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Analysis on Intervention of Science, Technology and Innovation for Tackling COVID-19 Pandemic

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Abstract

The major concern of the whole world presently is COVID-19 pandemic that affects people's lives, economy, education and many more. It has gone beyond medical problem and has become societal concern which has called for Scientists, Technologists and Inventors of modern technology to provide lasting solution to the spread of the pandemic. However, the main aim of this work is to discuss and present the modern technology from various fields of Science across the globe for tackling the pandemic. We present briefly some of the technologies such as data science, artificial intelligence, diagnostics machine and machine learning for fighting against the virus. Furthermore, secondary data on the pandemic collected from online is analyse and demonstrated in diagrams three countries each are selected randomly from each continent using simple random (lottery method), also cluster sampling is use in selecting three countries with highest and lowest number of each variable considered in the work. Then the variables are: total and new: cases, death, recovered, active cases, total tests, serious critical and fully vaccinated. The results reveal that North America continent records highest number of most cases, while Oceania has lowest number of those cases. Therefore, we gathered from the work done that modern technology has assisted immensely and significantly in enhancing and helping people to combat this virus globally.

Keywords: Artificial Intelligence; Cluster Sampling; Data Science; Diagnostics Machine; Machine Learning; Simple Random

Introduction

Coronavirus outbreak was first declared by World Health Organisation in December, 2019. The virus became terror, threat and quickly got the attention of mankind who are still on the surface of the earth Samrat et al. [1] and Yoo [2]. By February 24, 2020, COVID-19 has spread to about Twenty-Nine (29) countries and become a major issue in health sector across the globe. In January 20, 2020, South Korea announced its first case which led ministries to collaborate with the Korea Centers for Disease Control and Prevention (KCDC) to identify emergency needs. Hence, the emergency prompts the KCDCs to worked with manufacturing companies to make commercial diagnostic equipment. Then in February 6, 2020, the Ministry of Science and ICT (MSIT), Interior and Safety (MOIS) and the KCDC introduced the "Emergency Response Research Program for People's Safety," in which they responded to the emergency of the pandemic by develop rapid testing kits drug repurposing for COVID-19 etc. While in February 7, 2020, the first set of diagnostic kits developed in Korea was approved by Korean government and distributed to the regional health centers to assist the populace and boost their health sector [3].

Confirmed cases of COVID-19 worldwide in April 23, 2020 were 2,682,225 where 187,330 died and more than 730,000 people recovered. Hence, in June 3, 2020 of the same year the number of coronavirus cases had increased to 6,390,085 with record of 381,950 deaths and about 1.7 million patients recovered [4]. The scientists technologies and innovators working round the clock to support emergency responses and government actions globally. In the same year 2020, when the disaster was everywhere in the world. There were collaborations between scientists and technological innovators across the globe to support and promote health sectors of developing countries (e.g African countries) in fighting against the pandemic. international and national organizations, government and non-government organizations, public and private organizations and prominent individuals donated hospital equipment to various developing countries. For

example, in Nigeria, the same sets of organizations mentioned earlier donated equipment like ventilator machine to the Intensive Care Units (ICUs), beds, ambulance, testing kits, new standard laboratories and upgraded several existing laboratories in the university teaching hospitals to standard. Nigeria received 26 ventilators and 3560 pulse oximeters to response to COVID-19 disaster from WHO as donation.

The nature and the emergency caused by the pandemic globally have made ministries of health and agencies of science and technology to involved in decision making against the crisis. In some countries, science and technology ministries and agencies have been saddled with distinct responsibilities for coordinating measures or initiatives to curb and curtail the virus and prevent the spread. For instance some countries like Peru's National Council on science and innovation bring university laboratories and Ministry of Health working together to make testing easier and available. Costa Rica's Ministry of Science, Technology and Telecommunications (MICIT) supports public-private initiative to carry out the production of protective equipment such as apron, nose mask, face shield, hand sanitizer etc., other critical supplies for healthcare workers in tackling the airborne virus are not left out. But as at today events have over took the situation, meanwhile some precautions, preventions and some solutions have been made by scientists, technologists and innovators to curb and reduce the spread of the virus. Therefore, they have play vital and germane role in scenario of outbreak epidemic/pandemic and economic recovery (Anta et al., 2020).

