COVID-19 Wireless Self-Assessment Software for Rural Areas in Nigeria

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1 Introduction

Wuhan City, Hubei Province, China was the epicenter of an unexplained pneumonia outbreak in December 2019 [5, 10]. After the initial outbreak, a new coronavirus (Severe Acute Respiratory Syndrome Coronavirus2 [SARSCoV2]) was quickly identified as the causative agent and COVID19 was assigned to the associated disease (abbreviation for coronavirus disease, 19 is referred to the year the virus was original detected). The World Health Organization (WHO) on March 11, 2020, declared a pandemic with 3,002,303 cases that were confirmed with 208,131 number of dates worldwide as of April 27, 2020 and many more after [10].

Severe Acute Respiratory Syndrome Coronavirus disease 2019 (COVID 19) caused by coronavirus 2 (SARSCoV2) [5] has physicians, researchers, policy makers, and communities around the world. COVID 19 is the third major coronavirus that has been transmitted from animals to humans in the last 20 years [7]. The global impact was greater than the previous epidemics of 2003 (SARSCoV), 2012, 2015 and 2020 (Middle East Respiratory Syndrome Coronavirus / MERSCoV). Infection by asymptomatic and mildly symptomatic individuals may have promoted SARSCoV2 transmission. This is because SARSCoV and MERS tend to make patients sick, less mobile, and have a higher basic reproduction number (R0) for SARSCoV2 [7]. SARSCoV2 was first detected in China and soon spread around the world. The Americas, South Asia and Europe have been hit hardest ever.

As of the end of March 2021, COVID19 confirmed cases has exceeded 125 million, the deaths caused by the virus has also exceeded 2.7 million, the global

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mortality rate was 2.19% [2]. As of February 21, 2021, COVID19 casualties exceeded the total number of US casualties in World War II, the Korean War, and the Vietnam War. Incidence of COVID19 in Nigeria is gradually increasing, shifting from imported cases of elite patterns to community transmission. The case fatality rate for this event was 2.8%. Hence, Nigeria was able to block the spread of the virus through a combination of social and medical responses [8]. But during the short period of time when the blockade was lifted, the country saw a surge in COVID 19 infections (52 percent of all cases). However, there are proposed methods for diagnosing COVID19 infection, including Nucleic Acid Amplification Tests (NAAT) such as reverse transcription (RT) PCR to detect viral RNA [4]. Where COVID19 community infections are widespread and laboratory resources are limited or unavailable, a standalone wireless application for diagnosing COVID19 is required.

Nigeria has a self-assessment tool, but it's not on the home page of the NCDC, except on the coronavirus microsite. Also, because this self-assessment tool is visually unobtrusive and small, it is unlikely to be widely adopted by the general public. Coupled with the fact that many Nigerians are not proficient in enough technology to find a way to go to the site to take the test, it is unlikely that it has become widespread in general. Therefore, it is important to develop a self-assessment tool that can assess whether a user is at risk and inform them of the steps necessary to keep themselves and others safe. Easy to access and understand. As a result, this article introduced a stand-alone wireless application for COVID19 self-assessment that follows the guidelines of the NCDC. This software has been developed to address current COVID19 issues around the world. Especially in rural Nigeria, it was developed to support self-assessment because there is no network connection to access NCDC's current web-based COVID19 self-assessment website.

2 Related Research

According to the International Journal of Infectious Diseases, NCDC found that within the first 30 days, among the people (age range between 30 to 60 years) that were tested to be positive for COVID19, 70% were males and females were 30%. The most affected were people between the ages of 31 and 50 (39.0%). Approximately 44.0% [3] of cases were imported and 41.0% [9] of patients had incomplete epidemiological data, concluding to an unidentified source of infection. However, Thirty-five patients (15.0%) are identified acquaintances of positive cases, recommending communal or cross infectivity. Lagos happened to had more than half of all the COVID19 cases in Nigeria, then Abuja became the second (20.3%) and Osun the third (8.6%). Abuja and Lagos are well-known as major international airports as well as national commercial and administrative centers [1]. Similarly, many of the indigenous peoples of Ezigubo, the hotspot for this disease in Osun, work in Côte d'Ivoire and other bordering countries and have handled hundreds of COVID19 cases. Many of them were tested positive for COVID19 after being forced to return

