Cankiri Karatekin University

Graduate School of Health Sciences

Master of Nursing Science Thesis / Public Health Nursing

ASSESSMENT OF HEALTH CARE STAFF'S KNOWLEDGE, ATTITUDES, AND PRACTICES TOWARDS NOVEL CORONAVIRUS AT AL- SHAMIYA PRIMARY HEALTH CARE CENTERS

By

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2023

ACCEPTANCE AND APPROVAL

Hadi Kareem Abbood AL-ABEDI, the graduate student of The Institute of Health Sciences with the student number of 208205288, has successfully presented her thesis entitled "Assessment of Health Care Staff's Knowledge, Attitudes, and Practices Towards Novel Coronavirus at AL- Shamiya Primary Health Care Centers" before the jury whose signatures are below, after fulfilling all of the requirements determined by the relevant regulations for the degree of Master of Science:

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ETHICS STATEMENT

The thesis entitled "**Assessment of health care staff's knowledge, attitudes, and practices towards novel coronavirus at al- shamiya primary health care centers**" which was prepared and presented as a thesis, was written by myself and in accordance with the scientific, academic rules and ethical conduct. The idea/hypothesis of my thesis solely belongs to my supervisor and to me. The research pertaining to the thesis was conducted by myself and therefore, all of the used sentences and interpretations within the work belongs to me.

I declare the aforementioned issues to be correct.

Signature

Feb. 06, 2023

HADI KAREEM ABBOOD

AL-ABEDI

ABSTRACT

ASSESSMENT OF HEALTH CARE STAFF'S KNOWLEDGE, ATTITUDES, AND PRACTICES TOWARDS NOVEL CORONAVIRUS AT AL- SHAMIYA PRIMARY HEALTH CARE CENTERS

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Feb. 2023

Background: Wuhan, China, was the epicenter of an unknown pneumonia epidemic in December 2019. The WHO determined that SARS-CoV-2 caused the outbreak in China and other countries. On February 22, 2020, Iraq, particularly Najaf, had its first case of COVID-19 infection. Infected people might produce fever, dry cough, breathing problems, and myalgia**. Objective:** assessment of healthcare staff's kap towards novel coronavirus at Al-Shamiya primary healthcare centers in Iraq**. Methodology:** A descriptive study design was used. 300 non-probability samples from primary health care staff in Shamiya from April 1, 2022, to June 1, 2022, were included in the study. To collect the study data a subjective questionnaire consisting of 4 parts was used: The first section contains the demographic information, the second section covers the healthcare staff's knowledge of COVID-19, the third section contains the healthcare staff's attitudes toward COVID-19, and the fourth section evaluates the healthcare staff's practices while dealing with COVID-19. In order to reach the results, we used descriptive statistics, percentages, frequencies, ANOVA, and correlation. **Result:** The majority of participants were females 57.3% and 67.7% youths, most of them were from health and nursing professions 89.7%, while the educational level was a diploma 51.3%. The vast majority use official health websites for information and the level of knowledge, attitudes, and practices of the participants were good. **Conclusion:** There were no statistically significant differences between gender, age, number of years of experience, and the participants' knowledge, While it was found between jobs, educational level, and the participants' knowledge. However, we did not find these differences in attitudes. There were statistically significant differences between gender, age, and the participants' practices. There is a positive correlation between knowledge and attitudes and between attitudes and practices**.**

2023, 123 pages

Keywords: COVID-19, Study of KAP, PHC, Healthcare staff**,** SARS-CoV-2.

ÖZET

AL-SHAMIYA BIRINCI BASAMAK SAĞLIK MERKEZLERINDE SAĞLIK ÇALIŞANLARININ YENI KORONAVIRÜSE KARŞI BILGI, TUTUM VE UYGULAMALARININ DEĞERLENDIRILMESI
Hadi Kareem Abbood AL-ABEDI
Hemşirelik, Yüksek Lisans
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Şubat 2023

Arka plan: Çin'in Wuhan kenti, Aralık 2019'da bilinmeyen bir pnömoni salgınının merkez üssü olmuştur. DSÖ, Çin ve diğer ülkelerde salgına SARS-CoV-2'nin neden olduğunu belirlemiştir. 22 Şubat 2020'de Irak, özellikle Necef'te, ilk COVID-19 enfeksiyonu vakasıyla karşılaşılmıştır. Enfekte kişilerde ateş, kuru öksürük, solunum problemleri ve miyalji görülebilir. **Amaç**: Irak/Al-Shamiya birinci basamak sağlık merkezlerinde sağlık personelinin yeni koronavirüse karşı bilgi, tutum ve uygulamalarının değerlendirilmesi. **Metodoloji:** Tanımlayıcı bir çalışma tasarımı uygulanmıştır. 1 Nisan 2022'den 1 Haziran 2022'ye kadar Shamiya'daki birinci basamak sağlık personelinden alınan 300 olasılık dışı örneklem çalışmaya dahil edilmiştir. Çalışma verilerini toplamak için 4 bölümden oluşan öznel bir anket kullanılmıştır: İlk bölüm demografik bilgileri, ikinci bölüm sağlık personelinin COVID-19 hakkındaki bilgilerini, üçüncü bölüm sağlık personelinin COVID-19'a yönelik tutumlarını, dördüncü bölüm ise sağlık personelinin COVID-19 ile uğraşırken yaptığı uygulamaları değerlendirmektedir. Sonuçlara ulaşmak için betimsel istatistikler, yüzdeler, frekanslar, ANOVA ve korelasyon kullanılmış. **Bulgular:** Katılımcıların çoğunluğunun %57,3'ü kadın, %67,7'si genç, %89,7'si sağlık ve hemşirelik mesleklerinden olup eğitim düzeyi ise %51.3 ile diploma edğitimi olmuştur. Büyük çoğunluk bilgi için resmi sağlık web sitelerini kullanmakta olup, katılımcıların bilgi düzeyi, tutumları ve uygulamaları iyi olmuştur. **Sonuç:** Cinsiyet, yaş, deneyim yılı ve katılımcıların bilgi düzeyleri arasında istatistiksel olarak anlamlı bir fark bulunamamış olup; meslek, eğitim düzeyi ve katılımcıların bilgileri arasında anlamlı bir fark bulunmuştur. Ancak, bu farklılıkları tutumlarda bulamadık. Cinsiyet, yaş ve katılımcıların uygulamaları arasında istatistiksel olarak anlamlı farklılıklar söz konusu olmuştur. Bilgi ve tutumlar ile tutumlar ve uygulamalar arasında pozitif bir ilişki vardır.

2023, 123 sayfa

Anahtar Kelimeler: COVID-19, KAP Çalışması, PHC, Sağlık personeli, SARS-CoV2.

PREFACE AND ACKNOWLEDGEMENTS

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HADI KAREEM ABBOOD AL-ABEDI
Cankiri-2023

CONTENTS

LIST OF ABBREVIATIONS

ACE II	Angiotensin-converting enzyme II
ACE2	Angiotensin-converting enzyme 2
ANOVA	Analysis of variance
CCU	critical care units
CD8+ T	Cytotoxic T cell
CDC	Centres for Disease Control and Prevention
cDNA	Complementary DNA
COVID-19	Coronavirus disease 2019
CT	Computerized tomography
DNA	Deoxyribonucleic acid
ECG	Electrocardiography
FDA	U.S. Food and Drug Administration
GI	Gastrointestinal
HCWs	health care workers
KAP	Knowledge, Attitude, and Practice
MERS	Middle East Respiratory Syndrome
MOH	Ministry of health
MRI	Magnetic resonance imaging
mRNA	Messenger ribonucleic acid
PHC	Primary Health Care
PHCC	Primary Health Care Centre
PHCS	Primary Health Care Sector
PHEIC	Public health emergency of international concern
PPE	Personal protective equipment
PRC	People's Republic of China
RBD	receptor-binding domain
RDV	Remdesivir
Rh	Rhesus factor
RNA	Ribonucleic acid
RT-PCR	Reverse transcription polymerase chain reaction
SCBA	Self-contained breathing apparatus
SPSS	Statistical Package for the Social Sciences
T.C	Republic of Turkey
U.K.	United Kingdom
U.S.A.	The United States of America
VTE	Venous thromboembolism
WHO	World Health Organization

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1. INTRODUCTION

Because infectious illnesses have the potential to eradicate whole communities, they have always posed a significant threat to the continued survival of the human race. Epidemiological research suggests that because of these pandemics and epidemics, the lives of millions of people were taken. Throughout the course of the previous century, humankind has been afflicted by a plethora of infectious diseases, the vast majority of which are viral in nature. The outbreak of a pandemic is a natural phenomenon that may take place at any point in time. The influenza virus struck again in 1957–1958 in the form of the H2N2 influenza A virus, triggering a pandemic that claimed 1.1 million lives worldwide. Pandemic outbreaks are not new and occur from time to time. (Saxena, 2020).

In December 2019, Wuhan, which is located in Hubei Province, China, was the hub of an outbreak of pneumonia, the roots of which were unknown up to that point. The World Health Organization made the determination that SARS-CoV-2 was the novel COVID-19 that was responsible for the pandemic that occurred in China and other areas of the world (Zhang & Ma, 2020).

As of the year 2020, the COVID-19 virus has already infected more than 50 million people across more than 90 nations. The environment in which governments function is fraught with high levels of uncertainty, which in turn provides them with a variety of physical, economic, and social challenges. At the start of the year 2020, strict containment measures were put in place for about half of the planet's population. It is now widely agreed that a pandemic induced by a COVID-19 was the primary contributor to the most severe economic downturn that has taken place since the end of World War II. The events that have taken place there is a disaster for all of mankind. It is quite improbable that many economies will recover to the levels of output they had in 2019 until at least 2022 (Economic Co-operation and Development, 2020).

A beta COVID-19 found in Wuhan, China, known as COVID-19 is the cause of SARS-CoV-2 infections. More than 34 million individuals were infected by October 2020,

and more than a million people died because of the epidemic. The most common symptoms include fever, dry cough, breathing difficulties, and myalgia, all of which can be caused by contact with an infected person (World Health Organization, 2020).

However, there are just less common symptoms, such as problems with the digestive system and an absence of smell and taste, which are not as common. The severity of these symptoms varies from person to person, but being old and having other illnesses are possible causes for more severe diseases. The average time from exposure to symptom onset is 5 days, and 97.5% of people who develop symptoms do so within 11.5 days. (Wiersinga et *al*., 2020).

On February 22, 2020, Iraq, and particularly Najaf, had its first case of COVID-19 infection. The number of verified COVID-19 cases increased significantly and alarmingly in June, jumping from 430 cases and 10 fatalities on June 1st to 1958 cases and 104 deaths on June 30th (UNICEF Iraq, 2020).

This new respiratory virus has quickly spread around the globe because its symptoms are often relatively mild, if not undiscovered, among people who are affected by it. Direct patient care is provided by nurses in a broad range of different environments, such as emergency departments, critical care units (CCU), long-term care institutions, nursing homes, schools, communities, and government health agencies. In the midst of the current epidemic caused by the COVID-19 virus, the many facets of nursing care that nurses provide are more crucial than ever. These crucial tasks and responsibilities span five different areas (CHEN et *al*., 2020).

Within the framework of the COVID-19 response, members of the healthcare staff may be exposed to dangers on the job that put them at a higher risk of being sick, getting injured, or even dying away. Infections like COVID-19, skin problems and heat stress from wearing personal protective equipment (PPE) for long periods of time, exposure to toxins from using more disinfectants, mental distress, chronic fatigue, stigma, discrimination, physical and mental violence, and harassment are all risks that workers face on the job (World Health Organization, 2021).

Numerous research studies have been conducted and published on the perception, knowledge and attitude of HCWs towards MERS-CoV. Researchers are presently attempting to optimize vaccines and treatments for COVID-19 since it is a relatively new virus that has been discovered. Therefore, nurses not only run the risk of catching this newly discovered infectious condition, but they also run the risk of acquiring work-related anxiety and mental health concerns as a consequence of their exposure to it. This is because nurses are more likely to be in close contact with patients. When caring for patients with COVID-19, it is crucial to use current best practices to prevent infection and safeguard healthcare workers and nurses. Medical professionals should be taught how to keep infectious diseases from spreading by doing things like keeping themselves clean, wearing the right protective gear, and taking other biosafety precautions in the workplace (Aldohyan et *al*., 2019; Khalid, et *al*., 2016).

1.1 Importance of the Study

Workers in the healthcare industry play an important part in improving both the overall health of a community and the quality of medical care that individuals receive. When it comes to health and wellness promotion, the prevention of sickness, and the delivery of services for individuals, families, and communities, they use a primary care approach. To reach the Millennium Development Goals, we will need to set up systems that make the most of the skills and abilities of healthcare professionals. The 59th World HealthAssembly adopted Resolution WHA59.23 which recognized the "centrality of human resourcesfor health for the effective operation of country health systems" and called for the use ofinnovative strategies to maximize health professionals' contributions. (WHO, 2018).

In order to combat this worldwide issue, medical professionals such as nurses, medical assistants, emergency medical technicians, and other first responders put in lengthy shifts while lacking enough supplies and personal protective equipment. This puts their lives in jeopardy (Unitek College, 2020).

As of July 24th, 2020, the virus has affected 3019 healthcare staff, or at least 6.6% of the total number of cadres, with at least 25 deaths. In addition, 633 doctors were injured

and 9 deaths were recorded, while pharmacists recorded 177 injuries and one death, the number of injuries among dentists reached 48, and nurses' injuries reached 1558, including 9 deaths, in addition to recording 262 injuries among those in charge. Conducting laboratory tests, and one death. As for the injuries of the rest of the workers in other medical professions, they amounted to 458 injuries and 5 deaths. Infecting healthcare personnel while trying to curb an outbreak is a big challenge. To prevent the virus from spreading to healthcare workers, we identify those at risk and take the required safeguards. Overcrowding, a lack of isolation rooms, and environmental pollutants all contribute to healthcare worker disease. Some healthcare personnel may not understand conventional steps to prevent sickness transmission, making the problem worse (Arabia net, 2020).

Their level of disease knowledge may influence healthcare workers' beliefs and behaviors, and negative beliefs and behaviors directly increase the likelihood of infection. Knowing the Knowledge, Attitude, and Practice (KAP) of healthcare professionals and the potential risk variables that affect them makes it possible to predict the outcomes of planned conduct. Because of this, we set out to investigate KAPs among health care workers (HCWs). In the early stages of an epidemic, healthcare workers' habits and skills on the job that are related to the virus, factors that affect their attitudes and behavior, proper training, and policies can be quickly identified and directed to protect themselves and avoid occupational exposure as much as possible (McEachan et *al*., 2016).

It is crucial that HCWs follow the suggested COVID-19 preventative strategies as part of the global effort to reduce the effect of COVID-19 on healthcare. However, it is important to keep in mind that HCWs' adherence to these standards is largely determined by their knowledge, attitudes, and behaviors (KAP) (Ejeh et *al*., 2020). Therefore, it is essential that HCWs have sufficient awareness of COVID-19 preventive measures in order to have favorable attitudes and suitable activities that help to lower the risk of infection (Polychronis & Roupa, 2021).

1.2. Problem Statement

Adequate knowledge of the epidemiological dynamics and pathways of infection acquisition influences the attitudes and practices of healthcare staff. Lack of knowledge and information about this epidemic, as well as mistakes made by healthcare staff, can delay diagnosis and lead to the wrong treatment. This can also make it more likely for patients, staff, and clients. In addition, the good KAPs of COVID-19 prevention and treatment of healthcare Staff affect the behaviors of patients, clients, and the general society.

1.3. Objective of the Study

The purpose of this study was to:

1. Assess of healthcare staff's knowledge, attitudes, and practices towards novel COVID-19 at AL- Shamiya primary health care centers/Iraq.
2. To find out the significant differences between healthcare staffs knowledge, attitudes, and practices and social demographic characteristic.
3. To find out the correlation between healthcare staffs knowledge, attitudes, and practices.

1.4. Hypotheses

1. What is the level of knowledge, attitudes, and practices of working healthcare staffs about COVID-19?
2. Are there any significant differences in primary healthcare staff's knowledge toward COVID-19 according to age, gender, educational level, profession, and years of experience as a primary health care specialist?
3. Are there any significant differences in primary healthcare staff's attitudes toward COVID-19 according to age, gender, educational level, profession, and years of experience as a primary health care specialist?

4. Are there any significant differences in primary healthcare staff's practices toward COVID-19 according to age, gender, educational level, profession, and years of experience as a primary health care specialist?
5. Is there a statistically clear correlation between healthcare Staffs knowledge, attitudes, and practices?

1.5. The Danger of Misinformation about the pandemic novel COVID-19

The COVID-19 pandemic is unique in the history of this modern age of technology. Millions of people have been hurt by other pandemics, but the constant news coverage of the SARS-CoV-2 disaster has brought it to the forefront of our minds. International leaders have been engaged in a political battle over differing policies and medical interpretations. Even though there is a lot of information available, patients, the media, and the general public put a lot of pressure on doctors and nurses to find the right answers. In a similar vein, the public is flooded with information, most of it from questionable sources. In today's connected world, one false idea can quickly spread too many people who are willing to listen. This makes false information a potentially dangerous force (Nelson et *al*., 2020).

It is possible to lose one's life by acting on incorrect information. According to a new study, during the first three months of 2020, approximately 6,000 individuals all around the world were hospitalized as a result of inaccurate information on the COVID-19. According to the findings of the research, there is a possibility that incorrect information concerning the COVID-19 was the cause of death in at least 800 people during the course of the aforementioned time period (WHO, 2021).

It has been shown that digital newspapers and social media platforms such as Facebook and Twitter are especially helpful tools for combating the propagation of misinformation and correcting widespread misunderstandings among the general public (Eckert et *al*., 2016).

Untrue information makes a tense situation even more difficult to handle emotionally. Even those working in healthcare aren't safe from this phenomenon. More than 1,200

Chinese healthcare professionals were surveyed in recent research assessing the mental health impacts of COVID-19. A majority of people felt emotionally distraught, citing issues including worry, sadness, and lack of sleep. Conflict, misunderstanding, and conspiracy theories propagated by the media and the internet amplify the negative psychological and emotional impacts of these events (Mehra et *al*., 2020).

Due to the lightning-fast rate at which new data is being disclosed and criteria are revised, there is a possibility that manuscripts published in journals that were formerly considered reputable may be called into question. Caregiving for patients with COVID-19 may be difficult, and in these uncharted times, it's possible that being a trusted healthcare professional will be more stressful in general. When trying to educate oneself and one's patients about controversial topics, one's confidence in one's own skills and one's own and one's patients' mental health could be hurt (Nelson et *al*., 2020).

There is a moral need for us to support efforts to enhance public health that seek to eliminate needless human suffering and death. Instead of being lauded, nurses who help in the dissemination of misleading information need to be exposed as the sources of inaccurate and heinous message that undermines the ethical underpinnings of our profession (Kelly & Jackson, 2021).

1.6. Importance of primary health care staff

The World Health Organization has stressed that governments and health ministers must confront all persistent threats that affect the health and safety of health workers and patients, recalling that the COVID-19 pandemic has highlighted the vital role that health workers play in reducing the suffering of the injured and saving their lives, as no country or health institution can preserve the safety of its patients if it is not able to preserve the safety of its health workers. The WHO health workers safety charter is an important first step that may lead to giving health workers the protections they need at work as well as fair treatment, adequate resources, and adequate compensation they deserve (Haddad, 2022).

This new strain of COVID-19 poses an unprecedented threat to healthcare professionals and their families. Around 14% of COVID-19 cases reported to WHO are among health professionals, despite the fact that health workers make up less than 3% of the population in most countries and less than 2% in practically all low-and middle-income nations. This percentage may go as high as 35% in certain nations. However, due to a lack of data and poor data quality, it is hard to determine whether health professionals have contracted an infection in the course of their professional or personal lives. Nonetheless, hundreds of healthcare providers infected with COVID-19 have died all over the globe (Haddad, 2022).

