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*Keywords:* *fish-bone, pareto, africa, trend, pie chart.*

*GJMR-F Classification:* *NLMC Code: WD 300*



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# Monitoring Coronavirus Disease 2019 (COVID-19) Pandemic Outbreak in Africa

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*Keywords: fish-bone, pareto, africa, trend, pie chart.*

## I. Introduction

On the 10th of January 2020, 41 cases of pneumonia due to a novel coronavirus (2019-nCoV) was reported by Chinese health officials, including seven patients with severe sickness and one death. The symptoms of the virus include fever, cough, and difficulty breathing [1]. The initial diagnosis date for a case acknowledged in China was on the 08th of December, 2019. Preliminary investigation of viral genomes from China and other countries suggests that first transmission from a zoonotic reservoir to humans might have occurred as early as late October. The initial cases reported had links to seafood and live animal market in Wuhan, China, suggesting the disease of humans from an animal source [2 and 3]. Health authorities in China have restricted transportation in and out of heavily affected cities and are continuing to check close contacts, together with health care workers, for illness. Some territories in Asia and countries across the globe are tesingt incoming travelers from Wuhan. Coronaviruses (COVID-19) are a large group of viruses. There are numerous known human coronaviruses that always cause mild respiratory disease, for instance, the common cold. However, at least twice before, coronaviruses have emerged to infect people and cause severe disease: such as severe acute respiratory syndrome (SARS) and the Middle East respiratory syndrome (MERS) [4, 5 and 6]. The cases in this epidemic tested negative for both SARS and MERS. The clinical characteristics of disease, such as the incubation period, have not been determined. On the bases of incubation period of SARS and MERS, signs of 2019-nCoV might appear from 2-14 days after contact to infected person. Human to human spread has been documented, and healthcare workers have also been infected. Similar to other coronaviruses, people may be contagious before showing any symptoms of the disease [3 and 7].

*As of 9:00 AM, 14 April 2020,* a total of 15,284 COVID-19 cases and 816 (CFR: 5%) deaths were reported in 52 African countries. Out of the 52 Member States that were reported cases, six of them have community transmission, 44 have local transmission, and two have imported cases. Ever since the last brief, the number of tested positive COVID-19 cases has increased by 52% (that is, 5,198 cases). The five countries in Africa with the highest increasing number of cases are South Africa (2,272; 15%), Egypt (2,190; 14%), Algeria (1,914; 13%), Morocco (1,763; 12%), and Cameroon (820; 5%). When the population is been taken into consideration, Djibouti (30.2), Mauritius (25.5), Seychelles (11.2), Tunisia (6.1), and Morocco (4.8) are reporting a large amount of cases per 100,000 populations within the continent. Fifteen countries are reporting case death rates higher than the worldwide case fatality rate of 6%. See Table 1 below for the complete list of countries in Africa reporting cases, deaths, and COVID-19 recoveries as well as transmission type being reported. Africa CDC is currently working with all affected countries and is organizing laboratory, supervision, and other response support were needed [8, 9, 10, and 11].

*a) Intervention of Africa CDC*

1. Africa CDC set in motion its Emergency Operations Center and Incident Management System (IMS) for the 2019-nCoV outbreak on the 27th of January, 2020.
2. Africa CDC is getting test kits for and also working with laboratories in the Member States to check specimens for novel coronavirus infection.
3. Training of 16 African laboratories took place in Senegal on 6th-7th February, 2020.
4. In partnership with WHO, Africa CDC has set up a specimen referral system. After training was

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completed, Africa CDC shared the list of laboratories with capacity to test for COVID-19 with all Member States and how to submit specimens.