to Nigeria for COVID19. Since the first index and other imported cases, it has continued to spread to other states through interstate travel. The distribution of Nigerian disease was elite in the first 30 days of COVID19. Most of the people that were tested to be positive were people that arrived from overseas [1]. Due to the high poverty rate in Nigeria, air travel is primarily elitist. Among the people that were earlier tested to be positive for COVID19 were 3 governors and several political appointees, which placed many political elites at risk. COVID19 was initially considered a disease in which the elite returned from traveling abroad and inter-acted with political bourgeoisie based on (early) patterns. Control efforts have been hampered by this unabated view. COVID19 broke the class barrier earlier than planned, indicating a community infection. It was the responsibility of everyone in Nigeria [1].

Since the transmission route of COVID19 it became very essential for people to take precautionary measures (safe hand washing, social distance, staying at home, etc.). The nature of Nigeria's social life and reality is changing as a result of these behavioral changes. In the face of completely inadequate palliative care, new social normality is negatively impacting livelihood and viability [11]. Experiences and lessons learned from the most affected countries (eg, US, UK, Italy, France, Spain) shows that no government is well prepared to contain the COVID19 pandemic. Few countries in the world have achieved testing all its citizens. In most nations, the COVID19 epidemic has created significant obstacles such as a shortage of medical staff to care for patients, medical resources (especially personal protective equipment [PPE] and ventilators), and infrastructure [12]. Many health experts predicted that if a coronavirus pandemic was identified on the continent, Africa would have a hard time controlling it. Concerns arose from widespread poverty, inadequate treatment, and the illnesses that plagued much of Africa. In Africa, there wasn't any country that was reported to be infected with COVID19 as of seventh June 2020 [1]. General testing is an important A total of 192,721 confirmed cases (Africa) killed a total of approximately 5200 and recovered 85,107 tool for discovering instances. However, due to lack of resources, it may not be possible to conduct a universal testing in various parts of Africa, which includes Nigeria. However, until a solution is found, the imperfect but best effort to stop the infection is a small benefit and a step in the right direction. Between 6 and 8 February, the Africa Centers for Disease Control and Prevention (ACDC) trained experts from Nigeria and 15 other African countries to use the polymerase chain reaction (PCR) to produce COVID19 diagnosis [1]. As a result, most tests were performed in molecular laboratories using PCR assays, but investigations are underway to assess the integrity of the Rapid Diagnostic Test (RDT) kit. As soon as GeneXpert machines are available, their integration is planned, in Nigeria, 76,802 people were tested between February 27 and June 7 (see Table 1). Due to lack of testing and treatment resources, the Federal Government of Nigeria has decided to test only those who need it urgently. This will test other countries in the region that already handle hundreds of COVID19 cases. Many of them were tested positive for COVID19 after being forced to return to Nigeria for COVID19. Since the first index and other imported cases, it has continued to spread to other states through interstate travel.

Table 1 Age group suitable for Covid-19 test

Adults over 18 years old	Self-testing and reporting, support as needed
Youth in old age 12–17	Self-test and report under adult supervision Adults can run the test as needed
Children under 12 years old	Children under the age of 12 should be tested by an adult. Do not run this test unless you are sure about your child's test. If the child feels pain, do not continue the test

As a result, the following are tested:

1. Those who have returned from an overseas trip and have symptoms between 1 to 14 days of their arrival (they are recommended to quarantine themselves for 2 weeks after their arrival to Nigeria).
2. The people that came in contact with other people that are confirmed to be COVID19 positive and showed symptoms with 14 days.

Individuals with COVID19-related symptoms of unknown origin 4 and individuals with moderate or high prevalence of COVID19.