As if the physical dangers weren't enough, the epidemic has also caused extreme psychological stress for health professionals who have had to work long hours in high-demand environments while living in continuous dread of disease exposure, apart from family, and enduring societal stigmatization. Medical doctors and nurses already faced an increased risk of suicide even before the spread of COVID-19. One-quarter of healthcare workers reported depressive and anxious feelings during COVID-19, and one-third had sleeplessness, according to a recent study (Pappa et *al*., 2020).

The health, safety and well-being of health workers is a legal and moral responsibility of governments and a prerequisite for an effective response to the COVID-19 pandemic and other public health emergencies. As part of Patient Safety Global Day 2020, WHO has outlined a number of specific objectives that healthcare institutions should strive to achieve in order to invest in, evaluate, and enhance the safety of healthcare workers. The aim are intended for healthcare facilities to address five areas: the prevention of injuries caused by sharp objects; the reduction of stress and burnout caused by work; the improvement of the use of personal protective equipment; the promotion of zero tolerance for violence against health workers; and the reporting and analysis of serious safety-related incidents (World Health Organization, 2020).

1.7. Definition of terms

1.Knowledge

When it comes to knowledge, it can be defined as what an individual gain from their experiences and skills, which are mostly derived from experience and learning in the first place and is represented by the theoretical and practical understanding of any topic or subject. (Zagzebski, 2017).

2. Attitude

It is a psychological construct that is a mental and emotional entity that inheres or characterizes a person, their attitude to approach to something, or their personal view on it. Attitude involves their mindset, outlook and feelings. Attitudes are complex and are an acquired state through life experience. Trends can be triggered by many of the exciting results that arise from learning, as well as the ability to group and discriminate, which are both exciting to other responses as well as an engine of behavior that is important in the society in which the individual lives. (Perloff, 2016).

3. Practice

It refers to any function, paid or unpaid, in which a person uses their knowledge and skills as a health practitioner in their chosen profession. This might be at a hospital, a private practice, or a community clinic. In order to meet the criteria of this registration criterion, a practitioner's scope of practice does not necessarily need to be restricted to the provision of direct clinical treatment. It also includes applying professional knowledge in a direct non-clinical relationship with clients, working in management, administration, education, research, advisory, regulatory, or policy development roles, as well as any other roles that have an impact on the secure and efficient delivery of services within the profession. Clinical practice is when the nurse or midwife is directly involved in providing direct clinical care or providing oversight of direct clinical care of patients, or is directly involved in clinical education of either pre-registration or post-registration students, including bridging programs. Non-clinical

practice is where a nurse or midwife is not directly involved in providing direct clinical care or providing oversight of direct care of patients or is not directly involved in clinical education of either pre-registration or post-registration students, including bridging programs. (Nursing and Midwifery Board of Australia, 2020).

4. Healthcare staff

The healthcare staff is a scientifically qualified person who provides health care, therapeutic and preventive services, and psychological support to patients, clients, and the wounded, such as doctors and nurses who provide services directly, bio-laboratory specialists, physicists, radiologists, medical equipment engineers, or medical waste cleaners who provide services indirectly. Globally, there is now more than 59 million healthcare staff worldwide. (Joseph & Joseph, 2016).

2. GENERAL INFORMATION

In this part of the study, we highlighted the important information about COVID-19 by reviewing the previous literature about it, from which the approach was chosen for our study.

2.1. Overview of Covid-19

SARS-CoV-2, also known as COVID-19 disease, was initially found in Hubei Province, People's Republic of China. Many countries around the world have reported high prevalence rates. The Emergency Committee of the World Health Organization imposed, in its meeting, a state of health emergency worldwide due to the high rate of infections with the COVID-19 and related cases, and this decision was taken as a result of the increase in serious infections. Travel has been enjoyed, and schools, universities, factories, and laboratories have been disrupted all over the world. In order to keep track of the increasing numbers and to prevent rumors and false information, Johns Hopkins University has established a website to monitor the daily numbers (Velavan & Meyer, 2020).

SARS-CoV-2 belong to the order Nidovirales, which includes the families Roniviridae, Mesoniviridae, Arteriviridae, and Coronaviridae. One of the two subfamilies that make up the family Coronaviridae is called the Coronavirinae. The other is called the Torovirinae. In the family Coronavirinae, four genera, which are called alpha, beta, gamma, and delta coronaviruses, in order. Viruses used to be grouped into these genera based on their antibodies, but now phylogenetic grouping is used. The viruses belonging to the Nidovirales order are all positive-sense ribonucleic acid (RNA) viruses that lack segments and have an envelope. All of these viruses have very big genomes for RNA viruses, with some having the largest RNA genomes yet discovered at up to 33.5 kilobase genomes in size. The order Nidovirales has several characteristics in common, such as:

i. -genomes that are very similar to one another are organized with a big replicase gene coming first, followed by structural and auxiliary genes.
ii. -Many non-structural genes are expressed by ribosomal frameshifting.

iii. -The big replicase-transcriptase polyprotein encodes a number of rare or special enzymatic activities.

iv. -Gene expression downstream through 3′ nested sub-genomic mRNA production.

The nucleocapsids and virions are drastically changed in structure and shape as a result of these variations (Fehr & Perlman, 2015).

2.2. Structure of COVID-19

The coronavirus family may be divided into four major groups: (α, β, γ, and δ). Human diseases are among the six members of the coronavirus group. Two different human coronaviruses, CoV-HKU1 and Cov-229E. Human infections such as CoV-OC43, SARS-CoV, and MERS-CoV all belong to the β coronavirus family. The seven conserved domains of the amino acid sequence in genomic open reading frame 1ab (ORF1ab) of SARS-CoV-2 are 94.6% similar to those of the original SARS-CoV (Lefkowitz et *al*., 2018; Zhou et *al*., 2020).

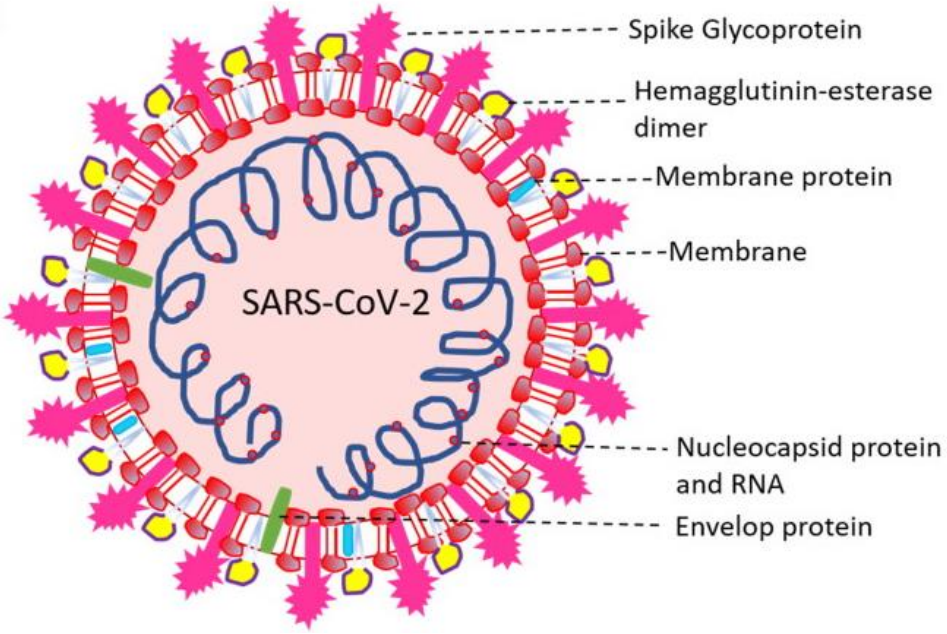

Figure 2.1 the structure of SARS-CoV-2 (Boopathi et *al*., 2021)

The virion particle of COVID-19 may be either multi shaped or spherical. It has a diameter of 120-160 nm and, like other coronaviruses, has a petal-shaped protrusion

made up of a triple Spike (S) protein. During infection, the S protein intercedes viral attachment to host cells and membrane fusion (King et *al*., 2012).

Besides the signature S protein, COVID-19 genomes often code for three other structural proteins: Membrane (M) protein, envelope (E) protein, and Nucleocapsid (N) protein. The COVID-19 M protein is 218-263 amino acids (aa) long, with an O- or N-glycan-modified N-terminus and a hydrophilic C-terminal tail. About 20 copies of the E protein (74-109)aa exist per virion, and it is possible that this protein contributes to the virus' pathogenicity. The N protein in coronaviruses, which ranges in length from (349 to 470)aa amino acids, is a phosphorylated RNA-bound protein that aids in the proper folding of genomic RNA into the nucleocapsid (Shi et *al.*, 2020).

2.3. Pathophysiology

The droplets and aerosols in the air serve as vectors for the transmission of the COVID-19 virus from one person to another. Once within the body, the virus will connect to host receptors, and then either endocytosis or membrane fusion will allow it to enter host cells and replicate. Coronaviruses are composed of a total of four structural proteins, which are referred to as the spike (S) protein, the membrane (M) protein, the envelop (E) protein, and the nucleocapsid (N) protein (Cascella et *al*., 2020; Bosch et *al*., 2020).

S protein is the viral component that is most important for host attachment and penetration. This protein is exposed to the surface of the virus. This protein is functionally separated into two subunits known as S1 and S2. S1 is in charge of attaching itself to the receptor on the host cell, and S2 helps the membranes of the viral particle and the host cell join together (Cascella et *al*., 2022).

It has been shown that the Angiotensin-converting enzyme II is a functional receptor for SARS-CoV and that it is present at high levels in pulmonary epithelial cells. When a virus first makes contact with its host, it does so by attaching to the S protein, which then kicks off the process of cell invasion. This happens in the host cell. A two-step protease cleavage occurs when SARS-CoV-2 binds to Angiotensin-converting enzyme II, the first at the S1/S2 cleavage site for priming and the second at a point proximal to

a fusion peptide inside the S2 subunit for activation (Li et *al*., 2003; Belouzard et *al*., 2003).

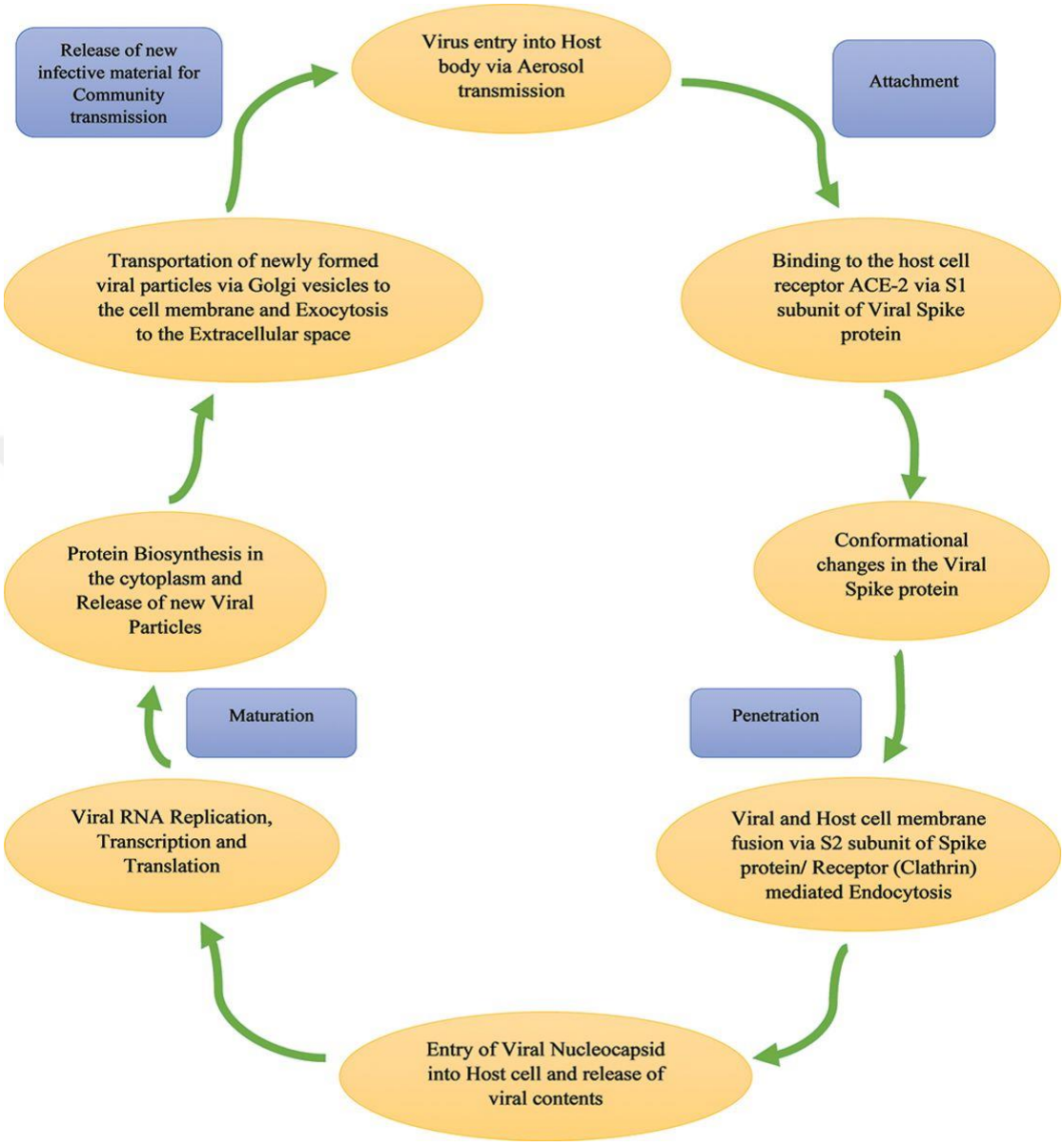

Figure 2.2 An overview of the Life Cycle of COVID-19 (Parasher, 2021)

The S2 subunit is stabilized after the first cleavage and activated after the second. Activation of the S protein presumably induces conformational changes that lead to the membrane fusion process of the virus-host cell. Once the membranes have fused, the virus may penetrate the pulmonary alveolar epithelial cells and release its infectious cargo. Once the virus has successfully entered the host cell, it will begin the process of replication, in which the initial single-strand positive RNA will be transformed by RNA polymerase into a complementary single-strand negative RNA

(transcription). This newly made negative strand RNA is used to make positive RNAs that match it. These positive RNAs are then used to make new proteins in the cytoplasm of the cell (a process called translation). The viral N protein is responsible for the binding of new genomic RNA, while the viral M protein is responsible for facilitating integration into the endoplasmic reticulum of the host cell. After being packaged in an ER membrane, these newly created Nucleocapsids are shuttled to the lumen, where they are eventually extruded into the extracellular environment by exocytosis (Parasher, 2021).

2.4. Epidemiology

The most recent information suggests that on December 31, 2019, the first patient of this virus infection was reported in Wuhan, which is located in the province of Hubei in the People's Republic of China. Which was subsequently revised to 41 on Jan 11, 2020, with seven severe cases and one death. From there, it quickly disseminated across the rest of the People's Republic of China, and beyond, impacting over 185 nations as of April 23, 2020, and triggering the ongoing worldwide pandemic (Chan et *al*.,2020).

Table 2.1 A number of countries impacted by COVID-19 as on May 24, 2020 (Shanmugam et *al*., 2020).

COUNTRY	**TOTAL CASES**	**TOTAL DEATHS**	**TOTAL RECOVERED**	**(CFR) %**
USA	1,682,599	99,226	451,392	5.89
BRAZIL	357,839	22,500	142,587	6.28
RUSSIA	344,481	3541	113,299	1.02
SPAIN	282,852	28,752	196,958	10.16
UK	259,559	36,793	N/A	14.17
ITALY	229,858	32,785	140,479	14.26
FRANCE	182,584	28,367	64,617	15.53
GERMANY	180,328	8371	160,300	4.64
TURKEY	156,827	4340	118,694	2.76
INDIA	138,536	4024	57,692	2.90

The WHO declared COVID-19 a Public health emergency of international concern (PHEIC) on the 30th of January in the year 2020, and on the 11th of March of the same year, it was formally acknowledged as a pandemic. As of the 24th of May, 2020, data from throughout the globe stated that COVID-19 had 5.48 million cases, 346,071 fatalities, and 2,290,776 recoveries (Eurosurveillance Editorial Team, 2020). It is emphasized that the novel COVID-19 has a very high basic reproduction number (R0) of between 1.4 and 3.9, which indicates that it spreads highly from person to person. The R0 might be significantly greater in public areas where large numbers of people congregate, such as on cruise ships, during religious, political, academic, or commercial events, or in some hospitals where patients and staff are not using appropriate personal protective equipment (Li et *al*., 2020).

2.4.1. Routes of transmission

SARS-CoV-2 is often passed on from person to person by contact with infected respiratory secretions. The following are the three primary ways in which individuals get exposed: the first method is the tiny respiratory droplets and airborne particles are breathed in, the second method is the splashes and sprays from the mouth, nose, or eyes depositing respiratory droplets and particles on sensitive mucosal membranes, and the third method is the splashes and sprays from the mouth, nose, or eyes depositing respiratory droplets and particles on sensitive mucosal membranes. People exhale a variety of-sized droplets of respiratory fluids throughout a wide variety of activities (silent breathing, speaking, and singing, exercising, coughing, and sneezing). These particles spread disease because they contain viruses. (Centres for Disease Control and Prevention, 2020).

The tiniest droplets and the very fine aerosol particles that develop when these tiny droplets dry very quickly and remain suspended in the atmosphere from minutes to hours, allowing for three primary (not mutually exclusive) methods of exposure to SARS-CoV-2:

a. Air pollution increases the likelihood that a person may inhale tiny droplets or aerosol particles harboring the disease. Within three to six feet of an infectious

source is where the danger of transmission is highest due to the high concentration of these extremely small droplets and particles.

b. Droplets and particles from exhaled air, which may contain viruses, may settle on exposed mucosal membranes as a consequence of splashes and sprays, such as when someone coughs on you. Similarly, the transmission risk is highest in close proximity to an infectious source, in which the concentration of these inhaled droplets and particles is greatest.
c. Direct contact with respiratory secretions or infected surfaces may spread the virus to the mucous membranes through touch (NCIRD, 2021).

Factors that increase the likelihood of contracting SARS-CoV-2 include being in a confind space with inadequate ventilation or air handling, where exhaled respiratory fluids, especially minute droplets, may accumulate. Increased outflow of respiratory fluid with vigorous activity or while raising the voice (e.g., sprinting, yelling, and singing); Time in excess of 15 mins (Shen et *al*., 2020; Groves et *al*., 2021).

2.4.2. Population susceptibility

Transmission is the passing of a pathogen causing communicable disease from an infected host individual or group to a particular individual or group, regardless of whether the other individual was previously infected. This definition presents the epidemiologic triad model, which suggests communicable diseases can develop through the interaction of an infectious agent, a vulnerable host, and a permissive environment. This model suggests that communicable diseases develop through the interaction of an infectious agent, a vulnerable host, and a permissive environment. Infectious agents leave their reservoir or host by an appropriate portal, are transported by some mechanism, and then enter an appropriate portal in order to infect a host that is vulnerable to infection (Dicker et *al*., 2011).

Although everyone is vulnerable to COVID-19 infection, young children are at a lesser risk of developing serious symptoms and dying from the disease than adults. Because their plasma Angiotensin-converting enzyme 2 (ACE2) levels are greater than men's, women have lower rates of adult illness (Ciaglia et *al*., 2020).

The elderly are particularly at risk for life-threatening infections due to a combination of factors that include a weakened immune system and the underlying impairment of organ systems that comes with advancing age. These factors are compounded in the elderly by the presence of other medical conditions, such as diabetes mellitus, hypertension, stroke, and chronic pulmonary, cardiac, and renal illness (Aprahamian & Cesari, 2020; Guan et *al*., 2020).

Several studies have investigated whether or whether there is a connection between blood type and COVID-19 infection. Those with blood type A may be more susceptible to COVID-19 infections than people with blood type O and Rhesus factor (Rh)-negative. This pattern notwithstanding, it remains unclear whether or not blood type really affects a patient's prognosis. There is no evidence that certain blood types are more or less susceptible to COVID-19 (Kim et *al*., 2021).

