1.Renowned epidemiologist William Foege, a for- mer Director of the Centers for Disease Control and Prevention (CDC) once said," Vaccines are the tugboats of preventive health" [2,3]. The first case of COVID-19 in the United Arab Emirates (UAE) was affirmed to be a 73-year-old Chinese woman who traveled with her family from China on 29 of January 2020 [4,37]. On 20 March, the first two deaths were reported along with 552 new cases with this number increasing to 12,481 total cases in the country by 30 April. The 18 May 2020 marked the first day with the number of recoveries higher than those of active cases found; this statistic increased to 24,190 cases with 1,065 cases recoveries [4,38]. As of 18 August 2021, the current status of COVID-19 is tal- lied at 19,185 active cases, 2,006 deaths, and 682,809 recoveries [4,36]. The UAE is one of the many countries embarking on this journey of immunizing the world against COVID-19. In July 2020, Sino- pharm began Phase III clinical trials to evaluate its COVID-19 vac- cine effectiveness in the UAE. In September 2020, Sinopharm's vaccine candidate was approved for emergency use by the UAE and then for general use in December 2020 [4,39]. Before the end of March 2021, the UAE government aimed at being half-way towards vaccinating its residents against the coronavirus [3]. The National Emergency Crisis and Disaster Management Authority (NCEMA) reports that as of the 18th of August 2021, the UAE dis- tributed 17,454,250 vaccine doses. Approximately 82.82 percent of the population has received at least one dose, while 73.21% have received the full dose. [26]. Moreover, the country has ranked as the world's second-fastest COVID-19 vaccination campaign, more than four times the United States of America [3]. There are currently five primary approved vaccines circulating in the UAE to protect the population from the coronavirus; Pfi- zer/BioNTech; Moderna; Oxford/AstraZeneca; Sputnik V, and Sino- pharm. Two vaccines, Sinopharm and Pfizer-BioNTech, are currently used on eligible individuals against the COVID-19 infec- tion in the UAE. Moreover, only weeks after vaccine trials began in the United Arab Emirates, state media reported that the ministry of health has also approved Russia's Sputnik V COVID-19 vaccine for emergency use, as infection levels hit a record [4]. The Russian developers stated that the shot is 91.4% effective in providing pro- tection and will soon be distributed to the citizens [5]. The Ministry of Health and Prevention (MOHAP) and Dubai Health Authority (DHA) via the 'Hasana' program offers both Sinopharm and Pfizer to its citizens and residents [4]. The DHA has recently approved the AstraZeneca vaccine and has added it to its list of vaccines that residents and citizens can use at its health facilities [6]. BioNTech's use of gene technology to beat the virus was crucial for the rapid development of Pfizer. It is tested on several candidates where BioNTech specializes in the messenger RNA platform technology where the mRNA trains the immune system to attack hostile inva- ders, from viruses to tumors [7]. The UAE is the first country in the Arab world to develop and produce a COVID-19 vaccine with a full production schedule in place; Hayat-Vax is a joint venture between Sinopharm CNBG and Abu Dhabi's G42. The launch of the vaccine manufacturing capabilities in the UAE is a momentous step in the fight against COVID-19 [4,25]. In adapting such an approach, the UAE government recognized the importance of building the vaccine confidence in order to tackle the COVID-19, including par- ticipating in the COVID-19 vaccine trials. There were more than 31,000 volunteers from the UAE who were a part of the trials, including more than 1,000 people with underlying health condi- tions. Those participating in the study reported mainly mild symp- toms such as a sore throat, a similar response seen in those who

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take the annual seasonal flu vaccine. Furthermore, Sinopharm con- ducted phases 1 and 2 of the trials in China and the third stage in Abu Dhabi, UAE. Furthermore, the UAE has been noted for its efforts on a global level to provide significant medical assistance to countries in need. For example, Abu Dhabi Medical Devices Company, together with international partners, has provided more than 500 million syr- inges and needles for the COVID-19 vaccines, equivalent to 25% of UNICEF and COVAX's global needs by 2021 [33]. This commen- tary addresses the role of the UAE Government in promoting vac- cination, building vaccine confidence, and paving the way by lessons learned on a global scale through its effective approach to becoming the country with the lowest COVID-19 mortality rate, only 0.4 percent [8]. This commentary focuses on vaccination, which is just one element of a comprehensive UAE COVID-19 strategy. 