



A Review of the Results of Senegal's Response to the COVID-19 Pandemic Through State of Emergency and Curfew

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Abstract

Public health security is about preventing and controlling infections around the world. These measures are everyone's business to ensure the prevention of any outbreak of diseases with epidemic potential. Africa may be particularly well placed to have the most serious and under-detected outcomes related to COVID-19 infection. This paper aims to examine the results of Senegal's response to the COVID-19 pandemic through a state of emergency and curfew. The methodology is based on the analysis of COVID-19 data in Senegal and a critical review of relevant articles to date and journal publications on the subject. The results show, despite the barrier measures taken, the state of emergency and the curfew, an increase in the number of newcomers in recent days, the majority coming from Dakar. This could be an indication of the spread of the virus in the general population as the government intensifies testing beyond clinical symptoms. In Senegal, the problem of high unemployment and the informal economy, which has been exacerbated by measures taken to contain and control the spread of the virus, will require specific interventions to mitigate the livelihoods of this group. With the recent announcement of a plan to relax measures, new guidelines and stricter procedures such as the wearing of masks need to be put in place and monitored to slow the rapid spread that could overwhelm the country's health systems and economy. Such measures and strategies to contain COVID-19 should enable Senegal to provide a robust response to the pandemic.

Keywords: Pandemi; COVID-19; State of emergency; Curfew; Senegal.

1. Introduction

Humanity has experienced outbreaks for millennia, from epidemics limited to universal pandemics that have claimed many victims and changed the course of civilizations. The advent of vaccines has eradicated some serious human pathogens and mitigated many others. However, pandemics are still part of our modern world, as we continue to have pandemics as devastating as HIV and as alarming as Severe Acute Respiratory Syndrome, Ebola and Middle East Respiratory Syndrome [1]. The COVID-19 epidemic with exponential curves reaching 3 million confirmed cases should not have come as a surprise. However, we seemed to ignore the past. [2]. Unfortunately, COVID-19 is not the last pandemic in the world and we need to learn what we missed and how to avoid failures [3].

Initially, pneumonia as an unknown upper respiratory infection reported by China was identified in Wuhan, China, and first reported to the World Health Organization (WHO) on 31 December 2019. Following WHO investigations of this new infection in China, WHO declared an outbreak as a public health emergency of international concern on 30 January 2020. On February 11, 2020, the World Health Organization named the outbreak COVID-19 [4]. It is now a global public health problem, which is accompanied by economic, social and development catastrophe for all nations of the world. It has spared no part of the world's population. It has left a trail of high morbidity and mortality in a very short period of time, leaving the world's population in a state of panic. The reason is that this virus has no therapy or vaccine to combat it. During this short period, while health experts are trying to find a cure and/or a vaccine, which takes time to move from experimentation to human use safely and with proven efficacy, the only option is to prevent its spread among humans [5].

New epidemiological trends on transmission and mortality in Africa and the most affected regions of the world suggest that better studies of this infection in sub-Saharan Africa than in other regions of the world are needed. The COVID-19 pandemic has lower rates of local transmission and mortality in Africa, the region where the virus was the last to arrive [6]. The daily statistics emanating from the high infectious property of the new coronavirus strain COVID-19, particularly its rapid transmission worldwide and the nature of the resulting deaths that sweep across countries, call for concerted efforts to limit local transmission in already colonized territories. Guidelines have been

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proposed for the prevention and containment of this pandemic. Countries quickly adopted these guidelines for prevention and containment and quickly implemented them without any experience of proven positive results against this new virus. The outcome of the pandemic in this short period of time worldwide is as follows: as of 25 May 2020, a total of 25,537,177 people have been infected, 2,869,500 active cases of the virus, more than 347,293 deaths, more than 53,263 critically ill and more than 2,320,384 recoveries [7].

All these responses are aimed at mitigating the impact of the virus on human life. It is too early to know whether they will slow down transmission, human mortality and suffering, not to mention economic devastation. Recent trends in transmission, morbidity and mortality around the world, however, seem to be at odds with the predictions of unhappiness for the people of sub-Saharan Africa. Current statistics that place Africa in the least affected region (as of 25 May 2020) with 108,644 cases and 3,270 deaths raise many questions given the particular social and infrastructural vulnerability of this region [8].

Since the first case of COVID-19 was confirmed in Senegal on 2 March 2020 [8], the Government of Senegal has taken measures to minimize the spread and impact of the virus. On March 18, 2020, the Ministry of Health and Social Action issued a regulation to prevent an escalation of the COVID-19 pandemic in Senegal. On 23 March 2020, 21 days after the detection of the first case of local transmission, President Macky Sall declared a state of emergency and instituted a curfew throughout the territory [9]. Senegal, which experienced the Ebola epidemic in 2013 and 2014, therefore did not wait for the increase in cases to take rigorous measures. Thus, in addition to curfews, schools and universities were closed, prayers in places of worship were banned, transport was reduced and strict hygiene rules were imposed [10]. Senegal has a large population of informal workers and business owners (41% of the working population) whose livelihoods and economic stability are threatened [11].

Despite the Senegalese government's swift and decisive action, COVID-19 still poses a high threat to the country [12]. This is due to the size of the high-risk population, such as the high prevalence of tuberculosis and other previous conditions, the high population density in informal settlements, and the low capacity of the health system to handle large numbers of patients. As of May 25, 2020, a total of 3,130 infected persons had been recorded, 1,580 active cases of the virus, 35 deaths, 12 in critical condition and more than 1,515 recoveries (WHO, 2020a). COVID-19 also poses a threat to Senegal's economic stability [12]. While the total opening up of economic activities is likely to exacerbate disease transmission, social isolation and remoteness have inevitable economic and financial repercussions, which disproportionately affect vulnerable and low-income populations [5]. Despite the progression of the pandemic, the President has relaxed measures, bringing Senegal into a new phase in which every citizen must learn to live in the presence of the virus by adapting his individual and collective behaviour to the evolution of the pandemic [13].

