine airport screening in Tokyo, Japan. The newest of the corona virus strain is the B.1.617.2 which is referred to as the Indian (delta) variant, was first identified in India on December 2020. During this period, Indian recorded the world's sharpest spike in coronavirus infection causing scientists to research on the unexpected surge. Laboratory based preliminary studies suggest potential increased transmissibility prompting the WHO to classify it as a "variant of concern" which also includes the British, Brazil and South Africa variants. Since the onset of the pandemic in Wuhan, china, there have been two major peaks in the number of deaths and infections as many countries have experienced the first and second wave of the COVID19 epidemic. These peaks also called waves can be defined according to WHO as a moment where a virus starts to when it is brought under control and cases have reduced substantially. The first wave of the pandemic involves the start of the pandemic until June 2020; the second wave took off and lasted until the end of 2020 (Soriano, et al 2021). These waves were controlled due to implementation of non pharmaceutical measures in controlling transmission (leung et al 2020). Only recently, a third wave of infections has occurred with a surge in tne number of cases and has been documented in Haiti, Lesotho and Sierra Leone, among other countries. Medical experts say the emergence of virus variants such as the highly contagious delta variant has contributed to this (PIH 2021)

1.9 Mode of transmission of COVID19

The role of the Huanan Seafood Wholesale Market in propagating disease is unclear. Many initial COVID-19 cases were linked to this market suggesting that SARS-CoV-2 was transmitted from animals to humans. However, a genomic study has provided evidence that the virus was introduced from another, yet unknown location, into the market where it spread more rapidly, although

human-to-human transmission may have occurred earlier. Initially, the infection was believed to be due to animal-to-human transmission without animal species association (Olivencia, et al 2020). Not until recently, it was discovered that due to the growing number of infected patients without a history of exposure to the market, human-to-human transmission is a common mode of transmission. Broadly, two modes of transmission of COVID19 exist –direct and indirect (WHO 2021). The direct mode includes transmission via aerosols in form of respiratory droplets, body fluids for example, saliva, urine, feces, semen and tears, and through mother to child transmission. The size of the infectious particles is on a continuum, ranging from small airborne particles that remain suspended in the air for long periods, to larger droplets that may remain airborne or fall to the ground. This continuum redefined the traditional understanding of how respiratory viruses transmit and how proximity of persons increases transmission rate. The exposure and risk of transmission are increased if the infected patient is present within 1meter length of susceptible host. Indirect transmission though not high, may occur via formites or surfaces within the immediate environment of an infected person and objects used on the infected person e.g. stethoscope and thermometer before touching the mouth, nose or eyes of an uninfected person

1.10 symptoms of covid19

The symptoms of 2019-nCoV infection have similarities with SARS-CoV; and may appear 2-14 days after exposure. The common symptoms of COVID-19 include cough, shortness of breath, and fever; disease ranges in severity from asymptomatic infection, mild disease (in 81% of patients), to pneumonia, respiratory failure, and death. Less common symptoms include headache, dizziness, abdominal pain, diarrhea, nausea, and vomiting. Based on the report of the first 425 confirmed cases in Wuhan, the common symptoms include fever, dry cough, myalgia and fatigue with less common are sputum production, headache, haemoptysis, abdominal pain, and diarrhea. Approximately 75% patients had bilateral pneumonia. Different from SARS-CoV and MERS-CoV

infections, however, is that very few COVID-19 patients show prominent upper respiratory tract signs and symptoms such as rhinorrhoea, sneezing, or sore throat, suggesting that the virus might have greater preference for infecting the lower respiratory tract. Pregnant and non-pregnant women have similar characteristics. Severe complications such as hypoxemia respiratory failure (HRF), acute respiratory distress syndrome (ARDS), arrhythmia, sepsis and septic shock, acute cardiac injury, and acute kidney injury have been reported among COVID-19 patients. Acute HRF is severe arterial hypoxemia that is refractory to supplemental oxygen which is caused by intrapulmonary shunting of blood resulting from air space filling or collapse. ARDS is said to be a new or worsening respiratory symptoms within one week of known clinical insult. Worsening respiratory distress is evidence by failure of response to standard oxygen therapy (continuous increased work of breathing /hypoxemia despite oxygen delivery via a face mask with reservoir bag).

1.11 Risk factors of COVID19

SARS-CoV-2 is also more likely to infect people with chronic co-morbidities such as cardiovascular and cerebrovascular diseases and diabetes. Severe manifestations maybe also associated with co-infections of bacteria and fungi. Potential risk factors include age, race/ethnicity, gender, co-morbidities, and pregnancy. There is importance in understanding the risk factors as people with these risk factors may be more likely to be severely affected by the covid19 virus and may need intensive care or hospitalization. According to a study done on risk for developing severe covid19 in china, the study showed that risk factors includes being male, older age, fever, cough, fatigue, delayed diagnosis, hypertension, diabetes, chronic kidney disease and they can help in predicting the severity of covid19 cases (Geng, et al 2021). Due to increased chance of health conditions as one gets older, it becomes more important that preventive measures

such as mass vaccination, social distancing, practicing good hygiene and use of facial mask should be strictly adhere to. People prone to these risk factors should always work together with their health care providers so as their risk factors are managed effectively.

