Mathematics as an important tool in managing human health: implication on COVID-19 outbreak

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A R T I C L E   I N F O

A B S T R A C T

Mathematics plays a crucial role in human lives in terms of calculation with the use of numbers and different operations. Human health needs proper attention and error-free calculations. It is imperative for the people in the health sector to have the knowledge and skills required by the health workers based on a different area to carry out the job properly. The application of various skills in Mathematics is needed during the outbreak of any strange disease to protect people's lives and reduce the rapid spread of such disease. In this article, the history of the past pandemic, and COVID-19 were discussed. The Post COVID-19, and the skills needed were explained. The roles of Mathematics knowledge in the COVID-19 were highlighted, and the roles of Mathematics knowledge and skills in the Health sector were explained. It was therefore concluded, that, Mathematics serves as an important tool in health, and the health workers must possess basic knowledge of the skills required in different health fields. It was recommended that the healthcare professionals must undergo in-service training in the required Mathematics skills relevant to their specific area of specialization to avoid the error that can increase the mortality rate. Regular training is needed in the technology used to carry out successfully the test and practical aspects of their work with zero or minimal error.

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1. INTRODUCTION

The pandemic issue is not new in the system of the whole world, the issue is as old as the world and anytime there is an outbreak of a strange disease such as Coronavirus the recent pandemic, it always claims so many lives before the discovery of the measure. Such pandemic includes Plague of Justinian 541-542 A.D, The Black Death 1347-1351, The Spanish Flu 1918, Ebola 1976, and Ebola 2014-2016 outbreak. The recent outbreak of such pandemic refers to as COVID -19 or Coronavirus emerged from Wuhan in China in December 2019 affects and still affecting the whole world and put everything in life to stand still. Its effect is not on health issues only, it affected the economy, education, social life, business of every individual. The spread of this disease was rapid being an infectious disease that can quickly spread with social interaction in society. People were panic, the spread was so rapid leading to isolation and

increasing the mortality and untimely death of the victims. The movement was restricted throughout the whole world it was a global tragedy, there was curfew everywhere especially in Nigeria, with no interstate movement for some months due to the virus effect. The outbreak paralyzed virtually everything even when the virus disappears its effect will remain for a long period. Some people lost their jobs because most of the works were done online at home without reporting in the office which requires less individual workers, majority of the companies reduced their mode of operation by closing up most of the stations since realized that the job carried out by majority can easily be done on the internet by few workers at home. There is no decision on this arrangement that does not need calculation skills in Mathematics.

Mathematics skills in terms of calculation, measurement (distance, time, and temperature), addition, subtraction, multiplication, division, percentages played an unlimited role during the outbreak of this recent COVID-19 pandemic. Invariably, Mathematics skills play a substantial role in knowing the numbers of individuals and the percentage of population affected. It is the measurement skills in Mathematics that were used to determine the limit of social distancing as about 2 meters being the extent to which the micro-organism can travel. The spread of the virus or how the virus multiplies within the short period if get in contact with the carrier through the number of places visited and the number of people present in the occasion, the close relatives or those living with the attendees can be determine using different mathematical skills including multiplication.

The incubation period of the virus which requires fourteen days quarantine as calculated with the isolation of an individual to know whether the person has the virus or not cannot be determined without calculation and the use of the number. The lockdown period for each country and state can be determined through calculation which could be extended if the initial number of days is not enough. It does not matter whether literate or illiterate, Mathematics students, or not before the skills can be used, it is useful in every individual's life. The number of time to wash hands, how long to use the face mask which might reduce the intake of oxygen that can probably reduce oxygen in the brain and course weakness which can even lead to death, and other precautions can also be obtained using a mathematical calculation.

One can easily see perpetually that Mathematics is everywhere including the health sector without which nothing can be done without the use and application of its skills regularly. American Psychological Association (2020) averred that the COVID -19 research shows that the pandemic has increased the psychological distress of the general population including those that at high risk. High or low risk is being determined through measurement and addition. Among those at high risk include the medical practitioners, and generally the health workers which include Doctors, Nurses, Pharmacists, Administrative staff, Technologists and Technicians, and Therapists.

