**Patient costs of diabetes mellitus care in public healthcare facilities in Kenya**

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**Abstract**

***Objective:***To estimate the direct and indirect costs of diabetes mellitus care at five public health facilities in Kenya.

***Methods:*** We conducted a cross-sectional study in two counties and interviewed diabetes patients who were aged 18 years and above. A total of 163 patients seeking diabetes care at five public facilities were interviewed and information on care seeking and the associated costs was obtained using the cost-of-illness approach. Medicines and user charges were classified as direct healthcare costs while expenses on transport, food, and accommodation were classified as direct non-healthcare costs. Productivity losses due to diabetes were classified as indirect costs. We computed annual direct and indirect costs borne by these patients.

***Results:*** More than half (57.7%) of sampled patients had hypertension comorbidity. Overall, the mean annual direct patient cost was KES 53,907 (95% CI, 43,625.4-64,188.6) (US$ 528.5 (95% CI, 427.7-629.3)). Medicines accounted for 52.4%, transport 22.6%, user charges 17.5% and food 7.5% of total direct costs. Overall mean annual indirect cost was KES 23,174 (95% CI, 20,910-25,438.8) (US$ 227.2 (95% CI, 205-249.4)). Patients reporting hypertension comorbidity incurred higher costs compared to diabetes only patients. The incidence of catastrophic costs was 63.1% (95% CI, 55.7,70.7) and increased to 75.4% (95% CI, 68.3,82.1) when transport costs were included.

***Conclusion:*** There are substantial direct and indirect costs borne by diabetic patients in seeking care from public facilities in Kenya. High incidence of catastrophic costs suggest diabetes services are unaffordable to majority of diabetic patients and illustrate the urgent need to improve financial risk protection to ensure access to care.

**Key words:** out-of-pocket costs, productivity losses, catastrophe, diabetes mellitus, Kenya.

**Background**

Diabetes mellitus (DM) is a chronic, incurable and potentially disabling disease that presents a substantial public health challenge worldwide. [1](#_ENREF_1) Evidence suggests that the unprecedented increase in DM burden has major clinical, economic and social implications particularly in low and middle-income countries (LMICs). [2-7](#_ENREF_2). In addition to reducing well-being, the chronic nature and complications associated with DM may lead to substantial costs of medical care and productivity losses to patients and their households. Unfortunately, progress in attainment of Sustainable Development Goal 3.4 that aims to reduce premature mortality from non-communicable diseases (NCDs) by one third by 2030 continues to be constrained by *inter alia,* weak health systems in most LMICs[1](#_ENREF_1).

The Kenyan health system is devolved, with the national ministry of health (MOH) having policy and regulatory roles while the 47 county health systems have service provision roles [8](#_ENREF_8). Service delivery is pluralistic and is characterised by a mix of public, private for profit and private not-for-profit providers [9](#_ENREF_9),[10](#_ENREF_10). Kenya’s public healthcare delivery system is organized into six levels. Level 1 is comprised of community health services which includes all community-based demand creation activities that are guided by the MOH community strategy. Level 2 and 3 refer to dispensaries and health centers respectively, which offer outpatient primary healthcare services. Level 4 represents sub-county hospitals which are first referral hospitals while level 5 represents county referral hospitals that provide secondary care. Level 6 represents national tertiary referral hospitals. Diabetes care is typically offered through dedicated specialized clinics located in public level 4-6 hospitals [11-14](#_ENREF_11). In some areas however, patients can access medication from health centres and dispensaries, but this is the exception rather than the norm. Each of these levels are expected to provide some aspects of preventive, promotive, curative and rehabilitative services as outlined in the Kenya Essential Package for Health [15](#_ENREF_15), which includes interventions and services targeted at DM. Private providers mimic this classification though most are stand-alone units with weak referral mechanisms. Kenya’s health system is financed by (1) tax revenues collected by the government (national and county); (2) donor funding; (3) household contributions to the National Hospital Insurance Fund (NHIF); (4) household contributions to private health insurance companies; and (5) out-of-pocket (OOP) payments at points of care.

The first nationally representative survey of 2015 found a national age-standardized DM prevalence of 2.4% with 3.1% of Kenya’s population having impaired fasting glycemia[12](#_ENREF_12),[16](#_ENREF_16). The increasing prevalence and the chronic nature of DM makes it a costly disease both to Kenya’s health system and the affected households as it has been shown that persons with diabetes incur up to three times higher medical costs compared to nondiabetics [17-19](#_ENREF_17). In addition, delay in diagnosis, poor quality of care or the lack thereof, presence and severity of complications, as well as comorbid conditions are the most important factors related to DM care costs [20](#_ENREF_20),[21](#_ENREF_21).

Evidence of patient costs associated with DM care is needed to assess the economic impact of DM to households, the extent to which DM patients and households are protected from financial hardship due to health care use and to design effective financial risk protection mechanisms for this group of patients [6](#_ENREF_6),[21](#_ENREF_21),[22](#_ENREF_22). We therefore conducted this study to document the patient costs of DM at primary care level in Kenya.