1.12 Diagnosis of COVID19

Efforts to control spread of COVID-19, institute quarantine and isolation measures, and appropriately clinically manage patients all require useful screening and diagnostic tools. While SARS-CoV-2 is spreading, other respiratory infections may be more common in a local community. The WHO has released a guideline on case surveillance of COVID-19 on January 31, 2020. For a person who meets certain criteria, WHO recommends to first screen for more common causes of respiratory illness given the season and location. If a negative result is found, the sample should be sent to referral laboratory for SARS-CoV-2 detection. Case definitions can vary by country and will evolve over time as the epidemiological circumstances change in a given location. In China, a confirmed case from January 15, 2020 required an epidemiological linkage to Wuhan within 2 weeks and clinical features such as fever, pneumonia, and low white blood cell count. On January 18, 2020 the epidemiological criterion was expanded to include contact with anyone who had been in Wuhan in the past 2 weeks. Later, the case definitions removed the epidemiological linkage. The WHO has put forward case definitions. Suspected cases of COVID-19 are persons (a) with severe acute respiratory infections (history of fever and cough requiring admission to hospital) and with no other etiology that fully explains the clinical presentation and a history of travel to or residence in China during the 14 days prior to symptom onset; or (b) a patient with any acute respiratory illness and at least one of the following during the 14 days prior to symptom onset: contact with a confirmed or probable case of SARS-CoV-2 infection or worked in or attended a health care facility where patients with confirmed or probable SARS-CoV-2 acute respiratory disease patients were being treated. Probable cases are those for who testing for SARS-

CoV-2 is inconclusive or who test positive using a pan-coronavirus assay and without laboratory evidence of other respiratory pathogens. A confirmed case is one with a laboratory confirmation of SARS-CoV-2 infection, irrespective of clinical signs and symptoms. For patients who meet diagnostic criteria for SARS-CoV-2 testing, the CDC recommends collection of specimens from the upper respiratory tract (nasopharyngeal and oropharyngeal swab) and, if possible, the lower respiratory tract (sputum, tracheal aspirate, or broncho-alveolar lavage). In each country, the tests are performed by laboratories designated by the government.

1.13 Control and prevention strategies of COVID19

COVID-19 is clearly a serious disease of international concern. By some estimates it has a higher reproductive number than SARS, and more people have been reported to have been infected or died from it than SARS. Similar to SARS-CoV and MERS-CoV, disrupting the chain of transmission is considered key to stopping the spread of disease. Different strategies should be implemented in health care settings and at the local and global levels. The most effective prevention included according to WHO, namely: 1. Maintain physical distance (at least 1 meter) with other people; 2. Frequently clean hands, using an alcohol-based antiseptic liquid if the hands do not look dirty or soap and clean running water when the hands look dirty; 3. Avoid touching the mouth, nose, and eyes; 4. Conduct ethics coughing and sneezing by covering the nose and mouth with folded elbows or tissue when coughing or sneezing and immediately removing the tissue after use; 5. Use a medical mask if you experience symptoms of respiratory disease and clean your hands after removing the mask; 6. Often clean and disinfect the surface of surrounding objects and other objects that are often touched. Health care settings can unfortunately be an important source of viral transmission (Chen et al 2020).

Moreover, educating the public to recognize unusual symptoms such as chronic cough or shortness of breath is essential therefore that they could seek medical care for early detection of the virus. If large-scale community transmission occurs, mitigating social gatherings, temporary school closure, home isolation, close monitoring of symptomatic individual, provision of life supports (e.g. oxygen supply, mechanical ventilator), personal hand hygiene, and wearing personal protective equipment such as facemask should also be enforced. In global setting, locking down Wuhan city was one of the immediate measures taken by Chinese authorities and hence had slowed the global spread of COVID-19. Air travel should be limited for the cases unless severe medical attentions are required. Setting up temperature check or scanning is mandatory at airport and border to identify the suspected cases. Continued research into the virus is critical to trace the source of the outbreak and provide evidence for future outbreak.

1.14 Treatment and Management of COVID19

Before the development of vaccines the World Health Organization (WHO), the Centers for Disease Control and prevention (CDC), and the FDA, initially thought that there will be no medicines or vaccines that would be able to successfully manage or prevent the spread of SARS-CoV-2 (Tim et al 2020). The only alternatives available then were the use of wide-spectrum anti-viral drugs such as nucleoside analogs, as well as HIV-protease inhibitors that can attenuate viral infection before the actual antiviral is available (Wang et al. 2020). Pharmacological management of young, stable patients with minor symptoms and no inherent comorbid circumstances were usually not recommended [Tim et al 2020]. During this period the use of Chloroquine phosphate was supported by The People's Republic of China's National Health Commission to treat COVID-19 patients. This was stated in its revised guidelines for the prevention, diagnosis, and treatment of pneumonia developed due to COVID-19 infection in its country (Ali et al. 2020). Yao X et al. demonstrated result of a study that chloroquine and hydroxychloroquine inhibit SARS-CoV-2 in

vitro with hydroxychloroquine (EC50=0.72% µM) found to be more potent than chloroquine (EC50=5.47% µM) in vitro. (Gautret P et al. 2020)

Lopinavir available in a fixed dose combination alongside ritonavir was also used clinically by suppressing the primary SARS-CoV-1 protease, reducing coronavirus activity (McCreary EK et.al 2020). According to Chinese SARS-CoV-2 guidelines the recommended dose of Lopinavir; Ritonavir was 400 mg/100 mg (2 capsules/ tablets) by mouth twice a day for no more than 10 days while In pediatric patients weighing 15-40 kg, the recommended dose was 10 mg/kg suspension by mouth twice daily according to the United States guidelines (Young BE et.al 2020). According to WHO solidarity trial publication 15th October 2020, all 4 treatments evaluated (remdesivir, hydroxychloroquine, lopinavir/ritonavir and interferon) had little or no effect on overall mortality, initiation of ventilation and duration of hospital stay in hospitalized patients with only corticosteroids showing effectiveness against severe and critical covid19 (WHO2021). As the pandemic continues to ravage the world, health care works and particularly pharmacists' contributions as medication experts in providing patient care.