Because of increased interaction with infected patients, non-immune members of the patient's household and healthcare workers are at increased risk of contracting COVID-19. Nearly a third of the COVID-19 patients hospitalized at the Zhongnan Hospital at Wuhan University between January 1 and February 8, 2020, were members of the medical staff (Wang et *al*., 2020).

2.4.3. Covid-19 as a pandemic

An epidemic is a rapid, widespread increase in disease incidence that occurs at a certain period in time. A large-scale epidemic is the best way to characterize a pandemic. Ebola was an epidemic, if not a pandemic, by all accounts in 2014. The influenza outbreak that killed 50 million people globally in 1918 was a pandemic. The number of instances of COVID-19 outside of China has increased 13-fold in the previous two weeks, and the number of nations affected has tripled (McMillen, 2016).

Outside of China, COVID-19 cases climbed 13-fold, the number of countries impacted quadrupled, and the world had never seen a pandemic caused by the COVID-19. It's the first time a COVID-19 outbreak has happened. According to the WHO, COVID-19 is a pandemic. The term "pandemic" should not be misunderstood or dismissed. It's a word that, if used incorrectly, can cause to irrational dread or an erroneous

acceptance that a struggle has ended, which leads to unnecessary suffering and death (García-Basteiro et *al*., 2020).

By looking at COVID-19 statistics, we have a lot of cause for serious concern, with nearly 44,748,380 patients affected worldwide, with 1,179,035 patients losing the battle and rising as of October 29, 2020. Although the United States of America is one of the most promoted countries in health care, it has the highest number of victims of the virus, followed by Brazil, India, Russia and South Africa, and the list continues to 215 countries worldwide. At least 9,120,751 COVID-19 virus patients were diagnosed in the United States, with 5,933,212 recoveries and 233,130 deaths from the beginning of the epidemic until October 29, 2020 (Bhattacharya et *al*., 2021).

2.4.4. Virus incubation period and sequence interval

Virus incubation period of refers to the amount of time that passes between the first contact with the infectious agent and the manifestation of the illness's first symptoms. Each illness has a characteristic incubation time, often measured in hours, days, or weeks, during which the infectious organism multiplies inside the host. When investigating the cause of an infectious disease epidemic, epidemiologists often consider the incubation period in relation to the time and situation of exposure and the kind of agent. For example, Measles (rubeola) has an incubation period of 7–18 days (median = 10 days), and the rash often appears two weeks after infection. In order for researchers to establish the source of an epidemic of foodborne disease, they use incubation times. (Friis & Sellers, 2020).

Research by Lauer et *al*.,(2020) estimates that 2.5% of patients would exhibit symptoms within 2.2 days (1.8-2.9 days) and that 97.5 % of patients would experience symptoms by 11.5 days (8.2–15.6 days).

The time that has gone between the onset of symptoms in the first instance and the onset of symptoms in the second instance is referred to as the "serial interval" in discussions of the main case and secondary case. It is estimated that there is an average of 4.5 days between occurrences in a series. When studying a group of 468 different infector-infected-person combinations, we found that 59 of the secondary cases

showed symptoms before the primary case. Based on these results, researchers think that the people in this study may have been exposed to the illness while they still didn't have any signs of it (Du et *al*., 2020).

2.4.5. Period of Infectivity

the infectious period is the time interval during which a host (individual or patient) is infectious, i.e. capable of directly or indirectly transmitting pathogenic infectious agents or pathogens to another susceptible host, whether that transmission takes place between humans, between animals, or between humans and insects (Porta et *al*., 2014).

The infectious period can start before, during or after the onset of symptoms, and it may stop before or after the symptoms stop showing. The length of time a person infected with COVID-19 will stay infectious is unknown. Oropharyngeal secretions have the largest viral loads at the beginning of the disease's symptomatic phase. The virus may be shed from the patient's body after the patient's symptoms have subsided. According to Chinese research, the median time that survivors shed the virus was 20 days (Dhar Chowdhury & Oommen, 2020; Zhou et *al*., 2020).

Despite the fact that individuals may RNA-positive persistence for several weeks after symptoms appear, the live virus can't be cultivated from specimens taken later than 9days following symptom onset, this is confirmed by some previous studies. Indicating that the peak infectious time may be contained to the two to three days before symptom onset and the eight days after symptom starts at as mean (Peeling et *al*., 2022).

2.5. Clinical Manifestations

Primary presentation — Coughing, muscle aches, and headaches are often mentioned by COVID-19 individuals who are experiencing symptoms. Other features, having diarrhea, a sore throat, and a changed sense of smell or taste are all symptoms that are thoroughly described. Those with the Delta and Omicron variants are more likely to have mild upper respiratory symptoms like congestion and sneezing. Pneumonia, caused by infections, is characterized by a high fever, a cough, breathing difficulties, and bilateral infiltrates on a chest x-ray. (Menni et *al*., 2022; Huang et *al*., 2020). No

symptoms or indicators consistently identify COVID-19 from other viral respiratory infections, despite the fact that certain clinical aspects (especially taste or smell problems) are more prevalent with COVID-19 than with other such illnesses. However, the emergence of dyspnea around a week after the beginning of the first symptoms is suggestive of COVID-19 (Zayet et *al*., 2020).

Even in hospitalized populations, fever is not always evident at arrival. Almost all patients in one research reported having a fever, however, only around 20% had a fever that was low-grade (38°C). Forty-four percent of the 1,099 patients evaluated, from Wuhan and other regions of the People's Republic of China (PRC), had an axillary temperature of 37.5 degrees Celsius before admission. However, by the time their hospital stays were through, 89% of those individuals stay the same fever (Huang et *al*., 2020; Guan et *al*., 2020).

Disturbed gustatory and olfactory perception, although the omicron variant seems to have a lower incidence of smell and taste abnormalities. The pooled prevalence estimates for olfactory or gustatory anomalies were 52% and 44%, respectively, in a meta-analysis of observational research (although percentage rates ranged from 5% to 98% by investigating studies) (Chung et *al*., 2020). Sixty-four percent of 202 Italian COVID-19 moderate outpatients reported some degree of change in their sense of smell or taste, and 24 percent reported extremely severe change; Changes in taste or smell were reported as the sole symptom by 3% of people and as the first sign by 12%. It's possible, however, that the actual prevalence of olfactory or gustatory abnormalities is lower than what people describe (Menni et *al*., 2022; Tong et *al*., 2020).

Results from the digestive system, some patients may first come to the doctor because they are experiencing gastrointestinal issues, such as nausea and diarrhea. The pooled prevalence of Gastrointestinal (GI) symptoms in patients with confirmed COVID-19 was 18%, with diarrhea, nausea/vomiting, or stomach pain reported by 13, 10, and 9% of patients, respectively, in the included trials (Huang et *al*., 2020; Cheung et *al*., 2020).

Results of a dermatological examination, patients infected with COVID-19 may display a variety of dermatological symptoms. Skin reactions such as transitory livedo reticularis, urticarial dermatitis, vesicular eruptions, and maculopapular (morbilliform) rashes have been reported. COVID toes, or reddish-purple nodules on the distal digits, have also been documented, most often in teenagers and young adults with otherwise asymptomatic or moderate illness; in some instances, they appeared up to several weeks after the first COVID-19 symptoms (Recalcati, 2020; Galván et *al*., 2020).

2.6. Long-Term Complications

Preliminary data on COVID-19's long-term effects suggest it persists after the acute infection resolves, namely in the lung, heart and blood vessels, nervous system, hematology, multi-system infections, kidney, endocrine, digestive system, and integumental systems. Some of the long-term issues depicted in Fig. 2.3 are more common among intensive care unit patients. The subsequent infection may require a more in-depth examination and diagnostic analysis as result.

2.6.1. Pulmonary Complications

Though SARS-CoV-2 may have systemic effects, COVID-19 is still mostly a respiratory disease. Long-term respiratory problems due to COVID-19 infection have been reported often. Conditions include dyspnea, requiring a ventilator or oxygen, having abnormal tests of pulmonary function (PFTs), and fibrotic lung disease are all in this category (Carfì et *al*., 2020). Dyspnea is the most often reported pulmonary symptom after COVID-19, and it may continue in 22.9%-53% of patient's ∼2 months after symptom start. Objective alterations in lung physiology may follow infection with SARS-CoV-2, beyond the subjective symptoms that may be present initially (Mandal et *al*., 2021). Around 6.6% of people who make it to hospital discharge still need oxygen. Those who have respiratory failure severe enough to need a tracheostomy seldom succeed in weaning themselves off of ventilator support for the long term (Chopra et *al*., 2021).

SARS-CoV-2 can cause lung damage via a number of different routes. Acute infections can cause a variety of alterations, many of which can induce fibrosis and lead to chronic problems. Specifically, type II alveolar epithelial cells, which serve to maintain the integrity of the epithelial barrier, are particularly vulnerable to direct viral entry, which results in cell death and an uptick in proinflammatory cytokines. Damage to the alveoli and the release of cytokines trigger an inflammatory response that includes the recruitment of macrophages, lymphocytes, and neutrophils, which in turn recruit fibroblasts. In addition to the lung parenchyma, there is evidence that the pulmonary vasculature has been damaged. Microthrombi were shown in early autopsy investigations to be present in the pulmonary vasculature's tiny arteries (McDonald, 2021; Wichmann, 2020).

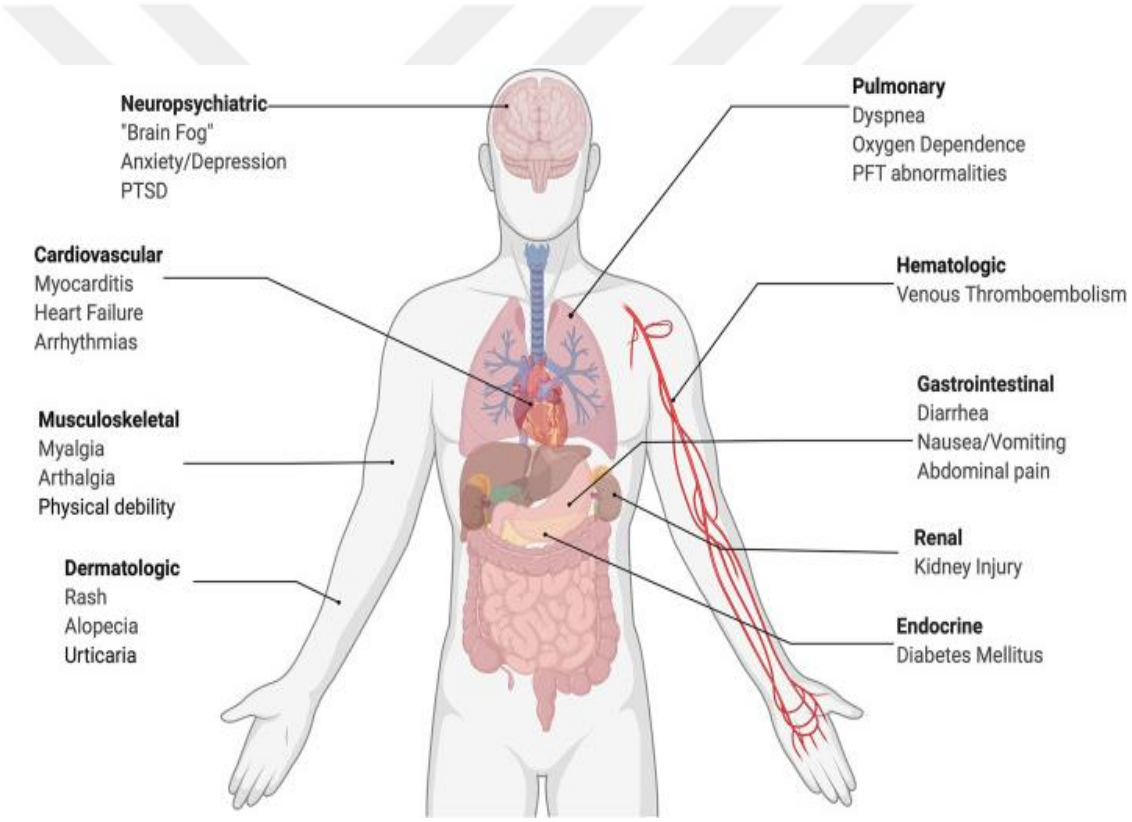

Figure 2.3 Consequences of COVID-19 Infection, Shown in Schematic Form (Desai et *al*., 2022).

Following the discharge of a patient diagnosed with COVID-19, the bulk of the treatment decisions that need to be made include predicting, monitoring, and providing support for the issues that were previously detailed. An early and thorough evaluation after hospital release is indicated in a proposed design for the post COVID-19 disease recovery phase presented by Lutchmansigh et *al*.(2021). Clinical symptom monitoring

over time, together with the collection of relevant laboratory indicators, Multiple 6-minute walk tests, pulmonary function tests, and high-resolution computed tomography scans of the pulmonary within three months. Within a year, if the patient's symptoms improve or any anomalies detected by diagnostic tests return to normal, they may be able to go back to their regular family doctor. Alternatively, severe lung disease patients who continue to have symptoms or anomalies may benefit from being referred to an expert in the field.

2.6.2. Cardiovascular Complications

After being released from the hospital after being treated for COVID-19, many patients report experiencing cardiac symptoms. Twenty-one percent or more of patients had chest discomfort 60 days following hospitalization, according to many studies. Up to 9 percent of individuals have regular palpitations over the 60-day follow-up period. Aside from subjective cardiac symptoms, long-term effects of COVID-19 infection include, also been some observable results. Postural tachycardia syndrome has been linked to SARS-CoV-2 infection, and its prevalence is now being studied. Chronic cardiovascular effects of COVID-19 have been documented after just one infection. Myocarditis was detected in 2.3% of otherwise healthy young men and women who participated in a major study of competitive collegiate athletes, with most cases being asymptomatic myocarditis found by cardiac Magnetic resonance imaging (MRI) (Raj et *al*., 2021; Puntmann et *al*., 2020).

The mechanisms number have been suggested to explain how SARS-CoV-2 causes cardiac damage. Many results on histological examination of the heart have been noted in early descriptive autopsy investigations, including a positive Reverse transcription polymerase chain reaction (RT-PCR) for COVID-19, interstitial inflammatory infiltration, cardiac enlargement, and necrosis are some of the symptoms that may be present. The available data suggest that COVID-19 has a strong binding affinity for the ACE2 receptor expressed on the cell surface. A direct entry method is enabled by the virus's affinity for the host cell. Research using single-cell RNA sequencing found that 7.5% of myocytes express ACE2, making the myocardium a vulnerable organ to direct viral damage (Kang et *al*., 2020; Shang et *al*., 2020). Cardiac damage, infarction, and endothelial dysfunction have all been linked to an increase in cytokine expression,

which has been hypothesized as a cause of cardiac injury (Guzik et *al*., 2020; Zou et *al*., 2020).

Patients who develop cardiovascular problems during the late phase of the illness, many weeks to months after the acute infection, should be sent for assessment by a cardiologist who specializes in this area. Patients should have a thorough evaluation that includes a thorough history, Electrocardiography (ECG), and, physical exam as well as other diagnostic tests, such as cardiac biomarkers and cardiovascular imaging, as needed (Richter et *al*., 2021).

2.6.3. Hematological Complications

In critically sick patients, acute COVID-19 has been linked to a higher risk of thrombotic events. This coagulopathy is brought on in part by difficulties with the blood vessels; an increase in the production of tissue factors as a reaction to inflammatory cytokines, and the influence that hypoxia has on the activation of hypoxia-inducible transcription factors. Doctors have examined the effects of routinely using intermediate-dose anticoagulation (enoxaparin 1mg/kg/daily) versus conventional prophylactic dosage anticoagulation (enoxaparin 40mg/daily) in critically sick patients with COVID-19 (Helms et *al*., 2020; Hadid et *al*., 2021; inspiration Investigators et *al*., 2021).

Even though no one knows how long hypercoagulability lasts, most cases of venous thromboembolism (VTE) happen within two to four weeks after infection. Some have advocated continuing venous thromboembolism prophylaxis for COVID-19 patients after they are released from the hospital, although this is not recommended by current recommendations. Studies have demonstrated a decreased incidence of VTE, but an increased risk of bleeding, making the overall benefit of prolonged pharmacological thromboprophylaxis in severely unwell medical patients uncertain (Roberts et *al*., 2020; Leentjens et *al*., 2021; Liew et *al*., 2017).

2.6.4. Neuropsychiatric Complications

Several neurological and psychological disorders have been linked to COVIDD-19 infection in the long run. Multiple sources of long-term symptom data showed that individuals with the acute infection still had neurological abnormalities 2 months later, including tiredness, muscular weakness, sleep problems, myalgia, and headache. These signs and symptoms now characterize the long-COVID-19 syndrome. The inability to smell or taste has been reported as a symptom of COVID-19 infection, making it distinct from other viral illnesses. Between 11%-13% of patients had a persistent loss of taste and smell during the 2-month follow-up (Carfì et *al*., 2020; Huang et *al*., 2021).

Multiple pathways have been postulated to explain how SARS-CoV-2 might lead to problems in the nervous system, just as it has in other organs. Direct viral damage, systemic inflammation, and cerebrovascular alterations are some of the postulated causes, with a combination of all three is the most plausible scenario. Brain genome sequences were discovered in autopsy examinations conducted during the initial SARS-CoV-1 pandemic; however, studies validating this discovery in COVID-19 have not yet been published. (Heneka et *al*., 2020). These results back up the idea that neurocognitive problems after COVID-19 infection are caused by damage to the neurocognitive system. The pathophysiology of smell and taste loss is poorly understood. Direct viral damage to olfactory epithelium cells, as well as directly damage to other olfactory epithelial cells that are needed for smell and express Angiotensin-converting enzyme II (ACE II), is also a possible route. It has also been hypothesized that widespread ACE II expression on the tongue and other oral mucosal surfaces contributes to the taste loss that some people suffer. Due to how closely smell and taste are related, it has been thought that a loss of smell contributes a lot to a loss of taste (Vaira et *al*., 2020).

2.6.5. Renal Complications

Acute renal damage is a common and serious consequence in COVID-19 critical care unit patients and 5% of hospitalized patients require a kidney replacement (transplant of a new kidney for them).The severity of the illness course is directly related to the

development of COVID-19-associated acute renal damage. The need for invasive ventilation is the greatest renal failure risk factor necessitating kidney replacement treatment, effects of inflammatory cytokines, and abnormal coagulation. Furthermore, it has been demonstrated that the risk variables for a severe course of COVID-19 are also renal failure risk factors. Acute renal damage in COVID-19 has a high death rate and can lead to chronic kidney disease in certain patients; nevertheless, complete recovery of kidney function in survivors who require dialysis is not unusual. Those who suffer from acute kidney damage have a higher risk of dying while in the hospital, and even if they do, they may still be impaired in their kidney function after being released (Robbins-Juarez et *al*., 2020).

2.6.6. Gastrointestinal Complications

Early symptoms of SARS-CoV-2 often include abdominal discomfort, nausea, vomiting, and diarrhea, these symptoms typically last throughout the healing phase. Diarrhea was reported by 6% of people with acute COVID-19 symptoms, making it one of the top 10 most common complaints overall. In addition to this, those who have had symptoms for a long time may also have decreased appetite, nausea, pain in the stomach, and sometimes vomiting. This may be because SARS-CoV-2 continues to be shed in the feces even after respiratory samples have tested negative, suggesting that viral replication is continuing in the gastrointestinal tract and contributing to the persistence of symptoms (Aiyegbusi et *al*., 2021; Cheung et *al*., 2020; Xu et *al*., 2020).

In the acute phase, it is common for patients to have hepatocellular damage and/or biliary stasis, both of which manifest as abnormalities in the liver function tests (Zhang et *al*., 2020; Spearman et *al*., 2021). Additionally, it is common for patients to have jaundice. Injuries may be caused by a number of factors, including, for example, a lot of examples, including viral toxicity that it causes to cells and is direct, especially in the biliary tree; systemic inflammation; hypoxia; coagulopathy; and bad medication effects. Autopsies often reveal liver pathologies such as hepatic steatosis, congestion, arterial thrombosis, fibrosis, portal inflammation, and lobular inflammation. Abnormalities in liver function may remain but improve over weeks to months in COVID-19 survivors with acute liver damage (Díaz et *al*., 2020; An et *al*., 2021).

