Economic and Direct Medical Cost of Covid-19 in A Designated Isolation and Treatment Center In South Nigeria

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Abstract

Background: No disease outbreak in the last century has had a more catastrophic effect and put a halt on all sectors of life than COVID-19. It has taken a large toll on communities, nations, health systems, politics and socioeconomic systems. The medical cost of managing cases of this disease is unprecedented - no study had estimated the economic cost of the disease to the best of our knowledge in Nigeria. **Objective**: Hence, this study was set to determine the total (economic) cost, the average cost, the direct medical cost, and the capital cost associated with the management, prevention and control of COVID-19 in one of the isolation centres in Nigeria. **Methods:** The cost estimations were collected using the micro costing approach. A structured questionnaire was developed to extract the unit cost of each component and the total number of items consumed. The total cost of an item was computed by multiplying the unit cost by the total number of items consumed. Data were analysed using Microsoft Excel 2016. **Results**: The economic cost and average cost used in the treatment and care of hospitalised cases of COVID-19 in the isolation center during the study period were $309,544:41 and $2,799:90 respectively, of which most of the monies were spent on remunerations and personnel protective equipment. **Conclusion**: The average cost of treatment and care of COVID-19 was huge as estimated in this study. Government efforts to cater for the health needs of victims have greatly eliminated the hardship on individuals.

Key Words: *Economic, Direct Medical Cost, Covid-19, Nigeria*

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Introduction

COVID-19 a highly contagious disease, with mild to severe pathogenicity, changed the narratives of the world economic in the year 2020. The disease ravaged all nations of the globe in diverse proportions - the enterprising countries of America, Europe, Asia and Australia, and the presumed never do well, low resource nations of black Africa.[1,2] It put the entire world systems in jeopardy; cracked the world economy, halted social activities, ruffled the health systems, conquered advancements and innovations in medicine, and wasted lives in their thousands.[2-4]

The disease reached fortified castles of nobles, kings, prime ministers, and the shanty of paupers. It infected considerable numbers of politicians, legislators, medical professionals, business magnates,

the wealthy and the distinguished famous.[5] Everyone was at risk but older persons and those with pre-existing medical disorders were at increased risk of fatality.[6] Thousands of vulnerable groups, the guttersnipes and the unpopular also succumbed to the disease.[7,8] The disease made medical treatment looked insignificant and long; and they were lots of anecdotal evidence of cures and vaccines. They were restricted international and inter-states movements; no gathering in mosques, churches, clubs and all recreation centres. [4,9] Establishments, markets, business places, schools were locked down![9,10] The world went on a compulsory holiday and everything became COVID-19. Other preventive measures such as two metres distancing between persons, wearing of face mask, hand hygiene and cough etiquette were also prescribed.[11]

Lots of dynamisms, enthusiasms, selfless efforts and resources were committed by individuals, nations, humanitarian agencies, bilateral and multilateral organisations to halt the spread of the disease. Large donations and contributions were made towards combating the disease by nations and organisations. Critical stakeholders worked frantically, collectively, to win against the disease. Everyone scrambling for solution! Scientists explored new grounds, searched for new drugs and developed novel vaccines.[12,13] Many erroneous results were published, and conclusions drawn, however, there were few incontrovertible evidence of some clinical trials and the natural history of the disease.[14-18]

The 2020 pandemic started in mid-December of the preceding year in the city of Hubei, in the province of Wuhan and by the end of February 2020 it had spread to the whole world.[19,20] Many countries blamed China for internationally fuelling the pandemic and not giving the true picture of the severity of the disease. There were huge community and nosocomial spread of the disease. Patients in hospitals positive for SARS-CoV2 infected healthcare workers and other patients probably got the disease from healthcare workers. Infected healthcare workers infected other healthcare workers. Over 15 million cases and 635 173 deaths were recorded at the end of the July 2020.[21] The attitudinal disposition of some members of the public and the unprofessional conducts of some health personnel aided the continuous spread of the disease.