1.15 Covid-19 Vaccines

Vaccines have the potential to catalyze the development of herd immunity and stop the viral COVID-19 rampage. Herd immunity is a form of indirect protection from an infectious disease when a sufficient number of people of a community became immune to an infection. To reach herd immunity through the vaccinations, there are two phases:

1. Ensuring the availability of vaccines for all, and
2. Administering the vaccine

Having enough vaccine available for the population, the biggest challenge is to administer the vaccine to enough population because of many common issues including vaccine hesitancy. Hence immediate availability of vaccines creates consumers concern about safety and effectiveness

(Borriello et al 2021). As the biggest vaccination campaign in history is underway, countries have experienced unequal access to vaccines and varying degrees of efficiency in getting shots into people's arms. More than 2.89 billion doses have been administered across 180 countries, according to data collected by Bloomberg. Enough doses have now been administered to fully vaccinate 18.9% of the global population. But the distribution has been lopsided as countries and regions with the highest incomes are getting vaccinated more than 30times faster than those with the lowest. Before March, few African nations had received single shipments of shots. Currently, the United Arab Emirates and Israel's coronavirus vaccination campaigns are the most successful worldwide (apart from tiny states and territory like Seychelles, the Maldives, Gibraltar, etc.) based on doses per population. In terms of sheer numbers, China and the United States are the leading nations, with over one billion doses and 320 million doses administered respectively.

Within 1 month of discovering the SARS-CoV-2, a full-length sequence of the dubbed SARSCoV-2 (SARS-CoV-2) was available for global dissemination so researchers could begin to address the challenges of immunity. Within 5 days of the sequence being distributed, an mRNA vaccine candidate was produced using Good Manufacturing Practices for early testing (Corbett et.al 2020). Within 66 days, a Phase I human study begun and within 2 months, a Phase II human study was initiated.

Within 2 months of sequence identification, a Phase I human study was conducted with the Moderna vaccine. Fifteen participants were given 2 vaccine doses of 25 mg, 100 mg, and 250 mg separated by 28 days (Jackson et. Al 2020). In short, the 100-mg dose offered the best combination of neutralizing antibody titers with acceptable reactogenicity. Doses of 50 mg and 100 mg were used for the subsequent Phase II study of 600 participants before progressing to the larger Phase III trial (Moderna TX Inc. FDA briefing document-moderna COVID-19 vaccine 2021). In this study that formed the basis of the EUA, >30,000 participants were enrolled in a placebo-controlled trial.

Randomized and blinded participants were given either 2 doses of either vaccine or saline injection, separated by 28 days, and followed up for reactogenicity and clinical symptoms consistent with COVID-19. An interim follow-up period of 2 months was planned to evaluate for safety and efficacy. Vaccine efficacy was estimated to be 94.5% in all participants, which was consistent between those aged 18 and 65 years and those >65 years of age.

The Pfizer/BioNTech vaccine followed a similar path of development. Rodent and non-human primate studies showed acceptable immunogenicity, which was duplicated in human studies. A combined Phase I/II study was conducted with 45 participants randomized into 3 dose groups, 12 receiving doses of 10 mg, 30 mg, or 100 mg, and 3 participants in each group receiving placebo (Mulligan et.al 2020).

Local reactogenicity was common in all dosing groups, and the 30-mg dose offered the best combination of immunogenicity and tolerable reactogenicity. The 30-mg dose was used in the large Phase III study, with results now well publicized (Pfizer/BioNTech. FDA briefing document-Pfizer-BioNTech COVID-19 vaccine. 2021). More than 37,000 randomized and blinded participants received 2 doses of either 30 mg of vaccine or saline injection, administered 21 days apart. The efficacy was similar to that of the Moderna vaccine. The interim evaluation was planned to occur after ninety-four COVID-19 cases were identified among all participants. Estimated vaccine efficacy was noted to be 95%, with 4 cases found in the vaccine group and 90 in the placebo group. A more complete evaluation was presented to the US Food and Drug Administration (FDA) before issuing of the EUA, with 170 total COVID-19 cases continuing to exhibit the same 95% estimated efficacy. Efficacy among the cases identified in the vaccine group after 1 dose of vaccine resulted in an estimated efficacy against COVID-19 of 52% after 1 dose of the Pfizer/ BioNTech vaccine.

Although the efficacy of the 2 mRNA vaccines is very similar, the major difference lies in the product storage requirements and temperature stability. The Pfizer/BioNTech mRNA vaccine requires storage at −60 to −80 C, which requires either dry ice temporary storage or use of an "ultra-low" freezer (Pfizer/BioNTech. FDA briefing document-pfizer-BioNTech COVID19 vaccine 2020). After thawing, the vaccine is diluted in saline and should be administered within 6 h. The requirement for either dry ice or ultra-low freezers severely limits the types of facilities where the cold chain can be maintained and the Pfizer/BioNTech vaccine administered. The Moderna mRNA vaccine is a bit more forgiving in its requirements. Long-term storage can be between −15 and −25 C, the temperature of a conventional freezer and after thawing can be kept at 2 to 8 C for 30 days or room temperature if unopened for 12 h and once opened discarded after 6 h 200. These more flexible storage requirements have allowed the Moderna product to be distributed to health departments, urgent care centers, clinical practices, and most importantly to rural entities where essential workers and residents of long-term care facilities may be immunized.

Many did express concern at the speed at which these vaccines where approved and whether safety requirements were fulfilled appropriately. Although the EUA mechanism of approval does not convey licensure, it does facilitate use under a situation that is deemed to be emergent hence its approval can be justified. So far so god the vaccines have be able to control the pandemic and slowly bring the word back to normalcy.