2.6.7. Musculoskeletal Complications

Patients diagnosed with SARS-COV-2 often report experiencing issues with their musculoskeletal systems throughout both the acute and chronic phases of their disease. Skeletal muscle and synovial tissue have their own unique populations of ACE2 receptors. This lends credence to the hypothesis that the onset of symptoms may be linked to viral invasion of the aforementioned tissues. Myalgias and arthralgias are symptoms of COVID-19 infection that are reported more often than arthritis symptoms associated with other viral infections (Abdullahi et *al*., 2020; Zacharias et *al*., 2021). This is because myalgias and arthralgias occur in the absence of genuine inflammatory arthritis. Case reports include the overwhelming bulk of the material that we have on new instances of rheumatological disorders after the SARS-COV-2 outbreak. It is usual for patients with severe COVID-19 to have catabolic muscle wasting is the result of systemic inflammation, prolonged bed rest, and poor patient nutrition.This is not unlike the consequences of other critical illnesses. After making a full recovery, it is possible that some persons who survived the SARS-COV-2 virus would continue to suffer from physical limitations for a significant amount of time, perhaps even for many years. At the 6-month follow-up, individuals with more acute SARS-COV-2 had a higher prevalence of muscle weakness, mobility difficulties, and shorter distances walked in 6 minutes (Piotrowicz et *al*., 2021; Fan et *al*., 2014).

2.6.8. Genitourinary Complications

However, infertility in men in particular has been brought to light as a potential long-term health risk associated with COVID-19 infection. Although there have been no reports of genitourinary symptoms in patients who have been diagnosed with post-symptomatic COVID-19, these symptoms have been brought to light as a potential long-term health risk (Mosleh et *al*., 2021). There is evidence to suggest that male gonads may be more susceptible to infection due to an increased expression of ACE II receptors, and viral mRNA has been found in the semen of men who have been infected with the virus. In addition, research has demonstrated a significant decline in both testosterone and dihydrotestosterone levels, in addition to testicular signs of pathological inflammation in a number of different people, with the potential incidence

of viral orchitis being recorded as being as high as 19% of the overall cases. This is due to the fact that a number of people have tested positive for both testosterone and dihydrotestosterone (Khalili et *al*., 2020).

Premature delivery and a rise in luteinizing hormone in female patients are two factors that have been postulated to be connected to a lower chance of vertical transmission, however, More comprehensive research is required if we are to have a deeper comprehension of the relevance of these theories (Li et *al*., 2021).

2.7. Diagnosis

Due to the fact that the symptoms of COVID-19, such as fever, cough, trouble breathing, and muscular discomfort, might be similar to those of a wide variety of other illnesses, such as the flu, diagnostic tests are very necessary in order to identify those who genuinely have COVID-19.

The patterns of illness severity reported in table (2.2) range from very mild to very severe, according to the most up-to-date national standard for the diagnosis and treatment of COVID-19, the severity of symptoms may range from mild to life-threatening. Each pattern's evolutionary history needs further explanation. For instance, the percentage of mild to moderate instances that progress to severe or critical illness remains unknown.

Table 2.2 Criteria for evaluating the impact of COVID-19

Level	Criteria
Mild & Moderate	high body temperature and/or breathing difficulties; chest x-rays showing many small, patchy shadows and interstitial alterations
Severe	Conditions that warrant hospitalization include dyspnea with a respiratory rate of >30 breaths per minute, oxygen saturation of 95%, or arterial blood oxygen partial pressure/oxygen concentration of 300 mmHg (1 mmHg=0.133 kPa); multi-lobular disease or lesion progression of >50% within 48 h;

	SOFA of 2 points; pneumothorax; and/or other clinical conditions.
Critically ill	Organ failure; respiratory failure necessitating mechanical ventilation; septic shock.

2.7.1. Laboratory test

SARS-CoV-2 Deoxyribonucleic acid (DNA) is often identified using RT-PCR. Using this method, viral RNA is first turned into Complementary DNA (cDNA), and then a part of the cDNA is amplified for further study (Sethuraman et *al*., 2020).

Different RT-PCR kits have varying degrees of sensitivity and specificity, and neither is guaranteed to work in every situation. Although this is the gold standard for diagnosing COVID-19 infection, its sensitivity is only about 70% and its specificity is only around 95%. Whether it's the virus itself, the technique (how it was collected and handled), or the sample's viral load, a lot of things may mess with the findings (collection method, illness severity, and length of symptoms) (Tahamtan & Ardebili, 2020).

Many times, false negatives may be traced back to issues with the collection process or how the sample was handled. Use Dacron or polyester swabs, and store them in the refrigerator as soon as possible after collection. The samples need to be stored cold and delivered to the lab without delay (Tahamtan & Ardebili, 2020).

The use of serological testing is a viable option for determining whether or not a humoral reaction to COVID-19 exists. The enzyme-linked immunosorbent test detects antibodies of the IgA, IgM, and IgG isotypes against particular viral proteins (ELISA) or immunoassays and chemiluminescence (CLIA) tests, with the latter being found to be more sensitive. Natural killer cells and Cytotoxic T cell (CD8+ T) lymphocytes are recognized to play a pivotal role in the immune response to the virus due to their cytotoxic activity. Despite the findings of serological testing, there is evidence of a strong cellular response to COVID-19; however, there are currently no commercially accessible diagnostics to gauge how well the body can mount an immunological response to COVID-19 (Sekine et *al*., 2020).

At the time that the patient's blood is obtained, the severity of the clinical picture as well as the length of time that symptoms have been present might potentially confuse the results. Although IgM may be discovered as early as the fifth day of symptoms, by the eighth day is when it starts to become very meaningful. Compared to IgM, IgA values tend to rise more quickly and are more sensitive to how much each person takes (Deeks et *al*., 2020).

These are diagnostic procedures using imaging or laboratory methods that show the hallmarks of SARS-CoV-2 and its consequences and risk factors. In other laboratory investigations, a lower neutrophil (lymphocyte) ratio of 3.13 is associated with increased severity and worse prognosis, as are lymphopenia, eosinopenia, and a complete blood count. A more dire prognosis and increased risk of cardiac injury are linked to thrombocytopenia. The cytopathic action of the virus, activation of apoptosis, IL1-mediated pyroptosis, and bone marrow suppression by inflammatory cytokines all contribute to the development of lymphopenia (Azkur et *al*., 2020).

D-dimer, a byproduct of fibrin breakdown, is often measured as a biomarker for thrombotic diseases. D-dimer levels of over 0.5 g/mL are abnormal, and both advancing age and being pregnant tend to increase levels. The severity of community-acquired pneumonia is correlated with an increase in D-dimer levels. After the COVID-19 epidemic broke out, patients with COVID-19 had their D-dimer levels studied as a possible prognostic factor (Poudelet *al*., 2021).

2.7.2. Radiological findings

Several investigators have reported on short-term CT follow-up of patients with COVID-19 infection. Patients who had COVID-19 frequently had ground glass opacities on their Computerized tomography (CT) scans. These opacities are typically located in the lower and peripheral lobes of the lung. Also, people with COVID-19 often have many lobular and subsegmental areas of consolidation on both sides. This happens most often in ICU patients. Disease severity was shown to be proportional to the number of pulmonary lobes affected. As the illness advanced, these opacities tended to merge and thicken. Late-stage CT findings (14 days or longer) showed varying degrees of clearing but no resolution up to at least 26 days. Pleural effusion

was one of the most uncommon CT abnormalities (affecting just around 5%), along with masses, lymphadenopathies, and cavitations (Kanne et *al*., 2020; Adhikari et *al*., 2020).

The sensitivity of a regular chest X-ray is lower by around 59%. Few diagnostic ultrasounds have been performed. The specificity of ultrasound isn't great, and the sensitivity is only thought to be around 75%, depending on things like the severity of the illness, the patient's weight, and the operator's competence. Using ultrasonography to look for signs of interstitial lung disease, like B lines and subpleural consolidations, makes it easier to track the progression of the disease as it gets worse. In Figure 2.4, we see three different interstitial presentations on ultrasonography for COVID-19 (Bernheim et *al*., 2020; Pascarella et *al*., 2020).

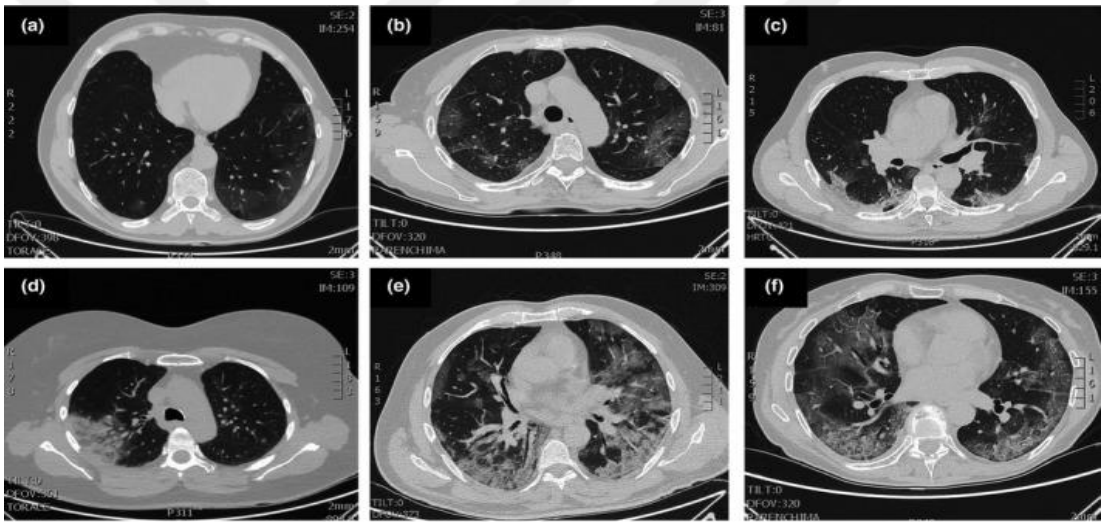

Figure 2.4 Typical patterns of COVID- 19 at CT imaging, from (a) early stage, to (f) end-stage (Pascarella et *al*., 2020).

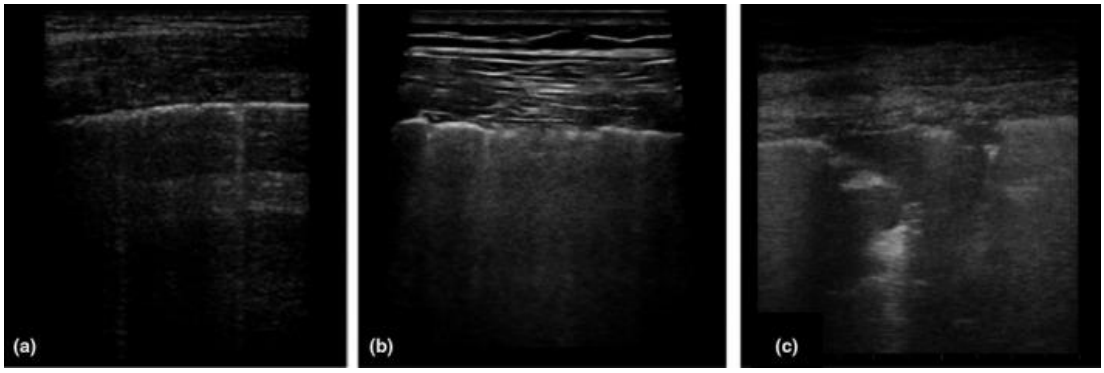

Figure 2.5 chest ultrasound COVID-19 patterns. (Pascarella et *al*., 2020).

2.8. Treatment

Patients who are afflicted with COVID-19 illness now have access to a more comprehensive assortment of therapy choices. The Food and Pharmacological Administration in the United States has given its approval to one drug therapy for COVID-19 and has permitted the use of others in urgent situations. In addition, several various therapies for COVID-19 are now being evaluated in clinical studies to see whether or not they are safe and whether or not they are effective. Even though there are still many things about SARS-CoV-2 that we do not fully understand, there are a number of potential treatments for it that might be tested as soon as feasible. These treatments might potentially be explored quickly in patients who have just been diagnosed with COVID-19 infection.

2.8.1. Neutralizing Antibodies Targeting Virus S Protein

Neutralizing antibodies elicited by prior infection or vaccination are likely to be key for future protection of individuals and populations against SARS-CoV-2. In addition, antibodies given inactively have shown great promise as both a therapeutic and preventative treatment against SARS-CoV-2. However, it is not known how well novel COVID-19 will be able to modify itself to avoid being neutralized by antibodies. Results show that functional COVID-19 S protein variants with mutations in the receptor-binding domain (RBD) and amino-terminus domain that confer resistance to monoclonal antibodies or convalescent plasma may be swiftly chosen using a recombinant chimeric Vesicular stomatitis virus/novel coronavirus reporter virus. COVID-19 S variants that are resistant to routinely evoked neutralizing antibodies are currently prevalent at low frequency in circulating COVID-19 populations (Weisblum et *al*., 2020).

2.8.2. Inhibitors of viral replication

Remdesivir (RDV) is a mono-phosphoramidite nucleoside analog that, when exposed to metabolism, changes into the creation of GS-441524, which is the active form. RDV is an analog of adenosine and a mono-phosphoramidite nucleoside. The active form could be able to inhibit the production of viral RNA due to the impact it has on viral

RNA polymerase. Because RDV combats viruses by performing the function of a nucleotide, it is more likely to be effective once the virus has already established a foothold within the host cell. Gilead Sciences first developed it in 2017 to treat illnesses caused by the Ebola virus. However, it is now also used to treat infections caused by the Marburg virus, Middle East Respiratory Syndrome (MERS), and coronavirus 1. Remdesivir activity was also shown against a wide variety of other human and zoonotic coronaviruses, including mouse hepatitis beta, COVID-19, bat beta coronaviruses HKU5, WIV1, and SHC014, and pig delta COVID-19. As a possible treatment for SARS-CoV-2, it may thus be given in this context (Sahebnasagh et *al*., 2020; Al-Tawfiq et *al*., 2020).

The RDV therapy is the first experimental treatment to be given permission by the U.S. Food and Drug Administration (FDA), and it has already been put through two clinical tests in China. Even though RDV was given intravenously (IV) to the person who was the first person in the US to be diagnosed with SARS-CoV-2 on day 7, it is still not clear how well the treatment works (Al-Tawfiq et *al*., 2020).

In animal studies of prophylaxis and treatment, RDV has a more effective antiviral impact on lung tissues and leads to larger gains in lung function than the combination of lopinavir and ritonavir. Because RDV worked well in treating people with SARS-CoV-2, research into the drug has moved on to the phase III stage (Sahebnasagh et *al*., 2020).

On April 25, 2022, the FDA authorized the use of Veklury (Remdesivir) to treat SARS-CoV-2 in children. Children above the age of 28 days and weighing more than 3 kilograms (approximately 7 pounds) who have a positive result from direct COVID-19 viral testing are now included in the expanded indication. Who have mild to moderate COVID-19 and are hospitalized or are at high risk for severe COVID-19 consequences but are not hospitalized (FDA, 2022).

2.8.3. Inhibitors of viral proteases

Kaletra® is a combination of the major protease inhibitors lopinavir and ritonavir (LPV/r) used to treat HIV infection. In the liver, the P450 cytochrome system breaks

down Kaletra. There isn't much difference between Kaletra and lopinavir in how they fight viruses, so lopinavir is the main reason why Kaletra works. (Sahebnasagh et *al*., 2020).

Since SARS-CoV2, like HIV, is an RNA virus, and since clinical experiences with treating COVID-19 1 and MERS led to the first suggestion of Kaletra for controlling COVID-19 infection, it is not surprising that this treatment has since become the standard. The molecular mass of the protease may be determined using the molecular weight calculator, given the viral sequence and the functional motif indicating protease function (Chong et *al*., 2015; Mallat et *al*., 2020; Sahebnasagh et *al*., 2020)

For the time being, we don't know how Kaletra works to stop the spread of COVID-19 illnesses. Instance SARS-CoV-2 and other coronaviruses preserve their structural and functional proteins by synthesizing polyproteins followed by hydrolysis, inhibiting their proteases might be one way in which Kaletra thwarts coronaviruses' ability to replicate. Further research is required, however, to determine how HIV protease inhibitors block SARS-3-chymotrypsin-like COVID-19' and papain-like proteases (Liu et *al*., 2020; Ortega et *al*., 2020; Zumla et *al*., 2016).

2.8.4. Anti-inflammatory agents

Tocilizumab (TCZ) is an interleukin 6 receptor antagonist. It is an immunoglobulin G1k subclass recombinant humanized anti-human monoclonal antibody (IL-6R). RoActemra is the brand name in the European Union, whereas Actemra is the brand name in the United States. Actemra was designated as an orphan drug by the Japanese, in 2005 for the treatment of Castleman's disease. Some evidence suggests that interleukin-6 (IL-6) contributes to the cytokine storm, taking medications that target this cytokine a promising therapeutic option for very unwell patients with COVID-19 (Sheppard et *al*., 2017; Zhang et *al*., 2020a).

Actemra has been approved by the Food and Drug Administration (FDA) of the United States for the treatment of severe instances of cytokine release syndrome, as well as inflammatory illnesses such rheumatoid arthritis, psoriatic arthritis, and giant cell arteritis. In addition, off-label use of tocilizumab improved respiratory and laboratory

markers in a pilot prospective open-arm single-arm research study including 63 individuals with severe COVID-19. Actemra has a number of serious long-term side effects, including infections (such as pneumonia, UTI, cellulitis, etc.), GI perforations, infusion reactions (such as high blood pressure, headaches, and skin reactions), anaphylactic shock, thrombocytopenia, elevated liver enzymes, and an elevated lipid profile (Zhang et *al*., 2020a).

Specifically, the Diagnosis and Treatment Protocol for COVID-19 Pneumonia (Trial Version 7) issued by the RPC government recommends Actemra for the treatment of COVID-19 (Arnaldez et *al*., 2020).

The FDA has approved the IL-6 receptor antagonist sarilumab (trade name Kevzara®) for the treatment of people with moderate-to-severely active rheumatoid arthritis who have had an insufficient response to or intolerance of one or more disease-modifying anti-rheumatic medications. Given the significance of IL-6 in the cytokine storm, this may serve as a treatment for COVID-19. Given the significance of IL-6 in the cytokine storm, this may serve as a treatment for COVID-19. It interacts with IL-6 receptors in both free and bound forms. Since most hospitals don't provide IL-6 level monitoring, checking CRP might be a good alternative for tracking improvement throughout treatment. The effects of Kevzara 400 mg, Kevzara 200 mg, and placebo on 400 patients with COVID-19 are being compared in a randomized, double-blind, placebo-controlled study. An ongoing phase II/III Kevzara experiment (NCT04315298) has shown encouraging preliminary findings from the phase II section, suggesting that Kevzara may reduce CRP when compared to a placebo. Moreover, Kevzara did not improve clinical outcomes for those with "severe" illnesses (Clerkin et *al*., 2020; Chen & Chen, 2015).

2.9. Prevention

Since COVID-19 is an infectious illness that poses a significant threat until effective vaccinations are available to a sizable portion of the world population, public health measures including social isolation, quarantine, and limiting contact between infected people are warranted. To help stop the transmission of the illness, the World Health Organization suggests taking precautions like regularly washing your hands, not

touching your face, keeping your distance (at least 1 meter), and using proper respiratory hygiene (Dhar Chowdhury & Oommen, 2020).