During this period, Senegal adopted many responses to the pandemic: preserving public health and strengthening health systems, social protection and economic stabilization [12]. In order to limit the economic impact of this health crisis, a response and solidarity fund, Force-COVID-19, has been created by the government and will be endowed with CFAF 1,000 billion. An envelope of CFAF 50 billion will be devoted to the purchase of food for emergency food aid, particularly on the eve of Ramadan. In addition, Law No. 2020-13 empowering the President of the Republic to take, by ordinances, measures within the scope of the law to deal with the COVID-19 pandemic and authorizing the extension of the state of emergency [10]. The aim is to minimize the health, social and economic impact on the population, especially the poor and vulnerable. To do this, health systems must develop strategies to stop the chain of transmission. For this, Senegal needs functional health facilities that can provide symptomatic treatment and hospitalization of cases, as well as infrastructure, equipment and human resources that can manage the disease and prevent mortality [8].

In such emergencies, the social and health implications of response measures to limit the spread of the COVID-19 virus must be considered and interventions carefully planned [3]. This can be achieved through sound and responsible government approaches. The objective is to ensure that the pandemic does not spread to populations that the Senegalese health system could not handle, to reduce the proportion of the population whose living conditions could be worsened by the pandemic, and to reduce Senegal's capacity to care for its population. Economic stability and recovery must also be guaranteed so that the Senegalese economy does not collapse during this period [12]. The Force-COVID-19 must do everything possible to prevent poverty, unemployment and inequality from reaching certain proportions. Small enterprises, including informal trade, must be supported to enable their rapid recovery after the COVID-19 period. The objective of this paper is therefore to review the results of Senegal's response to the COVID-19 pandemic through the state of emergency and curfew. The challenges to health care delivery systems in the context of the COVID-19 pandemic and possible strategies for improvement in such contexts are highlighted.

2. Materials and Methods

2.1. Description of the Study Area and Context

The Republic of Senegal, located on the extreme western tip of the African continent, covers an area of 196722 km². In 2013, its population was 13,508,715 [14], a population estimated in 2018 to be 15,850,000 [15]. A coastal country with 700 km of Atlantic coastline, Senegal is located between 12.5° and 16.5° north latitude and 12° and 17° west longitude, and has three climatic domains: southern Sudanian, northern Sudanian and Sahelian [16]. The Senegalese territory is bordered to the north by Mauritania, to the east by Mali and to the south by Guinea and Guinea Bissau. The Republic of the Gambia is an enclave 25 km wide and nearly 300 km deep inside Senegal. **Table 1** gives the evolution of some characteristic information of Senegal, more or less useful for the characterization of COVID-19.

Table-1. Some characteristic information about Senegal World Bank data (Données Banque mondiale) [15]

Settings	1990	2000	2010	2018
Total population (in millions)	7,53	9,80	12,68	15,85
Population growth (annual %)	3.0	2.4	2.7	2.8
Population density (people per km ² of area)	39.1	50.9	65.9	82.3
Poverty ratio at \$1.90 per day (2011 PPP) (% of population)	67.9	48.3	38.0	-
Gross National Income per capita, Atlas method (in US\$)	900	650	1340	1410
Life expectancy at birth, total (in years)	57	58	64	68
Fertility rate, total (births per woman)	6.4	5.4	5.1	4.6
Under-five mortality rate (per 1,000 live births)	139	132	66	44
HIV prevalence, total (% of population aged 15-49)	0.2	0.6	0.6	0.4
Gross Domestic Product (GDP) (in Billions US\$)	7.24	5.92	16.22	24.13
GDP growth (annual %)	-0.7	3.2	3.6	6.8
Agriculture, forestry and fisheries, value added (% of GDP)	18	17	16	17
Industry (including construction), value added (% of GDP)	20	20	22	26
Outstanding external debt (in US\$ million)	3750	3653	3909	12273
Net official development assistance received (in US\$ million)	811,7	432,1	936,4	991,6

The Senegalese health system is mixed, with both public and private health care provision. The health system is organized according to a three-tier pyramid scheme. The operational peripheral level constitutes the base of the pyramid, which corresponds to the health district. There are 69 districts in Senegal and each district is made up of at least one health centre, health posts located in the communes, the chief towns of rural communes or relatively populated villages. The intermediate level corresponds to the Medical Region in charge of putting health policies and strategies into action. There is one in each administrative region. The central level includes the minister's office, health directorates and services responsible, among other things, for developing health policies and mobilizing and providing the resources necessary to achieve health objectives [17].

Senegal understood very early on the importance of the health sector in economic activity and reaffirms this commitment by ratifying international texts. Thus the Government of Senegal has worked to ensure that quality curative, preventive and promotional health care is accessible to all social strata of the population without any form of exclusion and where an economically and socially productive level of health is guaranteed. To this end, the establishment of the universal health coverage programme guarantees the population access to a minimum package of care [18].

The State is involved in the organization of the health system and is generally visible at several levels. However, as in all sub-Saharan countries, the weight of the colonial legacy, the absence of social security mechanisms, programmatic will, the typology of care, the footprint of international institutions, and dependence on budgetary availability pose major accessibility problems [19]. Although social security coverage is almost non-existent, the social security fund is austere and still operates according to texts dating back to colonialism: the Bismarckian model [20]. At the management level, the Ministry suffers from poor coordination of the activities of the technical directorates and medical regions. In Senegal, the governance of the health system is marked by the institutionalization of the elaboration of ten-year health development plans since 1998 and the practice of planning at all levels of the health pyramid.

Despite the hospital reform, health structures in Senegal are plagued with illnesses that slow down their proper functioning [18]. These include [20-23]: The state of the buildings (feeling of abandonment and dilapidation despite the fact that most of the hospitals were recently created); the state of the equipment (extreme weakness of the technical platform in Senegalese hospitals, enormous difficulties in the regular maintenance of medical imaging and/or laboratory equipment); the availability and distribution of human resources (lack of human resources); the insufficient number of staff admitted to training structures; the lack of control over the recruitment process in the civil service; the inadequacy of staff retention measures.

Senegal, a developing country, is strongly affected by the current COVID-19 pandemic. In this context, access to quality and sustainable health care remains the greatest challenge. In spite of the achievements made in terms of the fulfilment of the MDG3 ("*enabling all people to live in good health and promoting the well-being of all people at all ages*"), the general observation unfortunately remains the same: the population still suffers from a lack of access to care. In order to deal with this unprecedented global health crisis, the Government of Senegal has taken a number of health and safety measures to stem the spread of the coronavirus in the country is a priority, measures that will above all correct the structural deficiencies that make our health system vulnerable.