The disease puts a stringent demand on the poorly equipped hospital and resources of developing countries.[22] Infected cases in states in Nigeria were managed in government owned isolation centres with collaboration and supports from Federal Government, multilateral organisations, bilateral agencies, Non-Governmental Organisations (NGOs), oil rich firms and the affluent. Everything was practically paid for by the government: buildings, Personnel Protective Equipment (PPEs), drugs, medical interventions, diagnostic test, salaries, meals and other conveniences.

From rough estimation, the treatment and preventive measures cost of the management of COVID-19 disease seems huge and of economical toll on government. Therefore, a structured estimation of the cost of interventions of the disease is rational for a government funded programme. An appraised evidence of the total (economic) cost of COVID-19, the average cost, direct health cost and capital cost of cases will reflect the actual economic value of the disease. Hence this paper was for the identification, quantification and valuation of COVID-19 interventions.

Objectives

To determine the total (economic) cost, the average cost, direct medical cost and capital cost associated with the management, prevention and control of COVID-19 in one of the isolation centers in Delta State of Nigeria.

Methods

The study was conducted in Delta State University Teaching Hospital (DELSUTH) Isolation/treatment center, Ijomi, Oghara, Delta State Nigeria. The GPS coordinate of the center is between latitude $5^0$57' north of the equator and longitude $5^0$42'east of the Greenwich Meridian. The DELSUTH Isolation/treatment center was the first in Delta State ─ commenced full activities on the 27th of March 2020 but it was on the 06 April 2020, that the hospital was confronted with the primary case of COVID-19 in Delta, since then staff have been committed to the treatment and care of the patients. Specialised healthcare in the state is hinged on this 220 bed tertiary health facility.

The center was not purposefully designed as an isolation/treatment center. It was a facility situated two kilometers outside the hospital complex for admitting psychiatric cases. Although, some modifications were made, it is still not the ideal model. There was no ante-room and other rooms were make shift. It was delineated in an area of land 20,000 square metres fenced with a gate with the building at the far end occupying about one third of the land area. The building had a screen front porch, three spacious halls with cross ventilations, six tiny rooms, and functional bathing and toilet facilities. The walls and roofs were in good condition with functional doors and netted windows. The building was airy and had good lighting. There was a lawn and defined parking area in front of the building.

The entrance into the building opens into a spacious reception hall with solid aluminium doors. There were posters and protocols with pictures on transmission and prevention of COVID-19 displayed on the walls of the entrance. The reception hall was the entry point to the holding room and treatment room separated by double glaze glass doors. It also serves as the nursing station. The holding room was for the suspected cases and the treatment room for the confirmed cases. There are six tiny rooms: one house the CCTV and computer; another served as the pharmacy, one as the donning room, one as the store, one in the holding room and another in the treatment room. It also had two toilets around the nursing station connected to sanitary waste collection point. The exit doors from the holding and treatment rooms lead to the doffing area. Cases are taken into the wards through the exit doors. There were protocols with pictures for doffing displayed on the wall and a mirror that guides proper doffing. The laundry area was by the side of the doffing area.

Hand hygiene stations were located in the donning and doffing areas. The infectious waste bins for disposing off used PPEs were placed in the doffing and dirty area. The rest area for patients' that wish to come outside for some fresh air was located in the restricted area.

There was availability of clean water supply within the premises powered by a motorized borehole. Electricity was supplied by the national grid and alternative power source connected to the hospital generator house.

Staff accommodation detached from the main building but within the facility ─ two units of one-bedroom apartments with bathing and toilet facilities. The treatment center had sixteen beds.

The response team was a mixed of experts and skilled healthcare workers from various disciplines and specialties in the health sector: doctors, nurses, pharmacists, laboratory scientists, data clerk, kitchen staff, porters, cleaners, Environmental Health Officer (EHO), security men, drivers, incinerator operators and morticians.