2.9.1. Personal Protective Equipment

Protection of the healthcare practitioner by extra PPE is another aspect of readiness and reaction (PPE). Toxins produced by chemical or biological processes, as well as radiation, are often odorless and colorless yet are still lethal. When caring for polluted patients, PPE is worn to protect healthcare professionals from potential chemical, physical, biological, and radioactive risks. Using a scale from A (the lowest) to D (the highest), the EPA classifies the degree of protection offered by various combinations of clothing and breathing apparatus (Hinkle & Cheever, 2018) :

- *Level A:* When maximum protection for the lungs, skin, eyes and mucous membranes is essential, people put on protective gear. This includes a self-contained breathing apparatus (SCBA) and a fully encapsulating, vapor-tight, chemical-resistant suit with chemical-resistant gloves and boots.
- *Level B:* Maximum respiratory protection is required, although less skin and eye protection is needed than in a Level a condition. The SCBA and chemically resistant suit provide this degree of protection; nevertheless, this level of protection includes the SCBA and a chemical-resistant suit, but the suit is not vapor tight.
- *Level C:* A respirator that filters or adsorbs hazardous particles from the air is required for safety. With level C protection, you get a coverall, a splash hood, gloves, and boots that can withstand chemicals.
- *Level D:* protection is the typical work uniform.

PPE levels C and D are the most common in healthcare settings. Before interacting with a potentially infected patient, it is imperative that the appropriate precautions be taken. Standard precaution personal protective equipment (level D) at an acute care hospital is often insufficient for protecting staff from a chemically, biologically, or radiologically contaminated patient. Average patients just need level C PPE (Hinkle & Cheever, 2018) .

1. Medical masks

When caring for a group of patients COVID-19, we employ a device that has been designed for long-term usage (for use with numerous patients) and can be worn continuously for up to 6 hours. Most surgical masks have three layers: one that repels fluids, one with good filtration, and one that absorbs moisture. Surgical masks are ineffective without these three layers (Park, 2020).

If health departments do not provide clear guidance on the use of masks in these situations, HCWs may continue using contaminated masks and may get infection. The risk of self-contamination of HCWs is influenced by the mask itself, its shape and properties, and the virus concentration on its surface (Park, 2020).

Prolonged use of a medical mask may increase the risk of COVID-19 infection for both the healthcare provider and the patient, as well as the risk of mask deterioration, face skin tissue responses, and breathing difficulties due to the mask. There is a chance of breathing in unclean air from both sides. Remove the mask without touching its front. After touching/adjusting the mask, wash your hands. Wet, dirty, damaged, hard to breathe through, exposed to chemicals, infectious substances, or body fluids, or removed for drinking or eating must be replaced. Patients outside a COVID-19 cohort should utilize a new medical mask. Using novel coronavirus' mask (CDC, 2020a).

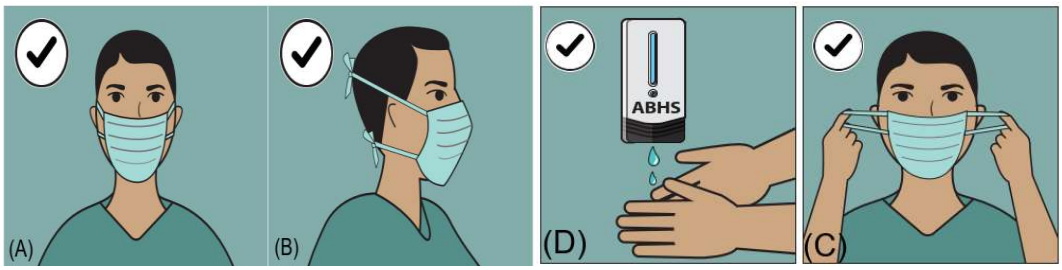

Figure 2.6 Procedures for putting on and taking off the mask
(A) and (B) while donning a face mask, and (C) and (D) after taking one off (CDC, 2020a).

2. Respirators

When caring for a group of patients, we utilize respirators such as the FFP2, FFP3, N95, N99, N100, or comparable, and we wear them continuously for up to 6 hours. Long-term respirator usage puts medical staff at risk for SARS-CoV-2 and other infections. If you wear a respirator for too long, the filter media may clog, making it

difficult to breathe and causing facial skin irritation. If you spill chemicals or bodily fluids on your respirator, remove it and wash your hands. When handling, changing, or removing respirators, wash your hands immediately, and Cross-contamination is a danger when using the same respirator on COVID-19 patients and healthy persons (Chughtai et *al*., 2019; CDC, 2020b).

3. Gown

When caring for patients with COVID-19, we are required to wear a gown at all times, including between patients. Prolonged use of protective clothing like gowns may increase the risk of self-contamination and the transmission of illness. If the gown becomes wet, soiled, damaged, or splattered with chemicals, infectious substances, or body fluids, or if it is used to treat patients outside of the predetermined COVID-19 group, it must be discarded. If you want to keep the environment clean, make sure you take off your robes properly (CDC, 2020b).

4. Gloves

Medical gloves are used by health care personnel to prevent the spread of micro-organisms that may potentially cause infection or illness. Medical gloves are disposable and include patient examination gloves and surgeon's gloves. It is not recommended that medical personnel use the same pair of gloves on more than one patient at a time, despite the fact that this practice is commonplace and that gloves are routinely used on a variety of patients. If you get any dirt or germs on your hands while taking off gloves, wash them well or use an alcohol-based hand sanitizer right away. To take off gloves while still wearing them, hold the palm of one glove with your non-gloved hand and peel off the other. Keep the glove you just took off in your other gloved hand, slide your ungloved hand's fingers under the remaining glove's wrist, and peel off the second glove over the first (Veenema, 2018).

5. Face Shields and Goggles

When caring for a group of patients infected with COVID-19, medical professionals may wear face shields and goggles during the shift without having to remove them. There is a chance that the outside of your goggles might get contaminated, and wearing them for long periods of time can be tiring and uncomfortable because of the tight

straps, blurred vision, and potential skin injury. Goggles should be removed after being splashed with chemicals, infectious substances, or bodily fluids; if they restrict sight; if they become loose; or if they have been dropped. If a healthcare professional is caring for both a patient with COVID-19 and a patient who is not suspected of having COVID-19, they must remove their goggles in a safe manner to avoid cross-contamination of their eyes (WHO, 2020a).

6. Steps to take off PPE

According to the WHO.(2015), personal protective equipment is taken off for health workers after the end of their dealings with patients, especially those with communicable diseases as well as the COVID-19 epidemic. These steps can be summarized as follows:

1. Always remove PPE under the guidance and supervision of a trained observer (colleague). Ensure that infectious waste containers are available in the doffing area for safe disposal of PPE. Separate containers should be available for reusable items.
2. Perform hand hygiene on gloved hands.
3. Carefully remove the forward-leaning apron and do not contaminate your hands.
4. Perform hand hygiene on gloved hands.

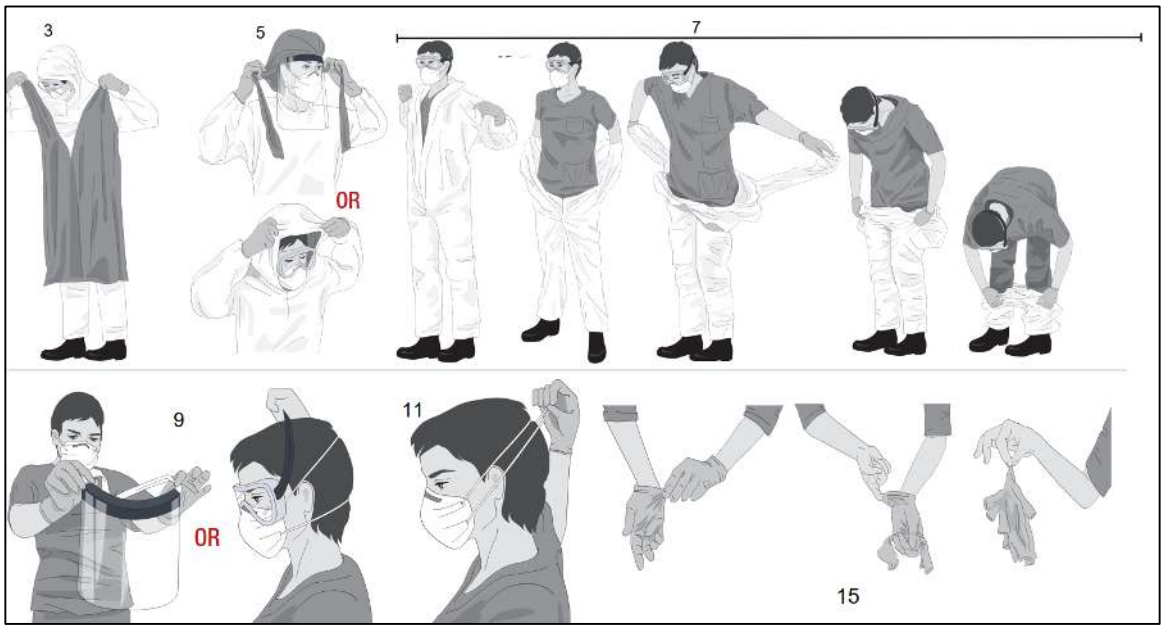

Figure 2.7 Steps to remove personal protective equipment (WHO, 2015).

5. Remove head and neck covering taking care to avoid contaminating your face by starting from the bottom of the hood in the back and rolling from back to front and from inside to outside, and dispose of it safely.
6. Perform hand hygiene on gloved hands.
7. Ideally, in front of a mirror, you should remove your coverall and outer pair of gloves as follows: bend your head back to access the zipper, unzip all the way without touching your skin or scrubs, and begin removing the coverall from the top down. After the shoulders have been unbuckled, the outer gloves may be taken off as the arms are pulled out of their sleeves. You may roll the coverall from the waist down and the inside out with inner gloves, all the way to the top of your boots. You may remove the coverall by stepping away from the coverall as you take it off with one boot and then the other, and then dispose of the coverall in a secure location.
8. Perform hand hygiene on gloved hands.
9. Lift the eye protection equipment by pulling the mounting string from the back of your head and dispose of it in the designated trash can.
10. Perform hand hygiene on gloved hands.
11. Remove the mask from behind the head by first untying the bottom string above the head and leaving it hanging in front; and then the top string next from behind head and dispose of it safely.
12. Perform hand hygiene on gloved hands.
13. Rubber boots should be taken off without touching them (or overshoes if wearing shoes). Keep your boots on, but clean and disinfect them as necessary before leaving the doffing area if you want to wear them outside of the high-risk zone.
14. Perform hand hygiene on gloved hands.
15. Take off away gloves the right way and dispose of them in a secure location.
16. Sanitize your hands with medical alcohol or wash them with surgical soap.

7. Disinfection & sterilization

Particularly in high-stress environments like intensive care units and surgical rooms, healthcare workers must be proficient in disinfecting, sterilizing, cleaning, and maintaining asepsis. This is useful for limiting the spread of infections among patients and safeguarding healthcare workers at all times, especially during epidemics.

Guidelines are in place for a reason, and when they aren't followed, it may lead to an infectious epidemic and bad results (Rutala & Weber, 2019).

Alcohols, quaternary ammonium compounds, potassium peroxymonosulfate, sodium hypochlorite, and sodium peroxymonosulfate, and hydrogen peroxide are all examples of common chemical disinfectants used in hospitals and other healthcare settings (De Lorenzi et *al*., 2020).

The practice of using chlorine in a germicide capacity extends back quite many years. In an aqueous solution of chlorine, both the ionic form of chlorine (HOCl) and the anionic form of chlorine (OCl) may be found. The effectiveness of hypochlorite disinfection is dependent on speciation, which is a function of pH. Hypochlorite disinfection is more successful at a neutral pH than at an alkaline solution (Choi et *al*., 2021). Despite its widespread acceptance, alcohol-based hand sanitizer has a mixed track record of success in reducing or eliminating bacterial/viral load. Disinfectants containing alcohols like ethanol, isopropanol, and n-propanol are often used as hand rub rinses, gels, or foams (Jing et *al*., 2020).

2.9.2. Handwashing

It's important to keep your hands clean since they might spread germs. When we don't properly wash our hands, we spread these germs to other people. Almost all the time, there have been programmes to raise awareness and encourage healthcare workers, patients, and visitors to wash their hands (Alzyood et *al*., 2020).

According to the CDC.(2020c), it is important to follow the correct methods, which can be summarized in the following steps:

1. Put some water on your hands.
2. Use enough soap to scrub the palms, backs, and in between your fingers.
3. Rub hands together and scrub the front and back of your hands and in between your fingers.
4. Clean the palms, backs, in between the fingers, and cuticle areas of your hands.
5. Please use clean water to wash your hands.

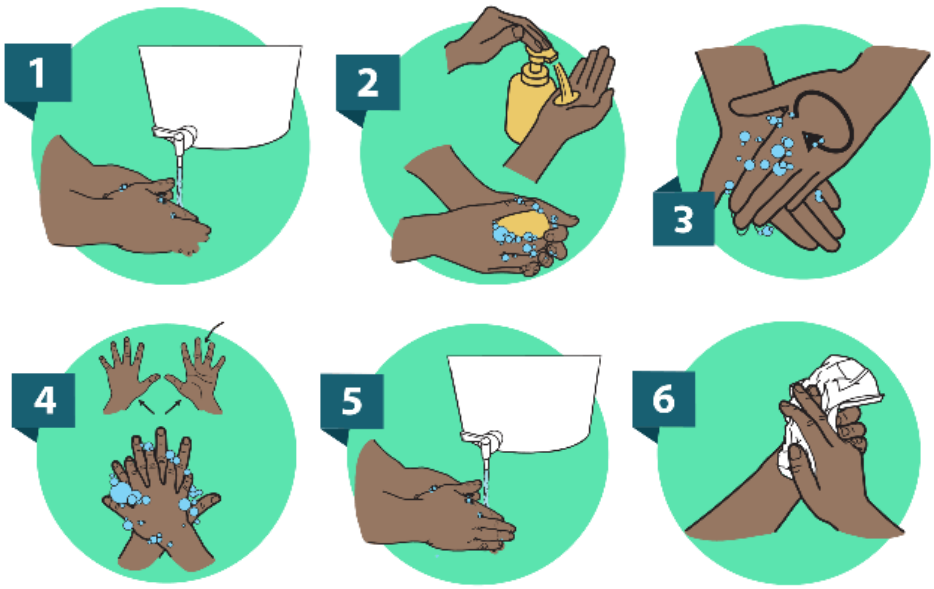

Figure 2.8 Handwashing (CDC, 2020c).

6. Dry hands completely using a clean towel or single-use towel or air dry.

2.9.3. Isolation and Quarantine

Isolation, in the context of practice care, refers to the practice of separating patients with communicable illnesses from healthy patients and visitors in order to prevent the spread of disease. Negative pressure chambers may be used to limit the spread of infection via aerosols, this wasn't necessary for controlling SARS-CoV-2 due to the virus' inability to condense into small enough droplets. If patients can be isolated prior to obvious signs of viral shedding, it may significantly reduce the likelihood of transmission. Influenza sufferers may spread the virus even before they develop overt symptoms. The term "quarantine" refers to the restriction of healthy people who are thought to have been exposed to a contagious illness but who are not yet sick (Wilder-Smith & Freedman, 2020).

Quarantine applies to people who have been in close contact with a person or animal infected with COVID-19. The person in contact continues to be quarantined for a period of 10 days after the last direct contact with a person or animal infected with COVID-19, and during this period we monitor his temperature (38 degrees celsius or more) and other signs such as coughing or shortness of breath and other symptoms of COVID-19. It can be applied at home, and wearing a mask is mandatory. If any of the

aforementioned symptoms appear, he is transferred to isolation immediately and tests are conducted for him. During a period of 10 days, if no symptoms appear, the quarantine can be ended and we can continue to wear the mask in public places for another 5 days (ECDC, 2022).

Isolation is applied to people with confirmed or suspected COVID-19 who have symptoms of COVID-19. We can end the isolation of the injured after 5 full days if their temperature is normal and for 24 hours without taking any antipyretic treatment and the rest of the symptoms have improved (and the recovery of the loss of taste and smell may be delayed for a long period, which may be weeks or months after the patient's recovery, and this does not affect the end of isolation). But we must continue to wear a mask at home and in public places for an additional 5 days (from the sixth to the tenth day) after the end of the isolation period. As for the practices applied by the patient, they are to monitor his symptoms. If he notices any emergency warning signs (especially difficulty breathing), he should seek emergency health care. During the isolation period, he should not contact family members as well as pets. A separate bathroom should be used, the ventilation of the place should be improved, and eating utensils and towels should be used (CDC, 2022).

2.9.4. Vaccine

Vaccines are synthetic versions of natural immunogens, such as the infectious virus itself, its parts, or a toxin. When given, a vaccine does not directly cause illness but rather prompts the healthy host to produce vast numbers of memory B and T cells that react to epitopes of the modified immunogen (Mak et *al*., 2014).

The progress made in vaccination against COVID-19 is unprecedented in the history of public health. In 2021, a total of 184 potential vaccines were now in the preclinical phases of research, with another 104 in the clinical stages. According to the most up-to-date statistics, 18 different COVID-19 vaccines have been licensed for use all over the globe. The SARS-CoV-2 vaccines may be broken down into four main groups, each employing a different platform: whole virus vaccines, protein-based vaccinations, viral vector vaccines; and nucleic acid-based vaccines (Nagy & Alhatlani, 2021).

Emergency approvals for the Pfizer-BioNTech and Moderna vaccines were granted by the FDA on August 23, 2021, and January 31, 2022, respectively. There is now renewed optimism that the SARS-COV-2 pandemic may be stopped thanks to the development of these two vaccines that protect against COVID-19 infections via the development of antibodies, providing immunity against a COVID-19 infection with humoral and, perhaps, cellular immunity. There is sufficient evidence to conclude that both vaccines are beneficial; however, they can have unwanted side effects like injection site discomfort, redness, or swelling; nausea, vomiting, high body temperature, tiredness, head pain, muscle pain, itching, chills, joint pain, and anaphylaxis. Reportedly, fewer of these side effects occurred in patients who received the Pfizer/BioNTech vaccination compared to those who received the Moderna vaccine. However, the Moderna vaccine is less susceptible to temperature changes than the Pfizer vaccine, making it more convenient to travel and store (FDA, 2022a; FDA, 2022b; Meo et *al*., 2021).

Both the Pfizer/BioNTech vaccine and the Moderna vaccine are Messenger RNA (mRNA) vaccines, with the Pfizer/BioNTech vaccine requiring two doses in the first series, 4 to 8 weeks apart, and the Moderna vaccination requiring two doses in the initial series, 3 to 8 weeks apart (CDC, 2022a).

CoronaVac (Manufactured by Sinovac Life Sciences) stands out as being among the first inactivated viral vaccines to enter the COVID-19 vaccination trial pipeline in April 2020. Everyone aged 18 and above may safely and successfully get the Sinovac-CoronaVac vaccination. According to the World Health Organization's values framework and Priority Setting roadmap people who have had COVID-19 for a long time can still get the Sinovac vaccine, but they should wait three months after being infected before getting the shot. Until further research is done on the vaccine's effectiveness in younger patients, however, it is not advised for anyone younger than 18. The Sinovac-CoronaVac vaccine should be administered intramuscularly twice (0.5 mL each time), as suggested by the Strategic Advisory Group of Experts on Immunization (Riad et *al*., 2021; WHO, 2022).

Pain and swelling at the injection site, temperature elevation, and an allergic reaction are all possible reactions to the Sinovac COVID-19 vaccination. The most common side effect seen in the COVID-19 vaccine phase I and II clinical trials was temporary injection-site discomfort that went away within 48 hours (Zhao & Wang, 2021).

The spike protein is produced using a replication-incompetent chimpanzee adenovirus vector used to create the Vaxzevria vaccine. It is given in two doses by intramuscular injection. The World Health Organization recommended waiting 8–12 weeks between dosages. This vaccine was manufactured by Oxford University, SII, and AstraZeneca (WHO, 2021a).

Studies on adults show a significant reduction in the risk of symptomatic COVID-19 in the first few months following immunization. The effectiveness of a two-dose main series of the novel COVID-19 vaccine in avoiding the onset of symptoms at a median of two months of follow-up or after 14 days after the second dose has been shown in large placebo-controlled studies. Up to 8% of vaccination recipients had significant post-administration weariness, headache, or fever (Folegatti et *al*., 2020; Falsey et *al*., 2021).