2.2. Matérials and Methods

The statistics on COVID-19 used in this study come from the databases of the World Health Organization (<https://www.worldometers.info/coronavirus/>) and the Ministry of Health and Social Action (MSAS) of Senegal (<http://www.sante.gouv.sn/Pr%C3%A9sentation/coronavirus-informations-officielles-et-quotidiennes-du-msas>), and are dated Monday 25 May 2020. The analysis of quantitative data is combined with population health and economic data based on literature reviews. It consisted essentially of a consultation of documents (publications, reports, articles, journal publications) that are of great interest for this theme. This allowed us to collect various data and available information related to the COVID-19 pandemic in Senegal and in areas where similar studies have been conducted. Other information used on this article comes from structures such as the WHO, the World Bank, the

MSAS of Senegal and other ministries that are related to the fight against COVID-19. From the data, trend lines were represented, and regression and correlation analysis was performed to establish relationships and generate predictive regression equations for each variable.

3. Results and Discussion

3.1. Evolution of the Pandemic and Senegalese Response

As of May 25, 2020, Senegal has reported 3,130 infected persons, including 1,580 active cases, 35 deaths related to COVID-19 [7] and 35,016 persons tested for COVID-19. The first case was reported on 2 March 2020. The first death related to COVID-19 was reported on 01 April 2020 and increased steadily, albeit slightly, during this period. Projections indicated an upward trajectory of cases reported daily. From 02 March to 20 April, the number of new cases rarely exceeded 20. Since April 21, the number of new cases has peaked well above the exponential curve, which is difficult to explain, except to assume that more people came forward with symptoms and eventually tested positive for COVID-19. However, on 23 March 2020, 21 days after the detection of the first case of local transmission, when President Macky Sall declared a state of emergency and established a curfew throughout the country [9], the number of tests carried out hardly reached 100 and the number of new cases was still very low. To date, out of 60 tests carried out, 12 had returned positive, including 6 imported cases, 2 follow-up contacts and 4 from community transmission, making a total of 79 cases declared positive, 8 of which were cured and 71 still under treatment [8]. However, despite the measures taken, cases have continued to increase. Only the announcement of these measures by the State on 23 March 2020 was to flatten the exponential curve. Although the number of positive COVID-19 cases reported since the lockout is increasing, it is below the exponential curve, which may suggest that the lockout interventions are having some effect on transmission.

As soon as the first case appeared on 2 March this year, the Government of Senegal put in place a quota strategy for the disease, which it adjusted as it evolved [13]. Recently, the Ministry of Health and Social Action has intensified screening and random testing, which is a better tool for measuring the existence of infection in the general population, as opposed to testing only those with clinical symptoms and/or those who were in contact with other COVID-19 affected individuals. Indeed, since April 21, the number of tests performed has risen dramatically to around 1000 or more. For example, on May 11, 2020, out of 917 tests performed, 177 had returned positive, including 0 imported cases, 169 follow-up contacts and 8 cases from community transmission, making a total of 1,886 cases declared positive, of which 715 were cured, 19 died and 1,151 were still under treatment [8].

However, despite this meteoric rise in the number of cases of COVID-19 and the spread of the pandemic over a large part of Senegalese territory (23 out of 45 departments affected), the President has relaxed measures, bringing Senegal into this new phase where every citizen must learn to live in the presence of the virus, adapting his individual and collective behaviour to the evolution of the pandemic [13]. Thus, as of 12 May 2020, curfew hours were reduced from 9 p.m. to 5 a.m. (instead of 8 p.m. to 6 a.m.), office hours were reorganized from 9 a.m. to 4 p.m., markets and other businesses (which were subject to special opening days) were open for 6 days, weekly markets were reopened (but within the limits of each department), and places of worship were also reopened. Such measures are expected to reduce the suffering of the population, but at the same time promote the spread of the pandemic throughout the country.

Fig-1. Trend lines for the number of new cases of COVID-19 in Senegal Data sources: [Ministry of Health and Social Action \[8\]](#)