As a result, the number of molecular laboratories that can test COVID19 has increased from 5 to 23 (as of June 7, 2020). That time, no private molecular laboratories are used for COVID19 testing in Nigeria. Over three months after the index case was confirmed, more than one-third of the 36 states still lack testing labs. If a case is suspected in a state without a test center, the sample should be transferred to Abuja, the federal capital of Nigeria, or one of the accessible molecular laboratories [1]. Despite the fact that there is no cure for COVID19, NCDC reported that treatment of COVID19 patients follows the criteria set by the ACDC.

Figure 1 illustrates the recovery rate from COVID19 as of June 7, 2020. The typical treatment period for positive patients is one month. The majority of people who died from the infection in Nigeria had serious underlying health problems exacerbated by the coronavirus infection. Based on international best practices, NCDC has created a prescription for safe burial techniques that reduce the risk to the deceased's loved ones. COVID19 requires expert laboratory diagnostics and a rigorous treatment protocol. Therefore, while PTFs value this for limited resources and facilities, home care by the primary caregiver (relatives) is not an option. The virus is highly contagious and requires personal protective equipment (PPE), even at the forefront. If implemented, home care options could lead to an increased burden of COVID 19 in Nigeria.

3 Methodology

This software is written in the C ++ programming language developed by Bjarne Stroustrup as an extension of the C programming language. This is also known as "C with classes". The first step in achieving these goals was to consider various self-assessment programs. The fact that some of these self-assessment tools are based on the Centers for Disease Control and Prevention (CDC) standards was our first discovery as shown in Fig. 2.

Timeline of Coronavirus Outbreak in Nigeria (February 27- June 7, 2020).

	Number	Percentage
Incidence of Coronavirus February 27 – March 27 (first 30 days)		
Total positive cases	81	
Total discharged	3	3.7% (of positive cases)
Total deaths	1	1.2% (of positive cases)
Incidence of Coronavirus February 27 – April 27, 2020 (first 60 days)		
Total positive cases	1337	12.2% (of the total tests)
Total discharged	255	19.2% (of positive cases)
Total deaths	40	3.0% (of positive cases)
Total tests	10,918	
Incidence of Coronavirus February 27 – June 7, 2020 (first 100 days)		
Total positive cases	12486	16.3% (of total tests)
Total discharged	3957	31.7% (of positive cases)
Total deaths	354	2.8% (of positive cases)
Total tests	76802	

Source: Nigeria Centre for Disease Control (NCDC, 2020; Worldometer, 2020)