The two COVID-19 mRNA vaccines represent an incredible scientific achievement and offer hope to reduce the devastating impact that COVID-19 has had both domestically and internationally, it has also paved way for other vaccines to be generated e.g. Oxford-Astrazeneca vaccine codenamed AZD1222 which is currently available. Oxford-Astrazeneca is currently the cheapest in the market and more affordable by developing countries. This vaccine was approved on 17th March 2021 by the W.H.O. The recommended dosage is two doses given intramuscularly (0.5ml) with an interval

of 8 to 12 weeks. The vaccine is in the global focus after receiving another setback. During mid-march, mostly European countries have suspended the use of the vaccine following reports of developing blood clots. It remained unclear whether the issue was related to the vaccine, certain batches, or just pure coincidence. On March 17, the world health organization recommended continuing using the vaccine, which the European EMA also agreed but the connection between some severe cases of coagulation disorders and the vaccine was not totally ruled out. As trust in the covid-19 vaccines are essential for the successful campaign and each day that vaccinations are stopped or suspended can be crucial, this blow against the most sought-after vaccine worldwide is also a blow against fighting the pandemic as a whole.

A total of seven vaccines are now available for public use, in limited quantities, in at least 180 countries. None of these shots, on its own is enough to inoculate a global population of some 7.8 billion people. But together they represent humanity's best chance of ending a scourge that has claimed more than 3 million lives and triggered global economic calamity. Four of these vaccines have been given emergency use listing by WHO (Pfizer/BioNTech, AstraZeneca-Oxford, serum institute of India/AstraZeneca, Janssen/Johnson & Johnson). As of march 2021, over 300 million people have received covid-19 vaccines in over 130 countries worldwide including 18 in the Africa continent and 16 in AFR. While COVAX is on track to meet its goal of covering 20% of the population in all countries by the end of 2021, competing bilateral arrangements and logistical complexities pose challenges to equitable distribution of the vaccines. Despite the exceptional speed of vaccine development and promising plans for vaccine program implementation, it is unlikely that covid-19 vaccines will have sufficient impact to substantially reduce transmission globally, at least in the first half of 2021 (WHO 2021).

Although the African countries still have a long way to fully combat the virus, vaccination programs have been rolled out to pin the majority of Africans. In Nigeria, nearly 4 million doses of

the covid-19 vaccine were shipped via COVAX facility, a partnership between coalitions for epidemic preparedness innovations (CEPI), GAVI, UNICEF and WHO. COVAX shipped 3.94 million doses of the AstraZeneca/oxford vaccine, manufactured by the Serum Institute of India (SII), from Mumbai to Abuja (WHO- regional office for Africa 2021). Also, according to a survey, public opinion in several African countries shows a high willingness to be vaccinated, with Ethiopia having numbers as high as 94%. As of march 2021, morocco was the country administering the highest number of vaccine doses; however, Seychelles had the highest per rate per 100 people.

1.16 WHO global response plan to covid19

Over the past year, much has been achieved by national authorities and communities with the support of who, donors and partners, and an unprecedented effort by the scientific community and the private sector.

The strategic preparedness and response plan 2021(SPRP 2021) builds on what we have learned about the virus and our collective response over the course of 2020 and translates that knowledge into strategic actions. This plan builds on achievements and also focuses on the new challenges, to mitigate, for example, risks related to new variants. The plan also considers the road we need to travel towards the safe, equitable and effective delivery of diagnostic and vaccines as part of the overall strategy to successfully tackle the covid-19 pandemic.

The world health organization director general requested all countries to adopt a “whole-of-government, whole-of-society” approach built around a comprehensive strategy to prevent infections, save lives and minimize the impact of the pandemic [WHO director-general’s opening remarks at the media briefing on covid-19 (2020)]. In order to assist UN country teams in scaling up country preparedness and response to covid-19, learning modules were developed as

companion to the operational planning guidelines to support country preparedness and response. The overall goal of the strategic preparedness and response plan is to stop further transmission of 2019-nCoV within china and to other countries and to mitigate the impact of the outbreak in all countries. The objectives of the SPRP can be achieved by;

- Rapidly establishing international coordination to deliver strategic, technical, and operational support through existing mechanism and partnership;
- Scaling up country preparedness and response operations, including strengthening readiness to rapidly follow-up of contacts when feasible (with priority given to high-risk settings such as health care settings; implementation of health measures for travelers; and awareness raising in the population through risk communication and community engagement.
- Accelerating priority research and innovation to support a clear and transparent global process to set research and innovation priorities to fast track and scale-up research, development, and the equitable availability of candidate therapeutics, vaccines, and diagnostics. This will build a common platform for standardized processes, protocols and tools, to facilitate multidisciplinary and collaborative research integrated with the response.

1.17 Research objectives of study

The general objective of this study is to explore the acceptance of COVID 19 vaccines among resident undergraduates of the University of Benin. Specific objectives of study includes;

1. To access their knowledge and perception of COVID-19.
2. To explore their attitudes towards COVID-19 vaccines.
3. To explore their willingness to take the covid-19 vaccine.

Chapter two

Method

This segment of the study deals with a description of the method employed in undertaking the study, which includes the research design, population and sampling technique, the research instruments, operationalization of variables, and the method of data analysis. All these sub-points are considered as follows;

2.1The Research Design

The research design employed in this study is the prospective research to find out the level of covid-19 vaccine acceptance among resident undergraduates of the University Of Benin. The research uses a non probability convenience sampling technique. Residences were chosen based on willingness of respondents to participate. This design forms the full basis upon which the data shall be analyzed and then generalized in attempt to make inferences.

2.2Study population

The study population involves undergraduates of University Of Benin residing in the halls of residence. Accordingly, the population of this study comprises of 2450 resident students which cut across all faculties of the university. The survey utilized a convenience sampling technique with a minimum sample size of 333 calculated based on the assumption of a 50% vaccine acceptance rate, a 5% margin of error and a confidence interval of 95%.

2.3Sample size

Calculation of sample size was done by using the Cochran formular and the calculation below

$SS= Z^2 \times Pq/e^2$

Where:

SS= sample size

Z= Z VALUE (e.g. 1.96 for 95% confidence level)

P= estimated proportion of an attribute that is present in a population (50% approx. 0.5)

q = p-1

e= margin of error (5% approx. 0.05)

The sample size derived from the calculation above is used to calculate the sample size for a finite population (where the population is less than 50,000).

