



## RESEARCH ARTICLE

# The demographic effects and public health infrastructure dearth of COVID-19 in Ghana [version 1; peer review: 1 approved with reservations]

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## Abstract

**Background:** Over the last two years, the world has been experiencing a worldwide health catastrophe. The Corona Virus (COVID-19) struck at the heart of societies and is a major health-care infrastructure problem. Infrastructure has been characterised as the basic requirement for carrying out productive and relevant public health actions. Mortality has direct and indirect relationship, with the former causing short and long-term mortality, resulting in a short life expectancy. Reduced accessibility and quality of health care, isolation, loneliness, and poverty were some of the indirect repercussions. The outcomes were sad and deeply felt when the two collided with ageing and persons with co-morbidities. The fertility effect of COVID-19 in the short-term on contraception presented itself in increased difficulties in accessing services and disruptions in the supply chain. Migration was mainly affected due to travel bans and restriction of movements through stay-at-home instructions.

**Methods:** This paper uses the qualitative paradigm of research that used corpus construction in the selection of material to represent a whole and this make it functionally equivalent to sampling but structurally different. It used secondary data to ascertain the demographic effects and the extent of health infrastructure deficit and ingenious ways to curb the challenges as exposed by the COVID - 19.

**Results:** The study underscores how demographic factors can be disrupted by pandemics to bring about high rates of mortality. Global health function is under-funded and under-produced, as a study by the World Health Organization suggests.

**Conclusions:** The study brings to bear that anthropogenic activities, air greenhouse gases, lifespan and hospital beds are key drivers of COVID-19 growth. The path forward to mitigate such pandemics is international harmony and alliances in the distribution of vaccines, strengthening of international health systems ability to hold back

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Any reports and responses or comments on the article can be found at the end of the article.

major infectious disease, addressing service quality and providing key financial injection.

### Keywords

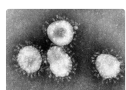
Demographic effects, public health, infrastructure, public health dearth, corona virus and Ghana.



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## Introduction

A mysterious pneumonia was discovered in Wuhan, the capital of Hubei province in China and later brought to the attention of the World Health Organisation on December 31, 2019 in China. [Huang \*et al.\* \(2020\)](#) submits that 41 people with confirmed infections had been admitted to hospitals in China as at January 2020. Officials in Wuhan declared a mainly quarantine measures which brought the case numbers around 80,000 in mid-February 2020 (ECDC 2020). Prior to this juncture, the World Health Organisation had called out the outbreak as a “a global public health emergency” on January 11, 2020, and a pandemic on March 11, 2020. All this while, the aviation industry had been very active due to the new year traditional/cultural festivities of various parts of the world. Thus, the global air travel had spread the virus all over the continents of the world and there were confirmed cases in 146 nations of the world in mid-March. As at 12:39 p.m. CET on March 17, 2021, there have been 120,164,106 confirmed cases of COVID-19 reported to WHO, with 2,660,422 deaths. Also, 363,691,238 vaccination doses had been delivered as of March 16, 2021. There are 88,228 confirmed cases in Ghana, including 698 deaths (Covidtracker.bsg.ox.ac.uk, March 2021). Presently, the Ghana Health Service reports that a total number of 13, 842,945 doses has been administered as at 20<sup>th</sup> April, 2022 ([www.ghs.gov.gh/covid19/](http://www.ghs.gov.gh/covid19/)) out of a total population of 30,823,019 (Ghana 2121 Population and Housing Census Report). This constitutes 45% of the population that has been vaccinated.

The virus had infected 188 countries as of May 13, 2020. At the time, there were no vaccines, drugs and the virus were very adept at quickly mutating and spreading ([Ferguson \*et al.\*, 2020](#); [Imai \*et al.\*, 2020](#)). Almost every country implemented nonpharmaceutical interventions (NPI), such as non- pharmaceutical interventions (NPI) such as restrictions on movements of goods and services, closure of land, sea and air borders except for key essential cargos, closures of all educational facilities at all levels, then work places as well as a ban on all public gatherings including conferences, religious activities and festivals. These were aimed at evening out the epidemiological curvature by cancellation of outdoor events and meetings, orders to the security agencies to enforce confinement at home rules and disruptions/cancellation of domestic and international travels. All these became essential as there was no known vaccine/drugs at the time and the virus had the capacity to multiply swiftly (Ibid). Apparently, this intervention at the superficial level may not seemed “water tight” but a study by [Nussbaumer-Streit \*et al.\* \(2020\)](#) and [Sjödín \*et al.\* \(2020\)](#) asserted that any holistic intervention in such an emergencies control disease. The battle over COVID-19 was country led governed by various socio-economic and political factors pertaining to each country.

The rondure in the last four decades has seen a number of great epidemics, but none have had the same economic impact as the COVID-19 pandemic. The tourism industry has shown resilience to a variety of shocks in the past, but current evidence suggested that the impacts and attempts at recovery from the pandemic will be a herculean task. Throughout the twenty-first century, growing pandemic threats as a result of population explosion, the dawn of an urban millennium (UNFP, 2007); the global chain value of industrialized food production, excessive patronage of processed foods; biophysical drivers such as vegetation, rock and soil type, livestock, military training, and recreational facilities; and biophysical drivers such as vegetation, rock and soil type, livestock, military training, and recreational facilities ([Labonte \*et al.\*, 2011](#); [Pongsiri \*et al.\*, 2009](#)). Recent emerging viruses like Ebola, Marburg, Sars, are all the upshot of anthropogenic influence.

Apart from different public health responses to the pandemic, a variety of climatic, social, and demographic variables reacts to make to make containments efforts difficult. These are pollution, temperature and variabilities of the weather ([Copat \*et al.\*, 2020](#); [Ricc \*et al.\*, 2020](#)), the level of sustainable development in a country, income, and gross domestic product ([Lippi \*et al.\*, 2020](#); [Mukherji, 2020](#)), and population ageing ([Lippi \*et al.\*, 2020](#); [Petretto & Pili, 2020](#)). In terms of meteorological factors, COVID-19 and a delayed in 14-days temperature moved in tandem (positively correlated), but when a 14-day lagged in wind speed occurred, a negative correlation between COVID-19 cases occurred. Moreso, at absolute humidity between ranging from 5–10 g/m<sup>3</sup> range, an increased rate of COVID-19 was detected ([Islam \*et al.\*, 2020](#)). As such, pollutants notably PM<sub>2.5</sub> and NO<sub>2</sub>, but to a lesser amount PM<sub>10</sub> are all triggers of COVID-19 and high rates of mortality ([Copat \*et al.\*, 2020](#)). Economic indicators particularly Gini’s inequality index link with COVID-19 induced death rate ([Mukherji, 2020](#)). Furthermore, COVID-19 death rates have been connected to socioeconomic and health characteristics such as old age, males, ethnic backgrounds, and comorbidities (diabetes, cancer, and other chronic-degenerative illnesses) are all linked to COVID-19 rate of fatality.

These outbreaks have underlined the motivation for governments to establish a resilient system to mitigate health emergencies which has been mostly linked to a weak health system, sluggish emergency response systems, and climate change. The goal is to broaden our infrastructure knowledge base in Ghana’s public health sector, allowing us to better evaluate previous efforts, prioritise current finance needs, and follow future progress.

The paper is part of a qualitative research paradigm in which Corpus Construction was used to select material to represent a whole, making it operationally similar to sampling but structurally different from sampling. To identify the scale of the health infrastructure gap and propose creative solutions to the concerns identified by COVID -19, it relies on secondary sources, primarily archival data, and documentary approaches, primarily document analysis. Aside from this, the demographic effects of the COVID-19 are also assessed and policy prescription are proposed.

### **Espousing literature**

In order to promote health care policy and welfare mechanisms inside a country, health infrastructure is an important indicator. A healthy work force is created by a well-developed health infrastructure, which typically includes specialist doctors, nurses, and paramedical personnel, as well as machinery and a well-developed pharmaceutical sector. World Health Organisation classify a health care system as “all the organisations, institutions, resources, and individuals whose primary goal is to enhance health” (2020). The availability of essential infrastructure is key for the provision of public health service (Public Health Infrastructure, 2020).

