Niger J Paediatr 2020; 47 (3):227 – 233

ORIGINAL

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Economic burden of acute watery diarrhoea in children aged 6 – 36 months presenting to a tertiary hospital in South-East Nigeria

DOI:http://dx.doi.org/10.4314/njp.v47i3.6

Accepted: 4th October 2019

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Abstract*: Introduction:* Globally, acute watery diarrhoea is a major cause of childhood morbidity and mortality. It is the fourth leading cause of death in children contributing as high as 11% of all childhood deaths. In Nigeria, acute watery diarrhoea causes 240,106 deaths per year. Out of pocket expenditure is a major source of healthcare funding in Nigeria, hence treatment of acute watery diarrhoea places extra financial burden on the families especially those in the low socioeconomic class.
Objective: To determine the cost of treatment of acute watery diarrhoea in children aged 6 to 36 months.
Methodology: This was a cross-sectional study conducted on children aged 6-36 months who presented with acute watery diarrhoea from January through October 2017. Data obtained using interviewer-administered questionnaire, included socio-demography, duration of illness, treatment cost of the index diarrhoeal episode before presenting to our facility, transportation cost, food and other incidental cost, duration of hospitalization. Diagnostic tests requested and medications prescribed were obtained from the patient's medical file. Information on drug cost, diagnostic test cost and hospital bed day cost were obtained from Nnamdi Azikiwe University Teaching Hospital (NAUTH) central pharmacy, NAUTH main laboratory and account section respectively. Statistical Package for Social Sciences (SPSS) version 20 was used for data analysis.
Result: Seventy two patients were recruited for the study, of whom 47(65.0%) were males giving a male female ratio of 1.9:1. Forty eight (66.6%) of the study participants belonged to the lower socioeconomic class while 22(30.6%) and 2(2.8%) belonged to the middle and upper socioeconomic class respectively. A mean total treatment cost per diarrhoea episode derived from this study was # 37,572.2 ± #12,479.0 which at the time of the study was equivalent to US$ 104.7 ± US$ 34.8. This is well above the then Nigerian minimum monthly wage of 18,000.0 (US$ 50.1).
Conclusion: The result of this study showed that the economic burden of acute watery diarrhoea is quite enormous especially to the low socio-economic group. Prevention and improvement of home treatment of diarrhoea may reduce the treatment cost.

Key words: Acute watery diarrhoea, Cost, Children, Hospital

Introduction

Diarrhoeal diseases are among the most common illnesses in infants and young children in both developing and developed countries.[1, 2] Globally, there are nearly 1.7 billion cases of diarrhoeal diseases every year.[3] Diarrhoeal diseases account for 11% of all under five deaths worldwide.[3] Acute watery diarrhoea is the fourth leading cause of under-fives death globally[4] and the third leading cause in developing countries.[5,6,7] In Nigeria it causes about 240,106 deaths annually.[8] Despite the progress made in the global reduction of diarrhoea mortality from 4.6 million to 1.8 million over the last three decades [9, 10] the number of diarrhoeal deaths remains unacceptably high.

The World Health Organization defines diarrhoea as the passage of three or more loose stool in a twenty-four-hour period, a loose stool being one that would take the shape of a container.[11] Most diarrhoeal deaths are preventable with health education on hygiene and proper

sanitation, early identification and presentation to a health facility, administration of oral Zinc and the use of inexpensive, properly constituted oral rehydration solution (ORS).[12] The cost implication of a child's death from diarrhoeal diseases cannot be quantified. Cost is a monetary valuation of effort, material, resources, time and utilities consumed, risks incurred and opportunity forgone in production and delivery of goods or services.[13] Direct medical costs result from direct patient care services like medication, personnel, diagnostics and hospital bed-day costs borne.[12] Travel costs are direct, non-medical costs borne by patients and caregivers. Indirect medical costs emanate from costs of time lost from productive work borne by the patients, caregivers and the society. In addition to the distortion in family dynamics, care of other children in the home will be negatively affected. Cost of an illness according to Osibogun, [14] goes beyond the cost of treatment. The high morbidity associated with acute watery diarrhoea makes it pertinent to determine the economic burden of its management, with a view to instituting appropriate preventive measures early. This may reduce mortality and morbidity and perhaps lessen the economic hardship of families.