2.10. Influence on Healthcare Staff

Healthcare staff must keep up with their regular duties while simultaneously caring for people who don't have COVID-19. High rates of illness and death, severe economic problems, anxiety caused by what is known and what is unknown about the situation, and worry about what will happen in the future are all bad results (Gupta et *al*., 2021).

The COVID-19 epidemic has had a disproportionately negative impact on the healthcare system. As a result, the importance of nurses has grown. Initial assessments of the effects of the COVID-19 pandemic reveal the severity of the threat to the mental health of nurses: Anxiety and hopelessness were found to be twice as common among Chinese nurses who worked closely with infected patients as they were among other workers (Lu et *al*., 2020).

2.11 Previous Studies

The COVID-19 pandemic is a new epidemic that the world is going through. Medical and health personnel have been exposed to many injuries all over the world, and in order to understand the direct causes of these injuries, many healthcare professionals conducted many research and studies and reached several results, and in this study we will present some of them.

Table 2.3 Previous studies related to examining the information, attitudes and practices of healthcare staff towards COVID-19

Authors	Purpose of Research	Informational/Study Type	Most Important Results/Conclusions	limitations & Strengths
(Zhang et *al*., 2020b)	The current study aimed to evaluate the (KAP) concerning COVID-19 among HCWs working in PHCs in Dubai to overcome any existing or future challenges.	Their surveyed 1357 HCWs from 10 hospitals in Henan, PRC, using a cross-sectional design from February 4th to February 8th, 2020.	89% of test-takers passed COVID-19. Doctors knew more than other medical workers. In this research, knowledge also affected attitudes. More knowledge gave HCWs confidence they could overcome the virus. Over 85% of HCWs feared catching an illness in the workplace. Healthcare employees with 5 to 9 years of experience reported less weariness, indicating they were competent to address public health emergencies. Removing PPE carefully was connected to higher education and lower work experience.	The investigation was confined to one province and a few participants.

(Kamacooko *et* al., 2021).	This study evaluated KAP towards COVID-19 among HCWs in Uganda.	A cross-sectional survey was performed for the project between September and November 2020. The Uganda Research Unit and three private, non-profit community hospitals performed the research. At the time of the study, the hospitals that took part had never taken care of a patient with COVID-19 before.	Radio and TV (96%) and social media sites like WhatsApp (70.2%) were the most common ways individuals learned about COVID-19. Knowledge, attitude, and practice all had somewhat positive associations. Clinical HCWs were more likely to comprehend COVID-19 than their non-clinical peers. Knowledge, attitude, and behaviour are linked in their study. COVID-19 awareness may change behaviour, and unfavourable behaviour increases SARS-CoV-2 risk. 78.4% of respondents were positive about COVID-19.	Study results may not apply to all HCWs working in Uganda's state hospitals. This study was successful because it had a large sample size, a very high response rate (92%), and HCWs from both rural and urban areas.
(Tien et *al*., 2021).	The goal of this study was to describe HCWs' COVID-19-related KAP at the district and commune levels	The sample size for this cross-sectional study was calculated using the proportion method (692 people). Participants were selected using a non-random method,	91.3% (879 HCWs) of the 963 participants scored above average. This is probably because most HCWs (97%, 97.5%) and Internet users (96.7%) utilize the Ministry of health (MOH) website, TV, and the Internet. Gender, education, and employment all affected knowledge scores. The logic regression model predicts with 83.2%	Researchers conducted an online cross-sectional investigation during the outbreak. Schedules may prevent many healthcare personnel

	during the first phases of the epidemic in Vietnam.	including self-nomination. Researchers surveyed medical professionals and healthcare workers in Daklak province, Vietnam's highland region.	accuracy. Each of COVID-19's six preventive strategies was related to age, location, and comprehension. Healthcare workers over 40, in rural regions, and with COVID expertise were more likely to use all 6 techniques.	from participating. This investigation was hurried to reveal COVID-19's expansion in Vietnam. Because this study was done in April 2020, at the beginning of the pandemic, information, attitudes, and actions may change.
(Maurya et *al*., 2020)	To evaluate the COVID-19 pandemic knowledge, attitude, and practices (KAP) of female healthcare professionals in	A cross-sectional survey performed in December 2020 included Basti and the surrounding areas in eastern Uttar Pradesh. FHCWs at a tertiary care centre completed a self-primed, pilot survey.	40% were medical students, followed by 21.2% of medical faculty, 16.5% of technicians, 10.4% of nurses, 7.2% of residents, and 4.2% of others. General knowledge questions were frequently accurate (over 85%). 232 out of 260 (89%) said a SARS-CoV-2-infected healthcare worker shouldn't see patients. 87% of healthcare workers avoided personal contact with COVID-19 patients. COVID-19 sufferers sometimes faced prejudice,	This study has a rather limited sample size to work with.

	eastern Uttar Pradesh and identify key KAP traits.		misunderstanding, and ignorance. Lack of PPE was regarded as the major factor contributing to increased vulnerability, followed by the non-committed public, poor ventilation, and congestion. Even after months of study, their research showed a COVID-19 and infection control knowledge gap.	
(Tamang et *al*., 2020)	This study looked at the COVID-19 knowledge, attitudes, and behaviors of (F-HCWs) in Nepali hospitals and found factors related to KAP.	They used a web-based survey and convenience sampling to get information from 603 F-HCWs in Nepal during the first week of June 2020.	64% were 18–29-year-olds, and 71% were women. Nearly half of the participants had a bachelor's degree and were single. Nearly two-thirds of the participants were RNs, and 36.3% had more than five years of experience. Social media provided most of the participants' information. 76% of F-HCWs studied understood COVID-19. IPC training and online courses provide enough information, attitude, and practice. IPC training enhanced knowledge but not motivation or behavior. Online course participants were positive and well-adjusted when questioned about COVID-19.	This study has a rather limited sample size to work with.
(Marthoe &	The purpose of this research is to characterize	Zainoel Abidin General Hospital, Aceh's COVID-19 reference	72.52% of the study's participants were women, most of whom were married and had worked in hospitals for fewer than 10 years. Avg. age: 32.64	First, the study was only done at one COVID-19 referral

Maskur, 2021).	the KAP of Indonesian frontline nurses toward COVID-19.	hospital, gathered cross-sectional data in July and August 2020. 62 of the hospital's 738 beds were designated for COVID-19 patients when the data was gathered.	This group was mostly under 40 (90.5%). Internet/social media sites covered 94.62% of COVID-19 news, while TV covered 44.80%. The staff at this referral hospital are well-versed on COVID-19 transmission, symptoms, and management, according to this study. This includes COVID-19 and ward nurses. 78% of nurses asked think the current COVID-19 pandemic will be controlled, and 70% are optimistic Indonesians can combat the virus. 86.36% of them were concerned about the COVID-19 epidemic. Most individuals worry that they (91.53%) or their immediate family (94.21%) will acquire COVID-19. Almost all nurses (99.99%) wear masks to and from work. More than 60% avoided supermarkets.	hospital, so its findings may not be generalizable throughout Indonesia. Second, the response rate remained poor despite repeated reminders. Since this study is cross-sectional, we can't follow nurses' KAP toward COVID-19 over time.

3. MATERIALS AND METHODS

3.1. Design of Study

This is a descriptive cross-sectional study styling was carried out in AL-Shamiya primary health care centers, Iraq in the period from 2022-2023. The study be conducted on healthcare staff who works in Primary Health Care Centre (PHCC).

3.2. Setting of the Study

This study was conducted during the period of April 1, 2022, to June 1, 2022, in the primary healthcare sector in the city of AL-Shamiya (It includes seven primary healthcare centers in addition to the sector center). Al-Shamiya is located in Al-Diwaniyah Governorate, in the middle of the Euphrates Governorates. In 2014, the city, people estimations were 300,000 inhabitants.

Table 3.1 The places from which the sample is taken.

Primary Health Care Sector	No. of all center	No. of study centers	%
Al-Shamiya PHCS	7	7	%100
Total	7	7	%100

3.3. Study Sample

Printed-paper forms were distributed and the non-probability sampling method (appropriate samples) was use. A subjective questionnaire was use to obtain study data from healthcare staff working in primary centers of healthcare in all seven Shamiya centers, and these centers are primary care centers, where COVID-19 patients are currently being cared for.

The sample size of the study was calculated using the Yamane equation that is used to calculate the sample size. In 1967, Yamane presented a simplified mathematical formula to measure the sample size of the study sample from the assumed study

population. According to him, the confidence level was 95% and (p = 0.05), the mathematical formula of the equation is:

$$n = \frac{N}{\left(1 + N(e^2)\right)}$$

Where, (N) is the size of the study population (the total number of health care employees in primary health care centers in Shamiya) and (e) is the level that was established for accuracy (Yemen, 1967).

N= 1200 $\therefore n = 300$

This number represents the representative sample of the present study for all healthcare staff in AL- Shamiya primary health care centres.

Table 3.2 Sample distribution areas

Name of PHCCs	NO. of HCWs	No. of participant
Sector Centre	55	14
The First Al-Shamiya	176	44
The Second Al-Shamiya	150	37
The third Al-Shamiya	130	33
Al- Salahiyah	150	37
Al- Mahawiya	205	51
The First Ghammas	174	44
The Second Ghammas	160	40
Total	1200	300

3.3.1 Criteria of the Sample

- Healthcare staff in primary healthcare centers in Al-Shamiya city.
- Males and females.
- Agree to participate in this study.

3.3.2 Criteria for those excluded from this study

- The level of education is less than high school.
- Age younger than 20 years.
- Years of experience low than 1 year.
- Refusal to participate.

3.4. Study Instrument and Data Collection

We used a questionnaire developed by Albahri et *al*.(2021) (Appendix 1). The present questionnaire consists of four parts:

- **Part I Demographic characteristics**: this part of the questionnaire contains (6-items) to the participants for their gender, age, nationality, profession and professional experience, workplace, and sources of COVID-19 information.
- **Part II Knowledge**: this part of the questionnaire contains (15-items) to assess the primary healthcare staff"s knowledge of COVID-19. The questions in this section focused on etiology, treatment, signs and symptoms and prevention, management, risk factors, and transmission. We used a 3-point Likert scale. Each question in this section had three options for the answer: true, false, or I don't know. The correct answer is given 3 scores; only one score was given to the wrong answer; then the answer "I don't know" was given two scores. Therefore, the total scores for this section ranged from 15 to 45.
- **Part III Attitude:** this part of the questionnaire contains seven items to evaluate the participants' level of fear of the COVID-19, their readiness to take more preventive measures and help workers in the first line be isolated if infected, and their confidence in beating the pandemic. We used a 3-point Likert scale. Each question in this section had three options for the answer: agree, disagree, or undecided. The positive attitude (agree) is given three scores; only one score was given to the disagree answer; then the answer "undecided" was given two scores. Therefore, the total scores for this section ranged from seven to 21.
- **Part IV Practice:** this part of the questionnaire contains (6-questions) to evaluate infection control and infection control measures implemented by participants during the pandemic of COVID-19. We used a 3-point Likert scale.

Each question in this section had three options for the answer: always, occasionally, or never. The good Practice (always) is given three scores; only one score was given to never answer; then the answer "occasionally" was given two scores. Therefore, the total scores for this section ranged from six to 18.

3.5. Validity of the questionnaire

Albahri et *al*.(2021) reviewed previous information from published questionnaires that was relevant in accordance with the guidance of the WHO regarding SARS-CoV, MERS-Co, and SARS-COV-2. After constructing the questionnaire, they flagged it for validity and reliability by presenting it to industry professionals with a facial and content validation check.

3.6. The Pilot Study

The pilot study was conducted prior to sample collection to see the reliability of the study instrument. We conducted this study in the primary health care center in the city of Al-Shamiya during the period from April 1 to 4, 2022, in the form of an experimental sample, and it consisted of 40 participants, who were excluded from the study samples. Our pilot study attempts to achieve the following objectives:

The study attempts to achieve the following goals:

A. Examine the validity and reliability of the research instrument to determine.
B. Identifying potential problems that may arise throughout the research period.
C. Familiarity with the study tool's content, including its readability, appropriateness for the intended participants, and technical polish.

Results of our pilot study:

A. The characteristics of the questionnaire are transparent, easy to understand, and excellent.
B. No changes were made to the questions.
C. Fifteen to twenty minutes per HCW was the average time needed for each participant.
D. The study's measuring instrument has been shown valid and reliable.

3.7. Reliability of the study instrument

We obtained information from (40) healthcare employees who participated in our study to determine the validity of the questionnaire. After that, we used the program SPSS version 24 to find the value of Cronbach's alpha correlation coefficient to check the reliability of the internal consistency of our study tool. To calculate the reliability estimate.

Table 3.3 Reliability Coefficients of the instrument used in the study

	Number	%
Valid	40	100.0
Excluded	0	0
Total	40	100.0

Table 3.4 Cronbach's alpha coefficient for the study instrument

The part	Items	Cronbach's Alpha
Knowledge	15	0.938
Attitudes	7	0.824
Practices	6	0.790

According to the table above, the questionnaire had a high value for Cronbach's Alpha and there was a high level of reliability. The statistical results showed that the questionnaire is valid for use in the same sample at any time.

3.8. Statistical Analysis

3.8.1 Descriptive approach

A. Frequencies and percentages through the statistical tables, which are:

$$\% = \frac{\boldsymbol{Frequency}}{\boldsymbol{Sample\ Size}}\ x100$$

B. "m.s." Mean of scores:

$$\bar{x} = \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right) = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

C. "SD" Standard deviation:

$$S.d = \frac{\sum(X - \bar{X})^2}{n - 1}$$

D. We used "Cronbach's alpha" to find out the internal consistency of the search tool, and it can be calculated using the following law:

$$\alpha = \frac{K}{K-1}\left[1 - \frac{\sum_{i=1}^{K} \sigma_{ii}}{\sum_{i=1}^{K}\sum_{j=1}^{K} \sigma_{ij}}\right]$$

3.8.2 Inferential approach

1. One Way ANOVA Analysis of variance to find out the average statistical differences between the knowledge, attitudes, and practices of healthcare staff and demographic variables.

Source of variance	Sum of square	d.f	Mean square	F
Between Groups	$SS_B = \sum \frac{(\sum xP1)^2}{n} - \frac{(\sum xP)^2}{n}$	$df_B = K\text{-}1$	$\frac{MS\beta}{MS\beta}$	$\frac{MSB}{MSW}$
Within Groups	$SS_W = \sum (\sum xP1)^2 \_ \frac{(\sum xP)^2}{N}$	$df_w = N\text{-}k$	$\frac{SSw}{DFw}$	
Total	$SS_T = \sum (\sum xP1)^2 \_ \frac{(\sum xP)^2}{N}$	$df_t = N\text{-}1$		

(1) "NS: Non significantly at probability-value >0.05".

(2) "S : Significantly at probability-value ≤ 0.05".

2. Pearson Correlation Coefficient: this coefficient was used to measure the degree and type of correlation between the knowledge, attitudes, and practices of healthcare staff.

$$r_{XY} = \frac{\sum_{i=1}^{n}(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \overline{X})^2}\sqrt{\sum_{i=1}^{n}(Y_i - \overline{Y})^2}}$$

3.9. Ethics Committee Approval

Before we started collecting the study data, we obtained some official and administrative approvals.

1. The Cankiri Karatekin University Scientific Research Ethics Committee approved this research (Application Code: ba8880ca16534698) on March 11, 2022 (Appendix 2).
2. The Cankiri Karatekin University/Institute of Health Sciences Scientific Research Ethics Committee approved this research (Resolution No. 09/05) on March 3, 2022 (Appendix 3).
3. To facilitate the task of obtaining information from participants, the approval of the Practical Research Committee in the Iraqi Ministry of Health/Diwaniyah Health Department/Training and Human Development Department/Research Committee was obtained by an administrative order directed to Al-Shamiya Primary Health Care Sector. The research was considered one of the priorities of the Ministry of Health (Appendix 4).
4. Participant's participation in the survey was entirely voluntary, and their informed consent was gathered through the survey itself.

4. RESULTS

Table 4.1 displays participants' socioeconomic characteristics as shown by statistical information in terms of percentages and frequencies. of the 300 healthcare staff participating within the scope of this study, their ages varied from 20–29, 30-39, 40–49, and 50–59 years old and made up 67.7%, 17.7%, 6%, and 8.7% of the total number of participants, respectively. In terms of gender, female healthcare staff were predominant and made up more than half of the comparison, with females making up 57.3%. According to the findings, the majority of the study sample, 51.3% of the total number, were diploma graduates. The vast majority of study participants were health and nursing professionals and accounted for 89.7% of the study sample. 76.3%, 11.3%, 6%, and 6.3% have 1-9, 10-19, 20-29, and 30-39 years of experience as a primary healthcare specialist, respectively.

Table 4.1 Descriptive statistic of the study sample's socio-demographic characteristics

Demographic data	**Groups**		
		F.	**%**
Age	20-29	203	67.7
	30-39	53	17.7
	40-49	18	6
	50-59	26	8.7
	Total	300	100
	Meam±SD	30.16±9.148	
Gender	Male	128	42.7
	Female	172	57.3
	Total	300	100
Educational level	High School	93	31
	Diploma	154	51.3
	Bachelor's	52	17.3
	Postgraduate	1	0.3
	Total	300	100
Profession	Medical Staff	31	10.3

	Nursing and health staff	269	89.7
	Total	300	100
Years of experience as a primary health care specialist	1- 9	229	76.3
	10 - 19	34	11.3
	20 - 29	18	6
	30 - 39	19	6.3
	Total	300	100

(F.): Frequency, (%): percentage, SD: standard deviation.

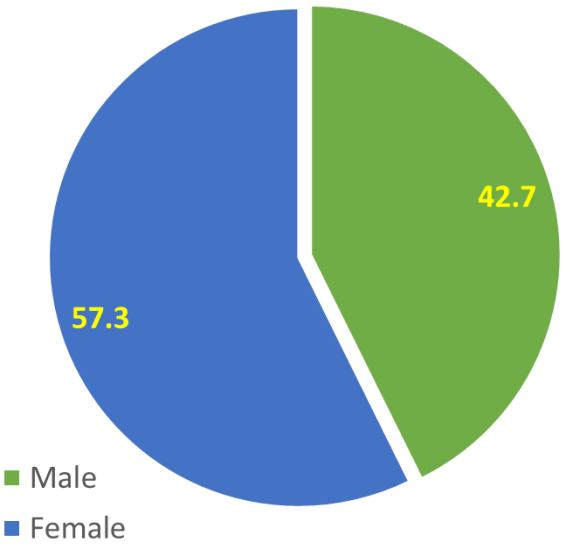

Figure 4.1 Distribution of participants by gender.

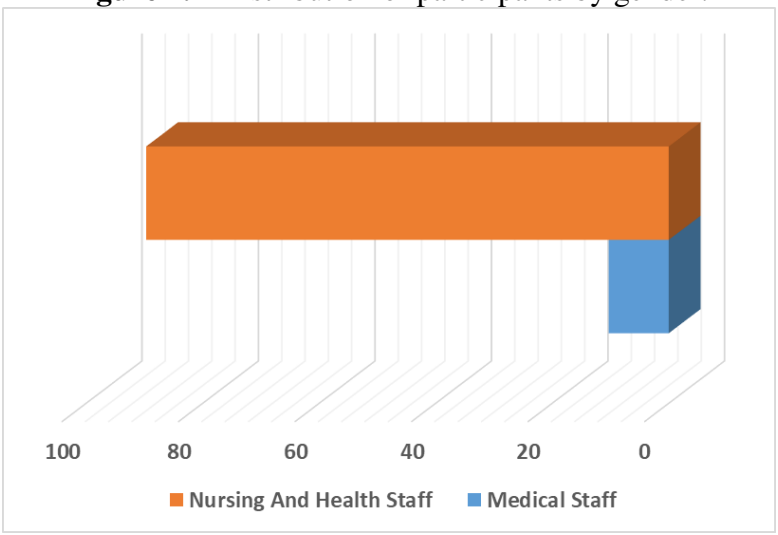

Figure 4.2 Distribution of participants by profession.