**Methods**

**Study setting:** The study was conducted from June to December 2017 in two sites in Kenya (Kilifi and Bungoma County) purposively selected to reflect a diverse set of demographic, socioeconomic and geographical settings. Kilifi is located on the coast of Kenya and a high burden of stroke and heart failure has been described in this area [23](#_ENREF_23). The population in Kilifi has been well characterized by data from the health and demographic surveillance system run by the KEMRI Wellcome Trust Research Programme[24](#_ENREF_24). The Webuye Health and Demographic Surveillance System run by Moi University is located in Bungoma County in the western region of Kenya [25](#_ENREF_25). Multiple cardiovascular risk factors have been identified in this area [26](#_ENREF_26). Table 1 outlines study site characteristics.

**Table 1** Selected study site indicators in 2017

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **County** | **Estimated population**  | **No. of public hospitals**[**27**](#_ENREF_27) | **No. of health centres and dispensaries**[**27**](#_ENREF_27) | **No. of OPD patients** | **No. of admissions**  | **No. of diabetes cases**  | **No. of hypertension cases**  |
| Bungoma |  1,759,499[28](#_ENREF_28)  |  9  | 125 |  1,215,525  |  70,665  |  3,038  |  15,908  |
| Kilifi |  1,466,856[29](#_ENREF_29)  |  5  | 123 |  1,243,315  |  28,746  |  4,663  |  26,458  |

(all data except where otherwise indicated [30](#_ENREF_30)).

Six public health care facilities were purposively selected in consultation with county health officials in respective counties to generate a sample of facilities with different workloads, plus the location of the clinics relative to the communities served. However, due to the 150-days nation-wide nurses’ strike at the time of data collection [31](#_ENREF_31), data was collected from 5 facilities unlike the anticipated 6 facilities in the two counties. In Kilifi, a public hospital and a health centre that provided DM treatment were selected while in Bungoma, three public hospitals were sampled. For this descriptive analysis, data from all the facilities were pooled.

**Sample size and sampling:** The target enrolment was 282 patients for a sample size sufficient to obtain a precise estimate of DM patient costs based on the formulae by Kirkwood [32](#_ENREF_32);

N = (Zα/2+Zβ)2 \*(P (1 – P))/e2)

Where:

Zα/2 is the critical value of the normal distribution at α/2 (for a confidence level of 95%, α is 0.05 and the critical value is 1.96)

Zβ is the critical value of the normal distribution at β (for a power of 80%, β is 0.2 and the critical value is 0.84)

P= expected true proportion of DM in the population in Kenya of 10% (0.10)

e= desired standard size of standard error around the estimated proportion of 5% (+/- 0.05).

Every DM patient receiving treatment and available at participating facilities during data collection was approached to participate in the study. Patients were eligible if they self-reported DM diagnosis, had received treatment for a minimum of six months after diagnosis and were more than 18 years of age. Consenting patients were selected based on meeting the eligibility criteria and the order of arrival at the clinic. Respondents were asked to report on their health service use, associated costs, income and coping mechanisms if they undertook any of the following to meet DM care costs: borrowing (having taken a loan), selling household items or assets (e.g. livestock), and use of savings.

**Measuring patient costs:** The ‘cost-of-illness’ approach was used to document patient costs [33](#_ENREF_33). Interviews were conducted using a structured questionnaire. Three trained interviewers collected the data in the two study sites. Interviews were conducted primarily in Kiswahili, with local languages (Kigiriama and Kibukusu in Kilifi and Bungoma, respectively) used to clarify questions where necessary. Respondents were asked about costs incurred for different care seeking episodes described in Table 2.

**Table 2** Care seeking episodes included in patient cost estimates

|  |  |  |
| --- | --- | --- |
| **Care seeking episode** | **Description** | **Recall period** |
| Sick visit | Cost of current care seeking (during interview), and any out-patient visit when the patient was ill due to DM outside the scheduled clinic appointments | 1 month |
| Inpatient visit | Cost of admission due to DM | 12 months |
| Drug collection visit | Cost of regular medicines prescribed to the patient to manage DM  | Frequency of drug collection i.e. monthly/ quarterly |
| Laboratory/diagnostic visits | Cost of routine laboratory/diagnostic services done at a health facility | Frequency of lab/diagnostic services i.e. monthly/ quarterly |
| Scheduled clinic check-up visits | Costs due to regular clinic appointments  | Frequency of clinic appointments i.e. monthly/ quarterly |

To annuitize sick visit costs, we summed up costs incurred during current care visit and any reported outpatient visit costs that occurred due to DM in the last four weeks prior to the study then multiplied by 13 (assuming there are 52 weeks in a year). On the other hand, to annuitize costs in other care seeking episodes described in Table 2, reported costs were multiplied by the frequency of visits i.e. weekly, monthly, or quarterly for each episode. Furthermore, any inpatient admission costs in the last one year was also collected. Overall DM care costs for all care seeking episodes were calculated by summing up the annual costs in each care seeking episode. Costs incurred by patients in the overall sample, costs incurred by diabetics without comorbidities (hereafter called diabetes only patients), and costs incurred by diabetics with comorbidities (hereafter called comorbid patients) i.e. patients who reported both DM and hypertension diagnosis were analysed and reported separately.