Materials and Methods

This was a prospective study that recorded all expenditures made during hospitalization of children aged 6 to 36 months with acute watery diarrhoea. The study was conducted at the Children's Emergency Room (CHER) and Paediatric Medical Ward (PMW) of NAUTH, Nnewi, Anambra State, South-East, Nigeria. NAUTH offers primary, secondary and tertiary level health care services to patients and draws clientele from the entire state and the surrounding states of Enugu, Delta, Abia and Imo. Nnewi-host town of NAUTH is the second largest town in Anambra state. Nnewi falls within the tropical rainforest region of Nigeria and is located on latitude 6°1'N and longitude 6° 55'E of the Niger River and 22km South East of Onitsha.[15] Majority of the populace source their water privately from water vendours, bore-holes, rainwater and stream water. There are lots of schools catering for children of all ages including infants. Even though government is providing some sanitation services, there is poor refuse disposal as refuse are sometimes indiscriminately disposed along the roads and drainage channels.

Ethics approval for the study was obtained from the Research and Ethics Committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi (NAUTH/CS/66/vol.11/139/2018/098). The concept of the study was carefully explained to the respondents and written informed consent received prior to the completion of the data abstraction form and questionnaire.

Study population

All children aged 6 to 36 months who were admitted for acute watery diarrhoea (for the purpose of the study, passage of loose or watery stool lasting less than 2 weeks).

The subjects who met the inclusion criteria and whose caregivers gave informed consent were recruited through consecutive enrollment until the desired sample size was reached. The following children were excluded from the study: HIV positive children, children with diarrhoea disease lasting more than two weeks, children that acquired diarrhoea in the course of admission for treatment of other diseases and children with visible blood in stool.

Sample size

Sample size was determined using the WHO guidelines.[12] From February 2015 to February 2016, 907 patients were admitted into CHER NAUTH, of whom 204 cases were treated for diarrhoea. With a coefficient of variation of 0.5 and 10% level of precision, the desired sample size was set at 65. With an attrition rate of 10%, a total of 72 patients were recruited, this made allowance for drop out or those excluded on account of duration of diarrhoea in the course of the study.

Data Collection

The records of the subjects were reviewed for prescriptions made and treatment given and data abstraction form, [12] filled and updated daily until discharge. The content of the data abstraction form (proforma) included: the duration of stay in days at different levels of care, the type, frequency, amount, duration of administration of oral rehydration solution (ORS), intravenous (IV) fluids and all medications including discharge medications directly related to the diarrheal episode, laboratory and diagnostic procedures requested for. Once any infusion was opened, the patient pays for it irrespective of the volume used, like wise antibiotics. Therefore, cost of the infusion and antibiotics were the quantity supplied and not only by the prescription alone. Some patients had antibiotic prescription for 5 days while they received it for approximately 48 hours. A pre-tested interviewer administered standard questionnaire developed by WHO,[12] was also used to elicit information on direct and indirect costs. Care givers were told to put down expenses made while on admission for the index diarrhoeal episode. Socio-economic status of the caregivers was determined using Oyedeji's classification.[16] First and second classes were merged as upper, third class was middle while fourth and fifth classes were merged as lower socioeconomic class.

Unit costs estimates were collected for each of the following items: medications, diagnostic tests, and hospital bed-day. These were collected in the pharmacy, laboratory, accounts section and interview with the head of accounts Department and the Hospital Chairman Medical Advisory Committee (CMAC).