2. METHOD

In this study, researchers used a literature review. The objectives of this paper include: to explain the history of the past pandemic, the Post COVID -19 Era, highlight the roles of Mathematics knowledge in the COVID -19 pandemic, and the roles of Mathematics knowledge in the Health Sector, Explain Mathematics Skills in health

3. RESULTS AND DISCUSSION

Pandemics History

Pandemics are occurrences that play major roles in shaping history, though rare, they have always existed. Some people experience it in their lifetime, others do not, but presently, we are

experiencing one and hoping we survive to tell our individual stories and share the lessons learned. The World Health Organization defined a pandemic as the spread of a new disease worldwide (WHO, 2020). The article seeks to go back in time on the history of what pandemic was, discuss the experience from our current state, and highlight evidenced-based predictions on the future of pandemics. Over many centuries and generations, pandemics have occurred. The few lessons from different eras are presented below.

From the Antiquity, the era before the middle ages there was a plague that occurred called the Plague of Justinian (541-542 A.D). This indicated that the occurrence and outbreak of pandemic are as old as the world. The Plague of Justinian afflicted Constantinopole in the Byzantine Empire spread by infected fleas and rats in the 6th century (Retief, et. al, 2010). It was one of the first pandemics to be properly documented in history and this made was possible with the help of the Historian and emperor's confidant, Procopius, and the two church historians, Euagrius and John of Ephesus. The causative agent Yersinia pestis caused a global health issue and would be seen to afflict generations hundreds of centuries later (Retief, et. al, 2010). It was said to have been carried over the Mediterranean Sea from major ports to the interior by rodents carrying fleas. It then spread aggressively across Europe, Asia, North Africa, and Arabia killing an estimated population of 30-50 million people, about a third of the known population of the world (Roos, 2020).

It was diagnosed as the Bubonic plague which was not transmitted from human to human as it was found that neither doctors nor other caregivers and those who took care of the corpses got the plague from contact with corpses or the patients. The disease presented with a sudden fever was followed within one or more days by painful swellings (called bubos) of lymphatic glands in the groins particularly and the armpits, neck, and thighs. Other symptoms and complications such as delirium, hallucinations, coma, and others were reported. Not infected persons died of the plague however no treatment was discovered and the disease was not well understood. It was assumed that the survivors and the unaffected had immunity strong enough to fight the plague (Retief, et. al, 2010).

From the Middle Age, another pandemic occurred and this was called The Black Death (1347-1351). The Black Death also knew as the Great Mortality from the Medieval chronicles Magna mortalitas in the Middle Ages (Britannica, 2020) caused a great catastrophe ravaged Europe and resulted in up to a 200million deaths (Rosenwald, 2020). Eight hundred years (800 years) after the Bubonic Plague of Justinian, the same causative agent Yersinia pestis resurfaced and caused the Black Death. In the space of 4years, this plague wiped out 30-50 percentage of the European entire population by spreading rapidly and killing hosts within a few days of being symptomatic. Like the Bubonic plague, the symptoms included high fever, swelling of lymph glands in the groin and armpits, rashes, etc. the buboes swellings were said to turn black and burst thereby expelling bacteria and pus. As reported by (Shipman, 2018) the disease spread through families, houses, villages, towns, and cities with terrifying speed and staggering mortality and this tragedy launched an evolutionary transformation and socioeconomic in Europe that changed the history course.

The disease was spread via various pathways, first the plague carried by fleas and infected black rats introduced the infection to many individuals, human to human transmission also occurred through respiratory droplets by handling infectious tissues unprotected. Response to the Black Death formed the genesis of quarantine when officials in the Venetian-controlled port city of Ragusa decided to keep newly arrived sailors in isolation for as long as 40days until it was proved they were not sick to avoid the risk of infecting others and this act was termed quarantine *(*Roos, 2020*)*. It originated in China and Inner Asia and spread via trading ports (Britannica, 2020). According to Historians, the plague got to England in May 1348. The disease spread to London in August 1348 and reached proportions of epidemic by September

end and violently attacked London between February and May 1349. By 1351 (4years later), the pandemic had died down (Shipman, 2018).