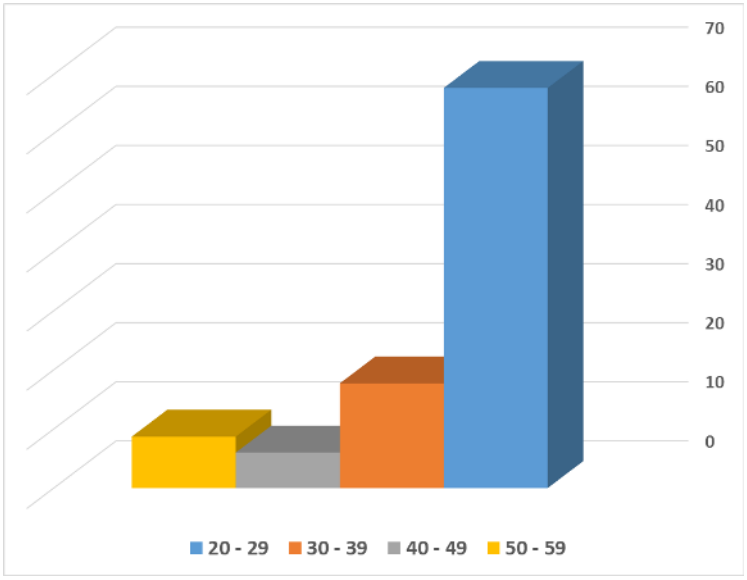

Figure 4.3 Distribution of participants by age group.

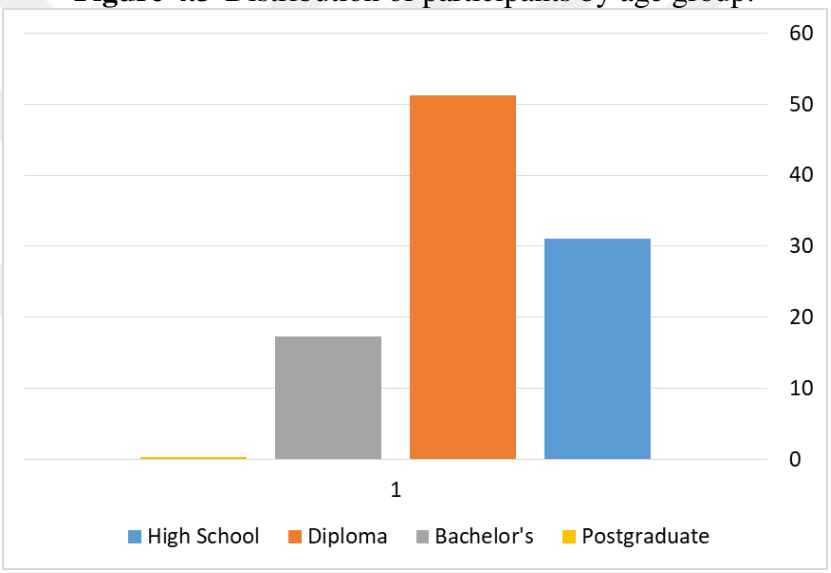

Figure 4.4 Distribution of participants by educational level.

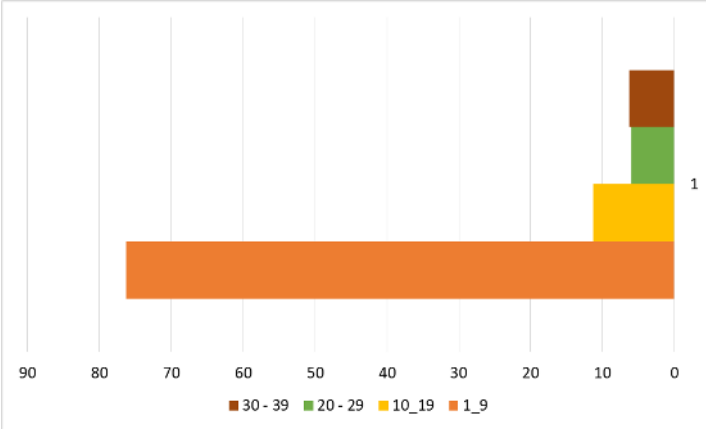

Figure 4.5 Distribution of participants according to the number of years of experience.

The descriptive data on the participants' sources of knowledge for COVID-19 are shown in terms of percentages and frequencies in table 4.2. According to the findings of the research, 90% of participants accessed the official websites of the Ministry of Health, the CDC, and the WHO; 71% used social networking sites such as Facebook and WhatsApp; 56.3% used news media such as television, radio, and newspapers; and 34% used scientific journals and research papers. For COVID-19, 66.7% of respondents obtained knowledge from their work colleagues, 47.7% obtained information via seminars and workshops, 78.3% obtained information from the Internet, and 48% used other sources of information.

Table 4.2 Sources of participant information about COVID-19

Sources	**Groups**		
		F.	**%**
Governmental and international health organizations' websites and media, e.g. MOH, WHO, and CDC	No	30	10
	Yes	270	90
	Total	300	100
Social media, e.g.whatsapp, facebook	No	87	29
	Yes	213	71
	Total	300	100
News media, e.g. tv, radio, newspaper	No	131	43.7
	Yes	169	56.3
	Total	300	100
Scientific journals and research papers	No	198	66
	Yes	102	34
	Total	300	100
Work colleagues	No	100	33.3
	Yes	200	66.7

	Total	300	100
Seminars and workshops	No	157	52.3
	Yes	143	47.7
	Total	300	100
Internet	No	65	21.7
	Yes	235	78.3
	Total	300	100
Other	No	156	52
	Yes	144	48
	Total	300	100

(F.): Frequency, (%): percentage,

In light of the cut-off point (0.66), of the statistical analysis, the results of the study shown in Table 4.3 showed the degree of knowledge of healthcare staff working in primary healthcare centers and information about the emerging COVID-19. The results indicate that employees know most of the information about this virus, with the exception of the incubation period, which was low, and the causative agent, where their knowledge of it was moderate.

The mean of the marks for the knowledge part was 2.50 (SD = 0.179), with only 222/300 74% of participants having enough knowledge at a cut-off point (0.66) of the total mark. The question with the least correct answer was related to the existence of COVID-19 vaccines on the market. With just 130 people choosing it, right. The questions' least mark was (each question has a false-positive response): contact with a confirmed case is subject to a period of surveillance lasting for a total of 28 days, the fact that the virus is now being referred to as SARS-CoV-1 rather than SARS-CoV-2, and beginning treatment with antibiotics sooner rather than later decreased the length of the illness, with 78% (234/300), 45% (135/300), and 57% (171/300), respectively. Additionally, just 64% (192/300) choose the correct answer for part COVID-19 is not always severe, only elderly, chronically unwell, and obese patients are more severe.

At least 75.3% (266/300) of the participants responded correctly to all of the remaining knowledge questions.

Table 4.3 Healthcare staff responses to the knowledge

Items	Rating	F	%	m.s	SD	Evaluation
1-There is currently no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the infection?	False	16	5.3	2.83	.499	Good
	I don't know	19	6.3			
	True	265	88.3			
	Total	300	100			
2-Not all persons with COVID-19 will develop severe cases. Those who are elderly, have chronic illnesses, and are obese are more likely to be severe cases.	False	81	27	2.37	.881	Good
	I don't know	27	9			
	True	192	64			
	Total	300	100			
3-Persons with COVID-19 cannot transmit the virus to others when a fever is not present.	True	33	11	2.64	.672	Good
	I don't know	41	13.7			
	False	226	75.3			
	Total	300	100			
4-The COVID-19 virus spreads via respiratory droplets of infected individuals.	False	7	2.3	2.79	.570	Good
	I don't know	6	2			
	True	287	95.7			
	Total	300	100			
	False	24	8	2.79	.570	Good

Items	Rating	F	%	m.s	SD	Evaluation
5-Wearing general medical masks by the public can prevent one from acquiring infection by the COVID-19.	I don't know	14	4.7			
	True	262	87.3			
	Total	300	100			
6-It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19 virus.	True	33	11	2.75	.639	Good
	I don't know	9	3			
	False	258	86			
	Total	300	100			
7-To prevent the infection by COVID-19, individuals should avoid going to crowded places such as bus parks and avoid taking public transportation.	I don't know	9	3	2.97	.171	Good
	True	291	97			
	Total	300	100			
8-Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus.	False	3	1	2.93	.287	Good
	I don't know	14	4.7			
	True	283	94.3			
	Total	300	100			
9-People who have contact with someone infected with the COVID-19 virus should be immediately isolatedin a proper place. In general, the	True	234	78	1.39	.757	Poor
	I don't know	16	5.3			
	False	50	16.7			
	Total	300	100			

Items	Rating	F	%	m.s	SD	Evaluation
observation period is 28 days.						
10-Diarrhea is a possible symptom of COVID-19.	I don't know	35	11.7	2.88	.322	Good
	True	265	88.3			
	Total	300	100			
11-Currently COVID-19 vaccine is available in the market.	False	149	49.7	1.94	.964	Moderate
	I don't know	21	7			
	True	130	43.3			
	Total	300	100			
12-Healthcare workers are at a higher risk of infection.	False	14	4.7	2.87	.455	Good
	I don't know	11	3.7			
	True	275	91.7			
	Total	300	100			
13-Early antibiotic use shortens the duration of COVID-19 illness.	True	171	57	1.71	.874	Moderate
	I don't know	46	15.3			
	False	83	27.7			
	Total	300	100			
14-SARS-CoV-1 is the causative agent of COVID-19 infection.	True	135	45	1.74	.761	Moderate
	I don't know	107	35.7			
	False	58	19.3			
	Total	300	100			
15-Detection of the viral protein via PCR analysis of the patient's sample is the main way	True	29	9.7	2.67	.646	Good
	I don't know	42	14			
	False	229	76.3			
	Total	300	100			

Items	Rating	F	%	m.s	SD	Evaluation
of diagnosingCOVID-19.						

N (300), cut-off point (0.66), poor (score mean 1-1.66), moderate (score mean 1.67-2.33), good (score mean 2.34-3), SD: standard deviation.

In light of the cut-off point of the statistical analysis, the research findings shown in Table (4.4) showed the Overall knowledge of healthcare staff working in primary health care centers about the COVID-19. The results indicate that (74%) of participants have good information about this pandemic.

Table 4.4 Healthcare staff Overall responses to the knowledge

Overall	Rating	F	%	m.s	SD	Evaluation
Overall knowledge	I don't know	78	26	2.50	.179	Good
	TRUE	222	74			
	Total	300	100			

N (300), cut-off point (0.66), poor (score mean 1-1.66), moderate (score mean 1.67-2.33), good (score mean 2.34-3), SD: standard deviation.

Figure 4.6 Healthcare staff Overall responses to the knowledge

In light of the cut-off point (0.66) of the statistical analysis, the results of the study shown in Table 4.5 showed the attitude of healthcare staff working in primary

healthcare centers regarding the emerging COVID-19. The results indicate a significant convergence between participants who expressed strong concern about infection themselves 41.3% and those who were not worried about infection 41.1%. While a large number of participants expressed strong concern about their family members with the infection, only 23.3% were not concerned about family members. Additionally, Only 85% of respondents were willing to receive a COVID-19 vaccine if it were to be found in the global market, and 65.3% believed that the world would be able to successfully control the COVID-19 epidemic. Meanwhile, 28.3% showed some hesitation or did not want to be isolated in health facilities if they contracted the COVID-19 epidemic. On the other hand, the vast majority of participants were ready to help in the front lines 86% and also believed in the importance of participating in infection control programs and courses as they said that it could reduce the spread of infection 89%.

Table 4.5 Healthcare staff responses about attitudes

Items	Rating	F	%	m.s	SD	Evaluation
1-You are extremely worried that you might catch the COVID-19 infection.	Agree	124	41.3	2	.909	Undecided
	Undecided	53	17.7			
	Disagree	123	41.0			
	Total	300	100			
2-You are extremely worried that one of your family members might get infected.	Agree	213	71.0	1.52	.848	Disagree
	Undecided	17	5.7			
	Disagree	70	23.3			
	Total	300	100			
3-If getting COVID-19, you will accept isolation in health facilities.	Disagree	85	28.3	2.33	.888	Undecided
	Undecided	32	10.7			
	Agree	183	61			
	Total	300	100			

Items	Rating	F	%	m.s	SD	Evaluation
4-Prevalence of COVID-19 can be reduced by the active participation of healthcare workers in infection control programs.	Disagree	14	4.7	2.84	.476	Agree
	Undecided	19	6.3			
	Agree	267	89.0			
	Total	300	100			
5-If a COVID-19 vaccine was available, I would have it.	Disagree	30	10	2.75	.624	Agree
	Undecided	15	5.0			
	Agree	255	85			
	Total	300	100			
6-COVID-19 pandemic will be successfully controlled.	Disagree	40	13.3	2.52	.720	Agree
	Undecided	64	21.3			
	Agree	196	65.3			
	Total	300	100			
7-If the country needs you, you will be willing to help in the frontline rescue.	Disagree	6	2	2.84	.418	Agree
	Undecided	36	12			
	Agree	258	86			
	Total	300	100			

N (300), cut-off point (0.66), Disagree (score mean 1-1.66), Undecided (score mean 1.67-2.33), Agree (score mean 2.34-3), SD: standard deviation.

In light of the cut-off point of the statistical analysis, the results of the research findings shown in Table 4.6. It showed the Overall showed attitude of participants regarding the pandemic COVID-19. 56.7% of the participants showed a positive attitude about dealing with the pandemic COVID-19, while 42.7% of the participants hesitated about this pandemic.

Table 4.6 Healthcare staff Overall responses to the attitudes

Over all	Rating	F	%	m.s	SD	Evaluation
Overall attitude	Disagree	2	0.7	2.4	0.277	Agree
	Undecided	128	42.7			
	Agree	170	56.7			
	Total	300	100			

N (300), cut-off point (0.66), Disagree (score mean 1-1.66), Undecided (score mean 1.67-2.33), Agree (score mean 2.34-3), SD: standard deviation.

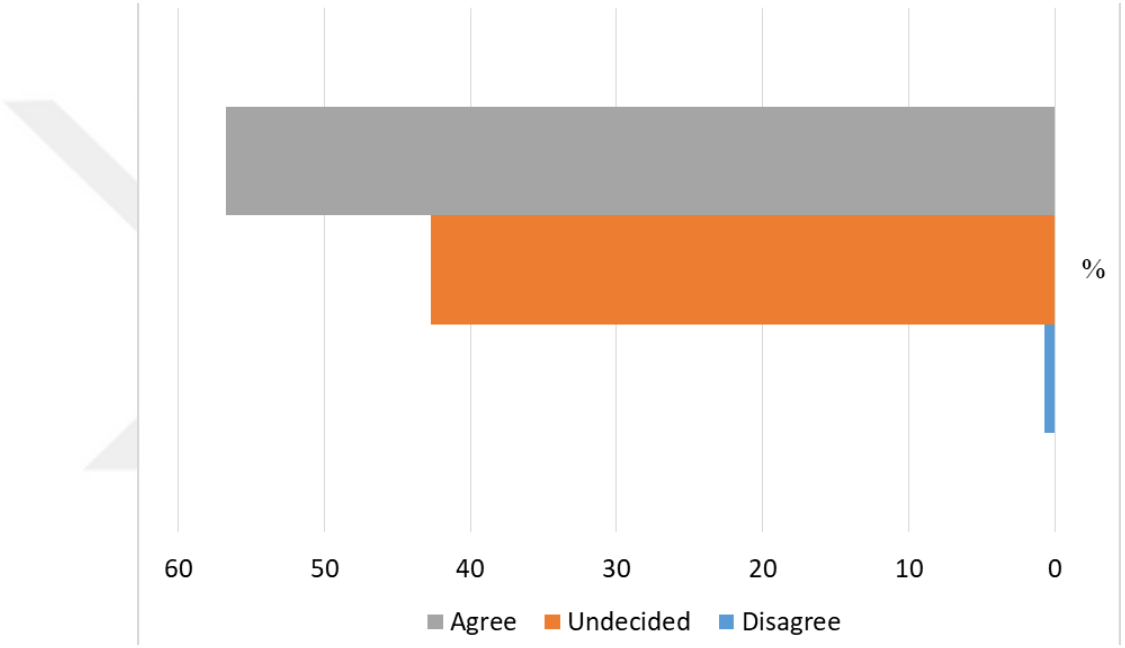

Figure 4.7 Healthcare staff Overall responses to the attitudes

In light of the cut-off point (0.66), of the statistical analysis, the results of the study shown in Table 4.7 showed the practices of participants regarding COVID-19. The second, third, and fourth items were answered well by 68.3% to 82.7% of the participants, while for the first practice item, where only 24.3% of the participants in our study participated continuously in an activity or training exercise related to infection control and control during any epidemic outbreak. Also, 40.3% of the participants removed their PPE according to the protocol continuously.

Table 4.7 Healthcare responses to practices

Items	Rating	F	%	m.s	SD	Evaluation
1-During the outbreak, did you participate in training programs to increase/refresh your practice on infection control and COVID-19?	Never	90	30	1.94	.736	sometimes
	sometimes	137	45.7			
	Always	73	24.3			
	Total	300	100			
2-During the outbreak, did you use sodium hypochlorite or 70% alcohol as surface disinfectant?	Never	15	5	2.63	.577	Always
	sometimes	80	26.7			
	Always	205	68.3			
	Total	300	100			
3-During the outbreak, did you wash your hands before and after contact with your patients?	Never	12	4	2.79	.499	Always
	sometimes	40	13.3			
	Always	248	82.7			
	Total	300	100			
4-During the outbreak, did you maintain social distance at work place?	Never	34	11.3	2.52	.691	Always
	sometimes	76	25.3			
	Always	190	63.3			
	Total	300	100			
5-During the outbreak, did you follow the steps in	Never	40	13.3	2.27	.682	sometimes
	sometimes	139	46.3			
	Always	121	40.3			

Items	Rating	F	%	m.s	SD	Evaluation
doffing your PPE as per protocol?	Total	300	100			
6-During the outbreak, did you wear surgical mask for routine patient contact?	Never	79	26.3	2.11	.790	sometimes
	sometimes	110	36.7			
	Always	111	37			
	Total	300	100			

N (300), cut-off point (0.66), Never (mean of score 1-1.66), sometimes (mean of scores (1.67-2.33), Always (mean of score 2.34-3), SD: standard deviation.

In light of the cut-off point of the statistical analysis, the results of the study are shown in table 4.7. It showed the Overall showed practices of participants regarding the pandemic COVID-19. 48.3% of the participants showed always true practices in dealing with the pandemic COVID-19, while 6.3% of the participants showed incorrect practices during this pandemic.

Table 4.8 Healthcare staff Overall responses to the practices

Overall	Rating	F	%	m.s	SD	Evaluation
Overall practices	Never	19	6.3	2.37	.395	Always
	Sometimes	136	45.3			
	Always	145	48.3			
	Total	300	100			

N (300), cut-off point (0.66), Never (score mean 1-1.66), sometimes (score mean 1.67-2.33), Always (score mean 2.34-3), SD: standard deviation.

According to the data presented in table (4.9), there are differences that are statistically significant between the participants and level of education with overall healthcare staff responses to the knowledge about COVID-19 at a p-value ≤0.05, and there are no statistically significant differences between healthcare staff gender, age, and overall responses of participants to the knowledge about COVID-19 at a p-value ≤0.05.

Table 4.9 Differences between Healthcare staff's knowledge and Characteristics of Socio-Demographic

		Sum of Squares	Df.	Mean Square	F	S.
Gender	Between Groups	5.229	15	.349	1.453	.123 NS
	Within Groups	68.158	284	.240		
	Total	73.387	299			
Age	Between Groups	1175.168	15	78.345	.933	.528 NS
	Within Groups	23845.829	284	83.964		
	Total	25020.997	299			
Profession	Between Groups	2.615	15	.174	1.966	**.018 S**
	Within Groups	25.181	284	.089		
	Total	27.797	299			
Number of years of practice in a health care profession	Between Groups	1109.764	15	73.984	.983	.473 NS
	Within Groups	21371.356	284	75.251		
	Total	22481.120	299			
degree of education	Between Groups	11.477	15	.765	1.641	**.050 S**
	Within Groups	132.453	284	.466		
	Total	143.930	299			

(Ns): Non-significant (S): significant, (Df.): degree of freedom.