Science

Science, as discussed by Dayananda [5] and Shankar Sharm (2005); the very fundamental sense, process of seeking truth and an inheritance of mankind. Scientific development presents open many door of opportunities for growth in economic, poverty eradication/reduction and human development. Anthony Bryne [6] stated that science and innovation stands as Nation's security whereby makes nation more effective, proactive and stronger in preparation, response and rapid in recovery. For example, Australia is one of those countries with high record of producing world-heading science and innovation [7]. Also, joint works are currently going on between individuals and communities in various ways to produce science and innovation which make them more resilient and secure. Scientists worldwide are seriously collaborating (their hands are on deck) to develop vaccines and antiviral medications to tackle the spread of coronavirus in the world Anta et al. (2020).

In the United States, there are several offices created to assist in fighting against the spread of COVID-19 such as Open Research Dataset (CORD-19), the largest collection of scientific literature with more than 52,000 academic articles related to COVID-19 and the related of coronaviruses and brought together artificial intelligence experts from around the world to develop new techniques for analyzing the data in CORD-19. National Institutes of Health (NIH) in the first phase they examined different doses for safety and the ability to induce an immune response [8]. This trial took off with immediate effect. Center for Disease Control and Protection (CDC) is working on increasing testing capacity in monitoring the spread of coronavirus and to curb any new infections. National Science Foundation (NSF) is very much in supporting non-medical and clinical care COVID-19 research project through a Rapid Response funding mechanism which was activated when pandemic occur [9]. Emergency declaration activates additional emergency funding for science stated that billions of US dollar was released to some bodies in preventing the spread and cares for COVID-19 patients; these include: the Centers for Disease Control and Prevention (CDC), Biomedical Advanced Research and Development Authority, National Institutes of Health (NIH), National Science Foundation (NSF) and National Institute of Standards and Technology (NIST) (Anta et al. 2020).

In the same vein, universities and polytechnics in some countries (global and Africa) mainly their scientific research sectors and technological innovation had rose up to the task and taken the lead in collaborating and coordinating initiatives with other stakeholders [10]. For example, in America the Office of Science and Technology Policy gave experts from eleven (11) countries to brain storm on scientific journals and provide free access to all coronavirus related articles/publications and make the associated data available on internet. Also, the office gave a task to National Library of Medicine, Microsoft, and the Allen Institute of AI (AI2) to develop the CORD-19 scientific literature with about Fifty-Two Thousand scholarly articles related to all coronavirus and it associates with open access and articles updated in real time to the world. Thereby, Johns Hopkins University (JHU) conjunction with University of Washington (UW) hosted several heightened symposiums on COVID-19. For example: the symposium was in three parts/sessions and held in October 6, 2020 [11].

Track Trends in COVID-19 Cares and Tests

The percentage record for new tests which are positive in all states in the United States according to JHU CCI as of March 3, 2021 and accessed October 2, 2021 are listed in (Table 1) follow by its bar chart in (Figure 1) below: Mamandipoor et al. [12], based their analysis on VENTILA dataset, mechanically ventilated patients in ICU. In their research, they reported that adult patients older than 18 years and admission in ICUs are about 12,596 and 12,755 which are on ventilation across 37 countries and received both invasive and non-invasive mechanical ventilation [13].

Scientists and Industry are Migrating toward Making Ventilators

The major concerns of scientists and industry is how to make more ventilator machine in helping the breath of those infected by coronavirus due to the way it attacks patient's lungs. The ventilator machines are very scarce in hospitals in which can cause intensive-care units to be overwhelmed. For this reason, they changed their line of business to manufacture ventilator machines between March and April 2020 after the outbreak of coronavirus in order to meet the demand when there was high demand for the machine Wind Rush [14]. Some of the industry dashing into ventilator manufacturing include: Becton Dickinson produces surgical equipment, Philips manufacturing company, Hamilton Medical, Fisher and Paykel Healthcare, Draeger, Medtronic etc. Jamie Bell [15].