5. Africa CDC is working to train and set out epidemiologists at headquarters and within the RCCs for daily event tracking and risk analysis, to be communicated with the Member States.
6. Africa CDC is also providing training and technical support to at-risk African airports.
7. Africa CDC is developing informational materials on infection prevention which are also been shared with the Member States.
8. Africa CDC is organizing weekly updates with the national public health institutes in Member States and forming working groups for high precedence areas of coronavirus control.
9. Africa CDC is working with the Member States to build infection impediment and control capacities in healthcare facilities, and with the airline division to support screening of travelers.
10. Africa CDC will continue to provide an updated and important information to the Member States as the outbreak progress.
11. Africa CDC has commenced a continent-wide network of 300 clinicians across the continent to talk about COVID-19 clinical management and is holding weekly webinars [10 and 11].

The problem is, how prompt should health management organizations interfere in order to curb the increase of this pandemic across the infected countries by intervention organizations? Secondly, if proper action is not properly taken, what will be the status of the pandemic in Africa as a continent?

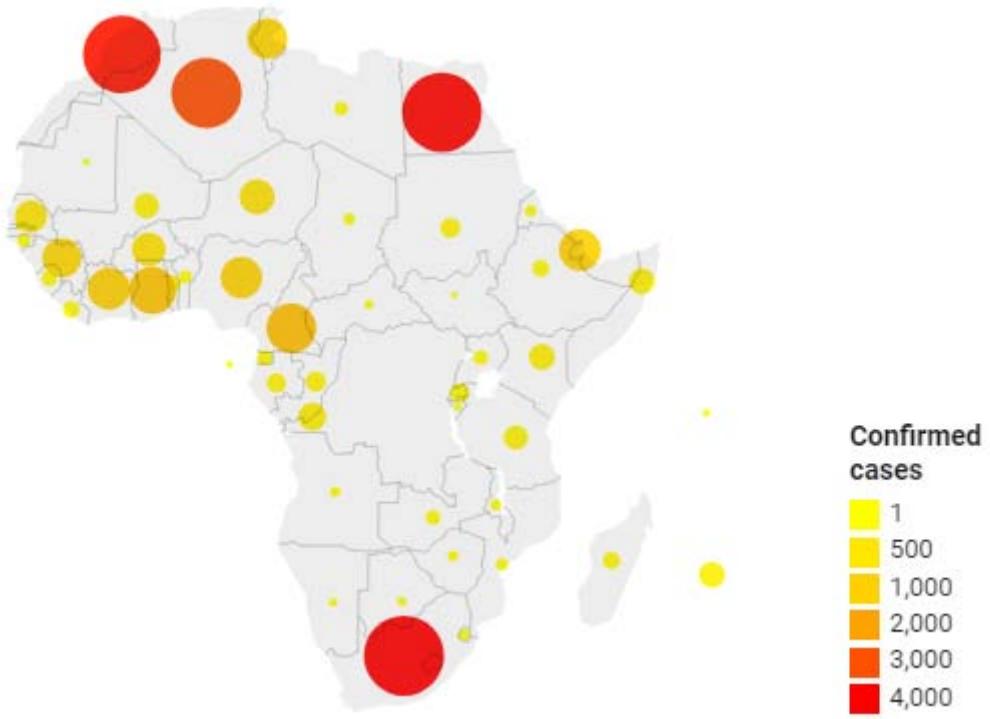
## II. Materials and Methods

In the course of proffering solutions to the above-posed questions, quality control tools were adopted to monitor the pandemic. Quality health control can be apply to various aspects of health care. Timeliness in health control relates to obtaining needed care while minimizing delays in intervention on any disease outbreak. Quality health control also looks at the consumer point of view of health care needs by the government (health management organizations/ ministries).

Appropriate steps must be taken by physician and other health providing activities whenever there is an epidemic or pandemic outbreak to maintain quality health standards in any society.

To understand the problem posed by the delay in the recent global ravaging outbreak (COVID-19), it may be useful to describe the trend to mitigate the impact of the virus spreads in Africa.

The control tools used in analyzing COVID-19 data include a fish-bone diagram, Pareto chart, control chart, bar chart, trend analysis, and pie chart.