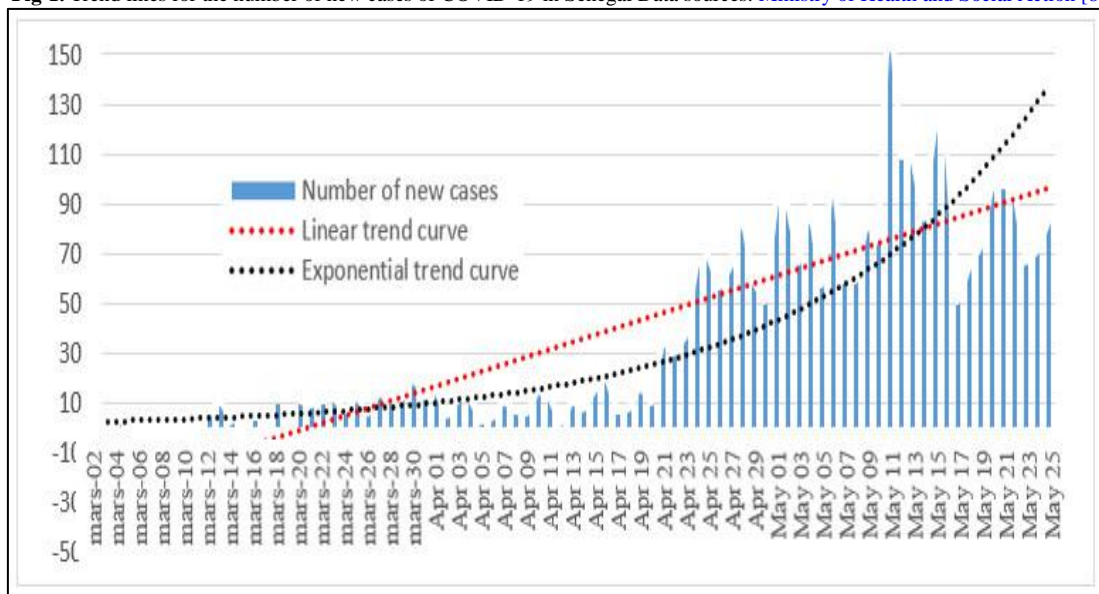


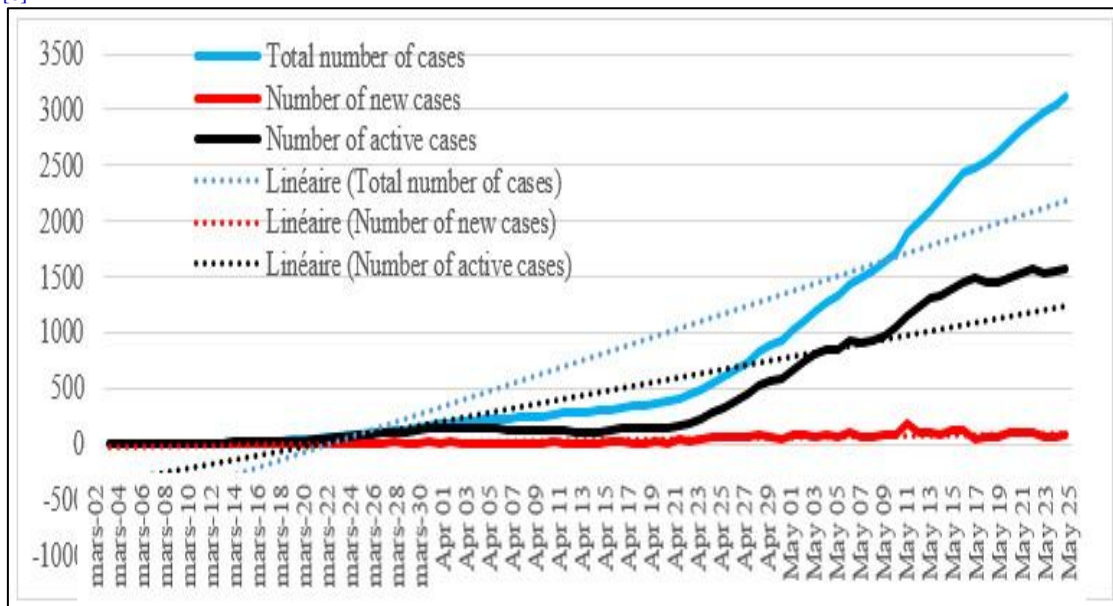
Fig. 1 confirms that, cumulatively, new cases of COVID-19 in Senegal, which was very low between 2 March and 20 April (the number of cases rarely reaching 20 cases per day), increased significantly over the period from 21 April to 25 May. Over this period (particularly between 24 April and 25 May), the number of new cases generally remains stable, despite an increase in the period from 11 to 16 May with values exceeding 100 cases per day.

However, since this period of 16 May, the number of new cases has started to decrease, although still significant (values ranging from 50 to 98 cases per day).

From March 2 to May 25, 2020, the total number of cases and active cases of COVID-19 increased drastically (Fig. 2). The total number of cases increased from one case on March 2, 2020 to 3130 cases on May 25, 2020. The number of active cases increased from one case on March 2, 2020 to 1580 cases on May 25, 2020. However, the number of active cases started to drop below the cumulative number of cases in early April. This means that the cases of COVID-19 retract, which may be the result of recovery or death [5].

Based on current statistics, the Fig. 2 show that we expect a significant number of recovery cases. Proportionally, out of the total number of cases, 1515 have recovered, representing 48.4% of all cases [8]. The slow rate of recovery may be due to the long time it takes for COVID-19 cases to recover. Since the first reported case on March 2, 2020, we began to see (beyond the first case that recovered 6 days later) actual recovery cases around March 20, 2020. This means that there is a time lag between when the diagnosis is made and when the test for the disease is negative. Thus, in the health care system, hospital beds are occupied by a COVID-19 patient for an extended period of time until recovery. Each day, the number of new positive cases is added to the pool of those who will be hospitalized for a period of time, the time it takes for these patients to be tested and to test negative. The protocol for managing this disease in Senegal requires that each positive case be isolated and quarantined until the test is negative.

Fig-2. Trend lines for total number of cases, new cases and active cases of COVID-19 in Senegal Data sources: Ministry of Health and Social Action [8]



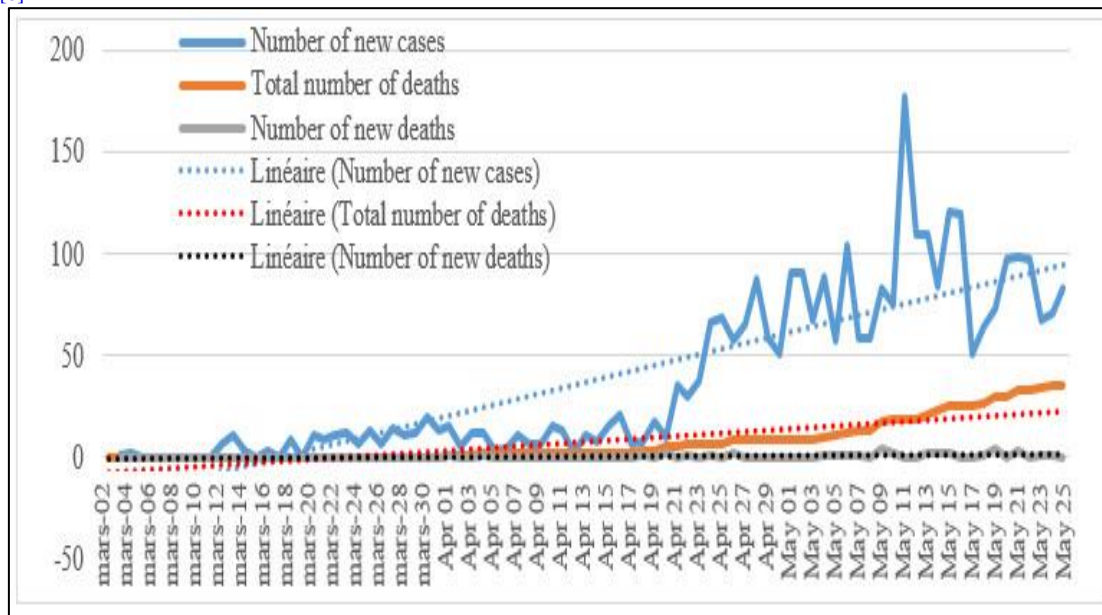
Other variables need to be monitored to make responsible decisions about this pandemic. These variables are important to know the extent of the existence of this virus in the population, the extent to which infected people recover from the disease, the extent to which infected people do not recover and eventually die from complications related to the virus. For new cases, in the first few weeks since the start of the pandemic, testing of individuals was based on the presentation of clinical symptoms. This means that people were tested when they presented to health care practitioners with one of the symptoms of IDVOC-19. This was the case of the first case that tested positive for COVID-19 and actually stayed only 6 days on hospital beds to test negative. The limitations of this approach are that it does not really allow us to know the level of spread of the virus in the population. By using this approach, many people who do not have symptoms but are infected cannot be counted in the pandemic statistics.