The study population were all patients who received health care at the Delta State University Teaching Hospital Isolation and Treatment Center, Oghara from 27 March 2020 to 31 July 2020. There are three groups in the study population:

confirmed cases on home care and hospitalised cases that either tested positive or negative to SARS-COV-2. Patients with comorbidities such as hypertension, diabetes mellitus, chronic liver disease, HIV/AIDS, tuberculosis, etc. were included in the study.

A total population study of all the cases hospitalised and on home based care.

Study Design (Costing Methods)

The micro costing estimation was used to compute costs used in the management of these patients.[23] The costs calculated in this study were the total (economic) cost, the average cost, the direct medical cost, and the capital cost. The total (economic) cost was the sum of all the resources for managing all hospitalised cases.[23] The resources used for the interventions are divided into the following categories: personnel, buildings and space; equipment, consumables, supplies and pharmaceuticals, Personnel Protective Equipment (PPE), laboratory equipment and reagents; transportation, training and social mobilization including information, education and communication, accommodation and feeding.[23] The average cost was calculated as the total cost divided by the number of hospitalised cases. The direct health care cost is the cost incurred in the treatment of cases. It was computed by summing up the cost of diagnostic test, drugs, oxygen, and medical interventions for each case. This was further divided into the cost of treatment for home based cases, asymptomatic cases, mild cases, moderate cases, severe cases, critical cases and hospitalised negative cases.

The capital cost was "the value of capital resources which had useful lives greater than one year".[23] It includes cost of equipment, vehicles, buildings and one-time training. The "Straight-line Depression Method" was used to calculate the capital cost.[23] It was calculated by dividing the start-up cost of each of these items by the useful life time (years) of these items to get the annualised cost (cost in one year). "The useful life of an asset is an estimate of the length of time the asset can reasonably be used to generate income and be of benefit to the company". It is not the duration of time an asset will last".[24] The useful years of the equipment used at the centre were between three and seven years; while that of the vehicles were 5 years and building 25 years.

Data Collection

The cost information (price and units of services or items consumed) was collated prospectively from patients' records and from a variety of hospital based records: the offices of the Chief Medical Director, Director of Clinical Services and Training, Director of Nursing Services, Laboratory Department and Pharmacy Department. The monthly remunerations paid was obtained directly from personnel.

An inventory was created to obtain information on the following costing: remunerations for personnel, buildings and space; equipment, consumables, supplies and pharmaceuticals; laboratory equipment and reagents; transportation, electricity, water supply, waste management, accommodation, feeding, cleaning, security, information, education and communication.

The micro components were itemised ─ posters, hand gloves, face mask, N95 mask, hazardous material suits, caps, hand sanitizers, soaps, disinfectant wipes, chlorine, mop sticks, mop-buckets, brush, scrubs, veronica buckets, waste bags, waste bins, decontaminating buckets, washing and bathing buckets, stationeries, microwaves, fridge, mobile x-ray machine, ventilator, nasal cannula, non-rebreather mask, oxygen therapy, pulse oximeter, syringe pump, electricity, gas cooker, blood sugar monitor, thermometers, sphygmomanometer, stethoscope, examination coach, bed linens, beds, pillows, furniture, meals, drugs, cotton wools, methylated spirit, plasters, cars, trunks and ambulance. The

Table 1: Characteristics of Cases that Received Care at the Isolation and Treatment Center from March 27th – July 31st, 2020

Variables	Home Care	Hospitalisation n=110		Total n=146 (100%)
	Tested positive n=36 (24.7%)	Tested Positive n=54 (37.0%)	Tested Negative n= 56 (38.3%)	
Age (in years)				
Child (<18)	0 (0.0)	0 (0.0)	2 (100.0)	2 (1.4)
Young Adults (18-45)	32 (37.6)	23 (27.1)	30 (35.3)	85 (58.2)
Middle Adulthood (46-59)	4 (10.3)	20 (51.3)	15 (38.5)	39 (26.7)
Elderly (60 and above)	0 (0.0)	11(55.0)	9 (45.0)	20 (13.7)
Sex				
Male	23(27.7)	34(41.0)	26(31.3)	83(56.8)
Female	13(20.6)	20(31.7)	30(47.7)	63(43.2)
Had at least one comorbidity				
Yes	0 (0.0)	30 (49.2)	31 (50.8)	61 (41.8)
No	36 (42.4)	24 (28.2)	25 (29.4)	85 (58.3)
Died	0 (0.0)	7 (25.9)	20 (74.1)	27 (18.5)

market price of each unit item was obtained and multiplied by the total items consumed to obtain the costs of items used.