During the Modern Era, another pandemic was The Spanish Flu (1918). The Spanish Flu pandemic was the 1918 Influenza double-waved pandemic which was said to have spread worldwide and infected one-third of the population of the world estimated to about 500million people (CDC, 2020). The flu was caused by the H1N1 virus of avian origin and infection by this virus caused the mortality of 50million people of varying age groups (CDC, 2020). The strain of the H1N1 influenza virus was spread via droplets from respiration of an infected person who coughs, sneezes, or talks, and mortality in younger people was believed by some scientists to have been caused by the aggressive response of their immune system to the infection (Sandoiu, 2020). There were no vaccines at that time to protect one's self against the risk of infection and no antibiotics as well for the superimposed secondary infection, conservative, non-pharmaceutical methods such as isolation, quarantine, good personal hygiene, use of disinfectants, and most especially, limitations of public gatherings (social distancing which was then known as crowd control) were adopted randomly by different cities and enforced in some others (Griffin, 2020). The issue of Social Distancing and good personal hygiene helped the situation.

Ebola virus disease which causes viral hemorrhagic fever was discovered in Central Africa in the year 1976 for the first time. In 2014-2016, a new Ebola outbreak occurred in West Africa and spread within months to become a global epidemic. The transmission was mainly via human contact hence 74% of cases involved family members. Contact with dead bodies if the affected also impacted hence human attitudes regarding mourning and burials had to change in that period. Individual hygiene was seriously observed in terms of regular hand wash, use of hand sanitizer, no unnecessary kissing or hugging, after some time, it became history before the outbreak of this present Coronavirus called COVID-19.

Today in the 21st century, the year 2020, there's an ongoing global pandemic reported to have affected 213 countries and territories worldwide (Worldometer, 2020). The World Health Organisation on the 30th of January 2020 declared a global health emergency and on March 11, 2020, declared a global pandemic caused by the Coronavirus disease 2019 (COVID-19). The COVID-19 is an illness caused by a novel coronavirus known as severe acute respiratory syndrome coronavirus 2 (SARs-CoV-2). This illness was identified first in Wuhan City, Hubei Province, China during an outbreak of a respiratory illness (Medscape, 2020). The disease presents in asymptomatic, mild, moderate, or severe forms in varying proportions which may develop within 2days to 2weeks after viral exposure. The symptoms include cough, difficulty in breathing mainly but not exclusively and with or without fever, muscle pain, chills, sore throat, loss of taste, loss of smell, fatigue, malaise, diarrhea, and others.

The COVID-19 pandemic is acute public health, humanitarian and economic crisis that has placed the world in a confused state because if taken with levity could result in a fatal disaster and if strictly managed puts the world at risk of massive recession (Loayza, 2020). This has caused for policy implementation of containment and mitigation measures simultaneously to control the disease outbreak. Containment is done in the early stage where infected persons are isolated and their contacts are traced and quarantined. Mitigation on the other hand is employed to limit community infection especially in cases like this where individuals are infected without being aware of their status or how they got exposed. The measures include personal preventive measures like use of face-masks in public places, proper hygiene such as regular hand washing and self- quarantine while community measures include social distancing by closing schools, religious places, bars, etc. to avoid mass gatherings and promoting environmental sanitation and cleaning of surfaces (Wikipedia, 2020). Some countries are applying the containment measure, some mitigation, and others both simultaneously.

Pharmacologically, no vaccine is currently available to prevent the coronavirus 2019 infection and drug trials are still on to discover the ideal medication for the management of the disease. As of the 16th of June, 2020 there are 8,151,342 confirmed cases worldwide, 439,932 deaths (Worldometer, 2020).