In order to better monitor the spread of the pandemic in Senegal, the Ministry of Health and Social Action has started to carry out mass testing in the population (with priority given to contact cases of COVID-19 patients) over the period from 21 April to 25 May. The aim is to measure the spread of the virus in the population, as it has been noted that those who do not show symptoms can transmit the virus. This increase in the number of tests may also have influenced the increase in the number of new cases from 21 April 2020. The advantage of increasing the number of tests is that it allows a better understanding of the behaviour of the virus in the population. Today, Senegal needs to start screening the general population and investing in random population testing, especially in communities that are prone to easy transmission, such as informal settlements and outbreaks. Other vulnerable groups at risk of infection are front-line workers such as health workers, security personnel, market traders and pharmacists. These people are always in contact with the general population because of the nature of their work.

All countries in the world have based their control and containment measures on reducing deaths from the virus, with deaths being kept to a minimum. However, in the absence of treatment, deaths are inevitable. Senegal, for the moment, has experienced two very low peaks in daily mortality (4 deaths on 9 May and 19 May 2020), but has fallen far short (Fig. 3). After the onset of the pandemic in Senegal (March 2, 2020), it took a month (April 1, 2020) to note the first case of deaths related to COVID-19. In total, in 84 days of COVID-19, Senegal recorded only 35 deaths in total (which is relatively low compared to the statistics noted in Western countries) and 63 days during which no

COVID-19-related deaths were reported [8]. Many factors are thus evoked to explain this more resistant character of the African ecosystem compared to that of other continents where the number of deaths is counted in thousands. According to several scientists, the less dramatic balance of the African continent compared to other continents is linked to the relatively high temperatures on the continent but also to the relatively young character of its population [3].

Fig-3. Trend lines for the number of new cases, total deaths and 0 deaths of COVID-19 in Senegal Data sources: Ministry of Health and Social Action [8]

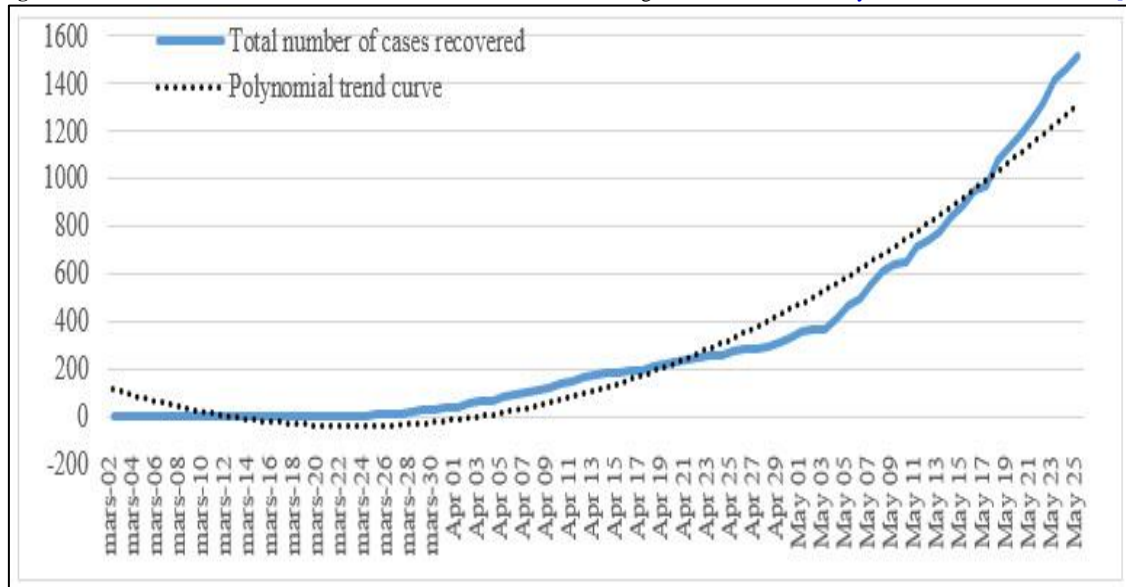


However, the number of cases, those in hospitals and quarantine centres, is increasing. This is due to the high number of new cases. This becomes a threat when the number of these cases that are moving to a critical state starts to be large. As of May 25, in addition to the 35 COVID-19 deaths that have been noted and that can be considered, in one way or another, as having experienced this critical illness before dying, we have 12 COVID-19 cases classified as critically ill (making a total of 47 cases). These cases require sophisticated and expensive medical care. For this reason, the Senegalese government favours containment and early detection measures that are designed to reduce the number of cases that progress to critical care, thus overwhelming the capacity of the health system. This would have had an impact on the relatively small number of deaths related to COVID-19, although the number of admissions is significant.

Faced with this significant wave of admissions to hospitals, the Government of Senegal decided to change the strategy as of May 7 (with 916 patients in treatment to date). With this large number of patients in treatment to date, it had become urgent to decongest the treatment centres, which were facing an untenable rush with the number of beds available in the health facilities. To rectify this situation, MSAS decided to provide out-of-hospital care for asymptomatic patients, who make up the vast majority of those who tested positive. According to MSAS, "Outpatient management is for anyone who tests positive for COVID-19, is under 50 years of age, has no chronic disease and shows no signs of coronavirus disease. This care is provided by medical staff and takes place in a specially equipped accommodation facility. Any person who does not meet the above criteria is treated in dedicated health structures" [8]. The management of patients who test positive for COVID-19 and who are asymptomatic for the disease will no longer occupy the places in the treatment centres, which are faced with a wave of new cases every day. In addition, the contact cases of people testing positive for COVID-19, who were previously confined to hotel receptacles, are now confined to their homes and monitored by caregivers. This has partially addressed difficulties with hotel confinement (as some individuals were not willing to leave their homes to be quarantined in hotel receptions) and cash flow issues (as hotel bills for accommodation of contact cases were very high). However, there are possible risks of this home confinement, which is really an individual and collective responsibility, as the persons concerned, if they do not comply with the instructions, could travel and be in contact with others before the end of the 15-day period.