Results

Among the diarrhoeal admissions, 103 patients were selected consecutively. Thirty-one patients were eliminated on the basis of exclusion criteria (21 patients due to bloody stool, 6 patients were HIV positive while 4 patients had diarrhoea that lasted for more than 14 days). Seventy-two patients were used in the final analysis. The socio-demographic characteristics of the study participants are depicted in table 1. Out of the 72 patients that were used in the final analysis, 47(65%) were males while 25(35%) were females, giving a male to female ratio of 1.9: 1

Table 1: Socio-demographic characteristics of the study Participants

Characteristics	Frequency (%) N =72
Gender	
Males	47 (65.0)
Females	25 (35.0)
Age group	
6-11 months	36 (50)
12-23 months	31 (43.1)
24-36 months	5 (6.9)
Socio-economic class	
Upper class	2 (2.8)
Middle class	22 (30.6)
Lower class	48 (66.6)

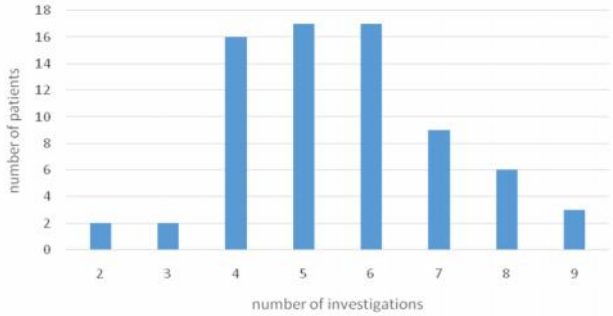
Duration of illness before presenting to NAUTH

Forty-two (58.5%) subjects were ill for 1 to 3 days before presentation to our facility. The remainders 30 (41.5%) were ill for 4 to 9 days.

Diagnostic tests

All the study participants were investigated; the minimum and maximum number of investigations done for each study participant was 2 and 9 respectively. This gave a mean (±SD) of 5.5(± 1.6).Seventeen (23.6%) patients had six investigations; five investigations were done for 17 (23.6%) patients, this showed a bimodal pattern with a mean of 5.54(±1.6). Four investigations were requested for another 16(22.2%) patients while seven investigations were requested for 9 (12.5%) patients. Six(8.3%)patients had eight investigations requested for each, three patients (4.2%) had 9 investigations done for them, while the remainder (2(2.8%) 2 (2.8%)) had two and three investigations requested forthem respectively (fig 1).

Fig 1: frequency of diagnostic tests requested



Cost of Diagnostic Tests

The major contributors to the diagnostic test cost were the number of investigations and the type of the diagnostic tests. Serum Electrolyte/Urea/Creatinine (SEUCr) was the most expensive (#2,500[US$7]) per test, followed by full blood count (FBC) which cost #1,860 (US$5.2) per test. Fifty-nine (81.9%) and 66 (91.6%) patients had SEUCr and FBC requested on them respectively. Blood film for malaria parasite (#600 [US$1.7]) was done in 50% of the patients. Erythrocyte sedimentation rate (#600[US$1.7]), stool microscopy, culture and sensitivity (#1,150[US$3.2]), urinalysis (#650 [US$1.8]) and abdominal ultrasound (#2,500 [US$7.0]), were performed among 14(19.4%), 8(11.1%), 6(8.3%) and 1 (1.4%), patients respectively. The minimum diagnostic test cost was #225 (US$ 0.6) and the maximum was # 8,360 (US$ 23.3). The mean cost of diagnostic test was #4,361.7(± #1343.2 SD). The US$ equivalent is 12.2± 3.7.

Treatment cost: This included the drugs and non-drug order costs. The non-drug order with their costs included cannula(#155 [US$ 0.43]), infusion (ranging from #180 (US$0.5) to #360(US$1.0) depending on the type of infusion), syringes(#40[US$0.1]), solusets (#1,700 [US$4.7]), hand gloves (#1,860[US$5.2]), water for injection (#30[US$0.1]) and plaster (#1,220[US$3.4]). The treatment cost (summation of non-drug order and all medications used for a patient) is shown in table 2. Antibiotics constituted a major contributor to the drug treatment cost while on admission; Majority of the patients had antibiotics 69 (94.5%) while only three (4.2%) did not receive antibiotics.