The Post COVID -19

As earlier mentioned, COVID-19 is a humanitarian crisis which asides from its health implications has affected individuals, and the global community financially and economically. Things were not the same as it was before, education, business, health, family practice, and social lives were fully affected, it was not as business as usual everything has changed. Due to the mitigation measures implemented, many jobs were lost as a result of this pandemic, individuals were frustrated because some of the industries reduced the operation centres to a minimum and sizeable number having discovered that members who have what it takes in terms of technology skills can work at home anywhere and still achieve the same results through the computer with just a few visiting the office in rotational bases. This has reduced the workforce and make many lose their job.

Amidst all that, technology is being used to alleviate some of these problems. This technology will be used to augment people's jobs. The issue of work at home cannot be a success without the use of technology, the majority of people engaged in different online business to serve as a substitute or to replace the lost job. This online business might not be a success without the basic knowledge of Mathematics which forms the bases of science and technology. Without adequate knowledge of Mathematics, the use of technological tools might be difficult. It has become imperative for those that want to move on and adapt to the changes come up with future learning and pandemic problem to find a way of improving their Mathematics knowledge. With the use of technology advertisement and online trade will be an alternative, a lot of work will be done at home, freelance and gig workers and the economy will continue to expand, there would be more automation, artificial intelligence, and robotics used. In terms of education, e-Learning and blended mode of learning will form a substitute, a high percentage of teaching will be done online through different mediums of online mode. Full face to face classroom learning might be a thing of the past. The teachers must have the appropriate teaching skills for e-Learning and digitalization to be visible and effective.

Mathematics knowledge of every individual has to be improved to be able to cope and be among the workforce for future preparation after this present pandemic and in preparation for further future occurrence since the world is volatile, uncertain, complex, and ambiguous (VUCA) (Akinoso, 2015) and unpredictable. To cope with depression and mental health created by the recent pandemic, an individual must adopt problem-solving skills and proper calculation embedded in Mathematics. The pandemic created a lot of havoc in first wave and the second wave including emotional tumors, in this case, appropriate coping strategies should be developed by every individual in managing the 'new normal' to function fully in society. This cannot be achieved without proper knowledge and skills in Mathematics. In new normal, approach to different activities has changed. Every sector encouraged work at home, in education most of the teaching is online also the healthcare professionals encouraged safety measure and precautions but for severe case, it has to be taken care of in the hospital while most of the test are carried out using technology.

The Roles of Mathematics Knowledge in COVID-19 Outbreak

Mathematics knowledge plays a substantial role during the outbreak of the recent pandemic COVID-19 or Coronavirus specifically, such roles include the following:

Percentage of population affected

Without the knowledge of the concept of percentage in Mathematics, it might be a bit difficult to calculate and present the population affected by calculating the number of people and then converting it to percentages.

Acceptable limit for social distance

Social distancing which is also physical distancing according to the Centers for Disease Control and Prevention (CDC), (2019) refers to keeping a safe space between oneself and other people for the distance of 6 feet at least which is about 2 arms' length. This measure was adopted to reduce the rate of spread of the disease. Measurement plays a significant role in the

adoption of social distancing either with the use of measuring instruments tape rule, meter rule, feet, or arm span people should not be in close contact to reduce the spread of the virus.

Clinical trials
Erin, Collier, Jennifer, Hsiao, and Vivian, (2020) emphasize that the clinic off-hours must be scheduled properly to minimize exposure the risk of COVID-19 for both research staff and participant; the patient examination room must be disinfected following proper procedures before and after each visit; every study participants must be discouraged from using public transport; and the participations must notify the trial team immediately if symptoms of COVID-19 infection develop, to re-scheduled the visit and for the participants to seek appropriate treatment. Every measure and precaution discussed above required proper calculation especially probability and statistics to curb the multiplication of the virus.