The other variable in the management of this pandemic is the number of cases that recover. This is an important indicator to monitor. As of May 25, 2020, as a proportion of the total number of infected cases (3130), 48.4% have recovered (Fig. 4) [8]. However, a slow recovery rate has been noted and may be due to the long time it takes for COVID-19 cases to recover. Although it is not known if those who recover will never be re-infected, what is certain is that they will have some immunity to the virus [5]. The more people recover and return to the community, transmission of the virus will be reduced and controlled as with many other viruses that exist in the Senegalese population.

Fig-4. Trend lines for the number of recovered cases of COVID-19 in Senegal Data sources: Ministry of Health and Social Action [8]



Since the beginning of this epidemic in Senegal, 1515 people have recovered. The rate of recovery is increasing cumulatively, although it takes some time from the date of diagnosis. The effect of the state of emergency and curfew, and the eventual compliance of the population with the barrier measures, has resulted in reasonable compliance. However, many individuals continue to sell out and fail to comply with barrier measures, as reported by the media and social networks. Nevertheless, the Government of Senegal and the State services continue to ensure strict compliance with the measures and have taken all necessary measures against offenders.

3.2. Projections of Confirmed Cases of Infection Deaths and Recoveries over Time

In order to understand and monitor the daily trend of confirmed cases (total number of cases, new cases and active cases), deaths (total number of deaths and new deaths) and recoveries (total number of recoveries and new recoveries) of COVID-19, using the available data (an 85-day period), regression and correlation analysis was performed to establish relationships and generate predictive regression equations for each variable. The higher the R^2 coefficient of determination, the higher the proportion of confirmed cases of infection, deaths and recoveries accounted for over time. Based on the analysis, a severity classification index was derived [24] to establish the relationships time-infection (total confirmed cases, new cases and active cases), time-death (total deaths and new deaths) and time-recovery (total recovered cases and new recovered cases) for Senegal (Table 2).

Table-2. Time - Relationships of confirmed cases of infection, deaths, recoveries and regression equations for Senegal

Country	Significance of the regression (P-value)	Regression equation $Y = bX \pm a$	Coefficient of determination R^2	Note on the projected rate of increase
Relationship between number of confirmed cases of infection and regression equations (Severity classification based on "b": <50 Very Low; 51-100 Low; 101-500 High; > 500 Very High)				
Total number of cases	< 0,0001	$y = 33.722x - 1000000$	0,7815	Very low
Number of new cases	< 0,0001	$y = 1.3699x - 60149$	0.7001	Very low
Number of active cases	< 0,0001	$y = 19.069x - 837346$	0.7781	Very low
Relationship between number of deaths and regression equations (Severity classification based on "b": <1 very low; 1-10 low; 11-50 high; > 50 very high)				
Total number of deaths	< 0,0001	$y = 0.3634x - 15958$	0.7419	Very low
Number of new deaths	< 0,0001	$y = 0.0169x - 741.98$	0.2259	Very low
Restored caseload relationships and regression equations (Severity classification based on "b": <1 very low; 1-10 low; 11-50 high; > 50 very high)				
Total number of cases recovered	< 0,0001	$y = 14.29x - 627489$	0.7558	High
Number of new recoveries	< 0,0001	$y = 0.7572x - 14.145$	0.5905	.
Relationship between confirmed infection - number of deaths - number of recoveries and regression equations (Severity classification based on "b": 0.00-0.05 low; 0.06-0.10 high)				
Between total cases and total deaths	< 0,0001	$y = 0.011x - 0.7622$	0.9843	Very low
Between total cases and total recoveries	< 0,0001	$y = 0.4261x - 10.328$	0.9777	Very high

For the number of confirmed cases of infection (total number of cases, new cases and active cases), the derived classification index [24] should be **very low** in Senegal. For the number of deaths (total number of deaths and new deaths), this index should also be **very low** in Senegal. For the number of recovered cases (total number of recovered and new recovered cases), the index for Senegal should be **high** (Table 2). In order to establish the relationship between first the total number of confirmed cases and the total number of reported deaths and then the total number of confirmed cases and the total number of b recovered, using the available data, regression and correlation analysis was carried out to establish the relationships in the reported values. Based on the analysis, the derived classification index [24] is used to classify the relationships of confirmed COVID-19 cases, deaths and recovered cases over time. Based on the derived indices, the relationship between the total number of confirmed cases and the total number of deaths was classified as **very low**, while the relationship between the total number of confirmed cases and the total number of recovered cases was classified as **very high** (Table 2).

In order to group the variables related to COVID-19 based on correlating trends in confirmed cases, deaths and confirmed recoveries, Pearson correlation matrices were calculated between the variables. These matrices are shown in Table 3. The total number of confirmed cases has its strongest relationship (0.99) to the total number of active cases, total deaths and total recoveries. On the other hand, the weakest relationship is noted with the number of new deaths (0.48). For its relationship to the number of new cases and the number of new cases recovered, the values are 0.82 and 0.86, respectively. The number of active cases is also highly correlated with the total number of deaths (0.98) and the total number of recovered cases (0.97). The total number of deaths is also highly correlated with the total number of recovered cases (0.99).

Table-3. Pearson correlation matrices between confirmed cases of infection, death and recovery for Senegal

Variables	Total number of cases	New Cases	Active cases	Total Deaths	New Deaths	Total restored	Newly Restored
Total number of cases	1						
New Cases	0,82	1					
Active cases	0,99	0,86	1				
Total Deaths	0,99	0,80	0,98	1			
New Deaths	0,48	0,41	0,48	0,50	1		
Total restored	0,99	0,77	0,97	0,99	0,47	1	
Newly Restored	0,86	0,69	0,85	0,85	0,43	0,86	1

3.3. Observations on the Management of COVID-19 in Senegal

As soon as the first case was diagnosed in the country, the Government of Senegal immediately announced the state of disaster and initiated all necessary processes and procedures to put in place systems, policies, procedures and guidelines to manage the pandemic. In order to cope with the spread of the COVID-19 pandemic, the strategies put in place in Senegal were gradually adjusted and adapted to the country's situation and the evolution of the virus in the territory. These different strategies are refined through State declarations (official declarations and documents of the State of Senegal, COVID-19 Force situation reports and MSAS press releases), awareness raising materials, official communication channels and safety and hygiene measures (basic hygiene measures and health recommendations and prevention measures) [25].