For each of the care seeking episode, two broad costs categories were estimated: direct out-of-pocket (OOP) costs and indirect (productivity losses) costs for both patients and their caregivers. Direct healthcare costs included any charges levied for medicines and user fees i.e. registration, consultation and laboratory services. Direct non-healthcare costs included transport costs to and from a health provider and any costs associated with food or accommodation while seeking care. For this analysis, OOP costs were defined as the sum of direct healthcare and direct non-healthcare costs. Analysis was restricted to patients who reported any OOP costs for each care seeking episode.

Indirect costs were estimated based on the total hours lost while seeking care as well as the cost of illness-related to lost productivity for both patients and their caregivers, assuming that these hours would have been used for productive activity in the absence of DM [34](#_ENREF_34). Income lost due to DM illness was therefore estimated by multiplying the estimated number of lost production hours due to DM by the official minimum wage of Kenya shillings (KES) 8,568 (US$ 84/month) in the agricultural sector in 2017 given the main economic activities in our study sites [35](#_ENREF_35). We assumed an average workday of 8h/day and 22 working days/month. Caregivers' lost productivity was also estimated by multiplying the total number of hours spent caring for the patient by the official minimum wage rate.

Income was estimated by asking detailed questions about income categories, including patient income, income for household members, welfare payments as well as government assistance. As a measure of financial risk protection, we compared total direct costs incurred, in the overall sample and by socio-economic status, against annual household income and total direct costs excluding transportation costs and defined costs as catastrophic if they exceeded 10% of annual household income [36](#_ENREF_36).

**Data management and analysis:** Data was double-entered to enhance data quality. The two data sets were compared to eliminate data entry errors. Consistency and range checks were used to ensure completeness of data. Data was analysed using STATA 14.0 (STATA, Statacorp, Texas, USA). Frequency counts and percentages were used to describe patient demographic and socio-economic variables. Due to skewed nature of costs data, mean and median values were reported for all cost estimates as a measure of central tendency and 95% confidence intervals (CI) and inter-quartile range (IQR) were reported. Cost results are presented in KES and United States Dollars (US$). Cost in KES was converted to US$ using the following exchange rate: US$ 1= KES 102 (average exchange rate, January-December 2017; Currency Converter/Foreign Exchange Rates/OANDA. <http://www.oanda.com/currency/converter/>).

**Ethical approval**

Ethical approval for the study was obtained from KEMRI’s Scientific Ethics Review Unit (SERU) (Ref: KEMRI/SERU/CGMR-C/041/3270) and from County Department of Health in both study sites. Written consent was obtained from each participant. Facility managers were informed of the study and granted permission to access clinics and patients.

**Results**

**Participants characteristics and health services utilisation**

Overall, 163 patients were interviewed; 92 (56.4%) from Bungoma and 71 (43.6%) from Kilifi. The mean age in the sample was 58.9 years and 58.9% of the respondents were female. More than half reported hypertension comorbidity (57.7%), were not enrolled to any health insurance scheme (68.1%) and were diagnosed with either DM or hypertension (HTN) more than five years ago (47.9%) (Table 3). The median travel time to a health facility was 30 minutes (IQR, 18-60). Forty-five patients (27.6%) reported that the facility where they sought care was not the nearest to them; of these, 48.9% (95% CI, 34.2-63.7) reported lack of resources such as medicines and/or diagnostic equipment, 37.8% (95% CI, 24.5-53.2) reported referral and 13.3% (95% CI, 5.9-27.3) reported other reasons (e.g. time consuming to wait) for not visiting the nearest facility.

**Table 3** Patient characteristics

|  |  |  |
| --- | --- | --- |
| **Characteristic** |  **Observations** **(n = 163)** | **Proportion (95% CI)** |
| Mean age in years |  163 | 58.9 (56.8-61.0) |
| Gender |  |  |
|  Male | 67 | 41.1% (33.7-48.9) |
|  Female | 96 | 58.9% (51.1-66.2) |
| Illness condition |  |  |
|  Diabetes mellitus | 69 | 42.3% (34.9-50.1) |
|  Diabetes mellitus and hypertension | 94 | 57.7% (49.9-65.1) |
| Enrolled to a health insurance scheme |  |  |
|  Yes |  52 | 31.9% (25.1-39.5) |
|  No |  111 | 68.1% (60.5-74.9) |
| Employment status |  |  |
|  Formal employment | 32 | 19.6 (14.2-26.5) |
|  Informal/unemployed |  131 | 80.4 (73.5-85.8) |
| Reason for not working |  |  |
| Related to DM/DM and HTN comorbidity |  48 | 29.4% (22.9-37.0) |
| Not related to DM/DM and HTN comorbidity |  115 | 70.6% (63.0-77.1) |
| Highest level of education |  |  |
|  None | 27 | 16.6% (11.6-23.2) |
|  Primary  | 66 | 40.5% (33.2-48.3) |
|  Secondary | 47 | 28.8% (22.3-36.3) |
|  Graduate/Certificate | 23 | 14.1% (9.5-20.4) |
| Where diagnosed |  |  |
|  Public facility |  132 | 81.0% (74.1-86.3) |
|  Mission facility |  7 | 4.3% (2.0-8.7) |
|  Private facility |  24 | 14.7% (10.0-21.1) |
| Illness duration |  |  |
|  6 months - 1 year | 16 | 9.8% (6.1-15.5) |
|  1-5 years | 69 | 42.3% (34.9-50.1) |
|  > 5 years | 78 | 47.9% (40.2-55.6) |