Table 2: Cost of Treatment (Drug and Non-Drug Order)

Treatment cost (drug and non-drug order) Naira(USD)	Frequency (%)
<10,000 (<27.9)	46 (63.9)
10,000 – 19,999 (27.9-55.7)	25 (34.7)
20,000 – 29,999 (55.7-83.6)	1 (1.4)
Total	72 (100.0)
Treatment cost analysis Amount	SPENT #(USD)
Minimum Treatment Cost	--- 5,455.0 (15.3)
Maximum Treatment Cost	--- 24,355.0 (67.8)
Mean Treatment Cost	--- 10,044.9 (27.9)
Standard Deviation	--- 2,827.9 (7.9)
Minimum Non-drug order cost	--- 2,955.0 (8.2)
Maximum Non-drug order cost	--- 7,245.0 (20,2)
Mean Non-drug order cost	--- 4,558.0 (12.7)
Standard Deviation	--- 823.6 (2.3)
Minimum Drug Treatment cost	--- 820.0 (2.3)
Maximum Drug Treatment cost	--- 20,116.0 (56.5)
Median Drug Treatment cost	--- 4,797.0(13.4)
Interquartile Range	--- 2,618.3 (7.3)

Hospital bed day cost

This included the heavily subsidized professional cost (doctors and nurses' charges), utilities and miscellaneous. The major determinant was the length of stay or duration of hospitalization. The hospital bed day cost is

directly proportional to the duration of stay. A day cost was # 2,135.0($6.0) and then increased to #3,115.0 ($8.7) at the end of July 2017. Things that made up the day cost included: bed fee initially #350($0.9), then #500($1.4), doctor's charge was initially #550($1.5), but later #815($2.3), nursing charge initially #385($1.1) but later #715($2.0), utility fee initially #325($0.9) later #480($1.3), miscellaneous fee initially #310 later #355 ($1.0)and antiseptic fee was initially #251 and later #250($0.7). The initial cost was used for patients recruited at that time, of which majority fell in this category, while the latter cost was utilized for the patients recruited after the increment. The hospital bed day cost is shown in table 3.

Table 3: Total hospital bed day cost in naira

Hospital bed day cost Naira Cost category	Frequency (%)	amount naira($)
< 10,000	31 (43.1)	
10,000 - <20,000	34 (47.2)	
20,000 - < 30,000	6(8.3)	
≥30,000	1 (1.4)	
Total	72 (100.0)	
Median Hospital bed day cost	- -	10,675.0 (29.7)
Interquartile range	- -	8,521.3 (23.7)
Minimum Hospital bed day cost	- -	4,035.0 (11.2)
Maximum Hospital bed day cost	- -	36,982.0 (103.0)

Cost of feeding

The median cost of food was # 4,025.0($11.5) (± #3,230.0 ($9.0) IQR) for the entire duration of admission. The daily food cost ranged from #700.0 ($1.9) to #2,250.0($6.3). The minimum and the maximum food costs for the entire duration of admission were #700.0 ($1.9) and # 13,840.0 ($38.6) respectively. The determinants of the feeding cost were the duration of stay, the sources of the food for the individual patient and the number of relatives that were also in the hospital.

Other incidental cost

The mean incidental cost was # 2,457.0($6.8) (± #990.0 ($2.8) SD). The items that made up this cost included; thermometer, bucket, toilet roll, detergents, hypochlorite solution, slippers. etc.

Transportation cost

The median transportation cost was #235.3($0.7) (± #386.0[$1.2] IQR)S. The maximum cost of transportation for the patients' caregivers and their relatives was #2,800.0 ($ 7.8)

The total cost incurred during admission

The mean total cost was #37,572.2($104.7) (± #12,479.0($34.8)SD) (Table 4). The components of this total cost are as depicted in figure 2.

The mean total monthly household expenditure obtained was #73,866.0 (±100,611.5), while the mean total cost per index diarrhoeal episode was #37,866.0. This is approximately 51% of the mean total household expenditure. The implication is that of catastrophic health expenditure for the individual families.