Communities to stop the occurrences of diseases, encourage healthy living and plan for and respond to both acute (emergency) and chronic (ongoing) threats to their health. Therefore, infrastructure becomes the spring board to initiate public health planning, delivery evaluation and improvement. All public health programmes- infectious disease surveillance, cancer and asthma prevention, drinking of quality water, immunization etc., rely on health professionals with cross cutting and technical skill, access to modern information equipment and the ability of such professionals to intervene in community needs. The “nerve center” of the health-care system. In the film Turnock, Turnock is a character (2001).

### **System thinking concepts**

This postulates the need to understand an entire system and the significant interplay of all the factors that make up that system in an ever-changing and complex world (Pidwiny, 2006; Checkland, 1981; Von Bertalanffy, 1976). Systems theory had a significant impact on how the world perceives and changes organisational performance (Best, 2007; Atun & Manade, 2006) One of the key instruments of the theory, which is described as a broad science of wholeness (Von Bertalanffy, 1976), is system thinking (Pidwiny, 2006). It aims to assist an individual in viewing systems from a wide perspective, including their structures, patterns, and cycles, rather than focusing on isolated events (Pidwiny, 2006; Atun & Manade, 2006).

Engineering, economics, and ecology are just a few of the domains where systems thinking has been used (Paina & Peters, 2012; Pidwiny, 2006). They have a non-linear relationship with a degree of unpredictability, are generally difficult to change, and solutions can sometimes exacerbate the situation (Best 2007; and Checkland 1981). In recent projects, system thinking has been applied to address some risk factors and health challenges in order to determine its functionality as a system. In the works of Paina and Peters (2012), Diane, Finegood and Carrie (2008) and Best (2007), programmes such as tuberculosis and obesity research and tobacco control are some classic examples. Nevertheless, its application in health infrastructure to a large extent is either immaculate or limited (WHO, 2009). In addition to these are tobacco control, obesity research, and tuberculosis research, to name a handful (Paina and Peters, 2012; Diane, Finegood and Carrie 2008; Best 2007). Its use to health infrastructure on a larger scale is either immaculate or limited (WHO, 2009).

System thinking is able to help identify and resolve health system difficulties as reported by WHO in 2009. The report further endorses it to be a fundamental component that enhances health system or infrastructure. Thus, it should be applied to critical paths in service delivery, financing, governance, information dissemination, workforce in the health sector, medical products and technologies (Paina & Peters 2012; Agyapong, Kodua, Adjei & Adam 2012). This critical paths by these authors ought to be adopted by Ghana Health Service (GHS) to better place it in the event of future pandemics.

### **Theory of health and development**

In 1975, Preston asserted that long-life is a panacea to increased human productivity and has the potential to spur a country (Ghana) into higher Gross Domestic Product (GDP). Going further, he postulated that those born in higher income countries tend to have a longer life span when juxtaposed with their counter parts from poorer regions of the world. The relationship is viewed as causal and levels of income. Otherwise stated, a causal relationship as far as the returns on income is concern will diminish life expectancy. Therefore, the Preston curve shifts upwards as health- care technology improves.

To influence development, Preston adds that a healthier work force means physically and technically, they are more likely to be resilient, active and equip with long life span. To put it in another way, the health of the population is critical for

national economic success. In Ghana as a sub-Saharan African (SSA) country, poor health caused by a high disease burden has a detrimental impact on productivity, education, demography, and finally economic development. For example, economic growth loss according to projections in Africa due to high malaria prevalence is roughly 1% each year. A country's population's poor health can stymie its economic well-being, growth, and development by reducing longevity and increasing disability adjusted life years (DALYS). As a result, a healthy population is key for poverty reduction, economic development, and overall societal expansion (CMH, 2001). As a result, it is critical that every country's health system and infrastructure receive adequate funding.

### Adopting

As COVID-19 persist, it was obvious that global workforce is compelled to work remotely, but at first, it was unclear whether the workforce could complete most jobs remotely without a major reduction in productivity or quality. With what is now the new normal, such as a hybrid workforce and scattered workplace, has been re-calibrated. Thus, the workplace is now split between home, office, and satellite offices. These teams must be virtual-ready, and managers must be able to coach and find innovative means to inspire employees entrusted to them to work from a distance.

With the support of video communications, healthcare, those in educational and financial institution, as well as large, medium and small enterprises all endured while some prospered from the pandemic. This was as a result of utilising video to interact with clients. A hybrid work paradigm emerged with the use of communication technology, working from home while some have maintained the remote working paradigm even after post COVID-19. In a business report of British Broadcasting Company (BBC) on May 2, 2022, a London Law Firm Stephenson Harwood is prepared to allow staff work from home permanently, but the convenience come at a price of 20% less the current salary ([www.bbc.com/news/business-61298394](http://www.bbc.com/news/business-61298394)).

Looking back at the onset of the COVID-19, 37.5% of business began or raised usage of mobile money while a tenth of business (9.0%) commenced or surged their use of the internet for business activities (Brem, Viardot & Nylund, 2021; Naem, 2020).

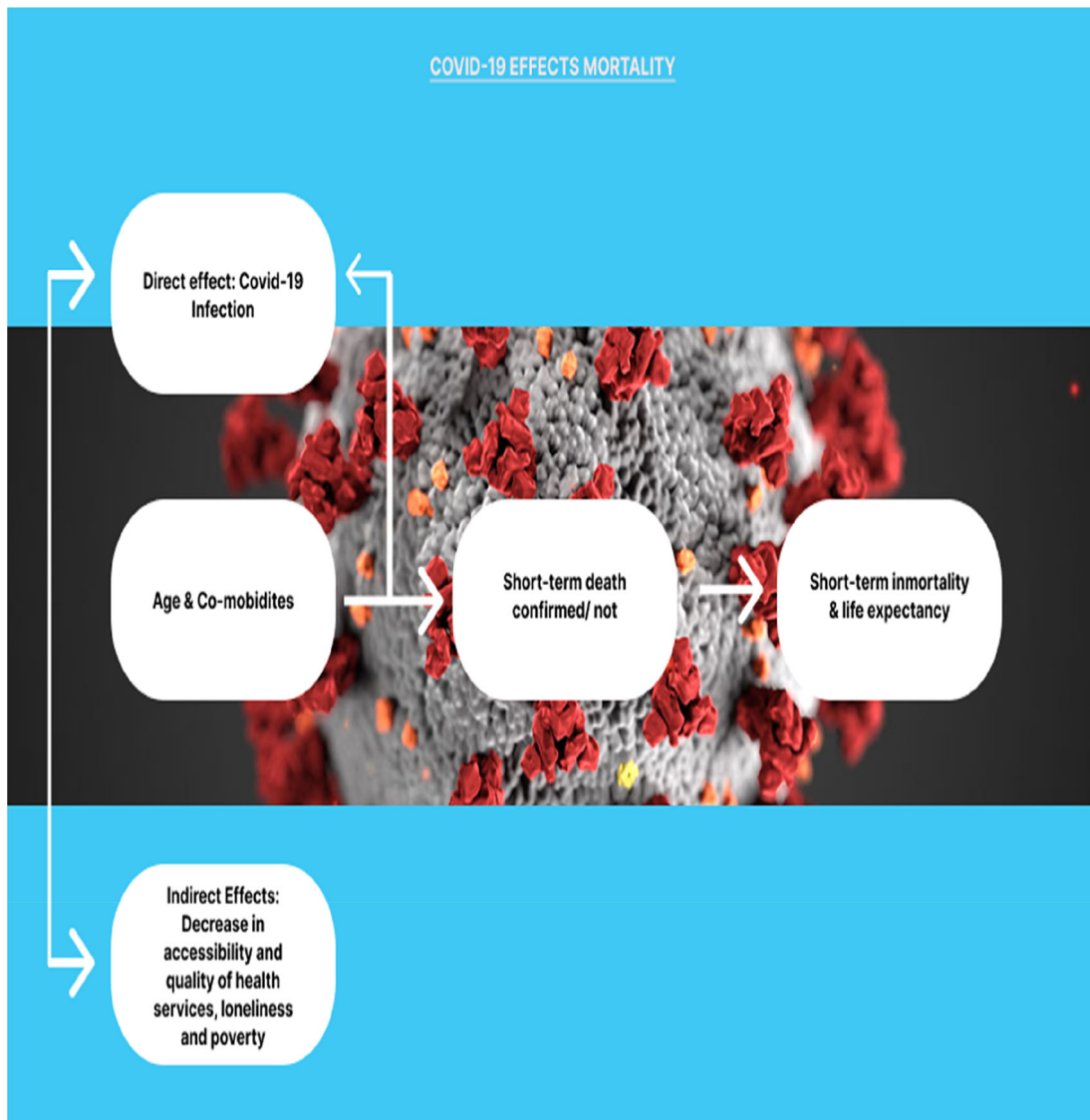
### COVID-19 effects on mortality and health

COVID-19 had a direct impact on the population, as measured by case counts or the number of people infected. The infected person's age and co-morbidities were important factors in survival or long-term disability and fatality, including mental health. The indirect consequences were apparent in health-care accessibility and quality interventions, as well as health-care and old people's rights and long-term care services.