According to the data presented in table (4.10), there are no differences that are statistically significant between participants' characteristics of socio-demographic (gender, age, profession, years of experience as healthcare professionals, or level of education) with the overall responses of participants to the attitudes about COVID-19 at a p-value ≤ 0.05.

Table 4.10 Differences between Healthcare staff's attitudes and Characteristics of Socio-Demographic

		Sum of Squares	df.	Mean Square	F	Sig.
Gender	Between Groups	4.255	11	.387	1.611	.095 NS
	Within Groups	69.132	288	.240		
	Total	73.387	299			
Age	Between Groups	1211.844	11	110.168	1.333	.206 NS
	Within Groups	23809.152	288	82.671		
	Total	25020.997	299			
Profession	Between Groups	1.026	11	.093	1.003	.443 NS
	Within Groups	26.771	288	.093		
	Total	27.797	299			
Number of years of practice in a health care profession	Between Groups	1206.597	11	109.691	1.485	.136 NS
	Within Groups	21274.523	288	73.870		
	Total	22481.120	299			
degree of education	Between Groups	1.642	11	.149	.302	.985 NS
	Within Groups	142.288	288	.494		
	Total	143.930	299			

(Ns): Non-significant (S): significant, (df.): degree of freedom.

According to the data presented in table (4.11), there are differences that are statistically significant between gender, and age, with the overall participants' practices about covid-19 at a p-value ≤0.05. Whilst there are no statistically significant differences between participants' professions, years of experience as healthcare professionals, and degree of education, with overall participants' responses to the attitudes about covid-19 at a p-value ≤0.05.

Table 4.11 Differences between Healthcare staff's practices and Characteristics of Socio-Demographic

		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Gender	Between Groups	7.354	11	.669	2.916	.001 **S**
	Within Groups	66.033	288	.229		
	Total	73.387	299			
Age	Between Groups	1587.385	11	144.308	1.774	.050 **S**
	Within Groups	23433.612	288	81.367		
	Total	25020.997	299			
Profession	Between Groups	.930	11	.085	.907	.534 NS
	Within Groups	26.866	288	.093		
	Total	27.797	299			
Number of years of	Between Groups	1171.113	11	106.465	1.439	.155

practice in a health care profession	Within Groups	21310.007	288	73.993		NS
	Total	22481.120	299			
degree of education	Between Groups	6.787	11	.617	1.296	.226 NS
	Within Groups	137.143	288	.476		
	Total	143.930	299			

(NS): Non-significant (S): significant, (df): degree of freedom.

Table (4.12) shows the correlation coefficient (Pearson) between Participants' scores of Knowledge, Attitudes, and Practices. There is a weak correlation between the three variables according to the values of the correlation, where the correlation between participants' knowledge and their attitudes toward COVID-19 was weak (.130). While the correlation between the participants' knowledge and their practices towards COVID-19 was weaker than the previous one (.082), while the correlation between participants' attitudes and practices towards the COVID-19 is higher than the previous two correlations (.225).

Table 4.12 Correlation between participants' scores Knowledge, Attitudes, and Practices

Variables	**Correlation**	**Sig.**
Knowledge–Attitudes	0.130*	0.024
Knowledge–Practices	0.082	0.156
Attitudes–Practices	0.225**	0.000

(N=300), *.Correlation is significant at the 0.05 level (2-tailed).

**.Correlation is significant at the 0.01 level (2-tailed).

5. DISCUSSION

Primary healthcare workers played crucial roles in the fight against the COVID-19 pandemic by fogging neighborhoods, disinfecting infected homes, and spreading awareness through the media. They served as the first line of defense in the PHCCs that treated those who were infected with the COVID-19 pandemic. It is essential to evaluate people's knowledge of the COVID-19 pandemic and how they would react to it in light of the huge number of illnesses and fatalities caused by the pandemic. So, in the next section, I'll talk about what we learned from our research and how the people who took the survey responded.

The study's overarching goal was to assess healthcare workers' familiarity with and response to the COVID-19 pandemic. The survey found that healthcare professionals had a high level of general knowledge about the topic.

5.1. Characteristics of Socio-demographic

This part will concentrate on the demographic and social characteristics of the study's participants. Some of the socio-demographic factors that were looked at were age, gender, level of education, job, and the number of years as a primary health care specialist.

The age groups 20–29 for participants in the study were the highest percentage among the age groups at 67.7%. This result was consistent with the study by Lingenda et *al*., 2021, which discussed healthcare providers' KAP concerning SARS-COV-2 preventive measures at the Women's And New-Born Hospital in Lusaka, Zambia, and this study found that the highest percentage among the age groups 20–29 was 46.9%. The reason for this is that most of the primary health care center staff in the place of our study are young people who were newly appointed to the Ministry of Health. Our study differed from the study by Tien et *al*.,2021 , which discussed, by 2020, Vietnamese healthcare personnel's KAP on SARS-COV-2 prevention, and this study found that the highest percentage among the 30-39 age group is 50.2%.

Among the participants in this study, the percentage of females was higher than the percentage of males, at 57.3%. In the Iraqi Ministry of Health, the number of female nurses is larger than the number of males. As this increase came for several reasons, including the desire of females to study medical and health specialties; the high school of nursing prep for females, and its absence for males; and the increase in the female percentage in the central admission to nursing colleges. This result was consistent with the study by Albahri et *al*., 2020, which discussed The KAP of Healthcare Providers Regarding COVID-19 in Dubai's primary care centers, and this study found the percentage of females was higher than the percentage of males, at 90%. Our study differed from the study by Zhang et *al*., 2021, which discussed in Henan, China HCWs' COVID-19 KAP, and this study found the percentage of males was higher than the percentage of females, at 53.4%.

If we talk about the educational level of the participants in the study, we found that the diploma degree was the highest, at 51.3%, among the participants. The reason for this is that most of the primary health care center staff in the place of our study are diploma degrees who were newly appointed to the Ministry of Health. Our result was in agreement with the study by Kamacooko et *al*., 2021, which discussed a cross-sectional study of healthcare workers' SARS-CoV-19 knowledge, attitudes, and practices in Uganda, and that study found that the diploma degree was the highest at 57.8% among the participants. The study by Tien et *al*., 2021 that was talked about, Health Care Workers in Vietnam in 2020: An Assessment of COVID-19 Prevention Knowledge, Attitudes, and Practices, was different from ours. In this study, 49.2% of the people had a diploma.

From the professional side, the health and nursing staff had the highest percentage of the medical staff at 89.7% of the participants. In addition, this is normal, as the Iraqi Ministry of Health suffers from a shortage of medical staff in health centers, especially family doctors. This result was in agreement with the study by Albahri et *al*., 2020, which discussed the KAP of Healthcare Providers Regarding COVID-19 in Dubai's primary care centers, and that study found the professional side, the nursing staff had the highest percentage of the medical staff at 72.7% of the participants.

As for the years of experience as a primary health care specialist, category 1–9 years was the highest category among the experienced participants in the study, with a percentage of 76.3%. Because most of the participants in the sample are under 30 years old. Our study differed from the study by Ayinde et *al*., 2020, which discussed, Corona Virus Disease in Nigeria: 2019 Cross-Sectional Study of Healthcare Professionals' Knowledge, Attitudes, and Practices in Oyo State (COVID-19), and this study found years of experience as a primary health care specialist category ≥10 years was the least experienced category among the participants in the study, with a percentage of 46.4%.

5.2. Sources of participant information about COVID-19

Access to information about COVID-19 positively affects the KAP of medical and health staff. Therefore, our study found the sources they relied on to develop their knowledge are as follows: Governmental and international health organizations' websites and media, e.g. MOH, WHO, and CDC by 90%, WhatsApp, Facebook, Twitter, and other social media, by 71%, Work colleagues by 66.7%, and the Internet by 78.3%. This result was in agreement with the study by Albahri et *al*.2020, which discussed the KAP of Healthcare Providers Regarding COVID-19 in Dubai's primary care centers, and that study found the sources of information they relied on to develop their knowledge were as follows: official health organizations by 91.5% and social media by 51%.

Study Tien et *al*., 2020, also agreed with our study, where it was found that the means of Corona information used by the participants are: Governmental MOH by 97.7%, Work colleagues by 83.7%, and the Internet by 96.7%. Our study differed from the study Kamacooko et *al*., 2021 where it was found that the means of Corona information used by the participants are: Governmental MOH by 18%.

5.3. Healthcare staff's knowledges

During the COVID-19 epidemic, our research sheds light on a number of difficulties that the healthcare professionals who work in primary healthcare centers in AL-Shamiya face. Since Iraq had already passed the peaks of the first, second, third, and

fourth outbreaks by the time the research was done, the knowledge gap is the lowest it has ever been 74% (222/300) scored an adequate level of knowledge (Basnews, 2022).

In a similar study conducted earlier in the epidemic, hospital health care workers in Vietnam showed a comparable level of knowledge (more than 88% had good knowledge) (Huynh, 2020).

In another similar study conducted in Dubai, although the peak of the first wave of the epidemic had passed by the time the research was done in the United Arab Emirates, the knowledge gap was quite large, only 57.4% of those who participated in the study scored a sufficient level of knowledge. (Albahri et *al*., 2020)

We continue to speculate that two main factors contribute to the discrepancies in knowledge: the first is the rapid frequent change in the evidence related to the disease. The second problem is the spread of erroneous information and anecdotal evidence, known as the "in formi," among the general public and healthcare professionals (Carley et *al*., 2020; Orso et *al*., 2020).

Some examples of these precautions include the use of antibiotics and the imposition of isolation periods for those who come into contact with COVID-19 patients. Neither the need for quarantining potential contacts nor the length of time the virus takes to incubate was immediately apparent. In the aftermath, the common recommendation across countries, including Iraq, was between 10 and 14 days (Wan et al., 2020).

We hypothesize that the culture of evidence-based medicine is weak among the studied community of HCWs. During the pandemic, only 34% of people used scientific articles or publications were their main source of information. As HCWs are considered frontline warriors against illness and disinformation campaigns. The lower their level of information, the less likely they are to be able to combat this false information. In addition, they may be the ones unknowingly spreading it. For example, when we asked the participants in our study about the scientific name of COVID-19, 80% chose the wrong answer, SARS-CoV-1, while the correct answer is SARS-CoV-2, according to the practical sources of this virus.

5.4. Healthcare staff's attitudes

In the part on attitude, a total score of positive attitudes was achieved by 56.7% of the participants, which is more than half of the participants. Our findings were supported by the findings of other research that were similar to those that had been previously reported in the scientific literature. In another research that was quite similar to this one that was carried out in Ho Chi Minh City, Vietnam, a great vast of participants owned a positive attitude toward COVID-19 (Huynh et *al*., 2020).

Our study differed from another similar study that was conducted in Dubai in the year 2020, where only 33% of acceptable attitudes towards this epidemic were recorded. This is because his study was done at the start of the epidemic when a lot of false information was being spread about the virus, which caused a lot of fear and terror (Albahri et *al*., 2020).

In the beginning, there was a lot of concern about becoming infected with the virus or having a member of one's family get sick from it, with the study recording the concern of 71% of the participants towards themselves, and 41.3% of the study participants towards their families.

This kind of anxiety was further studied and underlined in the literature as a comprehensive issue covering the organization's preparedness as well as its ability to preserve the mental and physical health of its personnel, and the literature describes the topic as a multifaceted problem (Shanafelt et *al*., 2020).

On the other side, almost 86% of those who participated in the study said that they are willing to keep fighting on the front lines in the future, and 89% of the participants believe that one of the most effective ways to eliminate the virus is to participate in infection control programs, while 85% of the participants expressed their agreement to receive the vaccine. 61% of the participants accepted isolation in health isolation centers if they were infected. 65.3% of the participants are optimistic that the epidemic can be successfully controlled. These results did not come out of emptiness, but great efforts were made during the past five years in the Al-Shamiya primary health care

sector, where there was an annual program to combat pollution and another to control communicable diseases, where workers are trained in a practical and theoretical way to combat disasters that may occur.

5.5. Healthcare staff's practices

In this study, 48.3% of participants reported using COVID-19 preventative techniques that were beneficial. 82.7% of participants did the right thing to keep their hands clean. For example, 63.3% of participants kept a healthy social distance at work, and 63.3% of participants used sterilizers like alcohol 70%. The survey's healthcare staff reported a good standard of infection prevention and control. The epidemic, however, also highlighted to emphasize the need for bettering health education initiatives. Only 24.3% of healthcare workers always participated in training programs. Our findings were supported by the findings of other research that were similar to those that had been previously reported in the scientific literature. A similar study by Olum et *al*.(2019) showed that the healthcare staff at Makerere University's teaching hospitals in Uganda use effective COVID-19 prevention methods. The majority of the Healthcare staff were taking the usual procedures recommended by the Ugandan MOH and the WHO in order to avoid the prevalence of the SARS-CoV-2 pandemic. These include wearing a mask in public settings, maintaining an appropriate distance from other people, and often washing your hands.

Another similar study by Zhong et *al*. (2020) showed at the height of the COVID-19 pandemic in China, 98% of individuals wore face masks, and 96.4% avoided crowded public spaces. This indicates that the Chinese people took extreme measures to protect themselves.

From a scientific perspective aimed at preventing and controlling infections, medical personnel should place a high priority on correctly removing personal protective equipment. After using potentially hazardous or polluted environments, it is critical to ensure that any worn PPE, such as gowns, gloves, medical masks, and goggles, is disposed of in an appropriate manner in order to prevent the spread of illness and germs. In our study, we found that only 40.3% of the participants follow the

scientifically accurate methods of removing and flaking their personal protective equipment after finishing work in a virus-contaminated environment. The reason for this is that most healthcare staff are not significantly trained to properly remove personal protective equipment in accordance with the protocol, and this may be a major reason for the large number of cases of infection of healthcare staff in the study area at the beginning of the pandemic.

5.6. Healthcare staff's knowledge and socio-demographic characteristics

There was a statistically significant difference between knowledge, and degree of education (probability value = .050), it affected the information of the participants and was towards a bachelor's degree because they were trained to deal with such epidemics during their academic study period, and with regard to the profession (probability value = .018), and was towards a medical staff degree because it is related to the degree of education, where each scientific degree has a profession that is different from the other.

Our findings differed from those of other research that were similar to those previously reported in the scientific literature. In similar studies by Tien et *al*. (2020) and Yakar et *al*. (2020), they found statistically significant differences between participants' knowledge and gender only, but they did not find statistically significant differences between participants' knowledge and between age and profession.

5.7. Healthcare staff's attitudes and Socio-Demographic Characteristics

There was no statistically significant relationship between the degree of attitudes and the demographic information of the participants (age, gender, occupation, educational level, and years of experience).

We are able to explain the factors that led to this statistical significance, the most important of which is as follows: In the region where our research was conducted, the COVID-19 pandemic was a recent disease. Attitudes toward this disease could not be affected by gender, age, years of experience, degree of education, or occupation. In

other words, these factors did not play a role. After four waves of exposure to the virus, every single participant had favorable opinions about it. Our findings were supported by other research findings that were similar to those previously reported in the scientific literature. In a similar study by Tien et *al*. (2021), they found no significant differences between participants' attitudes, age, education level and occupation.

Our findings differed from those of other research that was similar to those previously reported in the scientific literature. In similar studies by Tien et al. (2020) and Tien Yakar et *al*. (2020) and Tamanget et *al*. (2020), they found statistically significant differences between the participants' attitude, gender, and educational level.

5.8. Healthcare staff's practices and socio-demographic characteristics

There was a relationship that was statistically significant between the practices score with gender (p-value = 0.001), and age (p-value = 0.050).

When an epidemic is spreading, one of the most essential things to pay attention to is practices, particularly the procedures that must be followed in order to remove personal protective equipment in accordance with protocol. In our research, we found a statistically significant relationship between practices, gender, and age. These results were remarkably comparable to those of recent research that was conducted by Van Nhu et *al*. 2020. That study found that gender and age group substantially impacted the level of COVID-19 preventative behavior among the general population.

Our findings differed from those of other research that was similar to those previously reported in the scientific literature. In similar studies by Tien et al. (2020) and Tien Mauraya et *al*. (2020) and Tamanget et *al*. (2020), they found no significant differences between participants' practices, gender, and age.

5.9. Correlation between healthcare staff's scores knowledge, attitudes, and practices

We utilized the Pearson correlation coefficient to determine whether there was a no connection between the scores given for knowledge, attitudes, and practices by healthcare workers. There were no correlations (r = 0.082) that were statistically significant between the results on the knowledge test and the scores on the practice test. While analysis of the correlation between scores of knowledge and attitude revealed, but weakly positive correlation between the two (r = 0.130), indicating that those with higher scores on the knowledge parts were also more likely to have higher scores on the attitude items. It was found that there was a positive correlation between the scores of the participants' attitudes and practices, but there was only a weak correlation between the two (r = 0.225). This suggests that individuals who had higher scores on the attitude parts were also more likely to have higher scores on the practice items. The final part of our relationship was supported by Albahri et *al*.2020, a study similar to ours. According to his research, there is a positive but weak correlation between the levels of attitude and the levels of practice.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusion

In conclusion, the knowledge, attitudes and practices of primary health care staff in the Levant city were good, but there are some gaps in some aspects that should be taken care of in the future.

Conclusions that may be drawn from the study's results include:

- The participants' KAPs towards the COVID-19 were good.
- The majority of participants used reliable sources (MOH, CDC, WHO,…) for information about the COVID-19.
- The vast majority of participants were ignorant of the duration of quarantine and isolation that an infected person or contact should undergo, as well as the treatments for this virus, as they linked it to antibiotics, and they did not distinguish the causative agent of the disease from others.
- The vast majority of the participants had a fear that they or a member of their family might be infected, and they did not accept isolation in health isolation centers.
- There were no statistically significant differences between gender, age, number of years of experience, and the participants' knowledge, While There were statistically significant differences between jobs, educational level, and the participants' knowledge
- There were no statistically significant differences between the characteristics of socio-demographics (gender, age, profession, number of years of practice in a healthcare profession, and degree of education) and the participants' attitudes.
- There were statistically significant differences between gender, age, and the participants' practices. While there were no statistically significant differences between profession, the number of years of practice in a healthcare profession, degree of education, and the participants' practices.
- There is a weak positive correlation between the participants' knowledge and attitudes, and a strong positive correlation between the participants' attitudes and practices, while there is no correlation between the participants' information and their practices.

6.2. Recommendations

We suggest:

- Activating medical, nursing, and health training and education units in primary health care centers and making graduate degree holders the ones who train health care workers.

- Creating a health social network that focuses on publishing health information and is only accessible to people who work in health care.
- Develop a program in primary health care centers that deals with the COVID-19.
- Holding training courses and workshops on how to remove personal protective equipment in accordance with the scientific protocol.
- Urge primary health care workers to wash their hands before and after contact with the patient, and hang panels showing how to properly wash hands in all sections of the primary health care center.
- Develop a program to evaluate primary health care workers against communicable diseases, periodically within 3 months.
- Develop a program to evaluate pollution control and infection control in primary health care centers, and it will be periodically within 3 months.
- Establishing a printed work guide dealing with information and correct practices regarding the Corona virus to be a source of work in primary health care centers.
- We suggest that our fellow researchers study the practices of health personnel towards the Corona virus in more detail and on the way of programs.

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APPENDICES
Appendix 1: Questionnaire

Appendix 2: Ethical approval from Cankiri Karatekin University

Appendix 3: Ethical approval from Institute of Health Sciences - Cankiri Karatekin University

Appendix 4: Ethical approval from Iraq Ministry Health

Appendix 5: The decision to appoint a second supervisor

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