2. Background The UAE is a cooperative union of seven emirates with a popu- lation of 10,022 million (2021) and was founded in 1971 [9,19]. There are various nationalities living in the UAE, with 88.52% of the population being expatriates and immigrants, and 11.48% of the population are Emiratis [41]. The UAE government aspires to build a world-class health system to improve healthcare quality for its population [9,19]. The Ministry of Health and Prevention (MoHAP) is the federal health authority for all citizens and resi- dents through standardized health services. After establishing indi- vidual emirate-based healthcare bodies by Abu Dhabi- (DoH) overseeing all public and private healthcare in the Emirate of Abu Dhabi and Dubai Health Authority (DHA) sector needs in Dubai. MOHAP was shifted towards focusing on the Northern Emi- rates (Sharjah, Ajman, Umm Al Quwain, Ras Al Khaimah, and Fujairah). The UAE was the first in the Middle East region to report SARS-CoV-2 cases. The country took serious preventive measures and was a leader globally in many health indicators; some of the critical achievements were that the UAE was ranked as the first country where the number of COVID-19 tests performed since the pandemic's start exceeded its total population. The UAE is clas- sified second in the world for the daily distribution of COVID- 19 vaccine doses, with an average of 6.06 doses per 100 people [9]. According to Toluna International Consumer Survey (2020), The effective actions and policy implementation taken by the UAE have led to the country being ranked first in the Middle East and third globally for public satisfaction with the strategies to address COVID-19 [9]. As the pandemic progressed, the UAE's focus shifted from managing the effects of the pandemic to vaccinating the pop- ulation against COVID-19. The UAE took significant steps to help its citizens adjust to the shift from COVID-19 response to vaccine acceptance and uptake [4,35]. 2.1. Success factors for the COVID-19 vaccination program across the UAE UAE's successful early COVID-19 vaccination rollout has been attributed to a number of factors, including but not limited to: 2.1.1. Governance system The UAE government and leaders are playing an essential role in promoting COVID-19 vaccination. The UAE rulers have encouraged citizens and residents to get vaccinated at the earliest "Today, we are ranked the second globally in the vaccine administration rates. Taking the vaccine is every individual's responsibility to protect their health, families and wider society," said Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai [10].As for knowledge about the coronavirus vaccines, 71 percent of residents surveyed said this: "I feel well informed about the various Covid 19 vaccines" [4,43]. The UAE government had also launched the #TogetherWeRe- cover campaign, which has become one of the most impactful ini- tiatives in the country [15]. As part of the

campaign, the UAE National Emergency Crisis and Disaster Management Authority (NCEMA) posted various messages on social media platforms and public spaces to encourage vaccinations amongst UAE residents. By engaging with the hashtag campaign, the UAE citizens and res- idents were well-informed and active in showing their support for the national effort to counter this national challenge [4,34]. The UAE aimed to ensure its diverse community of citizens had access to legitimate information that is readily accessible across different platforms. Dissemination of vital information was done in several languages, including English, Arabic, Urdu, Filipino, and Mandarin, thereby reflecting the diversity of the population. As a cumulative effect of such unified efforts, the UAE government has also com- bated misinformation and kept the public informed about the lat- est developments with COVID-19, including new cases, recovered cases, and death tolls, as well as vaccination coverage [4,35]. Fur- thermore, in September 2021, the UAE Cabinet approved the National Policy on Vaccinations, aiming to ensure high-quality vac- cines and preventive care for many infectious diseases and not only COVID-19 [16]. 