**Patient costs associated with healthcare use**

1. **Sick visit costs**

In the overall sample, 36% of patients (n=59) reported a sick visit i.e. sought care out of their scheduled clinic appointments a month before the survey. On the other hand, 29% (n=20) of diabetes only patients and 41% (n=39) of comorbid patients reported a sick visit. Mean annual costs for medicines attracted the highest direct cost in the overall sample - KES 15,340.8 (95% CI, 6,120-24,561.6) (US$ 150.4 (95% CI, 60-240.8)) mainly driven by the contribution of medicine costs for comorbid patients - KES 17,880 (95% CI, 4,641.7-31,118.3) (US$ 175.3 (95% CI, 45.5-305.1)). However, among diabetes only patients, user charges attracted the highest cost, mean annual cost - KES 12,733.5 (95% CI, 1,825-27,292) (US$ 124.8 (95% CI, 17.9-267.6)) (Table 5). In addition, transport costs contributed 25.8% of annual mean costs in the overall sample,26.3% in the diabetes only group and 25.5% in the comorbid group (Table 4,5 and 6).

1. **Inpatient costs**

Twenty two percent (n=37) of the patients in the study reported an inpatient admission in the past year with each admission lasting a mean of 1.6 days (95% CI, 1.3-1.9). User charges constituted the highest direct costs attracting an estimated KES 16,718.8 (95% CI, 3,264-30,161.4) (US$ 163.9 (95% CI, 32-295.7)), KES 18,568.6 (95% CI, 11,234.9-48,372.1) (US$ 182.0 (95% CI, 110.1-474.2)) and KES 15,273.9 (95% CI, 287.2-30,834.9) (US$ 149.7 (95% CI, 2.8-302.3)) mean annual costs in the overall sample, diabetes only patients and comorbid patients, respectively. Additionally, direct costs were higher than indirect costs in all the three groups (Table 4,5 and 6).

1. **Medicine collection costs**

The median number of routine medicines prescribed to diabetes only patients was 2 (IQR 1-2) and 3 (IQR, 3-4) for comorbid patients. The most expensive antidiabetic regimen was metformin and insulin (mean annual cost, KES 15,636.6 (95% CI, 2,723.4-28,539.6) (US$ 153.3 (95% CI, 26.7-279.8)) while metformin, glibenclamide and enalapril combinations were the most expensive medicines prescribed to comorbid patients attracting a mean annual cost of KES 18,635.4 (95% CI, 3,131.4-40,402.2) (US$ 182.7 (95% CI, 30.7-396.1)) (Table 7). In addition, more than half (57.7%) of sampled patients reported obtaining their routine medicines from a public hospital (Figure 1). Medicines accounted for 87.3% of total OOP costs during medicine collection visit while transport and food accounted for 10.4% and 2.3% in the overall sample, respectively (Table 4).

1. **Diagnostic/laboratory test costs**

The main routine diagnostic tests reported by diabetes only patients were fasting blood sugar (FBS) and weight (mean annual cost KES 1,499.4 (95% CI, 1,030.2-4,029 ) (US$ 14.7, (95% CI, 10.1-39.5)) while comorbid patients reported FBS and blood pressure, mean annual cost KES 4,518.6 (95% CI, 173.4-8,853.6) (US$ 44.3 (95% CI, 1.7-86.8)) and echocardiogram and kidney function tests, mean annual cost, KES 3,335.4 (95% CI, 1,081.2-5,589.6) (US$ 32.7 (95% CI, 10.6-54.8). The mean annual direct costs for diagnostic/laboratory tests was KES 6,252.6 (95% CI, 3,111-9,384) (US$ 61.3 (95% CI, 30.5-92.0)) in the overall sample (Table 4), KES 7,886.4 (95% CI, 572.7-15,200.1) (US$ 77.3 (95% CI, 5.6-149.0)) for diabetes only patients (Table 5) and KES 5,110 (95% CI, 3,282.5-6,937.4) (US$ 50.1 (95% CI, 32.2-68.0)) for comorbid patients (Table 6). In addition, 18% (n=29) of the patients reported incurring costs to purchase of either a glucometer or a blood pressure monitoring machine incurring a mean cost of KES 3,542.9 (95% CI, 2,724.1-4,361.6) (US$ 34.7 (95% CI, 26.7-42.8)) with additional mean annual cost of KES 16,885.7 (95% CI, 12,377.3-21,394.1) (US$ 165.5 (95% CI, 121.3-209.7)) on consumables like glucose strips and lancets.

1. **Scheduled clinic appointment costs**

Majority of patients (76.7%, n=125) attended monthly scheduled clinic visits. Medicines attracted the highest cost in the overall sample, mean annual cost KES 10,159.2 (95% CI, 7,170.6-13,147.8) (US$ 99.6 (95% CI, 70.3-128.9)) and in the comorbid patients, mean annual cost KES 12,839.2 (95% CI, 7,966.7-17,711.6) (US$ 125.9 (95% CI, 78.1-173.6)). However, user charges attracted the highest cost, mean annual cost KES 6,362.2 (1,953.2-10,771.1) (US$ 62.4 (95% CI, 19.1-105.6)) in the diabetes only group during scheduled clinic appointments. In addition, transport costs accounted for 23.2%, 26.5% and 21.3% of total direct OOP costs in the overall sample, diabetes only and comorbid patients, respectively (Table 4,5 and 6).