*Source: Africa CDC (https://africacdc.org/covid-19)*

*Figure 1:* COVID-19 pandemic in Africa as at 24th of April 2020



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## III. Results and Analysis

The data used in this write-up were up to date published data in NCDC official website (https://africacdc.org/covid-19) as at 10:00 PM on the 24th April 2020.

*Table 1:* Full list of countries in Africa with COVID-19 Cases

| Summary table of confirmed cases in Africa (as of 23 April 2020) | | | |
|---|---|---|---|
| Location | Cases | Deaths | Recoveries |
| South Africa | 3,953 | 75 | 1,473 |
| Egypt | 3,891 | 287 | 1,004 |
| Morocco | 3,568 | 155 | 1,004 |
| Algeria | 3,007 | 407 | 1,355 |
| Cameroon | 1,334 | 43 | 668 |
| Ghana | 1,154 | 9 | 99 |
| Ivory Coast | 1,004 | 14 | 359 |
| Djibouti | 986 | 2 | 252 |
| Tunisia | 918 | 38 | 190 |
| Nigeria | 873 | 28 | 197 |
| Guinea | 862 | 6 | 170 |
| Niger | 662 | 22 | 193 |
| Burkina Faso | 609 | 39 | 389 |
| Senegal | 479 | 6 | 257 |
| Réunion | 412 | 0 | 238 |
| Democratic Republic of the Congo | 377 | 25 | 47 |
| Mauritius | 331 | 9 | 266 |
| Somalia | 328 | 16 | 8 |
| Mayotte | 326 | 4 | 125 |
| Kenya | 320 | 14 | 89 |
| Mali | 309 | 21 | 77 |
| Tanzania | 284 | 10 | 11 |
| Republic of the Congo | 186 | 6 | 16 |
| Gabon | 167 | 2 | 24 |
| Sudan | 162 | 13 | 14 |
| Rwanda | 154 | 0 | 87 |
| Madagascar | 121 | 0 | 58 |
| Ethiopia | 116 | 3 | 21 |
| Liberia | 101 | 8 | 20 |
| Togo | 88 | 6 | 56 |
| Equatorial Guinea | 84 | 1 | 7 |
| Cape Verde | 82 | 1 | 1 |
| Zambia | 76 | 3 | 37 |
| Sierra Leone | 64 | 1 | 10 |
| Uganda | 63 | 0 | 46 |



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| | | | |
|---|---|---|---|
| Libya | 60 | 1 | 15 |
| Benin | 54 | 1 | 27 |
| Guinea-Bissau | 50 | 0 | 3 |
| Mozambique | 46 | 0 | 9 |
| Eritrea | 39 | 0 | 6 |
| Chad | 33 | 0 | 8 |
| Malawi | 33 | 3 | 3 |
| Eswatini | 31 | 1 | 8 |
| Zimbabwe | 28 | 4 | 2 |
| Angola | 25 | 2 | 6 |
| Botswana | 22 | 1 | 0 |
| Namibia | 16 | 0 | 7 |
| Central African Republic | 14 | 0 | 10 |
| Burundi | 11 | 1 | 4 |
| Seychelles | 11 | 0 | 6 |
| Gambia | 10 | 1 | 2 |
| Mauritania | 7 | 1 | 6 |
| Western Sahara | 6 | 0 | 5 |
| São Tomé and Príncipe | 4 | 0 | 0 |
| South Sudan | 4 | 0 | 0 |
| Total | 27,210 | 1,286 | 8,087 |

*Source: World Health Organzation (WHO)*

*a) Fish-Bone Diagram*

The figure below depicts the symptoms to check out for in a COVID-19 infected person in Africa.