Data Analysis

Data were analysed using Microsoft Excel 2016. Cost was calculated in naira and converted to dollar equivalent for the purpose of comparison with similar studies. 360 Nigeria ₦= 1US$ at the time the study was conducted. All items for costing were first identified then quantified and valued. The total and average were used to summarise cost estimated.

Ethical Consideration

The study was approved by the Health Research and Ethics Committee of Delta State University Teaching Hospital Oghara.

Results

The isolation center had one Toyota Hiace Ambulance 2018 model; one JAC Minivan 2019 model, one mobile x-ray machine, two ventilators, a wheel chair, suction machine, CCTV, a computer, a printer, one washing machine and five sets of 32 inches' television and sixteen beds in the isolation center. PPE were always available; no stock out. There were sixteen doctors (coordinator, case managers, preventive medicine physicians, internist and anaesthetist); fifteen nurses, four laboratory scientists, two pharmacists, four drivers, two security men, six cleaners, two porters, an EHO, two incinerator operators and three morticians every single month.

As shown in table 1, a total of 36 (24.7%) cases were on home care and 110 (75.3%) cases were hospitalised at the isolation and treatment center during the study period. Of the hospitalised cases, 54 (49.1%) had positive SARS-COV-2 test result and 56 (50.9%) had negative SARS-COV-2 test result. The total number of cases that had positive SARS-COV-2 test result were 90 (61.6%) and those with at least one comorbidity 61 (41.8%). The most frequent comorbidities were hypertension (39.0%) and diabetes mellitus (27.3%). The number of males and females seen irrespective of their COVID-19 test results were 83 (56.8%) and 63 (43.2%) respectively. Of the confirmed cases, males were 57 (63.3%) and females 33 (36.7%) respectively.

Among the confirmed cases, twenty had Acute Respiratory Distress Syndrome (ARDS) on hospitalisation; two had renal complication, and one patient was

Table 2: The Economic Costs and Average Cost of Treatment and Care of Hospitalised Cases During the Four Months Study Period

Resource	Total (₦)	(%)
• Remunerations (salaries)	58,030,000	52.07
• Buildings & space (capital cost)	462,962	0.42
• Equipment (capital cost)	3,622,314	3.25
• *Pharmaceuticals & supplies	1,784,254	1.60
• Oxygen	1,980,000	1.78
• Consumables and cleaning equipment	1,214,360	1.09
• Medical intervention	242,000	0.22
• Personnel Protective Equipment	20,404,700	18.31
• Investigation	260,000	0.23
• Vehicles	3,300,000	2.96
• Transportation and vehicle maintenance	862,500	0.78
• **IEC materials	45,700	0.04
• Accommodation	14,400,000	12.92
• Feeding	4,823,200	4.33
• **Total cost**	111,435,990	100.00
No. of Hospitalised cases	110	
Average cost = Total cost ÷ no of hospitalised cases	₦1,013,054.45k	

**Cost of home-based care excluded. **IEC=Information Education and Communication.*

Table 3: Capital Costs Incurred During the Study Period

Resource	Useful life (years)	Total Cost (₦)	Annual Cost (₦)
• *Equipment	3-7	18,480,000	3,622,314
• Vehicles	5	16,500,000	3,300,000:00
• Building	27	10,000,000	370,370:37
• Land	27	2,500,000	92,592:59

***Laboratory equipment excluded*

discharged home with widespread pulmonary fibrosis. Two patients had nine sessions of renal dialysis, two were intubated, one had tracheostomy and a venous cut down. The duration of stay ranges from 2 - 41days and an average of 14 days for asymptomatic to moderate cases and 21days for severe to critical cases. Of the hospitalised cases, 20 of the cases with negative SARS-COV-2 test result died and 7 of the cases with positive SARS-COV-2 test result died.