1. **Overall care seeking cost**

When costs from all care seeking episodes were combined, the average direct annual costs (KES 53,907 (95% CI, 43,625.4-64,188.6) (US$ 528.5 (95% CI, 427.7-629.3)) was higher than the average indirect annual costs (KES 23,174.4 (95% CI, 20,910.0-25,438.8) (US$ 227.2 (95% CI, 205.0-249.4)) in the overall sample (Table 4). Of note, medicines costs (mean annual cost, KES 33,374.4 (95% CI, 25,092.0-41,656.8) (US$ 327.2 (95% CI, 246.0-408.4)) in the overall sample, in the diabetes only (mean annual cost KES 22,275.3 (95% CI, 16,647.7-27,902.8) (US$ 218.4 (95% CI, 163.2-273.6)) and in the comorbid patients (mean annual cost KES 41,187.2 (95% CI, 27,764.2-54,610.1) (US$ 403.8 (95% CI, 272.2-535.4)) attracted the highest costs. This was closely followed by transport costs (mean annual cost KES 12,168.6 (95% CI, 9,894 -14,433) (US$ 119.3 (95% CI, 97.0-141.5)) in the overall sample and in the comorbid patients (mean annual cost KES 12,873.2 (95% CI, 9,710.5-16,035.9) (US$ 126.2 (95% CI, 95.2-157.2)) while user charges (mean annual cost 14,839.1 (95% CI, 4,730.7-24,947.6) (US$ 145.5 (95% CI, 46.4-244.6)) was the second highest cost category after medicines in the diabetes only group (Table 4, 5 and 6).