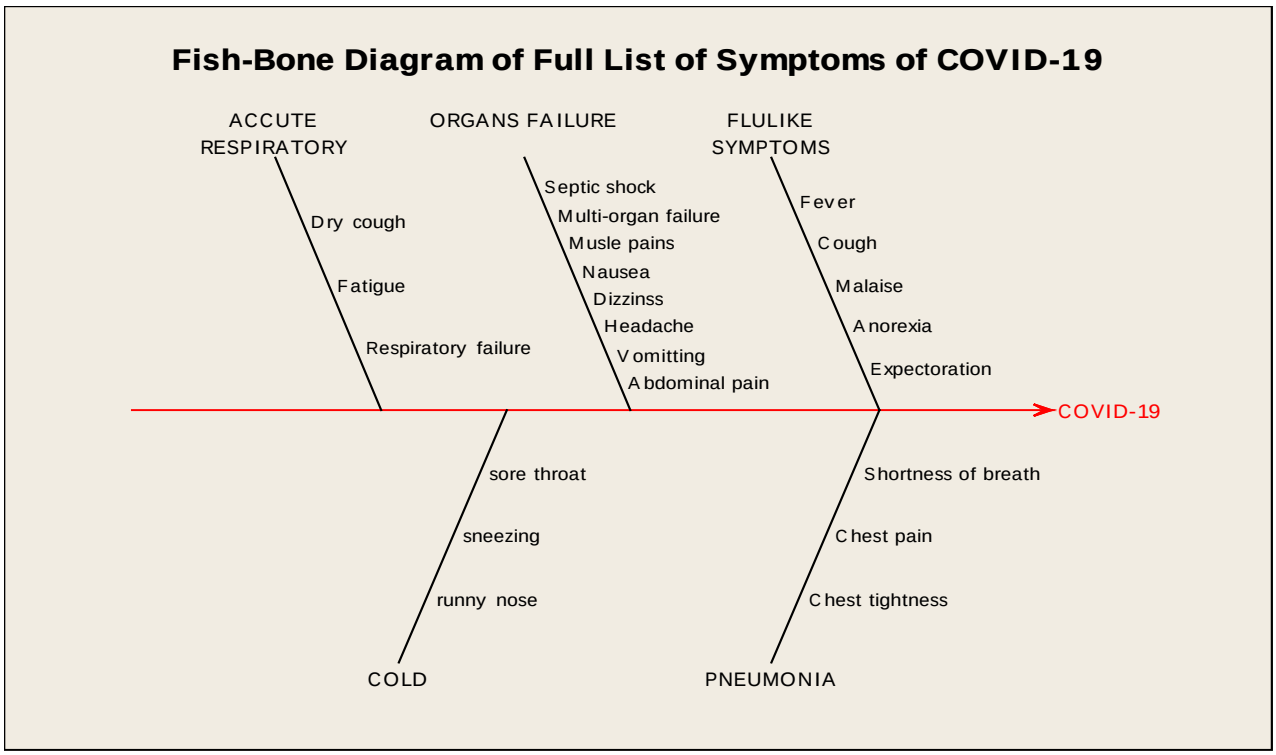


*Figure 2:* Fish-bone diagram of COVID-19 symptoms



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Figure 2 above is the full list of symptoms associated with a COVID-19 infected patient at both the initial and late stages of the disease in Africa.

*b) Pareto Chart*

To identify the Areas (Countries) where more intervention would be more needed, we would draw a horizontal line from the 80% mark on the vertical cumulative percentage axis. Where it crosses the line graph, and down to the horizontal axis is drawn.