3.3.1. Statements by the State of Senegal

To cope with the pandemic entered Senegal on March 2, 2020, the Minister of Interior signed an order on March 13, 2020 temporarily banning demonstrations or gatherings. This was followed the next day (14 March 2020) by the President of the Republic of Senegal who announced a set of measures on Senegalese territory: a 30-day ban on all public demonstrations; the temporary suspension of the reception of cruise ships; the systematic strengthening of health controls at land, air and sea borders; the suspension of teaching in schools and universities for a period of three weeks, starting on Monday, 16 March 2020; the strengthening of the protection of mobilized health, security, defence and rescue personnel; the suspension of national formalities related to pilgrimages to the holy places of Islam and Christianity for the year 2020. On 16 March 2020, the Senegalese authorities announced the suspension of all flights to and from the following countries: France, Spain, Italy, Belgium, Tunisia, Algeria, as of Wednesday 18 March at 11.59 pm and for a period of 30 days (medical evacuations are not concerned). 4 days later (on March 20, 2020), the Ministry of Tourism and Air Transport published a communiqué concerning the closure of Senegal's air borders from March 20 at 23h59 to April 17.

At the level of the Dakar region, the main focus of the pandemic in Senegal, the Governor of has published on March 19, 2020 a decree on the temporary closure of mosques in the Dakar region from Friday, March 20, until further notice. Faced with the progress of COVID-19, President Macky Sall declared a state of emergency in Senegal with immediate application on Monday 23 March at 23:59. Among the measures taken, a curfew was decreed from 8 pm to 6 am. In addition, 1,500 contact cases will be confined to hotel receptacles, limited regional transport, a 1,000 billion response and solidarity fund created to support businesses, households and the diaspora, 50 billion of this fund used to purchase emergency food aid and the 200 billion tax debt partially forgiven. Following the President's declaration of a state of emergency, a first order for a temporary travel ban was issued on 24 March. To this end, two bans were issued: the inter-city movement of persons and goods during all hours; and the movement of persons and goods in all constituencies from 8 p.m. to 6 a.m. SENELEC and Sen'EAU also described the modalities for

implementing the decision taken by the President of the Republic to take charge of paying the electricity and water bills of domestic customers in the social bracket for a two-month consumption period (April and May 2020).

On 7 April 2020, the Ministry of the Interior suspended special traffic permits. On 17 April 2020, the Government of Senegal, through the Minister of the Interior, Mr. Aly Ngouille Ndiaye, introduced a new measure in the fight against COVID-19. The Minister made public an order on the obligation to wear masks, as of April 19, 2020, for the population, particularly in public places during the entire period of the state of emergency decreed by the President of the Republic. In order to avoid a social crisis, the President of the Republic, following his speech of 11 May 2020, has made changes to the Orders relating to traffic bans and public gatherings. Traffic bans are maintained between departments (except in the Dakar region) and in the period between 9 p.m. and 5 a.m. for the whole territory. In addition, bans on public gatherings (in force since 23 March 2020) are lifted for places of worship and permanent and weekly markets from 11 May 2020. However, hygiene measures are now mandatory in these places.

3.3.2. Outreach Materials and Official Communication Channels

In this difficult context linked to the Coronavirus pandemic, disease prevention and hygiene awareness tools are very important. Awareness-raising videos, methodological booklets and practical information sheets have been produced and continue to be broadcast on television and radio. These include awareness videos in Wolof (Y'en A Marre), the series of videos in Wolof, subtitled and signed (Positive Video), the series of videos in national languages (Wolof, Serere, Pulaar, etc.), handwashing and confinement. As for the official communication channels for the management of COVID-19 in Senegal, we can note the Toll Free Number (800 00 50 50), the EMS Number (15 15) and the Alert Cell Numbers (77 172 10 81; 76 765 97 31; 70 717 14 92). A WhatsApp Abdu Number (00221 77 873 17 17), which is a virtual assistant that provides advice and information on COVID-19, was set up on 16 March 2020 and has had more than 115,000 requests in 24 hours. In addition to the website of the Senegalese ASM (<http://www.sante.gouv.sn/actualites?page=2>), there is also the "Sunu City" application which is linked (www.covid19.sn) to the Ministry of Health and which allows to have information in time and to inform if there is an incident to share [26]. In addition, there is the site that follows developments in Senegal in real time (<http://www.prevcovid19.com/#/carte>) and the code #2121# that provides prevention information free of charge (PrevCOVID-19, 2020).

3.3.3. Safety and Hygiene Measures

Faced with the COVID-19 pandemic, Senegal opted for a two-pronged strategy: no total containment to avoid a social crisis on the one hand, and isolation of COVID-19 patients on the other. However, a set of barrier measures have been taken to limit the spread of the pandemic on the national territory [25].

Fig-5. Some simple measures to avoid COVID-19 in Senegal Data sources: Ministry of Health and Social Action [8]



The MSAS in Senegal has asked everyone to adopt simple gestures and respect the rules of hygiene in order to avoid the spread of the virus (Fig. 5): Wash your hands very regularly with soap or a hydro-alcoholic solution (this minimizes the risk of being contaminated after touching a surface that has been previously contaminated by a sick person and then touching your face, mouth or eyes); cough or sneeze into your elbow or into a disposable handkerchief that you must throw away; avoid shaking hands or kissing each other when greeting each other; maintain a "social" distance, avoid gatherings, limit travel and contact to what is strictly necessary; avoid touching

your mouth, nose and eyes (nose, eyes and mouths are all possible "entry points" for the virus); cover your nose with a mask if necessary [26]. These various measures should collectively contribute to reducing the risks of contamination and the spread of COVID-19. Among other measures, people over 70 years of age are also asked to limit their outings and stay in their homes as much as possible, as well as those suffering from chronic diseases, respiratory disorders and disabilities. At the same time, the health authorities demand the collaboration of all Senegalese to contain the COVID-19 pandemic.