Technology and Innovation

In the area of technology and innovation, William et al. (2008) expressed their views on science and technology as underlie the elements of national power (diplomacy, intelligence, military, economics), but they are only rarely named as elements of national power, and the priorities, policies and personnel for science and technology are often neglected. Meanwhile, Kritikos [16] extensively discussed on ten technologies to fight coronavirus. They are: 1) Artificial intelligence (AI) use to track the epidemic in real-time so as to be able to predict where the virus might appear next and develop an effective response, 2) Blockchain track drug supply chains and medical supplies, 3) Open-source technologies allows laboratories to develop the necessary diagnostics within a very limited timeframe, 4) Telehealth technologies also allows hospitals to be kept clear for confirmed cases and reduces virus transmission rates, 5) Three-dimensional printing is shortened as 3D printing which can produce small quantities parts that are needed at a low cost, 6) Gene-editing technologies it genetic code shed light on the origins and spread of the disease, 7) Nanotech-

nology can diagnose, deliver drug and produce new therapeutic materials, 8) Synthetic biology has potential to design, develop and test solutions for an unexpected situation like the pandemic, 9) Drones is a replacement for helicopter patrols and regular disinfect of the affected places and 10) Robots are used for several assignments such as sterilize and remove contamination in public and private places rendering medical assistants in giving food and medication and taking patients temperatures to lower transmission of the virus within people.

In addition, anticipatory policy-making, potential impacts and developments and prototype of each device were shown in his paper. Technologists and innovators are collaborating to provide lasting solution to this global worrisome virus due to it concerns to the world (Anta et al. 2020). Furthermore, there were funds supports from some of the groups mentioned above to scientists, technological and innovations in some universities and polytechnics to massively produce hand sanitizers, modernize wash hand basin with water, disinfectants, nose mask, face shield, goggles, aprons, gloves, wash hand soaps to healthcare workers, patients and for the public use. In Pakistan, the first sets of PPE donated worth of $25 million by World Bank Group to assist them for the emergency [17]. Also in Africa technological innovators were given assistance through government and their universities to produce some PPE include: hand sanitizers, hand wash soap, fumigating materials, wash hand basin with water, nose mask of different types, gloves, aprons and so on for healthcare workers and public use; to curtail and prevent the spread of COVID-19 in the world [18].

Analysis of COVID-19 Pandemic Data

Here, we analyse coronavirus pandemic data based on continents (Europe, North America, Asia, South America, Africa and Oceania) and available data online from worldometer website. The analysis focus on seven variables these include: total and new cases, deaths, recovered, active cases, serious critical, total tests and fully vaccinated. In each continent three countries are selected as samples and sampling technique use in the selection of those countries is simple random sampling using lottery/balloting method as mentioned in the abstract (that is all countries have equal chance of selection from the box/container where their names are written, wrapped and randomly selected. Also, the selected countries at random from each continent are listed in (Tables 4,5) below. In addition, the analysis comprises of tables and graphs (such as bar, line and pie chart) that show numbers and percentages of each variable of the selected countries. These are depicting below as follows:

Summary, Conclusion and Recommendation

Summary

(Table 1) consists the fifty states in America, percentages of state with positivity equal or below and above 5%. It then follows by bar, line and pie chart in (Figure 1) depicts Twelve states equal or below 5% and remaining Thirty-Eight are above 5%. Also, (Table 2) contains percentages of "yes or no" of number of active constant tracers and exposure notification. While (Table 3) comprises of various types of PPE and infrared thermometer. Then (Table 4) shows the list of six continents with three selected countries from each, total number of cases, deaths, recovered, active cases and total number of tests with their bar, line and pie chart in (Figures 2-4) simultaneously. Furthermore, (Table 5) accommodates number of new: cases, deaths, recovered, serious critical and fully vaccinated across the selected countries as sated above. Their bar, line and pie chart in (Figures 5-7) respectively [19,20].