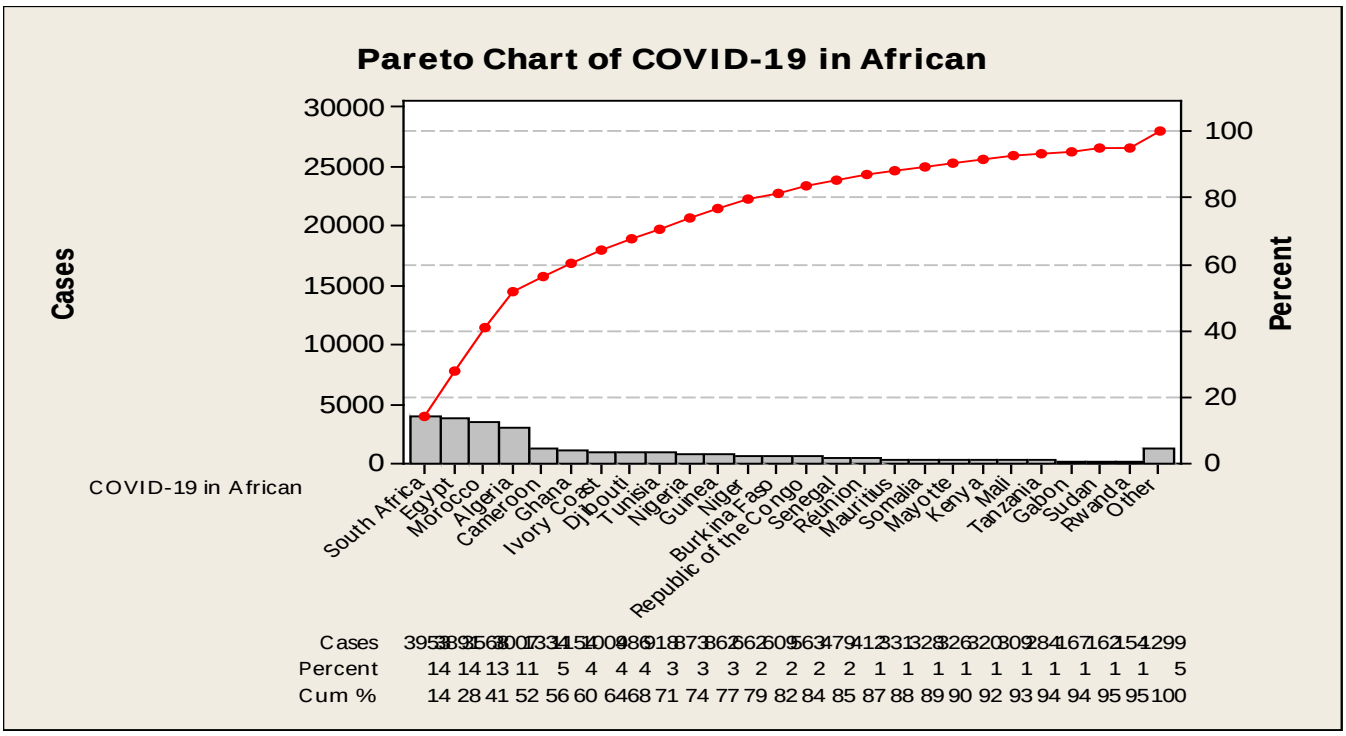


*Figure 3:* Pareto plot of COVID-19 infected African Countries

From the Pareto chart above, intervention efforts by World Health Organization (WHO) and other intervening bodies like Organization for African Union should give a better attention to the 14 countries to the left of the vertical line (South Africa, Egypt, Morocco, Algeria, Cameroon, Ghana, Ivory Coast, Djibouti, Tunisia, Nigeria, Guinea, Niger and Burkina Faso), known as the vital few. Therefore, the government and other intervention bodies should intervene more in these 14 countries among other African countries since they contribute 80% of the total out in the entire infected countries in the continent.

*c) Trend Analysis*

Figure 3 below shows the trend plot for the pattern of the outbreak of COVID-19 in Africa.