2.1.2. Logistical capabilities One of the essential factors for the success of the vaccination program in the UAE is the efficient Supply Chain and Logistics sys- tems. The UAE ranks fifth globally when it comes to vaccines avail- ability, after the US, China, UK, and Israel [9]. The UAE has wisely utilized its logistical capabilities for efficient vaccination delivery, with Abu Dhabi and Dubai becoming a hub for global vaccine dis- tribution. Founded in the UAE, Hope Consortium was formed to facilitate the availability of COVID-19 vaccines throughout the world through a public-private partnership. It aims to deliver 18 billion doses of vaccines by the end of 2021. The consortium includes some of the most prominent organizations in Abu Dhabi and around the world. Department of Health- Abu Dhabi (DoH) monitors the necessary regulatory compliance, scientific insight, and complete chain expertise. Other members include Etihad Cargo, Abu Dhabi Ports Company, Rafed, a healthcare purchasing company, and SkyCell (Switzerland's award-winning company that creates temperature-controlled logistics container solutions for the pharmaceutical industry). Hope Consortium has created the UAE's largest freezer farm with an overall capacity of 53 units. This facil- ity has the capacity to store over 11 million doses of COVID-19 vac- cine at ultra-cold temperatures [4,28]. In December 2020, Hope Consortium flew 2 million vaccine doses into the Capital to store and distribute the Sinopharm vac- cine. Abu Dhabi Ports empowers the vaccination campaign with a 19,000-square meter temperature-controlled warehouse facility in Khalifa Industrial Zone [20]. In support of the WHO's COVAX ini- tiative and its efforts to equitably distribute 2 billion doses of COVID-19 vaccines in 2021, the 'Vaccine Logistics Alliance' was launched to accelerate the distribution of COVID-19 vaccines around the world. The Dubai Vaccine Logistics Alliance brings together key stakeholders to expedite the worldwide transport of urgently needed vaccines through Dubai [29]. 2.1.3. Accessibility & delivery Citizens and residents of the UAE who are medically eligible to receive COVID-19 vaccines will be able to obtain them at no charge based on the priority announced by the UAE's health authorities from time to time. The UAE government makes the Pfizer- BioNTech and Sinopharm vaccines accessible to the population by providing different vaccination sites in all emirates to accom- modate the increasing demand. The COVID-19 vaccine has been made available at over 120 locations [16]. The Dubai Health Authority (DHA) also announced plans to set up the One Central COVID-19 Vaccination Centre at the Dubai World Trade Centre, which serves 4,000 people per day

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[16]. The Sinopharm CNBG Covid−19 vaccine will also be administered within select SEHA facilities, including 35 Ambulatory Health Services (AHS) facilities in Abu Dhabi and Al Ain [10,16]. Currently, COVID−19 vaccinations are available free of cost across all emirates through a prior appointment is required [4,32]. The Abu Dhabi Health Services Company (SEHA) offers Sino− pharm and Pfizer BioNTech vaccines through drive−through cen− ters [17]. Residents and citizens can schedule appointments via the SEHA mobile app. UAE citizens, seniors and residents (60 years and older), people with chronic diseases, and persons with disabil− ities are eligible to walk in at SEHA vaccination centers and clinics without an appointment [31]. In January 2021, the Ministry of Health and Prevention (MoHAP) had announced that all UAE citi− zens and residents aged 16 and above are eligible for a vaccination against COVID−19, and priority should be given to individuals who are most likely to develop complications of the disease [4,42]. As of May 2021, MOHAP approved the emergency local use of Pfizer vac− cine for children between 12 and 15 after clinical trials and assess− ment [4,32]. According to the UAE Ministry of Health and Prevention, there are six groups of people who can be exempt from vaccination, such as current COVID−19 patients, pregnant women, children under 12 years old, people previously infected with COVID−19, people vaccinated outside the country, those who are allergic to vaccines or any of their ingredients, and people suffering from conditions that may "conflict with the vaccine."Acknowledgment The author(s) disclosed receipt of the following financial sup− port for the research, authorship, and/or publication of this article: The authors would like to acknowledge Mohammed Bin Rashid School of Government, Dubai, UAE and the Alliance for Health Pol− icy and Systems Research at the World Health Organization for support as part of the Knowledge to Policy (K2P) Center Mentor− ship Program [BIRD Project].Vaccinated tourists can download the Al Hosn app and register using the "unified number" (UID) listed on their visa to prove one's vaccination. As part of the Abu Dhabi Emirate pandemic response, Malaffi, the established Health Infor− mation Exchange, had played a significant role. As part of a vacci− nation program in Abu Dhabi, Malaffi currently collects and shares vaccination information with more than 100 healthcare facilities connected to electronic medical records. Vaccination eligibility can also be verified through the Malaffi platform. Additionally, any vaccine side effect noted by clinicians in their electronic health records will be centralized through Malaff [27]. Other notable mobile apps centered around raising