**Table 4** Overall sample mean and median annual costs of diabetes at five public facilities in Kenya (2017 US$)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Care seeking episode** | **Cost category** | **n** | **Mean KES (95% CI)** | **Median KES (IQR)** | **Mean US$ (95% CI)** | **Median US$ (IQR)** | **As a % of total direct costs** |
| Sick visit | **Direct healthcare costs** |  |  |  |  |  |
|  User charges | 59 | 7,435.8 (2,611.2-12,260.4) | 4,549.2 (1,173.0-6,497.4) | 72.9 (25.6-120.2) | 44.6 (11.5-63.7) | 23.9 |
|  Medicines | 59 | 15,340.8 (6,120-24,561.6) | 5,202.0 (1,815.6-12,872.4) | 150.4 (60.0-240.8) | 51.0 (17.8-126.2) | 49.3 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 59 | 8,037.6 (4,845-11,220) | 5,202 (1,815.6-9,098.4) | 78.8 (47.5-110.0) | 51.0 (17.8-89.2) | 25.8 |
|  Food | 59 | 326.4 (10.2-632.4) | 0 | 3.2 (0.1-6.2) | 0 | 1.0 |
| **Subtotal (direct costs)** | 59 | 31,130.4 (18,961.8-43,299.0) | 17,156.4 (8,578.2-32,762.4) | 305.2 (185.9-424.5) | 168.2 (84.1-321.2) |  |
| **Indirect costs** | 59 | 7,466.4 (6,262.8-8,659.8) | 6,344.4 (3,906.6-8,884.2) | 73.2 (61.4-84.9) | 62.2 (38.3-87.1) |  |
| **Direct + Indirect costs** | 59 | 38,596.8 (25,928.4-51,265.2) | 24,388.2 (12,923.4-41,524.2) | 378.4 (254.2-502.6) | 239.1 (126.7-407.1) |  |
|  |  |  |  |  |  |  |  |
| In-patient admission | **Direct healthcare costs** |  |  |  |  |  |
|  User charges | 16 | 16,717.8 (3,264.0-30,161.4) | 7,170.6 (2,203.2-15,330.6) | 163.9 (32.0-295.7) | 70.3 (21.6-150.3) | 64.5 |
|  Medicines | 11 | 4,008.6 (1,366.8-6,660.6) | 3,468 (683.4-8,496.6) | 39.3 (13.4-65.3) | 34.0 (6.7-83.3) | 10.6 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 36 | 1,917.6 (703.8-3,131.4) | 938.4 (418.2-1,734.0) | 18.8 (6.9-30.7) | 9.2 (4.1-17.0) | 16.6 |
|  Food | 17 | 2,019.6 (204.0-3,825.0) | 795.6 (499.8-1,999.2) | 19.8 (2.0-37.5) | 7.8 (4.9-19.6) | 8.3 |
| **Subtotal (direct costs)** | 36 | 11,526.0 (3,825-19,216.8) | 2,478.6 (765.0-14,932.8) | 113.0 (37.5-188.4) | 24.3 (7.5-146.4) |  |
| **Indirect costs** | 37 | 4,804.2 (3,376.2-6,242.4) | 3,417.0 (1,662.6-6,058.8) | 47.1 (33.1-61.2) | 33.5 (16.3-59.4) |  |
| **Direct + Indirect costs** | 37 | 16,014.0 (7548.0-24,490.2) | 6,507.6 (3,498.6-20,094.0) | 157.0 (74.0-240.1) | 63.8 (34.3-197.0) |  |
|  |  |  |  |  |  |  |  |
| Medicine collection | **Direct healthcare costs** |  |  |  |  |  |
|  Medicines | 135 | 13,300.8 (9,608.4-16,983.0) | 5,997.6 (3,243.6-13,198.8) | 130.4 (94.2-166.5) | 58.8 (31.8-129.4) | 87.3 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 22 | 9,690.0 (5,385.6-13,984.2) | 7,201.2 (2,397.0-14,402.4) | 95.0 (52.8-137.1) | 70.6 (23.5-141.2) | 10.4 |
|  Food | 8 | 5,936.4 (4,304.4-7,568.4) | 7,201.2 (4,845.0-7,201.2) | 58.2 (42.2-74.2) | 70.6 (47.5-70.6) | 2.3 |
| **Subtotal (direct costs)** | 136 | 15,116.4 (11,189.4-19,043.4) | 8,404.8 (3,600.6-15,595.8) | 148.2 (109.7-186.7) | 82.4 (35.3-152.9) |  |
| **Indirect costs** | 163 | 8,017.2 (6,446.4-9,598.2) | 5,273.4 (3,419.2-9,373.8) | 78.6 (63.2-94.1) | 51.7 (33.5-91.9) |  |
| **Direct + Indirect costs** | 163 | 20,634.6 (16,503.6-24,765.6) | 12,739.8 (5,803.8-23,133.6) | 202.3 (161.8-242.8) | 124.9 (56.9-226.8) |  |