**Impact on older people's health, rights, and long-term care services:** COVID-19 confirmed cases puts the median age at 51 (according to the COVID Intel database as of October 2020). This means death cases of people aged over the age of 80 are five times higher than the global average. In Europe, over 95% deaths related to COVID-19 are those over age 60. Adults aged 60 and up account for nearly 95 percent of COVID-19 induced mortality in Europe while adults aged 65 and up accounted for 80% of deaths in the United States. In China, persons aged 60 and more accounted for nearly 80% of all deaths. For older people, this reality offered a number of direct and indirect obstacles.

**Access to health care:** This was a threatening disease and older people particularly struggled to get medical attention. The other side is that a large chunk of people in poorer regions of the globe lack access to basic health (Lu, Kong & Shelley, 2021), due to underdeveloped health systems. Lockdowns and a focus on COVID-19 appear to have disenfranchised older people and created impediments to their receiving health care for their underlying problems, make them even more vulnerable to COVID-19 (Ibid). Access to medical care for older people with impairments and chronic conditions at the time became more difficult, and some were marginalised. Workforce shortages have hampered the delivery of care and have a direct impact on the elderly, further isolating them. Access to health-care for older people with disabilities and chronic diseases may become more difficult, and they may become more marginalised (Campbell, 2020; Aikins *et al.*, 2021; Dovie, 2021; Boateng *et al.*, 2022).

In the midst of the pandemic, overburdened hospitals were confronted with various dilemmas about decisions on the use of limited resources. Advocates in human rights were concerned that in some situations, the use of ventilators were decided using age or broad assumptions of prevailing underlying Conditions such as dementia, general outcome with respect to survival of patient. This, they argued, flies in the face of triage rules which upholds medical ethics, application of scientific knowledge and the right to consent or refusal, as well as the ability to express their preferences in advance. There are allegations of elderly persons not being given the opportunity to provide consent to medical treatment and other inducement such as being made to sign forms not to be resuscitated under compulsion during this pandemic. See [Figure 1](#).



**Figure 1. COVID-19 effects on mortality.** Source: Author's Construct, 2022.

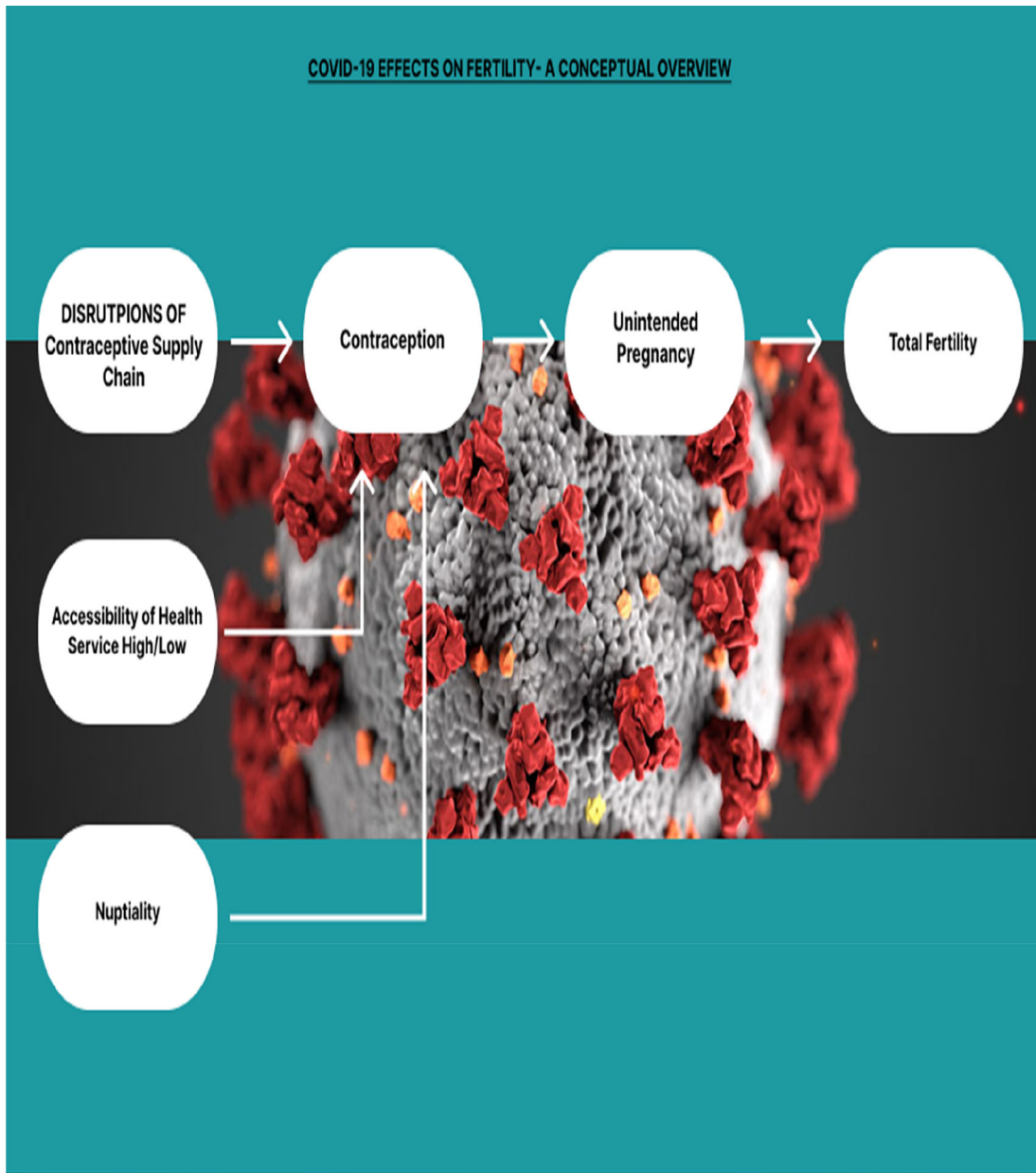
### COVID-19 effects on fertility

COVID-19's influence on contraception will manifest itself in increasing difficulty in getting services and supply chain interruptions in the near and long term. The long-term ramifications of this are currently impossible to predict, however they are changing. Sexual and reproductive health rights (SRHR) may have an impact on fertility and death. Family planning is the second most affected service (WHO, August 2020), and early data from Ghana during the school lockdown showed that adolescent pregnancy rose. Increased fertility or abortions, as well as linked reproductive health issues such as unwanted pregnancy, which is one of the main causes of maternal mortality and morbidity in the world, will be the overall consequence (Singh *et al.*, 2010; Abbasi-Shavazi *et al.*, 2004). As a result, if SRHR coverage drops by 10%, up to 15 million unplanned pregnancies and 3.3 million unsafe abortions could occur (Gutmacher, April 2020).