Fig. 1 Timeline of Coronavirus outbreak in Nigeria

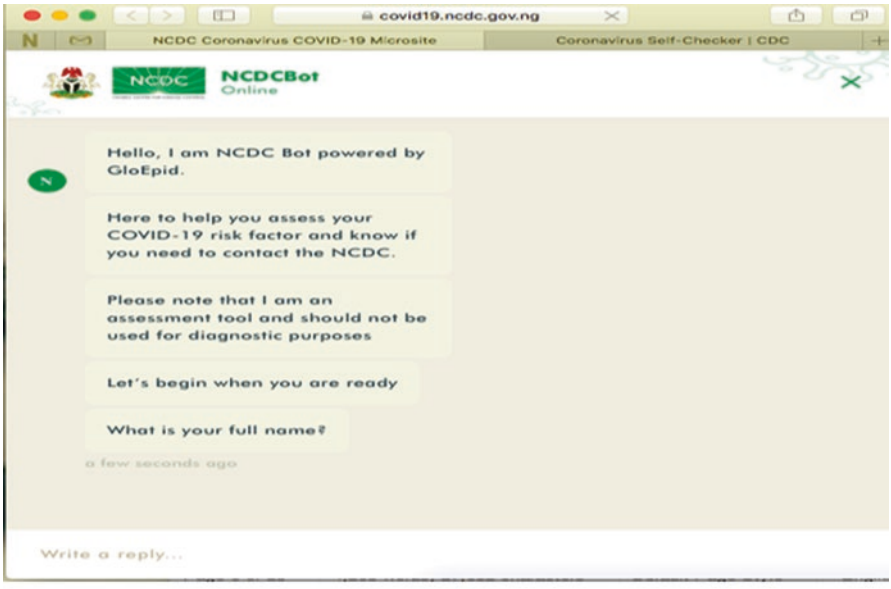

Fig. 2 Example of online assessment tool

Therefore, Fig. 3 shows a list of CDC screening protocols. It serves as a guide for the COVID19 self-assessment test form. This CDC screening protocol also served as a very useful guide to the symptoms and effects of the virus on the body. Therefore, this paper has adapted the CDC logging algorithm to a related version

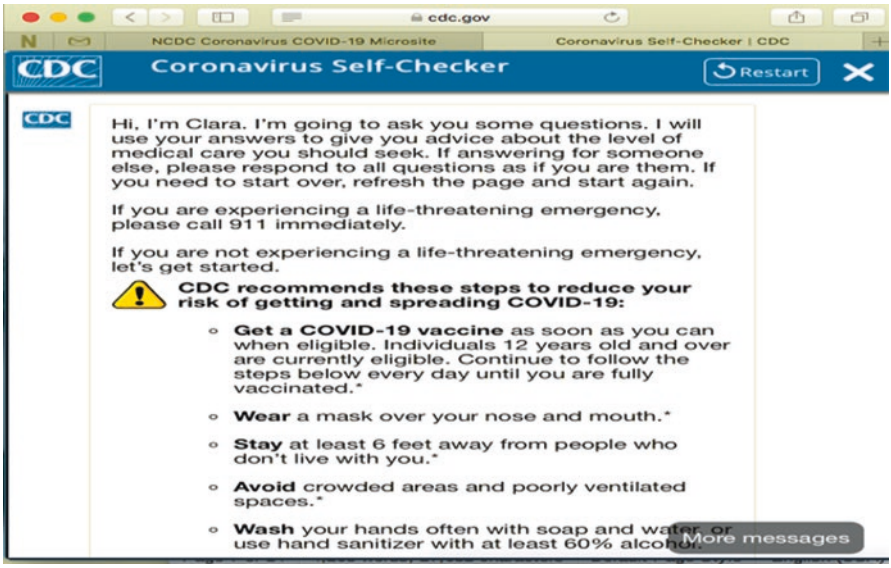

Fig. 3 Example of online assessment tool

that can be used with Nigeria's wireless self-assessment tools. To date, when COVID19 self-testing has been introduced, COVID19 has been used primarily in work environments with a high risk of exposure (such as medical facilities) or a high concentration of people (such as schools), as well as research environment. The Covid19 test is suitable for the following groups of people listed in Table 1.

4 Proposed Program Flow

Start Program
Enter Your Name:
Enter Your Body Temperature (Can Be Checked with Temperature Checker Available Immediately).

Ask About Life Threatening Symptoms.
Base On Your Answer, You'll Be Asked:

If You're Feeling Sick.

Based On Your Answer, You'll Be Asked:
If You Visited or Come Close with A Covid19 Patient.
If Yes, You'll Be Instructed to Seek Urgent Medical Attention.
If No, You'll Be Instructed to Monitor Your Symptoms and Take Care of Your Self and Stay Away from Covid19 Patient.

End of Program.

4.1 Advantages of Using the Self-Testing

1. Reduced risk of infection associated with travel to health care workers (HCW) or visits to laboratory clinics.
2. Convenience that you can take the exam at any time.
3. Reduces the burden on healthcare professionals / laboratory staff for collecting and analyzing specimens and reduces occupational exposure to healthcare professionals.
4. Results are readily available.
5. Cheaper than lab-based testing (taking into account HCW and / or lab staff time, lab consumables, etc.).
6. Reduces equipment and human / machine overhead and reduces pressure on the medical system.

4.2 Step by Step Guide on how to Use the Software

Step 1 - Open the .exe and wait for it to load.