awareness on the immuniza− tion programs and providing vaccine data integration include COVID−19 UAE, ALHOSN UAE, MOHAP App, MOHAP−SHEFAA, Health Heroes Game App, Tateem, and the UAE RADR APP. 2.1.5. Vaccine manufacturing facility The UAE builds a vaccine manufacturing facility to meet the growing global demand for vaccines, and thus considered to be the first nation in the Middle East to produce vaccines under a licensing agreement with Sinopharm, The UAE is the first country in the Arab world to develop and produce COVID−19 vaccine with a full production schedule in place; Hayat−Vax is a joint venture between Sinopharm CNBG and Abu Dhabi's G42. The launch of the vaccine manufacturing capabilities in the UAE is a momentous step in the fight against COVID−19. The new vaccine plant aims to produce about 200 million doses of the COVID−19 vaccine annu− ally. In the meantime, around two million doses of Hayat−Vax are currently produced per month in a plant owned by Julphar in Ras Al Khaimah until the newly launched facility is fully operational. To date, Sinopharm CNBG has supplied over 100 million

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doses of COVID−19 vaccine worldwide [25]. 2.1.6. Indirect vaccine enforcement mechanisms In the UAE, stricter measures have been implemented to restrict the movement of people unvaccinated against COVID−19 [30]. The government is considering strict measures to limit the movement of unvaccinated individuals, as well as preventative measures, including limiting access to some places and services to ensure everyone's health [4,30,36]. 2.2. Vaccine challenges and lessons to be learnt While vaccination provides hope as part of a pandemic solution, it also raises concerns over how vaccines will be deployed and accepted. At the same time, the UAE government is encouraging the population to take the vaccination as soon as possible. Some residents are reluctant to get vaccinated, and some officials reported anxiety among their nationals about the potential long− term side effects of the COVID−19 vaccination shot [18]. 2.2.1. Vaccine hesitancy A significant challenge is 'vaccine hesitancy' not only in the UAE but also worldwide. Vaccine hesitancy is a complex, context− specific phenomenon defined as a "delay in acceptance or refusal of vaccination despite the availability of vaccination services" [11,23].Therefore, individual vaccination resis− tance emerges from various factors: person and community influ− ence, numerous conditions which present difficulties in the acceptance of vaccines, such as social−economic and demographic contexts, vaccine awareness and facts, past vaccine experiences, subjective standards, religion, and moral conviction, and the move− ment against vaccines [21].It will be perilous to continuously monitor vaccine hesi− tancy across populations and quickly expand mitigation strategies to combat it. Health care workers play a decisive role in increasing awareness and addressing specific concerns during regular clinical visits.Al Hosn, the country's official COVID−19 contact tracing app, also serves as the national vaccine registry, fol− lowing its recent update that included a function for tracking res− idents' vaccination history.A better approach than putting pressure on vaccine hesitant or resistant individuals to get vaccinated is to foster community trust through enhanced transparency on national COVID−19 infection, mortality, and vacci− nation rates while minimizing actions that can negatively affect community trust .However, further research is warranted in understanding key reasons for vaccine hesitancy amongst this diverse population and exploring areas for increasing vaccine confidence, and enhanc− ing COVID−19 vaccination program effectiveness.Also, con− textual influences include understanding procedures for vaccine production, efficacy, safety, perceptions of health workers and media, which pose challenges to the hesitancy of COVID−19 vacci− nes [21,40].There were additional requirements for vac− cines and other vaccination protocols (ring vaccination [targeted groups of people through surveillance and containment] versus mass vaccination [entire population]), leading to confusion and anxieties among the public [23].This can be countered by public awareness and misinformation tracking, espe− cially among marginalized labor populations with limited literacy [13], including those undocumented residents/workers.Conclusion The UAE is foremost globally in many indicators for managing the COVID−19 pandemic, recognitions to effective preventive mea− sures, and a free vaccination drive.Digital infrastructure Healthcare data are digitized and centralized efficiently, so cit− izens can request an appointment for a vaccine immediately using apps or calling a hotline.Vaccination is considered a crucial strategy in mitigating COVID−19 spread, an infection which has had devastating impacts on human− kind with high death tolls and significant disruptions to economies and everyday life since late 2019.Among the four vaccines currently available in the UAE,