As shown in table 2, the total (economic) costs and average cost used in the treatment, care, prevention and control of hospitalised cases in the isolation center during the four months' study period were ₦111.4 million and ₦1 million respectively, of which most of the monies ₦58.0 million (52.07%) was spend on remunerations; ₦20.4 million (18.31%) on Personnel Protective Equipment, ₦14.4 million (12.92%) on accommodation, ₦4.8 million (4.33%) on feeding, ₦3.6 million (3.27%) on equipment, ₦4.0 million (3.595%) on drugs, supplies, oxygen and medical interventions. Note, the cost of laboratory equipment and cost of training were not done in our center hence the exclusion.

As shown in table 3, the capital cost (annualised cost) for each of the material resources used was calculated by dividing the start-up cost of each of these items by the useful life time (years) of these items. The annualised cost of all equipment was ₦3,622,314 for the vehicles was ₦3,300,000:00, building ₦370,370:37 and land was ₦92,592:59.

As shown in table 4, the direct medical costs for treating confirmed cases that required hospitalisation was about ₦3million and an average direct cost of ₦55,796, while the direct medical costs

Table 4: Direct Medical Care Costs of the Various Categories of Cases

Variables	No of Cases	Cost of Drug (₦)	Cost of Oxygen (₦)	*Cost of Investigations (₦)	Total Cost (₦)	Average Cost (₦)	Lowest and Highest Cost (₦)
Hospitalised Positive Cases							
• Asymptomatic	9	31,240	0	0	31,240	3,471:11k	1,600-4,000
• Mild	8	44,100	0	16250	60,350	7,543:75k	5,700-10,100
• Moderate	15	206,640	42,000	32500	281,140	18,742:67k	7,850-18,880
• Severe	15	542,276	438,000	66700	1,046,976	69,798:40k	21,610-94,420
• Critical	7	558,058	954,000	81250	1,593,308	227,615:43k	41,300-520,000
Total	54	1,382,314	1,434,000	196,700	3,013,014	55,796:56k	1,600-520,000
Hospitalised Negative Cases	56	401,940	546,000	63300	1,011,240	18,057:86k	6,740-60,112
Positive Cases on Home Care	36	57,000	0	0	57,600	1,600:00k	-
Grand total	146	1,841,254	1,980,000	260,000	4,081,254		

**The cost of investigation was small because the laboratory was set-up late and cost of RT-PCR excluded.*

for treating cases with negative SARS-COV-2 results that required hospitalisation was about ₦1million and an average direct cost of ₦18,057. The average direct cost for treating and caring for a critical case of COVID-19 was ₦227,615, for a severe case was ₦69,798, moderate case ₦18,742, mild case ₦7,543, hospitalised asymptomatic case ₦3,471 and for home care case ₦1,600.

Discussion

This study was set to determine the amount of monies needed in testing, treatment, prevention and control of COVID-19 in an isolation center in Nigeria. No study had structurally, estimated the economic cost of the disease in Nigeria to the best of our knowledge. COVID-19 testing, medications, treatment and care were at no cost to patients. The government of Nigeria took giant strides to provide all resources required for testing, treatment and hospitalisation. Funding was exclusively a collective action of government, multinational organisations and international donors.

In this study, more than four fifths of the cases managed at the center were young adults and middle aged while almost one seventh were senior citizens. A minuscule proportion of the cases were below the ages of 18 years with negative SARS-COV-2 test. The age range of confirmed cases was 21years to 76 years. This finding was different from what was obtained in developed countries where majority of persons affected were aged eighty and above.[25-28] The reasons for this difference may be because developed countries have mostly adult and aged population while Nigeria has a relatively young population. More males were infected in this setting than females. This was similar to findings in most studies except that of Korea and USA where the sex ratio was almost the same.[25-29] Almost two thirds of persons that had COVID-19 in this study had severe or critical form of the disease and about three fifths of the patients had at least one comorbidity.