From (Table 4) three countries with highest and lowest number of each variable are stated with their figures in parenthesis. Total cases: United States (46,502,517), India (34,227,720), Brazil (21,748,984), China (96,899), French Polynesia (40,178) and Solomon Islands (20); Total deaths: United States (760,080), India (456,354), Italy (131,954), Australia (1,669), French Polynesia (635) and Solomon Islands (1); Total recovered: United States (36,375,189), India (33,599,484), Brazil (20,944,087), Australia (130,922), French Polynesia (33,500) and Solomon Islands (20); Active cases: United States (9,367,246), Brazil (198,604), Germany (188,413), Kenya (1,167), China (643) and Solomon Islands (0) and Total tests: United States (692,816,053), India (601,901,543), China (160,000,000), Bolivia (2,516,925), French Polynesia (26,355) and Solomon Islands (4,500).

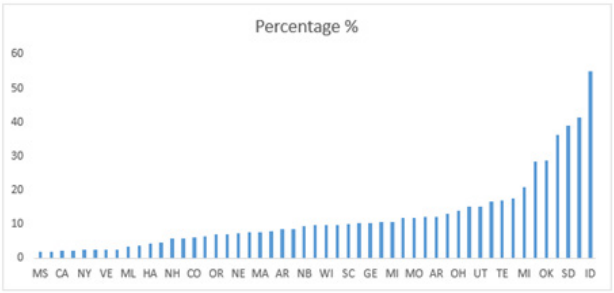

Figure 1: State with positivity equal or below 5% (the first 12 states) and state with positivity above 5%.

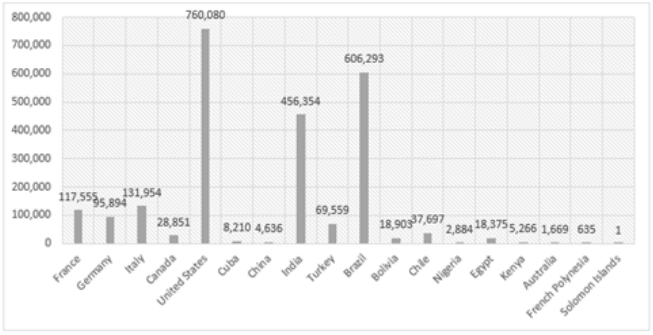

Figure 2: Bar chart for total deaths.

Table1: States in the US with positivity below and above 5%.

State	Percent %	State	Percent %	State	Percent %
Washington	0.00%	Minnesota	7.90%	Colorado	5.90%
Illinois	2.20%	Wisconsin	9.60%	Nebraska	9.30%
New York	2,5%	Michigan	10.50%	Missouri	10.50%
Vermont	2.50%	New Hampshipe	5.80%	Kenturky	15.00%
Rhode Island	1.80%	Maine	7.70%	West Vaginia	10.20%
Massachusetts	1.80%	Oregon	7.00%	Vaginia	11.70%
Califonia	2.00%	Nevada	7.40%	Delaware	8.40%
Maryland	3.40%	Wyoming	16.60%	Arizona	8.30%
District of Columbia	2.60%	South Dakota	39.10%	New Mexico	6.50%
Connecticut	2.50%	Iowa	41.30%	Kansas	28.30%
Hawaii	4.20%	Indiana	7.60%	Arkansas	12.20%
Louisiana	4.60%	Ohio	14.00%	Tennessee	16.80%
Alaska	13.00%	Pennsylvania	9.60%	Alabama	36.30%
Idaho	55.00%	New Jersey	7.00%	Georgia	10.30%
Montana	11.90%	Utah	15.20%	Texas	12.10%
North Dakota	17.70%	Oklahoma	28.60%	Mississipi	20.90%
North Califonia	9.80%	South Califonia	9.90%	Florida	5.80%

Source: https://coronavirus.jhu.edu/testing

Table 2: Selected countries from each continent with Total Cases, Deaths and Recovered, Active Cases and Total Tests against Coronavirus.