Fig 2: Components of the total direct cost in percentages

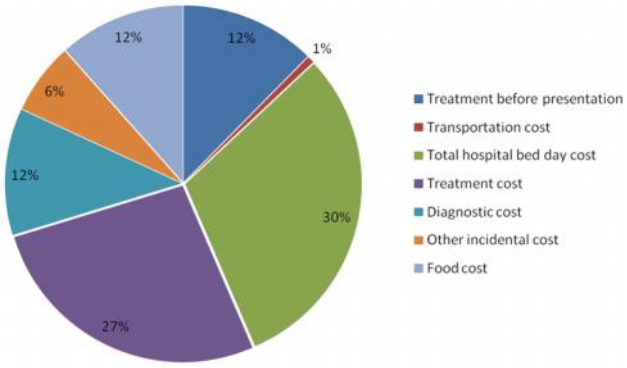


Table 4: Total Medical Cost in Naira

Total medical cost (Naira)	Frequency (%)	amount spent #($)
< 15,000	2 (2.8)	
15,000 - < 30,000	16 (22.2)	
30,000 - <45,000	42 (58.3)	
45,000 - < 60,000	7 (9.7)	
≥ 60,000	5 (6.9)	
Mean total medical cost	---	37,572.2 (104.7)
Standard deviation	---	12,479.9 (34.8)
Minimum total medical cost	---	14,635.0 (40.8)
Maximum total medical cost	---	87,452.0 (243.6)

Discussion

The mean treatment cost per acute watery diarrhoea episode obtained in this study was #37,572 (#14,635 #87,452), equivalent to US$ 104.7 (US$4.1 -243.6), which is slightly higher than $97 documented by Aikins *et al*[17] in Northern Ghana. Aikins *et al*[17] documented a treatment cost of $97 for treatment by rehydration and administration of antibiotics. The work of Aikins *et al*[18] was similar to this study as most of the patients (69 out of 72) received antibiotics while only three patients did not receive antibiotics. The slight difference observed in the treatment cost reported in this study and that of Aikins *et al*[17] could be due to geographical variation, the year of the study and the costing system obtained in different institutions. This cost is enormous for the lower socioeconomic class in which majority of the study participants belonged to.

The mean treatment cost recorded in this work is much lower than what MacIntyre *et al*[18] in South Africa reported. MacIntyre *et al*[18] recorded a mean treatment cost of 7079 Rands which was equivalent to $490.2. On the other hand, this study observed a mean diagnostic test cost of $12.2 which was lower than that of the South African study that reported a total diagnostic cost ranging from US$20.9 to US$25.7. This difference observed in both treatment and diagnostic test costs could be due to the socio-demographic variables in the two nations,

South Africa is a more developed country with mixed economy than Nigeria.
Fischer *et al*[19] in Europe recorded a treatment cost of sixty pounds (£) which was equivalent to $79.5 for the health sector perspective, and a societal treatment cost of £176, equivalent to $230.7. These are both lower and higher than the mean treatment cost obtained from the present study respectively. The higher cost of £176 was due to the combination of direct medical, parental and societal costs. This could have been possible due to wages per hour done in most European countries which is not usually the case in Nigeria and so it was difficult estimating wages lost as a result of time utilized in taking care of the admitted patients with diarrhoea.