NEW SS = SS ÷ [1 + (SS-1)/pop]

Pop = population

Study population = 2450

Using the formulas' above;

SS= $1.96^2 \times 0.5 \times (1-0.5)/0.05^2$

= 384.16

NEW SS = 384.16 ÷ [1 + (384.16-1)/2450] = 333

2.4Sampling technique

The sampling technique is convenience sampling involving selection of participants based on availability and willingness to take part in the study. A male and a female hostel were chosen based on convenience and accessibility to the targeted population.

2.5Inclusion and exclusion criteria

Inclusion criteria

- Participants must be full-time students of University Of Benin.
- Participants must be residing on campus in either of the halls of residence.
- Participants must be undergraduates.

Exclusion criteria

- Students staying outside the university campus.
- Post graduate students.
- Academic and non academic staff of the university.

2.6 Research instrument

The research instrument for this study consists of a structured questionnaire consisting of three sections. Section A includes the social demographic-data of respondents such as sex, age, level,

department, faculty and marital status. Section b contains questions which tests their knowledge about covid-19. Section c contains questions about the knowledge about the covid-19 vaccine while section d contains willingness to take the covid-19 vaccine. Also, a further yes/maybe/no query was asked whether they will take the vaccine when made available. Overall 30 items; 6 questions for social demographics, 6 questions for knowledge of the virus, 10 questions for knowledge about the COVID-19 vaccine and 8 questions on willingness to take the covid-19 vaccine were used to assess respondents level of knowledge and willingness. This is in order to obtain first-hand information and adequate answers from the respondents.

The validity was checked by doing a pre-test on 20 participants. Modification of the tool was made based on the pre-test result. To make sure the questions are externally and internally consistent, pilot testing and Cronbach's alpha test was carried out. All the questions were tested using Cronbach's alpha test and a result greater than 0.7, indicated excellent internal consistency in their responses.

2.7Data collection

The principal executive officers of each hostel were informed and the questionnaires distributed to the residents. In order to ensure a high response rate, a cover letter accompanied each questionnaire to respondents explaining the research objectives with the assurance of the confidentiality of the information were provided. To enhance the response rate, questionnaires were delivered in the halls of residents and collected in person.

2.8 Data analysis

The gathered data were sorted, coded and entered into Microsoft excel spreadsheet. All data were analyzed using the statistical package for the social science version 24 (IBM: SPSS Inc.) software package for statistical analysis. Mean of the sample, standard error of mean, variance and standard deviation were gotten and used to find the average data results. The data were presented in percentage for easier assessment and evaluation.

2.9Ethical consideration

Ethical approval was gotten from the dean of student affairs office of the university through the dean, faculty of pharmacy while copying the principal executive officers of the halls of residents. Informed consent was also obtained from the respondents and they were made to understand that participation was voluntary. There were no consequence for non participation and all information obtained was kept confidential.

CHAPTER THREE

RESULTS

A total of 350 questionnaires were printed and distributed of which 343 were completely filled and retrieved indicating a response rate of 98% of which the required number of sample size(333) was collected. Respondents gave responses based on the data requirements provided;

Table 1 shows social demographic data of respondents consisting of 164(49.1%) males and 169(50.9%). The respondents were segmented by age of majorly 133(38.9%) students of age range 16-20 years and 167(50.3%) students between 21-25 years. According to year in school, 89(26.8%) students were first year; 85(25.3%) students were second year; 74(22.3%) were third year; 67(20.2%) fourth year; while fifth and sixth year were 13(3.9) and 5(1.5%) students respectively. 332(99.7%) of the students were single, 1(0.3%) married and none either divorced or others.

Table 1: social demographic data of respondents (sample size = 333)

	Frequency	**Percentage**
Q 1. Gender		
Male	163	49.1
Female	169	50.9
Q 2. Age (years)		
16-20	132	39.8
21-25	167	50.3
26-30	31	9.3
30 and above	2	0.6
Q 3. Level		
100	89	26.8
200	85	25.3
300	74	22.3
400	67	20.2
500	13	3.9
600	5	1.5
Q 4. Marital status		
Single	332	99.7
Married	1	0.3
Divorced	0	0
Others	0	0

Table 2 describes the knowledge of the coronavirus disease with a 100% of study participant reportedly have heard about covid-19 of which their most common source of information was media and internet 315(94.9%) having compared it to other sources; Health professionals 134 (40.4%) for ticked: Media and internet, ticked 316 (94.9%); Family and friends, ticked 155 (46.4%); Seminars, ticked 33 (9.6%); Government agencies, ticked 118 (35.2%). This support the claim that people, especially college students' major source of information is the media and internet.

On symptoms and modes of transmission, high response rates were seen across all options supporting the claim that most of the symptoms and modes of transmission were well known. On effective ways of prevention, prevention by covid-19 vaccines seems to have the least response when compared to the other preventive measures.

Table 2 Descriptive statistics for observed indicators of covid19 knowledge and source of information