S.No	Continent	Selected Country	Total Cases	Total Death	Total Recovered	Active Cases	Total Tests
1	Europe	France	7,133,766	117,555	6,921,146	95,065	151,204,954
		Germany	4,521,407	95,894	4,237,100	188,413	73,348,901
		Italy	4,752,368	131,954	4,545,049	75,365	102,379,323
		Canada	1,704,712	28,851	1,649,966	25,895	45,819,418
2	North America	United States	46,502,517	760,080	36,375,189	9,367,246	692,816,053
		Cuba	948,847	8,210	935,732	4,905	10,425,790
		China	96,899	4,636	91,620	643	160,000,000
3	Asia	India	34,227,720	456,354	33,599,484	171,882	601,901,543
		Turkey	7,909,111	69,559	7,346,279	493,273	95,211,266
		Brazil	21,748,984	606,293	20,944,087	198,604	63,776,166
4	South America	Bolivia	510,470	18,903	473,195	18,372	2,516,925
		Chile	1,686,318	37,697	1,634,860	13,761	23,293,371
		Nigeria	211,330	2,884	202,803	5,643	3,298,966
5	Africa	Egypt	326,379	18,375	275,637	32,367	3,693,367
		Kenya	252,938	5,266	246,505	1,167	2,687,142
		Australia	163,866	1,669	130,922	31,275	42,692,931
6	Oceania	French Polynesia	40,178	635	33,500	6,043	26,355
		Solomon Islands	20	1	20	0	4,500

Source: woldometers.info/coronavirus (Accessed October 27, 2021).

Table 3: Selected countries from each continent with New Cases, Deaths and Recovered, Serious Critical and fully vaccinated against Coronavirus.

S.No	Continent	Selected Country	New Cases	New Death	New Recovered	Serious Critical	Fully Vaccinated
1	Europe	France	0	0	0	1,049	68%
		Germany	20,386	100	11,200	1,336	66%
		Italy	4,598	50	4,226	341	71%
		Canada	321	10	384	765	75%
2	North America	United States	4,798	148	0	13,280	57%
		Cuba	912	9	1,382	130	62%
		China	59	0	19	27	38%
3	Asia	India	12,855	670	9,812	8,944	22%
		Turkey	0	0	0	1405	58%
		Brazil	0	0	0	8,318	55%
4	South America	Bolivia	0	0	0	220	30%
		Chile	1,710	6	1,342	458	77%
		Nigeria	0	0	0	11	1.40%
5	Africa	Egypt	0	0	0	90	8.30%
		Kenya	99	3	115	24	2.70%
		Australia	1,850	16	0	279	62%
6	Oceania	French Polynesia	0	0	0	12	52%
		Solomon Islands	0	0	0	0	4.60%

Source: woldometers.info/coronavirus (Accessed October 27, 2021).

Table 4: The Percentage of Yes and No of the Number of Active Contact Tracers, Contact Tracing and Exposure Notification in US.

	Yes	No
Publicly Available Information on the Number of Contact Tracers by State	7.10%	92.90%
Publicly Available Information on Contact Tracing and Transmission by State	35.70%	64.30%
Prevalence of Google/Apple Exposure Notification (GAEN) Adoption by States	41.10%	58.90%