| Diagnostic visit | **Direct healthcare costs** |  |  |  |  |  |
|  Test cost | 118 | 5,222.4 (2029.8-8,404.8) | 1,795.2 (1,795.2-3,600.6) | 51.2 (19.9-82.4) | 17.6 (17.6-35.3) | 80.8 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 21 | 5,844.6 (4,192.2-7,486.8) | 4,804.2 (2,397.0-9,598.2) | 57.3 (41.1-73.4) | 47.1 (23.5-94.1) | 16.1 |
|  Food | 7 | 3,396.6 (1,601.4-5,181.6) | 3,600.6 (2,397.0-3,600.6) | 33.3 (15.7-50.8) | 35.3 (23.5-35.3) | 3.1 |
| **Subtotal (direct costs)** | 122 | 6,252.6 (3,111.0-9,384.0) | 1,795.2 (1,795.2-3,600.6) | 61.3 (30.5-92.0) | 17.6 (17.6-35.3) |  |
| **Indirect costs** | 161 | 4,885.8 (4,222.8-5,548.8) | 3,886.2 (2,641.8-5,865.0) | 47.9 (41.4-54.4) | 38.1 (25.9-57.5) |  |
| **Direct + Indirect costs** | 161 | 9,618.6 (7,068.6-12,168.6) | 5,661.0 (3,825.0-9,455.4) | 94.3 (69.3-119.3) | 55.5 (37.5-92.7) |  |
| Scheduled clinics | **Direct healthcare costs** |  |  |  |  |  |
|  User charges | 128 | 4,610.4 (2,723.4-6,507.6) | 2,998.8 (2,397.0-4,141.2) | 45.2 (26.7-63.8) | 29.4 (23.5-40.6) | 24.1 |
|  Medicines | 122 | 10,159.2 (7,170.6-13,147.8) | 5,967.0 (2,397.0-11,995.2) | 99.6 (70.3-128.9) | 58.5 (23.5-117.6) | 50.5 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 144 | 3,957.6 (3,325.2-4,579.8) | 2,397.0 (1,203.6-4,804.2) | 38.8 (32.6-44.9) | 23.5 (11.8-47.1) | 23.2 |
|  Food | 11 | 4,834.8 (397.8-9,271.8) | 2,397.0 (1,795.2-4,804.2) | 47.4 (3.9-90.9) | 23.5 (17.6-47.1) | 2.2 |
| **Subtotal (direct costs)** | 163 | 15,045.0 (12,056.4-18,023.4) | 9,843.0 (4,804.2-17,401.2) | 147.5 (118.2-176.7) | 96.5 (47.1-170.6) |  |
| **Indirect costs** | 163 | 4,396.2 (3,957.6-4,824.6) | 3,519.0 (2,611.2-5,865.0) | 43.1 (38.8-47.3) | 34.5 (25.6-57.5) |  |
| **Direct + Indirect costs** | 163 | 19,441.2 (16,207.8-22,664.4) | 14,259.6 (7,476.6-23,878.2) | 190.6 (158.9-222.2) | 139.8 (73.3-234.1) |  |
| Overall costs | **Direct healthcare costs** |  |  |  |  |  |
|  User charges | 135 | 11,413.8 (6,987.0-15,840.6) | 6,293.4 (5,467.2-9,251.4) | 111.9 (68.5-155.3) | 61.7 (53.6-90.7) | 17.5 |
|  Medicines | 138 | 33,374.4 (25,092.0-41,656.8) | 19,818.6 (8,404.8-38,403.0) | 327.2 (246.0-408.4) | 194.3 (82.4-376.5) | 52.4 |
| **Direct non-healthcare costs** |  |  |  |  |  |
|  Transport | 147 | 12,168.6 (9,894.0-14,433.0) | 7,599.0 (3,702.6-14,800.2) | 119.3 (97.0-141.5) | 74.5 (36.3-145.1) | 22.6 |
|  Food | 31 | 6,232.2 (2,743.8-9,720.6) | 2,397.0 (7,956.0-6,497.4) | 61.1 (26.9-95.3) | 23.5 (78.0-63.7) | 7.5 |
| **Subtotal (direct costs)** | 163 | 53,907.0 (43,625.4-64,188.6) | 35,802.0 (16,462.8-59,884.2) | 528.5 (427.7-629.3) | 351.0 (161.4-587.1) |  |
| **Indirect costs** | 163 | 23,174.4 (20,910.0-25,438.8) | 19,216.8 (13,963.8-28,417.2) | 227.2 (205.0-249.4) | 188.4 (136.9-278.6) |  |
| **Direct + Indirect costs** | 163 | 77,081.4 (65,820.6-88,342.2) | 58,415.4 (33,966.0-90,922.8) | 755.7 (645.3-866.1) | 572.7 (333.0-891.4) |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 5** Mean and median annual cost for diabetes only patients at five public facilities in Kenya (2017 US$) |  |  |  |  |  |  |  |
|