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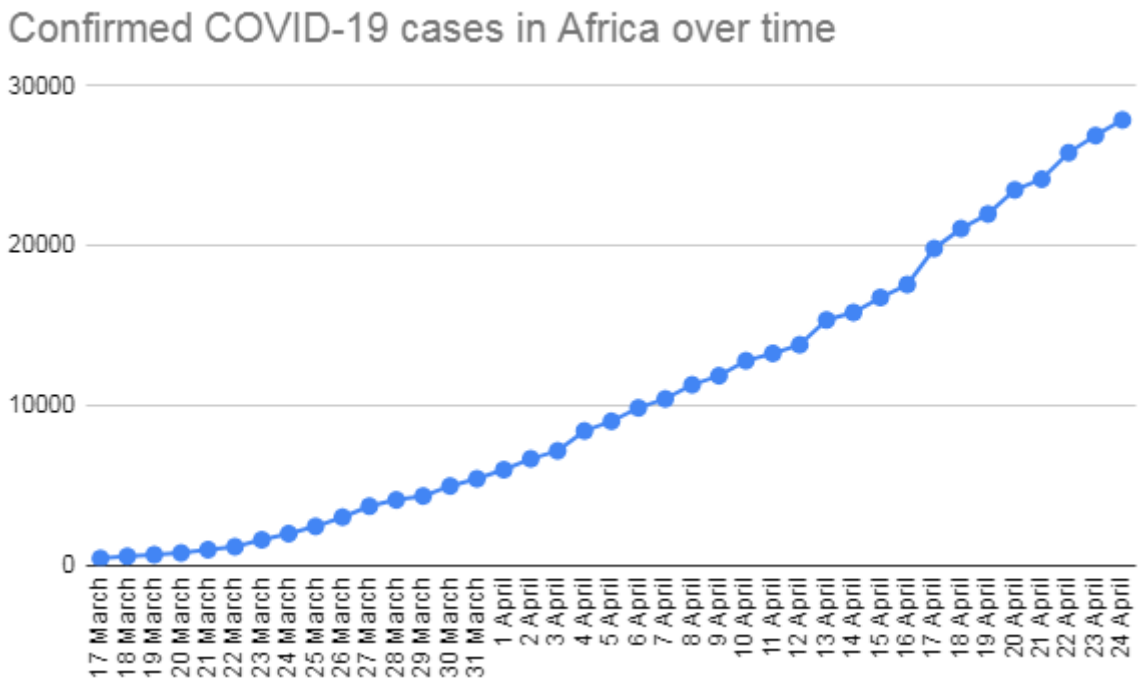


*Figure 4:* Trend plot of both active and daily confirmed cases is an increasing trend from 17th March till 24th of April.

Figure 4 above shows an increasing trend of laboratory-confirmed cases and an upward and downward trend of the daily confirmed cases from the 17th of March 2020. The increase in the rate of spread indicates that more effort need to be put in place to curb this pandemic spread both government and intervening bodies across Africa and the world.