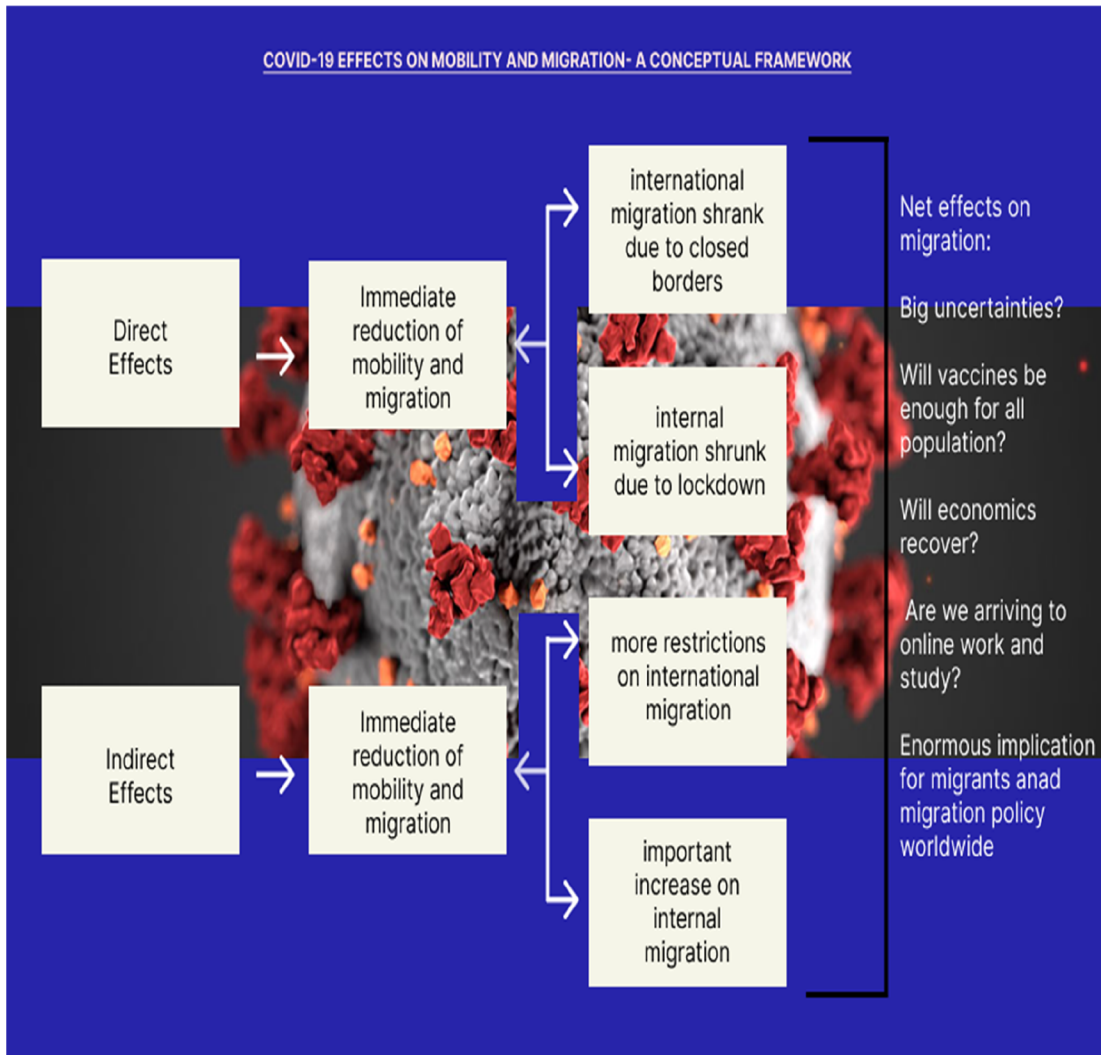
Teenage pregnancy during the COVID-19 lockdown, according to World Vision International, might jeopardize the education of one million African girls (World Vision International, May 2020). During the lockdown in Ghana, the Krachi West district in the Volta region had a nearly nine-fold increase in teen pregnancy, according to the same research. Thus, 51 teenage pregnancies were reported between March and May 2020, compared to only six incidences of teenage pregnancy in 2018. According to data from the Kenyan government, 4,000 adolescent girls attended health institutions for prenatal treatments in Machekos County between January and May 2020. As a result, the national figure might be in the tens of thousands.

On nuptiality and COVID-19, the likely short term could be marriage postponement which may result in decrease fertility. However, over the medium to long term, mortality may remain low due to job losses and bleak world economic outlook for the future of most national economies. In this way, without a return to normalcy at the economic front, fertility may decline, while long period outside school also increase fertility representing an oxymoron for demographers.

In the case of nuptiality and COVID-19, the most likely short-term outcome was marriage postponement, which led to lower fertility. However, due to employment losses and a grim global economic outlook for the foreseeable future of most national economies, mortality remained low in the medium to long- term. In this way, if the economy does not return to normal and drag as we are presently experiencing, fertility may stall or even drop, while long periods outside of school boost fertility at the height of the pandemic which is an oxymoron for demographers. With schools at all level now opened, and adopting various internet platforms to compliment in-person teaching and learning, a gradual reversal of the situation may be on the horizon. See [Figure 2](#).



**Figure 2.** COVID-19 effects on fertility - a conceptual overview. Source: Author's Construct, 2022.



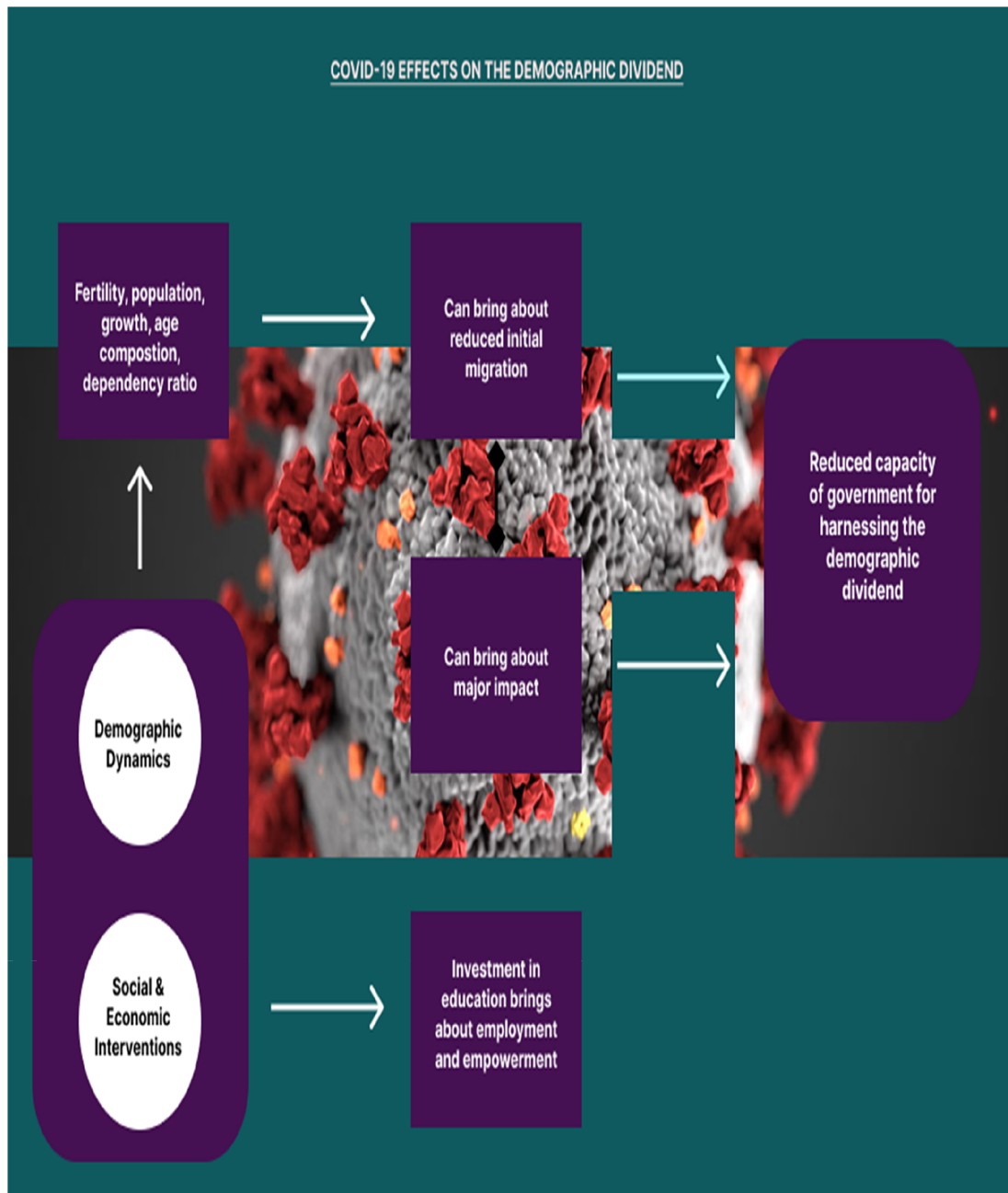
**Figure 3. COVID- 19 effects on mobility and migration - a conceptual overview.** Source: Author’s Construct, 2022.