Research
Every research and statistics adopted during this period of COVID – 19 need adequate knowledge of calculation. Data collection, mode of collection which is online mode due to the present situation, collation, coding, analysis with the correct use of the statistics and interpretation cannot be carried out effectively without Mathematics knowledge. Before the pandemic, the mode of data collection includes visitation to the collection centre which was not allowed since close contact is forbidden. Some researchers usually employ the analyst for data analysis and found it difficult to visit or locate any due to movement limited which forced the researcher to learn how to analyze and interpret data online which improves their calculation skills.

Incubation period and recovery rates
Estimation is needed in this area with proper monitoring to determine the number of the victim that responded to the treatment and recovered from the ailment within a certain period. Every aspect of the treatment required proper calculation.
Every point listed above requires proper and adequate knowledge of a different aspect of Mathematics which play an important role to discover the next step of action to improve the treatment and reduce the spread of the disease and at the same time, improve people's health recovery rate, minimize death rate, put a smile on people's face by bringing joy to the family and at the same time boost the individual and the social economy. To show the importance of Mathematics during COVID-19 Kuhfeld and Tarasawa, (2020) recommended that policymakers, educators, communities, and families should provide support particularly in Mathematics to students while school is disrupted. Emphasis was laid on Mathematics due to the importance and special roles Mathematics played in learning every other subject and its' application in every aspect of life.

Mathematics in Health Sector
Mathematics serves as a key that contributes directly and in fundamental ways to every aspect of life. Its roles in business, finance, health, defense, war, transportation, careers, decisions, and technology cannot be ignored. In medicine especially this digital-age, every step in treatment is linked with mathematical application to diagnose, for novel pharmacotherapies, and epidemiological datamining. Health providers must have proper knowledge of calculation to diagnose, treat, use and read properly the medical tools, the formula, and the units of measurement to reduce the risk of medical mistakes that can lead to tragedies. It plays a crucial role in different aspects of health practitioners' activities.
Doctors use Mathematics knowledge and skills in every aspect of their work to provide good health care for the patients. To check and examine the type of disease, how critical the ailment is, the body mass, the type of treatment to be given the patients, prescription, and checking the improvement of the treatment on such patients, and how long to be on such treatment and medication. To carry out any tests before the treatment like a blood test, urine, scan, x-ray,

endoscope, and every other test the knowledge of Mathematics is required to obtain the correct measurement. The doctors must have proper training in Mathematics to be able to carry out the job successively without any error since Mathematics is very useful in medicine. Some of the usefulness of Mathematics in medicine include prescription and medication, to calculate Body Mass Index (BMI), Computerized Axial Tomography (CAT) scan which can provide more and standard information than an x-ray that only provides a two-dimensional view of a particular part of the body. In medicine, Mathematics plays a substantial role since people's lives are involved accurate calculation is very essential with the use of numbers.

In Nursing as a profession, Mathematics matters and very germane, the nurses must have adequate knowledge of calculation to avoid errors that can cause life. Numerical reading from medical equipment such as blood pressure, body temperature, body weight, height must be carried out properly and record accurately to know the kind and dosage of the prescribed drugs. In short, the patient's condition according to the points above is directly related to the types and dosage of drugs that will be prescribed. Any slight mistake in this calculation can lead to deteriorating the patient's condition, causes damages, prolong recovery, and might even lead to death. According to the Royal College of Nursing (2020), accurate measurement is therefore mandatory for the nurses to be numerical competence to carry out their duties to the required standard through the knowledge of Mathematics. As suggested, the Nurse should practice Mathematics regularly and take the time needed to be confident in solutions possibly by consulting their peers, getting online resources, and watch videos online to get the required help to avoid the error of omission or commission. Mathematics education researchers can even work together with this set of people to improve the health numeracy among the health workers. From the Fields Institute for Research in Mathematics Sciences, (2019), Health numeracy is the degree to which individuals can access, process, interpret, communicate, and act on numerals, quantitative, graph, bio-statistical, and probability of health information needed to make health decisions effectively.