3.3.4. Methods of Treating COVID-19 used in Senegal

For the treatment of COVID-19 in Senegal, the health authorities tested the use of hydroxychloroquine, the drug used by Professor Didier Raoult. In view of the absolutely encouraging results, Professor Moussa Seydi, head of the department of infectious and tropical diseases at Fann Hospital, decided to continue treating patients with COVID-19 with this drug. Moreover, the use of this molecule has been generalized in all treatment sites in Senegal and this is due to the fact that patients treated with hydroxychloroquine heal faster (as indicated by Professor Moussa Seydi).

A number of positive results have been achieved in the current period. They have helped to reduce the number of deaths and overwhelm the health care system with an enormous demand for hospital beds, intensive care beds and sophisticated equipment. However, the use of chloroquine to treat the coronavirus initiated by Professor Didier Raoult continues to divide specialists and generate controversy between those who approve and those who reject this choice. While the use of chloroquine in the treatment of COVID-19 continues to divide specialists, Professor Moussa Seydi believes that the results are reassuring, hence the choice to continue in this direction. He also indicated that his services include azithromycin (an antibiotic), which should lead to better results.

An initial study of 181 patients showed that the median length of hospitalisation was 13 days for patients who received no treatment, 11 for those who received hydroxychloroquine alone, 9 for those who received hydroxychloroquine combined with azithromycin (antibiotic) and even 8 for those who consulted early and started treatment within 24 hours. In the other side effect study of hydroxychloroquine use based on 12 subjects, there were "no serious side effects" and all signs regressed at the end of treatment. On the basis of these studies conducted by Professor Moussa Seydi, the health authorities decided to continue to prescribe hydroxychloroquine to COVID-19 patients in Senegal.

As a precautionary measure, the World Health Organization (WHO) said on Monday it had "temporarily" suspended clinical trials with hydroxychloroquine it is conducting with partners in several countries. However, nations such as Algeria and Brazil have decided to ignore the organization's decision and continue the treatment. According to Dr. Abdoulaye Bousso, Director of the Centre for Emergency Health Operations, Senegal will also do the same and will continue treatment with hydroxychloroquine to treat coronavirus patients, since Professor Moussa Seydi's team has maintained its therapeutic protocol.

3.4. Limitation of the Study

As the COVID-19 pandemic is still ongoing, this article examined several variables associated with the disease over an 85-year observation period. Patterns and trends are still evolving and, at the time of writing and publication of the article, significant changes may have occurred. The number of COVID-19 tests performed over the study period in Senegal will also have a major impact on the actual number of confirmed cases of infection reported. The number of deaths associated with COVID-19 during the study period should, however, follow the same trend as reported. Only one country, Senegal, was selected for the evaluation, which may limit the generalization of the results in Africa. However, the findings extend across the continent, which will provide a scientific basis for detailed and more focused research.

4. Conclusion

In Senegal, the number of new cases seems to be increasing in recent days. This could be an indication of the spread of the virus in the general population as the government intensifies testing beyond clinical symptoms. The majority of cases in Senegal originate in localities such as Dakar, Touba, Guédiawaye, Sédhiou, Mbao, Thies. These localities have some common characteristics that may explain the high number of cases: they have a large population, often living in promiscuity, and they have large informal settlements. These variables, given the known modes of transmission of the virus, may be a factor in explaining the high number of new cases. Instead of general containment, the authorities advocate the relaxation of certain collective restrictive measures and the rigorous promotion of individual barrier measures that can be effective and sufficient if properly followed.

With the recent announcement of a plan to reduce curfews and a strategy for living with the virus, stricter guidelines and procedures for barrier measures and the strategy of mass screening accompanied by the widespread use of masks, which appears to be more effective, must be put in place and controlled to stem this increase in the number of 0-19 cases, which could overwhelm health systems and the economy. In particular, it seems wise to us to generalize the wearing of quality barrier masks with good communication targeted at their function and proper use, and also to dynamically evaluate their impact as well as that of other control measures undertaken so far. In addition, vulnerable groups such as the elderly, people in precarious situations and those taking immunosuppressive drugs, those working on the front line of the economy, those working in environments where social distancing is impossible, need a set of guidelines aimed at saving lives.

Generally speaking, the Government of Senegal has therefore mobilized the entire population in solidarity to deal with the COVID-19 pandemic in accordance with WHO guidelines and by observing the way the world is responding to the pandemic. This included closing borders, stopping population movements, learning new human

behaviours such as social distancing, general hygiene (frequent hand washing and use of hygiene products), isolating and quarantining infected people and closing down several social and economic activities. For the first time, all government departments and agencies, in all areas, worked in synchronization. The executive, legislative and judicial branches of government functioned as a unit. These actions are proof of the good leadership that the Senegalese government has forged since the beginning of the pandemic. The State has adopted a comprehensive approach to the COVID-19 pandemic, combining public health, economic and social security interventions to ensure that the health of the population and economic survival are at the centre of the response. In addition, Senegal has increased its testing and screening capacity. To date, screening sites have been multiplied and the number of tests performed per day has increased significantly, including the number of health personnel performing the tests.

The government has therefore announced many strategies to combat this virus. However, the social and economic variables that come into play must be taken into account and are important for sustainable livelihoods and economic recovery. In Senegal, the problem of high unemployment and the informal economy, which has been exacerbated by measures taken to contain and control the spread of the virus, has required specific interventions to mitigate the livelihoods of this group. In order to limit the economic impact of this health crisis, the President announced the creation of a response and solidarity fund, Force-COVID-19, endowed with CFAF 1 000 billion, including CFAF 50 billion earmarked for the purchase of food for emergency food aid. In addition, Act No. 2020-13 empowered the President of the Republic to take, by ordinance, measures within the scope of the law to deal with the COVID-19 pandemic and authorized the extension of the state of emergency.

Processes and systems to ensure access for this population need to be streamlined and simple. The informal economy provides a safety net for the poor and generates economic activities to support families. The economically active and unemployed are excluded from most social safety nets. The package should address their livelihood needs and possibly provide another safety net for this population group after the COVID-19 period. It is too early to make conclusive statements on the results of the COVID-19 containment strategies in Senegal. However, it appears that measures to identify infected persons are working (as evidenced by the numbers of new cases). The number of cases evolving towards a critical state is being kept to a minimum, the number of deaths is not increasing at an alarming rate, it seems stable, and the number of people receiving social and economic assistance, including in the private sector, is the subject of some relief efforts. This may suggest that the Senegalese response is moving in the right direction.

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Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript.

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