**COVID-19 effects on mobility and migration**

The main consequences were a decline in mobility and migration, as well as a contraction in economic and social interaction within and between countries. Passengers also decreased in the transportation industry from the on-set to the peak of the pandemic until a gradual return to semblance of normality when vaccines were rolled out. Between March and May, 2020, commuter minibuses were at 70 percent, and intercity buses were at 50 percent capacities. Monthly revenue for Metro-Mass Transport in the Country fell from GH5.5 million to GH2.1 million, according to government estimates. Since March 2020, the Intercity STC Company had lost planned income of GH5.0 million in preceding months, averaging GH3.0 million These among other factors forced most of these institutions to resort to financial institutions to honour their pay roll obligations in their bid to avoid layoffs (Mid - Year Review and Supplementary Estimate, 2020). See [Figure 3](#).

**COVID-19 effects on demographic dividend**

Fertility, population growth, age composition and dependency ration will impact demographic dynamics which could lead to higher fertility and mortality as well as less initial migration. As a result, in order to empower the general public, social and economic interventions in the areas of education and employment are required. This could take the form of a concentration on youth employment, educational support with a focus on the poor, such as Ghana’s free senior high school, technological training, expanded access to family planning, and gender equity policies that promote empowerment and increased work prospects. The first is that investments in family planning and health are critical because they affect Ghanaian youth’s education, employment, labor force participation, and poverty. The second point



**Figure 4. COVID-19 Effects on Demographic Dividend.** Source: Author's Construct, 2022.

is that infrastructure expenditures, such as housing, sanitation, and drinking water, should be prioritized because safe living is a fundamental human right, especially for young people and women. Third, Ghana must prepare for an aging population, which necessitates a greater focus on healthcare, pensions, and elderly care. See [Figure 4](#).

### Discussion

COVID-19 has wreaked havoc on society and businesses around the world in recent months, exposing flaws in medical care infrastructure. Although the epidemic continues to spread over the world, infections have peaked and fallen in some areas. With time, countries have eased social and economic restrictions with the view of achieving recovery.

Demographic, ecological, and communal dynamics all play a role in infection rates of COVID-19. Studies affirmed population of urban axes, air greenhouse gasses, lifespan and clinic beds are key drivers of COVID-19 growth.

In metropolitan clusters of more than 1 million people, the COVID-19 growth rate exhibits a positive association and a considerable effect on population. This is particularly the case for large continents like Americas and Australia. The CDC COVID-19 Response Team, explained it is mostly spread through droplets from respiratory so the plausibility for densely populated areas to experience high transmission (CDC COVID Response Team, 2020). Social distancing is very challenging in densely populated areas so this may explain the high fatality rates from other people becomes more difficult with higher population densities, and contact rates (Rocklöv & Sjödin, 2020). This finding is in consonance with the works of Bhadra *et al.* (2021) and Kadi and Khelifaoui (2020) that indicated a moderate relationship between population density and COVID-19 dissemination (Rader *et al.*, 2020). Other research, on the other hand, were unable to duplicate these findings, instead finding an inverse (Hamidi *et al.*, 2020) or no connection (Carozzi *et al.*, 2020).

There are fewer urban clusters in Ghana with a population density as at 2019 being 134 people per km<sup>2</sup> (346 people per mi<sup>2</sup>), computed on 227,540 km<sup>2</sup> (87,854 sq.miles) (Worldometer). This could perhaps explain why the Government could better managed the rate of infections which stands at 161,124 as at April 25, 2020 with the total fatality of 1,445 as at April 25, 2022

Air pollution has a positive relationship with growth rate and has a major impact on it. The transmission of COVID-19 is aided by air pollution. Pollutants can operate as a virus carrier, spreading the infection over a distance of 2 meters (Sharma & Balyan, 2020). Particular places having a high concentration of air pollution, like India, China, Italy, Russia, Chile, and Qatar have reported increased fatality cases, when compared with areas per lower levels of pollution (Paital & Agrawal, 2020). Ghana is not an even a moderately industrialised country as industry contributes to 29.74% of our Gross National Product (GNP) (www.statista.com). This could perhaps also explain the low rate of infections compared to others in the sub region and Africa as a whole.

At the time, the growing rate of COVID-19 had a promising link and a significant effect on life expectancy. This can be explained when comparing high-income and low-income countries. Despite the fact that high-income countries have longer life expectancies, their populations are aging, with many more persons over 70 (Schellekens & Sourrouille, 2020). Elderly adults are affected by a greater septicity and fatality rate (Chen *et al.*, 2020), but younger folks, on the other hand, have milder symptoms and may even have a quiet infection (Chen *et al.*, 2020; Velavan & Meyer, 2020). A new meta-analysis of almost half a million COVID-19 cases from various nations (China, Italy, Spain, the United Kingdom, and New York State, USA) demonstrated the impact of age on death, finding the key age as larger than 50 years and, in particular, greater than 60 years. This is consistent with our findings, which reveal a positive relationship between life expectancy and COVID-19 increase rate, particularly in North America, Europe, China, and Australia. The propagation of the virus, on the other hand, is projected to adversely effect on lifespan, reversing the materialistic upward trend (Marois *et al.*, 2020).

Again, Ghana and indeed the whole African continent has a youthful population. Indeed, the new census in Ghana project the youthful population to be 37.13% Which is 114,479, 29 of the total population of 30,832,019 (www.statista.com).

Quantity of available hospital beds has a considerable impact on COVID-19 growth rate and is also strongly associated. On the one hand, countries with more beds for every hospital experienced a reduced amount of burden and tension, necessitating the implementation of more radical and stringent procedures. On the other side, it has been demonstrated that having additional hospital beds as well as extra health-care means easily accessible helped COVID-19 spread faster. This may also result in a drop in care quality, resulting in insufficiency means of opportunity for ventilators cases of infection usage and upward trend in the cases of infection (Li *et al.*, 2020). In areas like Russia, Australia, North America and China, this might explain why the death tools were high as the hospital infrastructure got overwhelmed. This is consistent with a study undertaken in the United States (Karaca-Mandic *et al.*, 2020), which found that a surge in patients who were cared for in the non-intensive care unit (ICU) bed use greatly increased COVID-19 mortality. In Ghana, efforts were made to established more centers, the country was just fortunate the numbers were somehow under controlled else a public health catastrophe would have emerged.

One key priority area for rebuilding is the need to strengthen Ghana's health care infrastructure by the Government of Ghana. Admittedly, the COVID-19 pandemic exposed the fault lines of global health systems. Thus, for a robust and resilient recovery to be achieved, intercontinental improvements in health systems cannot be ruled out particularly when it comes to investing in global public goods.

## Global public goods in health

### Lexicon

Public goods meet critical societal needs and play a critical role in ensuring its security. However, because of the "free rider" dilemma, profit-seeking private enterprises are unable to produce them. Furthermore, compared to individual

consumers, public products have beneficial "spill-over effects" that does not translate to market value. Due to this, the market has historically underproduced public goods, the Ghanaian government must assume responsibility for supplying them domestically.

On a global scale, the international propagation of the coronavirus produced consequences by way of state reaction to the pandemic which highlight the value of universal mode of interaction of interaction between countries and coordination. This could take the shape of multiple frontier roles or involvements that aid in the advancement of health, but it has received little attention. Virus surveillance and control, infectious disease centers, research into illness causes and treatments, local vaccine production, giving out information, outbreak readiness and principles and procedures are just a few examples.