The Knowledge of Mathematics is required by Nurses in the following aspect of their work:

Vital signs such as taking the patience temperature, blood pressure, breathing rate, pulse rate should be read accurately through the use of the appropriate instruments; for medication, the Nurses should be able to translate the pills to normal dosage; conversion is very important in emergency cases like an operation that needs metric units called (SI) units for dilution, also the knowledge is needed for data analysis. In short, the Nurses need the knowledge of Mathematics for estimation, metric (SI) system, and medicine dosage both solid and liquid, IV drugs, and flow rates.

Mathematics Skills in Health

There are some common Mathematics skills needed in the health sector that will help the worker's career to ease the work in their different areas of specialization. Such mathematics skills include: numeracy skills which involve number, counting, and hierarchy; calculations skills the use of different operations like addition, subtraction, multiplication, and division; measurement skills in terms of time, date, volume, and others; a graph which must be reading correctly it also includes a correct reading of the tables, and figures; a fraction is another important skill in Mathematics which also include decimals, percentages, and proportion. The health practitioners must also demonstrate the knowledge of probability understanding; algebra, geometry, as well as calculus; Estimation is another important skill; problem-solving skills; logic skills not just the contextual knowledge but application of the skills knowledge which might be termed as applied skills. The health practitioners should be able to interpret the victims' situation before the application of problem-solving skills to proffer solutions to the health problems of various types. Critical thinking and logical reasoning form an important aspect of problem-solving.

Generally, Edwards and Taunda, (2020) quip that Mathematics goes hand-in-hand with medicine, and health also highlights the following as the must understand area for the health practitioners if they want to become expert and certified in their career fields. In summary,

converting Pounds, Milligrams, and Kilograms are very important to master and understand fully by the doctors' prescriptions to patients using milligrams per kilograms according to the weight of the patients. Though the nurses are not in charge of prescription but need the skills in ratios and proportions to administer medication to the patients. The person's size will help the nurse on the dosage the patient's body requires without risk of serious complications. How long the medication will stay in the body of the patient before another dosage also requires ratios and proportions. Measurement is also very important especially in the form of body mass which should be done accurately to know whether the patient should maintain or reduce for long living. Statistics cover all the records, the history, treatment, recovered, improvement, and even the death rate of a particular ailment which is necessary to know the way forward for such treatment. Dimensions either 2-dimensional or 3-dimensional X-ray or CAT-scan are also useful to see the in-depth of the body and find exactly where the problem is.

4. CONCLUSION

In conclusion, there is no aspect of health that does not require calculation, different knowledge as well as skills in Mathematics. The knowledge required by doctors might not be the same as that of nurses, dental surgeons, pharmacists, physiotherapists, radiographers, medical laboratory scientists, medical records or health information, and administration. Whatever test, treatment, and surgery to embark upon need proper calculation to avoid the risk of severe illness that can claim lives. Every measure to reduce the risk of COVID-19 spread is carried out with measurement as a concept like social distance, the use of face mask, hand washing, incubation period, quarantine, the use of sanitizer, avoidance of overpopulated area, and others. The history of the past pandemic was discussed fully, the roles of Mathematics knowledge in the COVID-19 pandemic were explained, the roles of Mathematics knowledge and skills in the Health Sector were properly explained as an important tool in medicine, economics, science, and technology. It is needed in human health and in developing the standard of living.

It was therefore recommended that every individual should have basic knowledge of Mathematics while it has become imperative for every health worker to possess a thorough knowledge of proper calculation useful for their area of specialization to avoid a costly error that can claim lives. Regular practice of the required concepts will contribute immensely to the proper usage of the knowledge and skills in Mathematics. The teaching and learning of Mathematics should be given special attention in terms of the use of strategies that will contribute to effective learning and make application of the knowledge easy for every individual.

Healthcare professionals must undergo in-service training in the required Mathematics skills relevant to their specific area of specialization to avoid the error that can increase the mortality rate. Regular training is needed in the technology used to carry out successfully the test and practical aspects of their work with zero or minimal error. This regular training in technology will help the healthcare professionals to become specialist in the usage of new machine relevant to outbreak of any strange disease.

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