Step 2 - The output screen opens when it finishes loading. It asks for your name first, and then display information about the software as shown in fig. 4.

Step 3 – The self-assessment test starts immediately; well-structured questions are asked. This questions are based on the Center for disease control (CDC) and prevention.

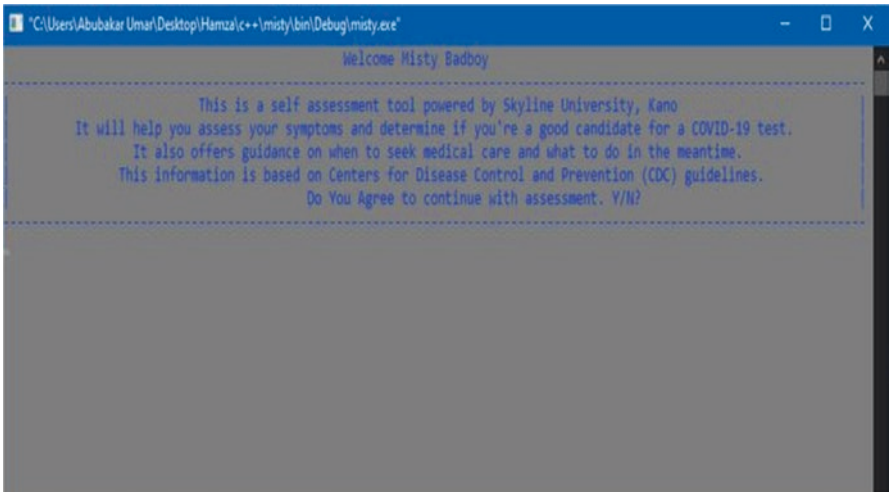

Fig. 4 Welcome page

Figure 5 shows the set of self-assessment questions displayed to the user and the answers are expected to be provided by the user before it moves to the next question.

As shown in fig. 6, at the end of the self-assessment, the result will be available immediately. However, based on the questions answered above, urgent medical attention is needed.

Hence, in fig. 7, based on the self-assessment result, it shows that user is safe, but have to monitor the symptoms. Here, the user answered the questions respectively to determine whether he/she requires medical attention.