### Global health functions are critical, yet they are underfunded and underproduced

In today's global community, health hazards and diseases can spread across national borders, with substantial health, social, and economic consequences. As proven by the present epidemic and previous health catastrophes, it is possible that national health capacities and measures are insufficient. Kaki (2004) underscored the relevance of the interplay of endogenous as well as exogenous structures. "On the endogenous level, state agencies alone are not capable of bringing about economic growth and political change. On the exogenous level, historically and currently established relations of interdependence bind national systems with supranational systems. Interdependence . . . significantly shapes the course of a nation's development experience" (Kaki, 2004:29). Therefore, global health interventions address crucial needs that cut across countries and brings about societal benefits to all. At the height of the Ebola outbreak in West Africa in 2014-2016, the problem of underinvestment in global well-being of health was highlighted. Generally, there was a state of being without test kits, treatment, or vaccines, as well as inadequate surveillance and preparedness procedures (Yamey and others, 2019). The situation at the time revealed the woefully unprepared nature of all countries to effectively handle competently epidemics and pandemics, as well as other significant public emergency health issues which will inevitably arise as a result of climate change in the future.

The international reaction to COVID-19 was besieged with years of under-funding in the global public health system. According to research (Schäfer and others, 2019), 25% of the fund's donors gave go into the areas of health of the population in the worldwide context. In 2017, there was \$24 billion in donor financing for health out of which \$7 billion (about 25%) went into areas of health of the population. Some authors point out a further need of \$9.5 billion per year extra funding (Yamey and others, 2019). When compared to the scale of the COVID-19, such estimations are small when compared to the effects of challenging global health emergencies. Preceding to the COVID-19, a study projected annual losses from pandemic risk at \$500 billion, or 0.6 percent of global revenue (Fan, Jamison and Summers, 2018). The IMF predicted a worldwide GDP fall of 4.9 percent in 2020, whereas UN (2020) estimations suggested output losses of \$8.5 trillion in 2020 and 2021, wiping out the previous four years' gains and resulting in 2,660,422 fatalities as of March 17, 2021.

COVID-19, as well as previous epidemics, clearly demonstrate the necessity for global public health goods. To limit outbreaks across borders, this should include comprehensive surveillance and preparedness mechanisms. Furthermore, inter-country cooperation and resource mobilization will be facilitated through the African Center for Disease Control, the European Center for Disease Control, and the United States Center for Disease Control will make inter-country cooperation and resource mobilisation easier. When epidemics strike, this will drastically minimise the time it takes for international response measures to be implemented. As particular countries are not generating them alone, global knowledge sharing and research resources will bridge treatment disparities, and economies of scale will lower costs. These public goods will serve to augment national public health systems in combating infections and meliorating the general physical, social and mental well-being of people and so contributing to the achievement of SDG 3 on health.

### The path forward is based on international harmony and multi-alliances

On February 17, 2021, the World Health Organization (WHO) held an African Health Ministers Conference to mark the transition from planned to action in the introduction of COVID-19 vaccinations. This was in anticipation of a rapid vaccination release for emergency usage of two versions of the AstraZeneca-Oxford COVID-19 vaccine. An independent regional review committee approved vaccinations from 190 participating economies, of which 35 are from African. The framework applied in accessing the vaccines was developed by WHO with GAVI as a Co-Leader to COVAX. Others were the Vaccine Alliance, and the Coalition for Epidemic Preparedness Innovations who provided fair access to COVID-19 vaccines.

Though an excellent long-term global public goods effort and after the Ebola epidemic, foreign donor money for global health functions soared but was not sustained (Schäfer and others, 2019). This trap should be avoided, and long-term

financing arrangements must be established. As the Decade of Action for achieving the SDGs for everyone gains traction, more investment is needed in this direction.

By its mandate, the WHO should act as a springboard for countries to collaborate, coordinate, and manage the world's health system's future in order to foster direction and stewardship that will result in information exchange, which is crucial to defeating COVID-19. To have an integral global community, more state actors and intergovernmental organizations, the scientific community, the corporate sector, and civil society, should all be marshalled in research and production. For this reason, most of us may be unaware of the availability of global public goods in health. The impact of its non-availability is felt particularly during crisis periods. COVID-19 can be defeated by a united world, restoring normalcy and preparing the world to be more resistant to viruses and epidemics.

### Closing the infrastructure dearth in public health in Ghana

Weak health system capacity, ambulance services, as well as clinical and public health critical care facility, quality issues in service delivery, financing health sector, health workforce management, low number of health centers/inadequate number of infectious disease centers, blood safety at blood banks, health-care concentration in cities and non-availability are all areas of health infrastructure that need to be improved.

### International health systems' ability to hold back the pandemic

The nature of the fragile health units that previously held back major infectious diseases like cholera and Ebola showed that Africa, and indeed Ghana are vulnerable. Accessibility to hospitals is also a problem. [Table 1](#) displays available hospital beds in 1000 population in seven African nations with the most COVID19 cases as of May 29, 2020. An overview of the bed-to-population ratio can be found elsewhere.

Notwithstanding this, the United States had 34 intensive care units (ICUs) per 100,000 inhabitants yet it suffered. Since there were no particular treatments for COVID19 then, the current standard of care was supportive care. If a patient suffered respiratory distress, this involves antipyretics, hydration, and ventilator assistance.

Most African countries that were severely afflicted by the virus had already faced a shortage of ventilators. One of the main causes of the ventilator shortage was problems with the worldwide supply chain. Exports of medical equipment, particularly ventilators, were halted because all manufacturing countries were battling the COVID-19 intensively and were not prepared for exports of ventilators. This peaked in March, 2020 where 54 countries had ceased the exploration of ventilators. Simply put, given the rising infection rate at the time, health-care systems in African nations lacked the ability to contain a pandemic. See [Table 1](#).

### Ambulance service, as well as clinical and public health emergency services

In Ghana, medical emergency care is in short supply. In 2015, there were 214 operational ambulances, with 300 expected by 2017. The service's expected response time is 50 minutes, however, this may differ depending on the area. In 2015, around 5000 patients/casualties were treated. Pandemics and large epidemics such as avian and pandemic influenzas, cholera, and Ebola have all been seen around the world over the years.

**Table 1.** As of April 24, 2022, the number of hospital beds per 1,000 persons in seven African countries with the highest number of Covid19 cases.

Country	Number of hospital beds/1000 people	Number of COVID-19 cases	Number of COVID-19 deaths	Total, vaccine doses administered per 100 people
South	2.30	3,750,830	100,276	56.33
Ethiopia	0.33	470,389	7,510	25.58
Reunion	-	374,295	742	-
Kenya	1.40	323,634	5,649	32.98
Zambia	2.00	318,984	3,974	18.41
Botswana	1.80	305,859	2,688	107.04
Algeria	1.90	265,754	6,874	-
Nigeria	0.50	255,679	3,143	16.46

Sources: COVID 19 Intel database; [Worldbank.org/Indicator/SH.MED.BEDS.ZS](https://www.worldbank.org/indicator/SH.MED.BEDS.ZS), Accessed on April 24, 2022.

Globalisation, deplorable hygiene and veterinary practices, outmoded surveillance technology for early detection, confirmation, and reaction, and an already overstretched health systems coping with other widespread diseases are all contributing to its gravity and diffusion in poorer nations. The Ghanaian government purchased 307 new ambulances for the Ministry of Health in 2019, yet this was grossly inadequate.

The government's purchase and subsequent deployment of 307 additional ambulances to the country's previously deficient National Ambulance Service has improved emergency medical services. Hence, the fact that the total number of operational public ambulances has increased from 50 to 357 in the last few years, representing a 600% increase. The government's action has also pushed Ghana closer to meeting the world's requirement for ambulance-to-population ratio. According to WHO, every country's ambulance to population ratio must be at least 1:50,000 for effective emergency care delivery. Thus, for every 50,000 people in a nation should be serviced by one ambulance for their emergency situations.