Q1. Have you heard about COVID-19?							
	Frequency			Percentage			
Yes	333			100			
No	0			0			
Q2. Source of information. Tick more than one if applicable							
	Ticked (percentage)			**Not ticked (percentage)**			
Health professionals	135(40.4%)			198(59.6%)			
Media and internet	315(94.9%)			18(5.1%)			
Family and friends	155(46.4%)			178(53.6%)			
Seminars	33(9.6%)			300(90.4%)			
Government agencies	118(35.2%)			215(64.8%)			
Q3. COVID-19 stands for Coronavirus disease 2019							
	S. Agree	**Agree**	**Undecided**	**Disagree**	**S. Disagree**	**Mean**	**Std.Deviation**
Frequency	193	115	14	8	3		
Percentage (%)	58.1	34.3	4.2	2.4	0.9	4.46	0.767
	92.4%		**4.2%**	**3.3%**			
Q4. Symptoms of COVID-19. Tick more than one if applicable							
	Ticked (percentage)			**Not ticked (percentage)**			
Cough	249 (75%)			84 (25%)			
Sneezing and catarrh	210 (63.3%)			123 (36.7%)			
Fever	221 (66.3%)			112 (33.7%)			
Difficulty in breathing	303 (91%)			30 (9%)			
Chest pain and loss of smell	187 (56%)			146 (44%)			
Q5. Mode of transmission of COVID-19, tick more than one if applicable							
Coughing and sneezing from an infected person	303 (91%)			30 (9%)			
Body contact with an infected person	237 (71.1%)			96 (28.9%)			
Touching of contaminated surfaces	219 (66%)			114 (34%)			
Staying in crowded places	263 (79.2%)			70 (20.8%)			
Q6. What are the effective ways of COVID-19 prevention; tick more than one if applicable							
Wearing of face mask	300 (90.4%)			33 (9.6%)			
Social distancing and self-isolation	306 (91.9%)			27 (8.1%)			
Washing of hands and the use of hand sanitizers	310 (93.1%)			23 (6.9%)			
COVID-19 vaccines	152 (45.5%)			181 (54.5%)			

Table 3 describes level of knowledge of the covid19 vaccines available with almost all of the respondents (331, 99.4%) giving positive responses. On sources of information, the media and internet had 313(94%) higher responses and seminar as a source of information had the least response of 25(7.5%). On whether they believe covid-19 vaccine prevents the disease, 23.5% and 28.6% strongly agree and agree respectively while 36.45% of respondents were undecided. On determining the knowledge of the types of covid-19 vaccines available, Moderate responses were gotten for Pfizer 92(27.7%) and AstraZeneca 71(21.4%) vaccines while majority 219(66%) had no knowledge of the types of covid-19 vaccine available. This also affected their response on the type available in Nigeria as a total of 257(77.4%) respondents were unaware of the type of covid-19 vaccine available in Nigeria.

Table 3 Descriptive statistics for observed indicators of knowledge of covid19 vaccines and source of information.

Q1. Have you heard of the COVID-19 vaccine?							
			Frequency			Percentage	
Yes			331			99.4	
No			2			0.6	
Q2. If yes, what are your sources of information? Tick more than one if applicable							
			Ticked (percentage)			Not ticked (percentage)	
Health professionals			120 (35.8%)			213 (64.2%)	
Media and internet			313 (94%)			20 (6%)	
Family and friends			110 (32.8%)			223 (67.2%)	
Seminars			25 (7.5%)			308 (92.5%)	
Government agencies			101 (30.1%)			232 (69.9%)	
Q3. COVID-19 vaccine prevents Coronavirus Disease							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	78	95	121	26	13		
Percentage (%)	23.5	28.6	36.4	7.8	3.6	3.61	1.42
	52.1%		36.4%	11.4%			
Q4. What are the types of COVID-19 vaccines you know, Tick more than one if applicable							
			Ticked (percentage)			Not ticked (percentage)	
Moderna			37 (10.8%)			296 (89.2%)	
Pfizer			93 (27.7%)			240 (72.3%)	

AstraZeneca			72 (21.4%)		261 (78.6%)		
I don't know			219 (66%)		114 (34%)		
Q5. Which of the COVID-19 vaccine is available in Nigeria							
Moderna			3 (0.6%)		330 (99.4%)		
Pfizer			33 (9.6%)		300 (90.4%)		
AstraZeneca			456 (13.6%)		287 (86.4%)		
I don't know			258 (77.4%)		75 (22.6%)		
Q6. COVID-19 vaccine is safe for use							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	27	89	166	28	23		
Percentage	8.1	26.8	49.7	8.4	6.9	3.21	0.956
	34.9%		49.7%	15.3%			
Q7. Do you know the number of doses needed to be completely vaccinated with the COVID-19 vaccine?							
			Frequency		Percentage		
Yes			53		15.7		
No			280		84.3		
Q8. Two doses are needed to completely vaccinate with the Covid-19 vaccine							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	23	27	254	19	10		
Percentage	6.9	8.1	76.2	5.7	3.0	3.10	0.726
Total	15.0%		76.2%	8.7%			
Q9. The COVID-19 vaccination can reduce Covid-19 infection rate							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	33	129	141	13	17		
Percentage	9.9	38.9	42.2	3.9	5.1	3.45	0.913
Total	48.8%		42.2%	9.0%			
Q10. Mass vaccination is the best way to overcome the COVID-19 pandemic							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	37	99	132	37	28		
Percentage	11.1	29.8	39.5	11.1	8.4	3.24	1.067
	40.9%		39.5%	19.5%			

Table 4 shows the covid19 vaccination coverage and the willingness to take the covid19 vaccine when available of which a lower proportion of participants (13, 3.9%) reportedly being vaccinated against covid-19 while the majority of the participants (319, 96.1%) have not. About 68(20.5%) of the study participants reported that they are willing to take the covid-19 vaccine when available, while 147(44.3%) responded that they are will not take the vaccine and 117(35.2%) said that they are undecided. As also presented in the result, 119(35.8%) participants were undecided on whether they will recommend covid-19 vaccine to their friends and family and a higher proportion of participants disagree and strongly disagree that the government should require everyone to take the covid-19 vaccine. A large proportion of participants strongly agree and agree that covid-19 vaccine should be taken when one feel at risk of getting infected. On whether approval of the covid-19 vaccine guarantees our safety, a higher percentage of participants were undecided while 10.2% and 22.2% strongly agree and agree respectively. The majority responded as either undecided, disagree or strongly disagree that the covid-19 vaccination should be made compulsory. 37.7% strongly agree and 33.1% agrees that adequate information about the vaccine will increase acceptance rate while 3.6% and 8.7% disagrees and strongly disagrees respectively.