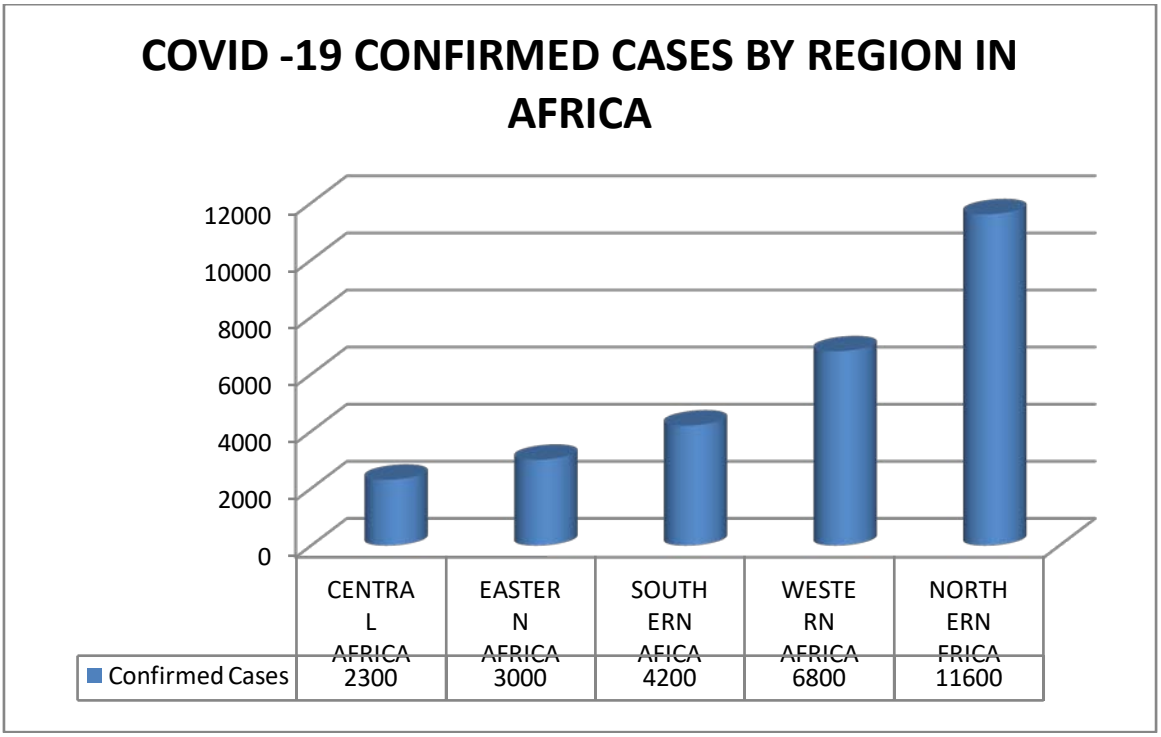


*Figure 5:* Bar chart of confirmed cases of COVID-19 by region outbreak in Africa

The bar chart above shows that Northern Africa has the highest COVID-19 with Western Africa the next, followed by Southern Africa, Eastern Africa, and the least being Central Africa.



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*d) Cumulative Sum (CUSUM) Chart*

The cumulative sum (CUSUM) control scheme is an efficient monitoring tool in detecting small shifts in the mean of a process (death rate). In particular, the Average Run Length (ARL) of CUSUM control charts shows that they are better than Shewart control charts when it is desired to detect shifts in the mean that are less two sigma or less. Let max(a,b) be the maximum of *a* and *b*. The i[th] CUSUM for an upward shift, $S_{hi}(i)$ for the i[th] observation (deaths), is defined as;

$S_{hi}(i) = \max(0, S_{hi}(i-1) + x_i - \mu_0 - k_1)$, where $k_1$ is the reference value for the upward CUSUM.