In time past, population-to-ambulance ratio in Ghana was 1:524,000, with only 50 ambulances. The ratio has improved substantially with the deployment of the 307 new ambulances, to 1:84,000. To achieve WHO requirements, Ghana, with a population of little over 30 million people, requires 600 operable ambulances. The coming of the extra 307 ambulances to add to the status quo of 50 fleet presupposes the current government requires 243 more ambulances to meet the WHO requirement ([www.abcnewsgh.com](http://www.abcnewsgh.com)).

As the COVID-19 disruptions have shown, emergency medical services that provide the first line of response to urgent healthcare requirements within a community are critical. Emergency care should be a top priority for the Ghanaian government, and it should be incorporated into the development of public health systems. In order to organize emergency care services, a system approach with interconnected components must be used. Pre-hospital care, transportation, and hospital treatment should all be included. Ghana's district hospitals are ideally positioned to organize these services in a synchronized fashion. Following that, a foundation for an urgent reaction structure must be built.

### Issues with service delivery quality

There is a distinction to be made between medical and overall quality of service. The former refers to aspects of the healthcare system that result in an improved result, such as surgical expertise, drug availability, logistics, and other factors. On the other hand, the latter refers to a variety of factors that influence patients' experiences and satisfaction, including hospital comfort, physician assistance, waiting time, appointments, and visits, as well as the facility's physical surroundings. It is critical for healthcare executives to continually assess the factors that influence patient satisfaction with the quality of care they receive in order to understand what patients value, how they perceive quality of care, and where, when, and how service changes and improvement can be implemented (Ford, Bach, & Fottler, 1997; Raposo, Alves, & Duarte, 2009).

### Financing the health sector

In order to improve health outcomes, it is necessary to support appropriate, sustainable, equitable, and effective health financing. The "role of a health system dealing with the mobilisation, accumulation, and allocation of money to cover the health demands of the people, individually and collectively, in the health system" is referred to as health financing (WHO, 2005). With the introduction of COVID-19, it is now more important than ever to provide the correct financial stimulus for suppliers while putting in organising structures to make everyone easily access medical care." Raising revenue, risk pooling, and purchasing are the three major roles of health financing proposed by the World Health Organisation (WHO). See [Table 2](#).

**Table 2. Areas of financing in health systems.**

Function	Aims
Increasing income	To furnish clients with a key set of needed solutions that will improve health outcomes while also ensuring financial security and customer satisfaction, raise sufficient and maintain revenues at acceptable levels in a productive and productive manner.
Sharing of risks	Manage revenue to create more equal and efficient insurance pools.
Purchasing	Ascertain that health-care services are purchased in an economical and studiously productive manner.

Source: Adopted from [Gorret and Schieber \(2006\)](#).

Ghana must pay particular attention to efficiently executing the three health financing functions, particularly in the aftermath of COVID-19 disruptions and setbacks, in order to achieve the fundamental goals of enhancing health outcomes, maintaining financial security, and responding to customers in a fair, efficient, and long-term manner.

### **Health workforce management**

Health workforce management is an integral component of the health-care system. Human resources, including their number, professional competence, skill mix, and incentive, are essential to Ghana's health-care sector's ability to function and provide the essential healthcare services to achieve the best possible health outcomes.

In terms of both quantity and quality, the Ghanaian government must invest in health worker training and specialisation. According to some studies, surgeons play a less role in influencing how treatment prescriptions and drugs are used and the general consumption of healthcare resources (Appiah-Denkyira, Herbst, Soucat, Lemiere, & Saleh, 2013; [World Health Organisation, 2016a](#); and [World Health Organisation \(human resources for health observer, 17\) 2016b](#)). Their official and informal functions create an enabling atmosphere that improves health-care practices and performance.

Other research on health-care system performance and clinical governance (Appiah-Denkyira *et al.*, 2013; Andersen, Davidson, & Baumeister, 2007; Nyoni & Gedik, 2012), highlights the need of good clinical management in driving improvement efforts and initiatives. As a result, there is a favorable association between hospital performance and medical specialists taking on job that is not directly related to patient care, as this will result in executive board cooperation. Even while the medical profession has a special standing, it is also crucial to remember that when other professionals' leadership is included in the decision-making process, health systems generally improve.

COVID-19 demonstrated once again how important it is for the government of Ghana to spend more in the training of physicians, paramedics, and other caregivers who worked on the front lines during the disturbances.

### **Low number of health centres/inadequate number of infectious disease centre**

In response to the COVID-19 epidemic, a new 100-bed hospital in Accra, Ghana's Infectious Disease Center (GIDC), was established. The GIDC will provide critical healthcare services to residents of Ghana's capital as the country's first infectious disease center. The urgent necessity for an infectious disease center at the height of global spikes in the pandemic resulted in the hospital being completed in a record span of 100 days. To make patient recovery as satisfying as possible, almost 700 square meters of water-efficient landscaping were built around the hospital. To reduce the hospital's utility expenses, measures such as insulation, energy-saving lighting, and low-flow plumbing fixtures were implemented.

Incorporating the green features' operating savings allowed for a straightforward payback period of less than a year. The Ghana COVID-19 Business Sector Fund, a private sector-led initiative aimed to promptly react to the agony and suffering caused by the COVID-19 pandemic, established the GIDC. The GIDC final EDGE certification has been issued by Think step-SGS. The project was completed within three months and commissioned in July, 2020 which costed USD 7.5 million (<https://ghanacovid19fund.com>). To achieve this crucial national task, the Ghana Armed Forces, the Architectural Institute of Ghana, the Institute of Engineers, and all other related professionals, as well as Corporate Ghana, should all be marshalled once more. The Ghanaian government should build similar facilities in the Western, Ashanti, and Northern regions of the country, with the goal of completing them by 2023.

The government has already expressed its willingness to construct 110 new district hospitals with the introduction of six new regions, bringing the total number of regions to 16. When fully implemented, this will vastly improve the health sector's infrastructure, allowing it to better satisfy Ghanaians' health requirements while also improving the management of future epidemics and pandemics.

### **Blood safety at blood banks**

As a result of the country's general lack of financial resources, this area of Ghana's health infrastructure is suffering. Again, in many countries, including Ghana, a high prevalence of transfusion transmissible illnesses, a lack of quality systems, and a significant reliance on family/replacement donations create ongoing issues that threaten the sustainability of national blood programs (Chigurupati, & Murthy, 2015; Tagny, Mbanya, Tapko, & Lefrère, 2008; Adjei, Kuma, Tettey, Ayeh-Kumi, Opintan, Apeagyei, & Narter-Olaga, 2009; Mohammed & Essel, 2018). For transfusion safety, Ghana needs increase vigilance and surveillance measures.

### **Remove obstacles and allow immediate access to research results and local production of urgently needed vaccines**

Vaccination against COVID-19 is progressing across Africa, despite the continent obtaining immunizations later and in smaller amounts, with more than 7 million doses delivered so far than other parts of the world (African Centre for Disease

Control, 2021). South Africa, Tunisia, Egypt, Senegal and Morocco. are the five African countries that produce vaccines. Most local enterprises focus entirely on packaging and labeling, therefore upstream production is extremely limited. Because immediate facilities cannot be adjusted for large-scale production through strategic partnerships, the COVID-19 disruptions had exposed the constraints in vaccine availability during disease emergencies. As a result, it is critical that vaccine makers in Africa shape supply chains in order to export their goods to new markets.

In 2014, a five-year clinical trial on malaria vaccine ended with seven nations where nearly 2,500 Ghanaian adolescents took part in facilities at Agogo and Kintampo. Participants were drawn from the Ghana Health Service Kintampo Health Research Centre, Agogo Presbyterian Hospital and The School of Medical Sciences at Kwame Nkrumah University of Science & Technology. This vaccine is a watershed occasion in Ghana's history where eventually malaria will be curbed and eradicated.

The School of Medical Sciences at Kwame Nkrumah University of Science and Technology, Agogo Presbyterian Hospital, and the Ghana Health Service's Kintampo Health Research Centre were among the participants. The release of a malaria vaccine in Ghana will be a watershed moment in history, indicating the path to a future where malaria will be curbed and eventually eradicated.