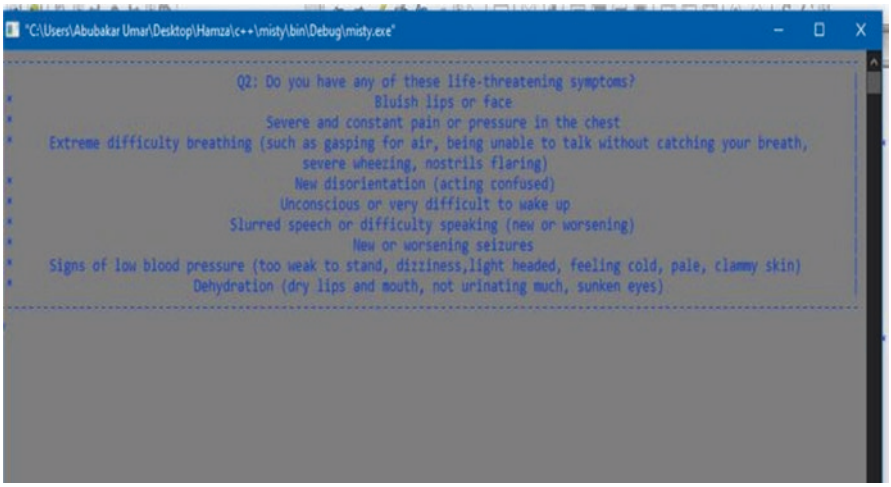

Fig. 5 Sets of self-assessment questions

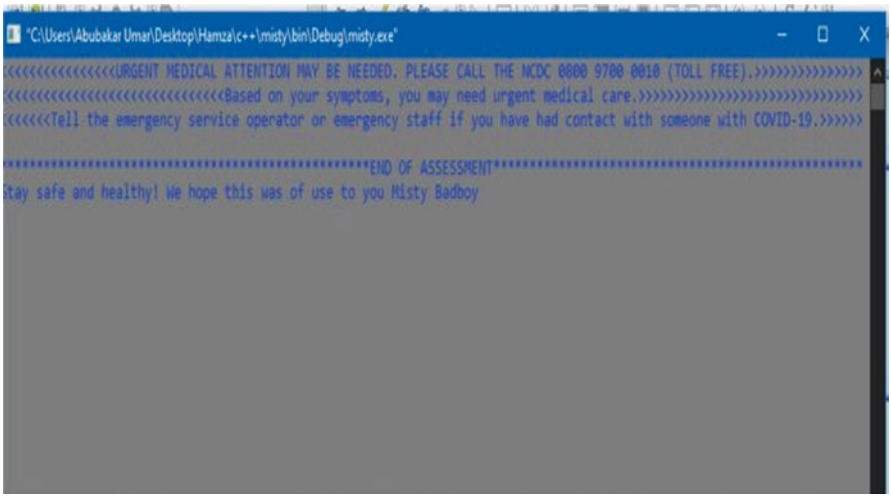

Fig. 6 Self-assessment result – Sample 1

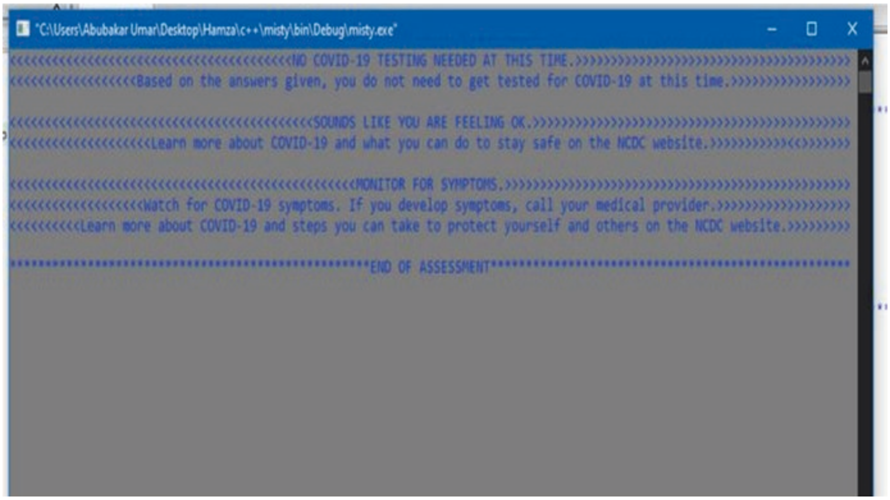

Fig. 7 Self-assessment result – Sample 2

5 Conclusion

In most other parts of Africa, the numbers indicate low levels of COVID19 cases. However, this is partly due to the low level of testing. In addition, many are skeptical of the existence of the virus. Therefore, testing is essential to control the spread of COVID19. If you have symptoms, or if you know that you have contacted someone with suspected or confirmed COVID19, you should be tested regardless of your vaccination status. While there is a self-assessment tool, but it is not on the NCDC web homepage but rather on their coronavirus microsite. And this self-assessment tool is visually unremarkable and small as to make it stand out from the barrage of information on the webpage and coupled with the fact that a lot of Nigerians aren't savvy enough to find their way to the website to conduct the test, it is very unlikely that it has been used extensively by the public. Therefore, this paper proposed a standalone wireless application intended for COVID19 self-assessment while taking into account the NCDC's protocols. The software was developed in view of the current challenges of COVID19 in the world, particularly to help aid self-assessment in the rural areas in Nigeria due to lack of network access for the local people to get the current web-based COVID19 self-assessment provided by the NCDC. Thus, the self-tests can be performed by a person at home or anywhere. This is because many persons infected with coronavirus (COVID19) show just minor symptoms or none at all, they can still spread the virus. Regular self-testing, on the other hand, can help slow the spread and safeguard the most vulnerable members of our families and communities.

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