Table 4 Descriptive statistics for observed indicators of level of covid19 vaccination coverage and willingness to take the covid19 vaccine.

Q1. Have you taken the COVID-19 vaccine?							
		Frequency			Percentage		
Yes		13			3.9		
No		320			96.1		
Q2. Will you take the COVID-19 vaccine when available?							
		Frequency			Percentage		
Yes		68			20.5		
No		148			44.3		
Maybe		117			35.2		
Q3. We should recommend COVID-19 vaccine to our friends and family							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	33	88	119	40	53		
Percentage	9.9	26.2	35.8	12	16	3.02	1.193
	36.1%		35.8%		28.0%		
Q4. The Government should require everyone to take the COVID-19 vaccine							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	23	71	85	85	69		
Percentage	6.9	21.4	25.6	25.3	20.8	2.68	1.216
	28.3%		25.6%		46.1%		
Q5. We should take the COVID-19 vaccine if we feel at risk of getting COVID-19							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	55	134	81	27	36		
Percentage	16.6	40.1	24.4	8.1	10.8	3.43	1.181
	56.6%		24.4%		18.9%		
Q6. The approval of the COVID-19 vaccine guarantees our safety							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	34	76	135	50	38		
Percentage	10.2	22.9	40.4	15.1	11.4	3.05	1.117
	33.1%		40.4%		26.5%		
Q7. COVID-19 vaccination should be compulsory once it is available							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	19	54	70	97	93		
Percentage	5.7	16.3	21.1	29.2	27.7	2.43	1.213
	22.0%		21.1%		56.9%		
Q8. Adequate information about the Covid-19 vaccine will encourage the acceptance rate							
	S. Agree	Agree	Undecided	Disagree	S. Disagree	Mean	Std. Deviation
Frequency	125	110	56	12	30		
Percentage	37.7	33.1	16.9	3.6	8.7	3.87	1.210
	70.8%		16.9%		12.3%		

CHAPTER FOUR

DISCUSSION

At present, vaccines are a critical new tool in the fight against covid-19 pandemic. Several COVID-19 vaccines have been developed through clinical trials while trying to meet the requirements for quality, safety and efficacy. These vaccines were manufactured within one year after the WHO declared covid-19 to be an international public health emergency. Due to remarkable determination in vaccine research, development and production, covid-19 vaccines were developed within the shortest period in the history of vaccine production. A step in the right direction will be equitable distribution of covid-19 vaccines globally especially to countries where there is high incident rate. This is a very significant step as it is critical in curbing the pandemic. During the first wave of arrivals in Nigeria, nearly 4 million doses of the covid-19 vaccine were shipped via COVAX facility, a partnership between coalitions for epidemic preparedness innovations (CEPI), GAVI, UNICEF and WHO. COVAX shipped 3.94 million doses of the AstraZeneca/oxford vaccine, manufactured by the Serum Institute of India (SII), from Mumbai to Abuja (WHO- Africa region 2021). The executive director, national primary health care development agency (NPHCDA), Faisal Shuaib, during a national briefing of the covid-19 presidential steering committee in Abuja stated that 3.924 million came through the COVAX facility and another 100,000 doses from the Government of India (the premium times Nigeria 2021). As of 6 June 2021, the country had administered over 2.3 million doses: about 1.96 million had received the first dose and 336,500 the second (WHO-Africa region 2021). These efforts have been made by the government and with an increased supply of COVID-19 vaccines; there is need for a large proportion of the population to accept it. For colleges and universities this is no exception as students across the country are becoming eligible for covid-19 vaccination. A few studies have emerged describing college students' intentions and attitudes regarding covid-19

vaccine uptake (Manning et al 2021; Qiao et al 2020; Kumar et al 2021). In Nigeria, very little studies have been done on regarding intentions of the public regarding covid19 vaccine uptake (Adebisi, et al 2021; Adebisi, et al 2020; Lazarus et al 2020; Ilesanmi, et al 2021). This current study adds to the growing number of studies done as regards acceptance of the covid-19 vaccine by several sets of the population. Although no study has been done regarding undergraduates' willingness to be vaccinated to prevent coronavirus disease in the University of Benin. In this study, we aim to determine their knowledge level and the intention of undergraduates to accept the covd19. It was found that all 100% of the respondents have heard firsthand of the covid19 virus of which their most common source of information was media and internet 315(94.9%) having compared it to other sources. This shows that the media and internet play an important role in undergraduates' knowledge (Abd Jalil et al 2010; Ayub et al 2017; Lin et al 2018). Seminar as a source of information had the least response. Overall, there were positive attitudes to symptoms and prevention while reduced knowledge was seen on covid19 vaccination as one of the effective ways of preventing covid19 when compared to other preventive measures (Peng et al 2020). On knowledge about the covid-19 vaccines, almost all of the respondents (330, 99.4%) have heard of the covid-19 vaccine with the media and internet sources also having 321(94%) higher responses and seminar as a source of information had the least response of 25(7.5%). But lower response was seen when their knowledge on the types of vaccines available was assessed with 456 (13.6%) responses on AstraZeneca as the vaccine available in Nigeria presently. This indicates that an inadequacy in covid19 vaccine knowledge among them with 49.2% of respondents indicating fear about the safety of the covid19 vaccines as safety and effectiveness of the covid19 vaccines has been identified to be a contributing factor to vaccine hesitancy (Al-Qerem et al 2021)

On willingness to take the vaccine, our findings indicate low vaccine coverage of only 3.9% of the total respondents. While 44.3% of the respondents indicated their refusal to take the COVID19

vaccine, 35.25% of respondents are yet to decide if they will take the vaccine. This needs to be addressed in other to increase the rate of acceptance. Furthermore, a significant number of students disagree on the need to make covid19 vaccination compulsory indicating their resistance to compulsory covid19 vaccination. On if adequate information about the covid19 vaccine will increase acceptance rate, a higher response was seen (70.8%) as respondents strongly agree/agree that information is key in increasing acceptance rate.