The mean treatment cost of #37,572.2(US$ 104.7) estimated from this present work is also at variance with what Nelson *et al*[21] obtained in Hong Kong. Nelson *et al*[20] reported a mean treatment cost of $2,037 which is much higher than the treatment cost recorded in this work. The mean treatment cost documented in this study is much higher than the treatment cost ranging from $26 to $42, reported by Burke *et al*[21] in Bolivia. Muraduzzaman *et al*[22] in Bogra, Bangladesh and Sowmyanarayanan *et al*[23] in India recorded a treatment cost that ranged from $2.5 to $13.14 and $53.75 to $66.05, respectively. Sowmyanarayanan's study[23] was on direct treatment cost of hospitalization for acute watery diarrhoea caused by Rotavirus and this might explain the relatively low cost obtained by them when compared with treatment cost of this present work. These variations reported above could also be due to different geographical locations, rising and dwindling economy, the type of patients studied, the year of the study and the different health insurance schemes obtainable in different nations and more so the economic equivalence of the nation's currency. The mean treatment cost obtained in this study is much higher than US$ 0.3 and US$14 documented by Rao *et al*[24] and Patel *et al*[25] in India. Their works were on out-patient treatment cost and this could be responsible for the relatively very low treatment cost when compared with the present study which was on in-patients.
The mean transportation cost obtained in this study was #569.7($1.6) which is slightly higher than R9.5 ($0.7) reported by MacIntyre *et al*[18] in South Africa. This slight difference could be due to the location of the study areas. Whereas NAUTH being the largest tertiary facility in the state receives referrals from many centers, the South African study[18] had majority of the study participants living close to the study site. This probably resulted in a relatively lower transportation cost.
Diagnostic test costs alone contributed 12.0% of the total cost. This is in contrast with what MacIntyre *et al*[18] documented; who reported that summation of investigation, medications and non-drug orders contributed to approximately 7.0 % of the total cost, whereas, the combination of these in the present study contributed up to 39.0% of the total cost. Full blood count and Serum Electrolyte, Urea and Creatinine (SEUCr) were the commonest investigations done. This also is comparable to other previous works.[17,18] The number of investigations requested for, were also determined by the doctor that reviewed at the point of patient's presentation to our facility. Stool microscopy, culture and senstivity (M/C/S) was done for only 11.1% of the subjects. SEUCr was commonly requested for, to assess the level of electrolyte derangement and renal injury resulting from the acute watery diarrhoea. Electrolyte imbalance is a known complication of acute watery diarrhoea. It was also used to monitor response to treatment for those with marked electrolyte derangements on presentation. SEUCr was among the most expensive investigation requested for; it amounted to #2,500 ($6.9) per sample. This is approximately 57% of the mean diagnostic test cost.

The major determinant of total hospital bed day cost was the duration of admission. The duration of stay obtained from this study ranged from 2 to 9 days with a mean of 5.25 days ± 2.1 days. This was similar to what Macintyre *et al*[18] in South Africa and Rao *et al*[24] in India reported. Professional cost (doctors' and nurses' charges) contributed majorly to this hospital bed day cost.
Treatment cost (drug and nondrug order) was a major contributor to the overall treatment, contributing as much as 27.0%, second only to the total hospital bed day cost. The major determinants of this included use and brand of antibiotics. The high use of antibiotics witnessed was not limited only to this study, but also reported by works in Ghana[17]and South Africa.[18]

Food and other incidental costs contributed to 12.0% and 6.0% respectively. The money used for this might have been enough to feed the individual patients family.
The effect of admission was felt (in terms of finance and time lost resulting from the hospitalization) by 94.4% of the study participants, even though some could not estimate the indirect cost. This was possibly due to some of the females being unemployed (23.6%), the ones that were employed were civil servants (29.2%) and did not lose any personal income as far as they showed evidence of their child's admission to their employer, but the government and society lost in reduced productivity. From the above it could be seen that diarrhoea causes a considerable burden to the family. The cost of an illness as rightly put by Osibogun[14] goes far beyond the treatment cost. It involves the actual treatment cost, all the inconveniences, opportunity forgone, the social cost, cost to pain and misery.[14] Due to a diarrhoeal related admission episode, the family dynamics is distorted and care of other children jeopardized. Efforts should therefore be heightened to prevent or limit the occurrence of diarrhoeal diseases.

Conclusion

The mean treatment cost per episode of acute watery diarrhoea is high (#37,572.2($104.7)), far more than the Nigerian minimum monthly wage bearing in mind that Nigeria is a developing country with many people living below poverty line. Moreso, majority of the study participants belonged to the lower social class. Efforts

aimed at preventing diarrhoea disease and continued training of health workers on adherence to WHO guidelines on management of acute watery diarrhoea may lead to reduction in cost burden.
Relating cost of care to family income will be an important line of future study.

Limitation of this study

The cost of treatment of acute watery diarrhoea might have been underestimated due to difficulty in obtaining the indirect costs. This was contributed by no formal employment of some of the mothers and some were reluctant to volunteer information about their income. It was difficult to calculate wages lost as a result of the diarrhoeal episode.

Conflict of interest: None
Funding: None

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