The range of resources involved in providing care were taken into consideration in computing for costs. The total costs which is the overall costs incurred for all cases that required hospitalisation at the end of the study period was significantly high ─ one tenth of a billion naira ($309,544:41), while the average cost of treating and caring for a case of COVID-19 was a million naira ($2,814:04), though the cost of laboratory equipment, training and SARS-COV-2 test were not included in this study. The total cost in this study was within the cost range of an economic analyst prediction of the cost of treating COVID-19 in Nigeria after using a conversion factor of 0.15 of the cost of treatment of the disease in United State of America (USA).[30] Moreover, from a study that computed

cost of COVID-19 in the USA using computer simulation model, the cost of treating a case of COVID-19 in USA requiring hospitalisation was five times the average cost in Nigeria.[31] Perhaps the variation in cost may be due to the cheaper labour cost in Nigeria, more severe cases, more patients on ventilators and ICU care in USA. In addition, the use of new medications, innovating procedures, sophisticated equipment may also highlight the huge cost in USA. The total costs incurred in this study was far lower compared with the total costs of Middle East Respiratory Syndrome Coronavirus (MERS-CoV) which was $2.6 million to $156.4 million with an average of $26.6 million.[32]

However, half of the monies was spent on staff remunerations; almost one quarter on Personnel Protective Equipment, slightly above one tenth on accommodation, a negligible percentage (approximately four percent) on drugs, supplies, oxygen and interventions. The outlay between what goes to healthcare workers and to drugs and supplies had been a topic of discussion for some time. As reported in a paper prepared for the world health report 2006, "remuneration of healthcare workers account for about 69% of total health expenditure", while according to the Fitch Ratings, 54.2% of hospital operating revenue in the year 2012 was attributed to personnel costs.[33,34] Also in service businesses, salaries of personnel take about 50%.[35] The likely explanation for this finding is human genius are needed to foster solutions to problems in healthcare and other highly skilled service based sectors. Hence, wages take a considerable amount of total cost.

The direct medical costs of treating the various categories of COVID-19 varied with the degree of severity of the disease as seen in this study. The average direct medical cost for a hospitalised mild and moderate case were $20.95 and $52.06 respectively, while the average direct medical costs of a hospitalised severe and critical cases were $193.88 and $632.26 respectively. The amount computed in this study for a critical case was equivalent to the average direct medical cost of treating a single case of Lassa Fever from a study conducted in Nigeria.[36] However, the direct medical cost for the treatment of a hospitalised COVID-19 case in the US far exceed what was observed in this study, while MERS-CoV was twenty times in excess of what was observed in this study.[31,32] The reasons for the difference may be what was earlier stated: more patients on ventilators and ICU care in the comparison countries.

The costs of treatment and care of hospitalised confirmed cases are great when compared to costs of treatment and care of hospitalised negative cases as determined in this study. This is because the length of stay for negative cases in the isolation center is for a short period. They are immediately transferred to the conventional wards to continue care on confirmation of their COVID status. Payment for healthcare at this point is at the expense of the patient which was not included in the study.

Conclusion

So far the havoc of COVID-19 on human cannot be underestimated. The cost of treatment is huge as seen in this study. If individuals were to pay for their care, it would have led to catastrophic health expenditure and the country would be worse hit by the pandemic. Government efforts to set up isolation centers' across the country and cater for the health needs of victims have virtually reduced the spread of the disease and have greatly eliminated the hardship on individuals and families. We therefore, recommend that government should continually play major role in the funding of public health services for better outcomes ─ it is even a common assertion that government should be responsible for funding public health systems.[37]

***Limitations*:** The PCR test, initial investigations and the first training were not done in our center hence the cost exclusion.

Declaration of Interest

We declare that we have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. We also do not have any financial interests/personal relationships which may be considered as potential competing interests.

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