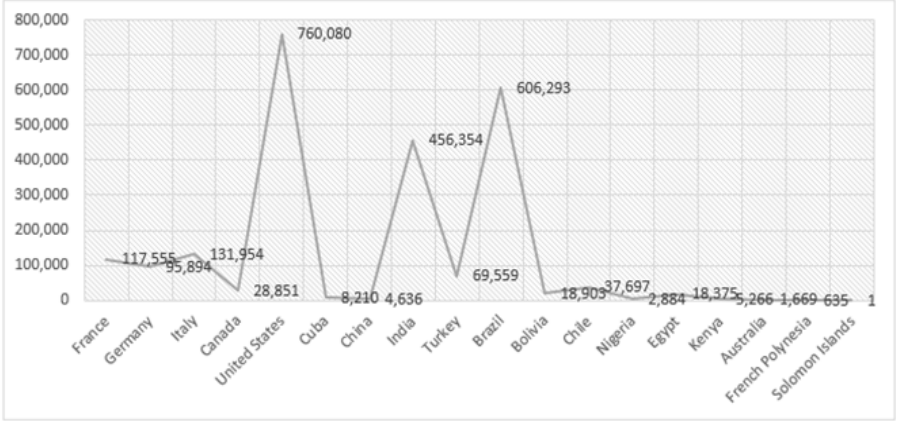

Figure 3: Line chart for total deaths.

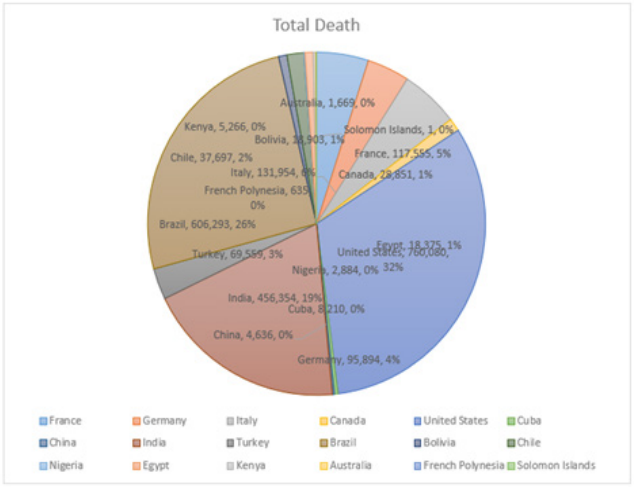

Figure 4: Pie chart for total deaths.

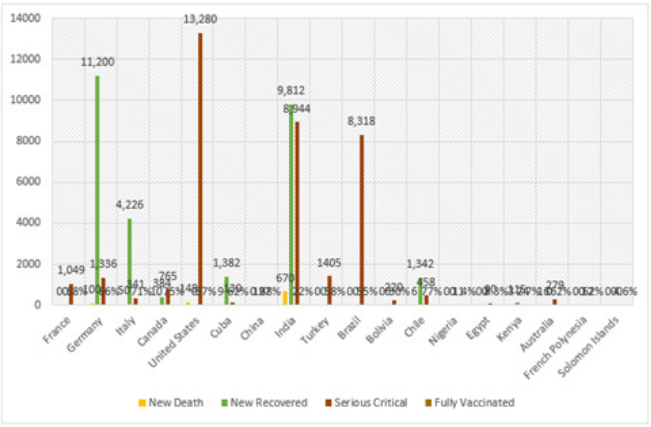

Figure 5: Bar chart for new deaths and recovered, serious critical and fully vaccinated.

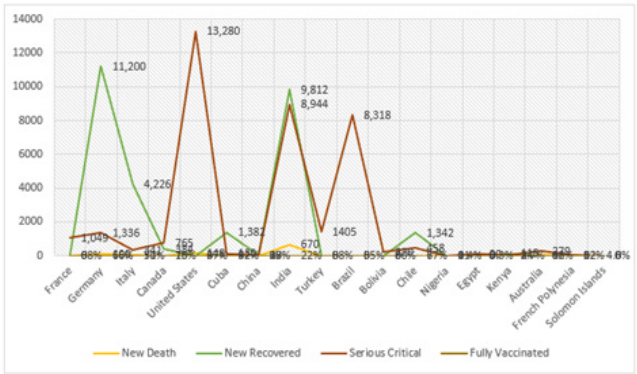

Figure 6: Line chart for new deaths and recovered, serious critical and fully vaccinated.