Similarly, Sibiri, Zankawah, and Prah (2020) highlighted Ghana's scientific and technological advances during the peak of the pandemic. Despite a severe lack of healthcare and scientific facilities, Ghanaian scientists were among the first to decode the novel coronavirus genome in Africa (SARS-CoV-2). Some of the well-known laboratories in Ghana's Universities were at the forefront of the fight and developed some novel testing procedures that allowed the country to test at a larger scale per million than its peers in Africa. Other auxiliaries used were drones for delivery of samples for testing at designated laboratories. Rapid test kits, ventilators and solar powered hand- washing machines were created by local scientists and developers.

The country's laboratories, which are at the forefront of the fight, had also developed some novel testing procedures that allowed the country to test on a far larger scale per million than the rest of Africa. Drones were also used to deliver samples to the laboratory for testing. Local scientists and developers created rapid diagnostic test kits, ventilators, and solar-powered hand-washing machines.

Vaccine production is complicated, and it necessitates significant financial investments as well as a long-term strategy. Ghana must begin with the objective in mind, concentrating on the African vaccine market and the present procurement and distribution of vaccinations. Prioritize concerns like creative funding, enabling local and regional regulatory authority to ensure quality. This must be laced with skills development, technical transfer, product development and collaborations. A good manufacturing etiquette and standard facility designs are important as well.

### **COVID-19 is speeding up the digital transformation process**

Government-imposed lockdowns and confinement measures to combat the virus. COVID-19's spread is hastening the rate of information and communications technology (ICT) advances. According to recent projections, the number of employees working remotely throughout the world would double by 2021 (Chavez-Dreyfuss, 2020). People are increasingly turning to the internet to work, interact, socialise, consume, and find pleasure resulting in an increase in Internet traffic (OECD, 2020).

Companies and industries have responded by speeding up the digitisation of their product portfolios, basic internal operations (McKinsey, Sneader & Sternfels, 2020). Business registration, tax filing, birth certificates, and other forms of identification are among the services that national and municipal governments are expanding their online offerings (UNDESA, 2020b).

Rapid technological change that is not accompanied by sustainable development exacerbates existing inequities while also introducing new ones. As a result, as stated by Heads of State and Government in the Declaration on the 75th Anniversary of the United States, adopted on September 21, 2020, all nations should prioritise a vision for future digitised collaboration. Given the increased reliance on digital tools for wealth and connectedness in our society, only a shared vision for a digital world that is secure, open, and free can unleash technology's full potential and address concerns about digital trust and security. As Ghana emerges from the COVID-19 crisis, closing the digital divide will be key to resuscitate socio-economic activities.

To bridge the digital divide, all must ensure that everyone has affordable Internet access by 2030. The government must proactively promote access to ICT infrastructure especially in all second and tertiary cycles educational institutions,

use technology transfer to make it affordable and improve digital skill and literacy and raise awareness of the advantages of being online. Again, this process will provide the government with a once-in-a-lifetime opportunity to combine all of the various cards currently in circulation, such as the Driver's License, Health Insurance Card, Social Security and National Insurance Trust Card (SSNIT), Voter's Identity Card, and Tax Identification Card (TIN), into The Ghana Identity Card, thereby expanding the country's tax net. This process has commenced and is ending in June 2022 where non-compliant citizens cannot transact banking business, purchase land, acquired driving license or passport or indeed register any movable or immovable property in once name as well the exercise of franchise.

Women, elderly people, people with debilities, displaced people, and native peoples, among other disadvantaged as well as marginalised groups, require specific and varied efforts to achieve digital inclusion. Recognising and reforming discriminatory stratagem and practices, as well as a general sensitization of the digital divide and contesting labels in the digital realm by presenting extra inspiring images of women, elderly persons, and other exploited groups are among them. National broadband plans that cater for women, educating people to close the digital skills gap and building gender-friendly training venues are all examples of policies that are specifically aimed to close gender disparities.

Nevertheless, digital inclusion can never be ascribed as the "magic bullet" in the crusade to eradicate poverty and inequality, rather it is at the nerve of the process. As a result, digital inclusion is at the heart of Member States' resolve to ensuring that, as the 2030 Agenda is implemented, no one is left behind and to facilitate a socially just evolution to a more comprehensive, impartial, robust, and sustainable future for all.

### **Future health and demographic implications**

In national and local emergency response activities, such as infectious disease outbreaks, hospitals and other healthcare facilities are critical. Therefore, the Ghana Health Service must ensure and enforce the undernoted key issues. Firstly, that there is an effective management in place in all hospitals, infection prevention and control policies, a communication plan, human resources policy that is actively being carried out, logistical support being available in sufficient quantities. There must also be the availability of the undernoted facilities such as hospital pharmacy, laboratory, concurrent emergencies, essential support services, continuity of essential care services, psychological and social support services, patient management and surge capacity.

The future demographic implication is mirrored by the demographic dividend- the potential for economic growth when an age structure shifts from young people with large families to older people with small families. The shift in age distribution, brings about less investments in younger age groups that gives opportunity to move resources to the "economic gift."

It indicates a faster growing working population than non-economic active population that it serves, allowing for higher economic growth and improved family well-being. In theory, this transformation can result in higher per capita incomes and better living standards for families at the household levels, but may create standards of living and per capita incomes at the macro level. This can result in major advances in a country's economic progress. The advantages usually fall into four categories: labor supply, human capital, and economic growth.

The economy can absorb and employ more individuals in terms of labour supply and women will have the chance to work outside their immediate home. As a result, personal savings rise and can be used to drive the economy. Reduced general fertility rates make women healthier and reduce domestic economic stressors. Parents can invest more resources per child, improving health and educational outcomes. Finally, a reduced dependency ratio can stimulate economic growth.

However, there may be some concomitants to reaching the demographic rewards. To achieve the dividend, these are normally predicated on the implementation of proper social, political, and economic policies. This means that, in addition to entering a period of decreased fertility. Therefore, demographic advantages inure to countries that have implemented policies and programmes especially in family planning, reproductive health, quality education, job creation and opportunities, investments in girls and women as well as good governance.

### **Conclusion**

In the end, the demographic dividend's benefits are not automatic. Reduced fertility is not a guarantee of prosperity in and of itself. The size of the demographic dividend is thus determined by the rate of fertility decline and population increase, the ability to profitably employ the extra people, and the nature of Ghana's political, economic, and social reforms.

COVID-19 has demonstrated that state agencies cannot bring about economic growth and political transformation on their own. Established interdependence binds national systems with supranational systems, both historically and lately, to ensure that global health interventions meet critical needs that cut across countries and provide social benefits to all.

The COVID-19 outages have underlined the need of emergency services, particularly in providing first-line responses to critical healthcare requirements at all levels of society. It is recommended that Ghana's government prioritizes emergency care requirements and plans for them as an integral part of public health system planning.

Pre-hospital care, transportation, and hospital treatment should all be included. District hospitals are in a unique position to organize these services in a synchronized fashion. Furthermore, it is critical to concentrate on executing the three health funding tasks in order to respond to future disruptions in an equitable, efficient, and long-term manner. Health infrastructure, such as well-equipped medical facilities, a well-trained workforce, regulatory capacity to ensure quality, technology transfers through the use of digital applications, and collaboration with the private sector, will help prepare the groundwork for more comprehensive robust, and viable healthcare systems in the future.

### **Ethics approval and consent to participate**

Not applicable as this was mainly a documentary study.

### **Data availability**

All data/articles underlying the work are available from the following sources.

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Version 1

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? **Osamah Shihab Albahri** 

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This paper uses the qualitative paradigm of research that used corpus construction in the selection of material to represent a whole and this makes it functionally equivalent to sampling but structurally different. It used secondary data to ascertain the demographic effects and the extent of health infrastructure deficit and ingenious ways to curb the challenges as exposed by COVID-19. Some limitations were found, as follows:

1. The abstract is not clear. re-write it considering the context, challenges, aim, method, results and implications.
2. Add research questions.
3. Novelty and contribution should be clarified.
4. Motivation behind the work should be discussed.
5. More discussion is essential.
6. Comparison analysis with more articles should be discussed.
7. Limitations and future directions should be highlighted.

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**

Partly

**Are all the source data underlying the results available to ensure full reproducibility?**

No source data required

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** AI, Decision science, medical informatics, etc.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

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