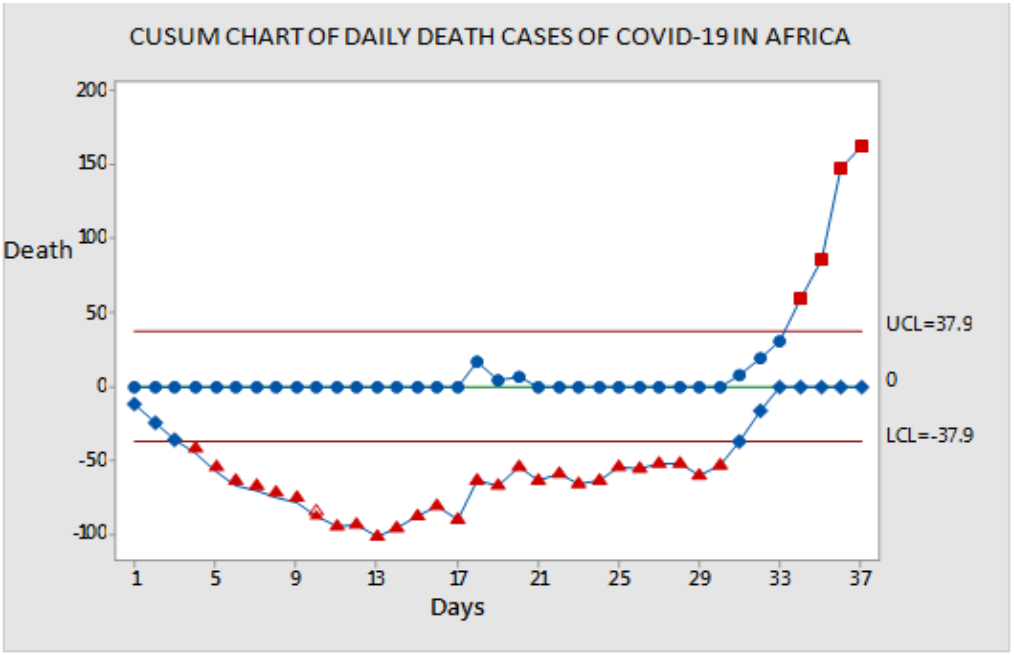


*Figure 6:* CUSUM chart of daily death cases of COVID-19 in entire Africa

The Figure above shows the CUSUM chart of death cases of COVID-19 between the 4th of March and 24th April, 2020. It reveals that the recorded death of COVID-19 in Africa are out of statistical control since the CUSUM points from the last four days (i.e., 21st April to 24th April) plotted above the upper control limit.

*e) Pie Chart*

To assess the performance of strategies put in place to monitor and curb the outbreak of this pandemic in the Africa continent, the number of laboratories confirmed cases, number of death, and number of discharged on testing negative after treatment were plotted in a pie chart using their percentages.

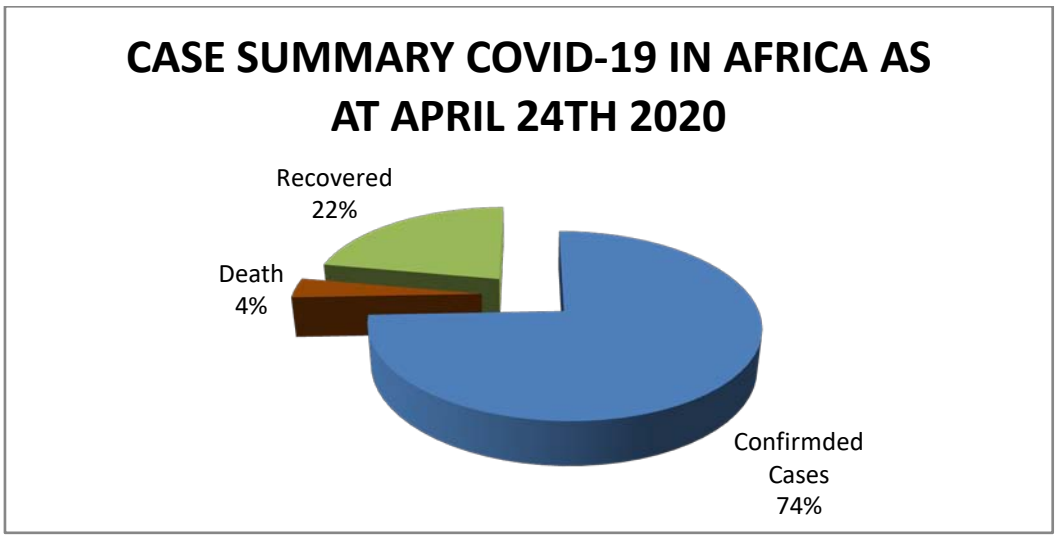


*Figure 7:* Pie chart of summary of COVID-19 cases in Africa



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The number of recovered and discharged cases after treatment is 22%, and the number of death is 4%. This 4% death rate shows that the pandemic control is still under control in Africa.

## IV. Conclusion

This paper aimed at monitoring COVID-19 outbreak in Africa and to make out the effect of palliative measures put in place to curb the spread of the virus by national and international bodies. The study reveals that 14 countries were more vulnerable, comprising of South Africa, Egypt, Morocco, Algeria, Cameroon, Ghana, Ivory Coast, Djibouti, Tunisia, Nigeria, Guinea, Niger, and Burkina Faso. The said 14 constitute the vital few (80%) of the entire outbreak in entire Africa continent. The pandemic is also on an increasing trend, with; Northern Africa having the highest cases of COVID-19 with Western Africa the next, followed by Southern Africa, Eastern Africa, and the least being Central Africa. The study also shows that the death rate of the pandemic is already out of control since the 21st of April, 2020. Lastly, the spreading outbreak is still under control with the measures carried out by various organizations and government in curtailing the spread of the pandemic.

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