Besides, we have in (Table 5) three countries with highest and lowest number of each variable listed with their figures in bracket. These are: New cases: Germany (20,386), India (12, 855), Italy (4,798), China (59), Kenya (99) and eight countries with zeros; New deaths: India (670), United States (148), Germany (100), Chile (6), Kenya (3) and nine countries record zeros; New recovered: Germany (11,200), India (9,812), Italy (4,226), China (19), Kenya (119) and ten countries had zeros; Serious Critical: United States (13,280), India (8,944), Brazil (8,318), Nigeria (11), French Polynesia (12) and Solomon Islands (0) and percentage fully vaccinated: Chile (77%), Canada (75%), Italy (71%), Solomon Islands (4.6%), Kenya (2.7%) and Nigeria (1.4%).

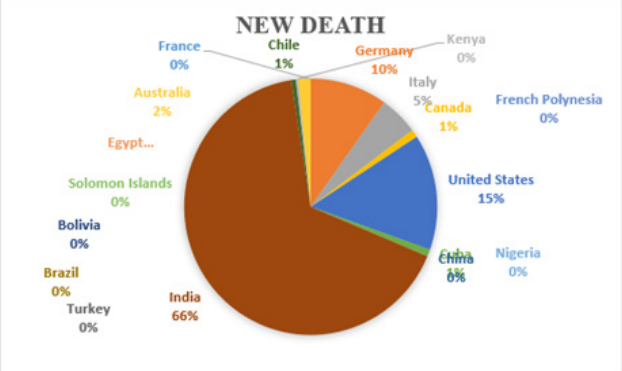

Figure 7: Pie chart for new deaths.

Table 5: Types of Personal Protective Equipment (PPE) and Infrared Thermometer

		
Surgical Mask	FFP1-Respirator Mask	FFP3-Respirator Mask
		
Clinical Infrared Thermometer	Digital Thermometer	Smart Sensor Ar212 Digital

Source: WHO (2020) and PPE google site.

Conclusion

Coronavirus in the history of pandemic has caused total locked down, closure of borders, airports, seaports and other point of entries across globe especially in the year 2020. This led to restriction of movement between and within countries and even has put some countries into economic disorder [21]. In view of this, scientists, technologist and innovators have woken up to the task as they had started global collaboration and focus on how to find lasting solutions, preventive equipment and invent different machines to fight the pandemic [22]. Hence, their collaboration has started yielding good results. For example, recently, borders and ports had reopened, government of various countries ease inter-country traveling in their respective countries, schools, private and public offices gradually began physical activities. In addition comparing the number of total cases, deaths, recovered and active cases with new cases, deaths, recovered and percentage fully vaccinated in the world one may say and see that truly science, technology and innovation are tackling COVID-19 worldwide.

Recommendations

The following recommendation was drawn after intensive studies on the topic of this paper. These are as follows:

- Science, technology and innovation should be integrated in health sector in such a way that improve the sectors.
- Enhance approval procedures for drugs and medical devices.
- Supplement competitive funds with baseline funding resources for centers and laboratories, with longer funding terms than what is typical for individual projects.
- Redesign incentives for careers in science and modernize science practices in universities.
- Implement new mechanisms for evaluating public investment to enhance the transparency and efficiency of public spending on science.
- Promote open science practices, such as sharing databases and preliminary results.
- Establish interdisciplinary mission centers that focus on addressing social needs and anticipating responses to future outbreaks of COVID-19 and the next pandemic.
- Train bioinformatics and data science researchers to pave the way for the development of

- machine learning and artificial intelligence.
- Expand availability and access to data to inform pandemic evolution models, decision making and development of technological solutions
- Continue to strengthen the institutional framework for science, technology, and innovation policy in a consistent manner with a long-term vision (Anta et al., 2020).

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