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Sinopharm is the most trusted vaccine (50 % indicated so), followed by the Pfizer–BioNTech vaccine with 27 percent, and the Russian vaccine Sputnik V received six percent of residents' trust.Continual public health awareness and limitation misinformation Nevertheless, family engagement, scientific evidence and open– ness, and public awareness programs provide a potential solution to these challenges through the public health campaigns.providing vaccination in places where people are comfortable such as workplaces, schools, shopping centers, religious sites, etc., especially in the minority population who might be unwilling to visit health facilities.Evidence suggests that the public health benefits of approved COVID–19 vaccines tend to be hindered by the population's hesitancy to be vaccinated [13,40].A cross–sectional survey among Arab parents in the UAE showed 12% of the study participants to be vaccine– hesitant with concerns mainly about the side–effects and safety of the vaccines [40].Evidence in the emergence of the new discipline of 'in– fodemiology' and 'misinfodemic' indicates that people's exposure primarily drives the unwillingness to misinformation.For example, two different vaccines were rolled out simultaneously in an Ebola outbreak in North Kivu, Democratic Republic of the Congo.Establishing a mechanism for managing the Change/ theory of change The success of COVID–19 vaccines can be determined by multi– faceted interventions that target populations based on unique needs.Finally, ensuring surveillance systems for adverse medical events that may be caused or perceived to be caused by vaccines are in place through independent monitoring bodies, impacting positively on the qual– ity of life [22,24].Public trust and integrity in both the vaccine and the UAE's leadership is key to any mass inoculation program's success to continue pos– itively impacting the quality of life and well–being of its citizens and residents.The concerted determinations from the UAE govern– ment and health authorities and the general public's active partic– ipation have led to the country's Vaccination Program's roll–out success.The UAE government has played a significant role in combating COVID–19 Vaccine misinformation through effective communica– tion.The UAE leadership viewed the COVID–19 experience as an opportunity to reflect, strengthen their resource security, and reinforce the critical supply chain.Declaration of Competing Interest The authors declare that they have no known competing finan– cial interests or personal relationships that could have appeared to influence the work reported in this paper.A number of UAE ministers also received the COVID–19 vaccine at the beginning of the campaign, which constituted great examples that leaders set to the public [14].Exemption certificates will be issued by accredited health centers, clinics, and hospitals in the country [4,44].Public awareness of the risk of vaccination is undoubtedly influenced by scientifically reported or non–public policy impacts.The coexistence of several vaccines in the same context can lead to mistrust, confu– sion, and anxieties.It uses your body's natural defenses to build resistance to specific infections and makes your immune sys– tem stronger [1].As a result, such health infrastructure and human resources as contributing factors for the success of the vaccination rollout.Vaccine hesitancy sometimes arises in the case of vaccines rapidly developed in an emergency.Public health authorities must take care when enacting reg– ulations or taking steps perceived as coercive.Introduction Vaccines are one of the most cost–effective and efficient public health interventions of all time, saving millions of lives each year.The health authorities also worked with the state's religious leaders to deliver the message that the vaccines were permissible under Islam.In 2019,

the WHO identified vaccine hesitancy as one of the leading global health threats [12,40].According to the World Health Organization (WHO), vaccination is a simple, safe, and effective way of protecting people against harmful diseases before coming into contact with them.has invested resources in reassuring the public that the vaccine is safe and effective.The UAE currently has several vaccines that are rolling out.Among those immunized, nearly half (47%) report that they do not have any concerns about the long-term effects, whereas 39 percent report they are concerned about those effects over time [43].The UAE.2.1.4.2.2.2.2.2.3.3.

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