CHAPTER FIVE

CONCLUSION

This study shows that undergraduate residents have adequate knowledge of covid19 and the COVID19 vaccines. Although on further assessment of their knowledge on the vaccines, lapses were seen which need to be address. There is low COVID19 vaccine coverage in the university with acceptance rate of the vaccine relatively low. This can be as a result of low acceptance rate resulting from inadequate information and low sensitization of the undergraduates by university authorities. This study indicates undergraduates' knowledge is inadequate in increasing COVID19 vaccination acceptance. Although they show very positive attitude towards the disease, however their reduced acceptance rate demonstrate that there is still gaps to be filled in achieving adequate coverage of COVID19 vaccination. The importance of reducing rate of transmission and increasing covid19 vaccination among resident undergraduates cannot be over emphasized as there are relaxed preventive measures in the halls of residence.

RECOMMENDATIONS

This study points out the urgent need for interventions that are particular to undergraduates of various health literacy levels in order to increase covid19 vaccine willingness. Also there is need for authorities to partner with health professionals in organizing seminars on COVID19 vaccination acceptances and also engaging in aggressive social media campaigns aimed not just at the public but specifically to undergraduates since they might feel less at risk due to reduced co-mobidities. Understanding the students perspective on covid19 vaccination particularly those in the hostel were there are relax preventive measures may be useful in reducing rate of transmission.

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COVID-19 VACCINE ACCEPTANCE AMONG RESIDENT UNDERGRADUATE STUDENTS OF UNIVERSITY OF BENIN,

EDO STATE, NIGERIA.

QUESTIONNAIRE

Please kindly respond to the questions below. It is strictly for research purposes and information obtained will be treated with utmost confidentiality.

Section A: demographic data (tick √ appropriately)

1. Sex : Male[ ] female[ ]
2. Age : 16-20years[ ] 21-25years[ ] 26-30years[ ] 30years and older[ ]
3. Level: 100[ ] 200[ ] 300[ ] 400[ ] 500[ ] 600[ ]
4. Department: _____
5. Faculty : _____
6. Marital status: single[ ] married[ ] divorced[ ] others[ ]

Section b: knowledge about the corona virus disease (covid19)

7. Have you heard about COVID 19: Yes[ ] No[ ]
8. If yes what is your source of information. Tick more than one if applicable: health professionals[ ] media [ ] internet[ ] family and friends[ ] seminar[ ] church[ ] government agency[ ]
9. What is COVID 19: bacterial infection[ ] coronavirus[ ] coronavirus disease 19[ ] I don't know[ ]
10. What are the symptoms of COVID 19? Tick more than one if applicable: cough[ ] catarrh[ ] sneezing[ ] fever[ ] difficulty in breathing[ ] tiredness[ ] chest pain[ ] loss of smell[ ]
11. Mode of transmission of COVID 19, tick more than one if applicable: coughing from an infected person[ ] staying in crowded places[ ] sneezing from infected persons[ ] shaking hands[ ] hugging[ ] touching of contaminated surfaces[ ] I don't know[ ]
12. What are the effective ways of COVID19 prevention; tick more than one if applicable: wearing of face mask[ ] social distancing[ ] self isolation[ ] washing of hands[ ] using hand sanitizers[ ] COVID 19 vaccines[ ]

13. Do you think COVID19 is real; Strongly agree[ ] Agree[ ] Undecided[ ] disagree[ ] strongly disagree[ ]

Section c: knowledge of the covid19 vaccine

14. Have you heard of the COVID19 vaccine: Yes[ ] No[ ]
15. If yes what is your source of information. Tick more than one if applicable: health professionals[ ] internet[ ] family and friends[ ] media[ ] seminars[ ] church[ ] government agency[ ]
16. What is COVID19 vaccine: A drug that can stop coronavirus[ ] A vaccine that can prevent coronavirus[ ] A vaccine that can reduce the symptoms of the virus[ ] A drug that can cure coronavirus[ ] I don't know[ ]
17. What are the types of COVID19 vaccines you know, Tick more than one if applicable: Moderna[ ] Pfizer[ ] Astrazeneca[ ] Gavi[ ] I don't know[ ]
18. Which of the COVID19 vaccine is available in Nigeria: Moderna[ ] Pfizer[ ] astrazeneca[ ] I don't know[ ]
19. Do you consider COVID19 vaccine as safe for use: Strongly agree[ ] Agree[ ] Undecided[ ] disagree[ ] strongly disagree[ ]
20. How many doses are needed to be completely vaccinated with the COVID19 vaccine: One[ ] Two[ ] Three[ ] Four[ ] I don't know[ ]
21. The COVID19 vaccination can prevent covid19 infection: Strongly agree[ ] agree[ ] undecided [ ] disagree[ ] strongly disagree[ ]
22. Do you believe that the way to overcome the COVID-19 pandemic is mass vaccination? Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]

Section c: willingness to take the covid19 vaccine

23. Have you taken the COVID19 vaccine: Yes[ ] No[ ]
24. Will you take the COVID19 vaccine when available: Yes[ ] No[ ]
25. Will you recommend COVID19 vaccine to your friends and family: Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]
26. Will you take the COVID19 vaccine if required by the government: Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]

27. Will you take the COVID19 vaccine if you feel at risk of getting COVID19: Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]
28. I think that approval of the COVID19 vaccine guarantees its safety: Strongly Agree [ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]
29. COVID-19 vaccination should be compulsory once it is available: Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]
30. If I was given adequate information about the vaccine, I will take it: Strongly Agree[ ] Agree[ ] Undecided[ ] Disagree[ ] Strongly Disagree[ ]