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Care seeking episode** | **Cost category** | **n** | **Mean KES (95% CI)** | **Median KES (IQR)** | **Mean US$ (95% CI)** | **Median US$ (IQR)** | **As a % of total direct costs** |
| Sick visit | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  User charges | 20 | 12,733.5 (1,825.0-27,292.0) | 3,055.0 (845.0-6,110.0) | 124.8 (17.9-267.6) | 30.0 (8.3-59.9) | 40.6 |
|  |  Medicines | 20 | 10,387 (488.6-20,305.4) | 2,340 (520-9,425) | 101.8 (4.8-199.1) | 22.9 (5.1-92.4) | 33.1 |
|  | **Direct non-healthcare costs** |  |  |  |  |  |  |
|  |  Transport | 20 | 8,268 (3,090.8-13,445.2) | 3,120 (1,560-9,100) | 81.1 (30.3-131.8) | 30.6 (15.3-89.2) | 26.3 |
|  |  Food | 20 | 0 | 0 | 0 | 0 | 0.0 |
|  | **Subtotal (direct costs)** | 20 | 31,388.5 (7,168.3-55,608.7) | 10,335 (6,630-33,605) | 307.7 (70.3-545.2) | 101.3 (65.0-329.5) |  |
|  | **Indirect costs** | 20 | 7,360.5 (4,925.0-9,796.1) | 4,545.6 (3,860.0-10,713.2) | 72.2 (48.3-96.0) | 44.6 (37.8-105.0) |  |
|  | **Direct + Indirect costs** | 20 | 38,749.0 (14,080.6-63,417.5) | 18,804.3 (11,197.4-42,818.0) | 379.9 (138.0-621.7) | 184.4 (109.8-419.8) |  |
|  |  |  |  |  |  |  |  |
| In-patient admission | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  User charges | 7 | 18,568.6 (11,234.9-48,372.1) | 4,700 (3,150-16,000) | 182.0 (110.1-474.2) | 46.1 (30.9-156.9) | 76.8 |
|  |  Medicines | 5 | 3,372 (1,624.9-8,368.9) | 1,200 (1,110-4,350) | 33.1 (15.9-82.0) | 11.8 (10.9-42.6) | 10.0 |
|  | **Direct non-healthcare costs** |  |  |  |  |  |  |
|  |  Transport | 15 | 910.7 (225.3-1,596.1) | 600 (200-1,080) | 8.9 (2.2-15.6) | 5.9 (2.0-10.6) | 8.1 |
|  |  Food | 6 | 1,441.7 (265.4-2,618.0) | 850 (750-2,500) | 14.1 (2.6-25.7) | 8.3 (7.4-24.5) | 5.1 |
|  | **Subtotal (direct costs)** | 15 | 11,276.7 (3,958.3-26,511.7) | 1,860 (400-7,130) | 110.6 (38.8-259.9) | 18.2 (3.9-69.9) |  |
|  | **Indirect costs** | 15 | 5,060.3 (2,042.4-8,078.2) | 3,101.0 (1,611.6-6,006.7) | 49.6 (20.0-79.2) | 30.4 (15.8-58.9) |  |
|  | **Direct + Indirect costs** | 15 | 16,337.0 (1,514.0-34,187.9) | 5,968.5 (2,567.1-14,181.8) | 160.2 (14.8-335.2) | 58.5 (25.2-139.0) |  |
|  |  |  |  |  |  |  |  |
| Medicine collection | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  Medicines | 57 | 9,230.5 (6,253.9-12,207.1) | 5,040 (2,400-10,680) | 90.5 (61.3-119.7) | 49.4 (23.5-104.7) | 84.7 |
|  | **Direct non-healthcare costs** |  |  |  |  |  |  |
|  |  Transport | 8 | 10,950 (581.6-22,481.6) | 6,000 (2,400-13,800) | 107.4 (5.7-220.4) | 58.8 (23.5-135.3) | 14.1 |
|  |  Food | 1 | 7200 | 7200 | 70.6 | 70.6 | 1.2 |
|  | **Subtotal (direct costs)** | 57 | 10,893.7 (6,884.9-14,902.5) | 6,000 (3,360-12,000) | 106.8 (67.5-146.1) | 58.8 (32.9-117.6) |  |
|  | **Indirect costs** | 69 | 7,771.4 (4,800.1-10,742.7) | 4,688.2 (3,223.1-7,325.3) | 76.2 (47.1-105.3) | 46.0 (31.6-71.8) |  |
|  | **Direct + Indirect costs** | 69 | 16,770.6 (11,672.9-21,868.2) | 10,395.2 (5,225.2-16,739.7) | 164.4 (114.4-214.4) | 101.9 (51.2-164.1) |  |
|  |  |  |  |  |  |  |  |
| Diagnostic visit | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  Test cost | 47 | 7,598.3 (201.4-15,398.0) | 1,800 (1,800-3,600) | 74.5 (2.0-151.0) | 17.6 (17.6-35.3) | 90.6 |
|  | **Direct non-healthcare costs** |  |  |  |  |  |  |
|  |  Transport | 7 | 4,971.4 (2,075.4-7,867.5) | 4,800 (2,400-7,200) | 48.7 (20.3-77.1) | 47.1 (23.5-70.6) | 8.8 |
|  |  Food | 1 | 2400 | 2400 | 23.5 | 23.5 | 0.6 |
|  | **Subtotal (direct costs)** | 50 | 7,886.4 (572.7-15,200.1) | 1,800 (1,800-3,600) | 77.3 (5.6-149.0) | 17.6 (17.6-35.3) |  |
|  | **Indirect costs** | 68 | 4,423.4 (3,644.7-5,202.1) | 3,850.2 (2,607.8-4,887.4) | 43.4 (35.7-51.0) | 37.7 (25.6-47.9) |  |
|  | **Direct + Indirect costs** | 68 | 10,222.2 (4,827.4-15,616.9) | 5,682.4 (3,809.1-9,273.8) | 100.2 (47.3-153.1) | 55.7 (37.3-90.9) |  |
|  |  |  |  |  |  |  |  |
| Scheduled clinics | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  User charges | 55 | 6,362.2 (1,953.2-10,771.1) | 3,000 (2,400-4,080) | 62.4 (19.1-105.6) | 29.4 (23.5-40.0) | 38.6 |
|  |  Medicines | 50 | 6,289.2 (4,546.0-8,032.4) | 4,350 (2,400-9,000) | 61.7 (44.6-78.7) | 42.6 (23.5-88.2) | 34.7 |
|  | **Direct non-healthcare costs** | 69 | 13,148.7 (9,166.8-17,130.6) | 9,000 (4,080-17,640) | 128.9 (89.9-167.9) | 88.2 (40-172.9) |  |
|  |  Transport | 62 | 3,878.7 (2,987.6-4,769.8) | 2,400 (1,200-4,800) | 38.0 (29.3-46.8) | 23.5 (11.8-47.1) | 26.5 |
|  |  Food | 1 | 2400 | 2400 | 23.5 | 23.5 | 0.3 |
|  | **Subtotal (direct costs)** | 69 | 13,148.7 (9,166.8-17,130.6) | 9,000 (4,080-17,640) | 128.9 (89.9-167.9) | 88.2 (40-172.9) |  |
|  | **Indirect costs** | 69 | 4,071.1 (3,542.5- 4,599.6) | 3,516.1 (2,344.1-5,086.7) | 39.9 (34.7-45.1) | 34.5 (23.0-49.9) |  |
|  | **Direct + Indirect costs** | 69 | 17,219.8 (13,072.6-21,366.9) | 12,792.3 (6,876.1-21,156.1) | 168.8 (128.2-209.5) | 125.4 (67.4-207.4) |  |
|  |  |  |  |  |  |  |  |
| Overall costs | **Direct healthcare costs** |  |  |  |  |  |  |
|  |  User charges | 58 | 14,839.1 (4,730.7-24,947.6) | 6,250 (5,000-7,880) | 145.5 (46.4-244.6) | 61.3 (49.0-77.3) | 30.3 |
|  |  Medicines | 57 | 22,275.3 (16,647.7-27,902.8) | 18,400 (7,400-30,500) | 218.4 (163.2-273.6) | 180.4 (75.5-299.0) | 44.0 |
|  | **Direct non-healthcare costs** |  |  |  |  |  |  |
|  |  Transport | 63 | 11,218.4 (7,919.4-14,517.5) | 6,300 (3,360-14,640) | 110.0 (77.6-142.3) | 61.8 (32.9-143.5) | 24.7 |
|  |  Food | 9 | 3,016.7 (609.4-5,423.9) | 2,400 (800-3,200) | 29.6 (6.0-53.2) | 23.5 (7.8-31.4) | 1.0 |
|  | **Subtotal (direct costs)** | 69 | 46,754.4 (31,008.3-62,500.4) | 31,500 (13,880-50,840) | 458.4 (304.0-612.7) | 308.8 (136.1-498.4) |  |
|  | **Indirect costs** | 64 | 21,861.1 (18,070.1-25,652.1) | 17,483.0 (13,136.7-26,187.8) | 214.3 (177.2-251.5) | 171.4 (128.8-256.7) |  |
|  | **Direct + Indirect costs** | 69 | 6,8615.5 (5,1472.6-85,758.3) | 52,372.5 (28,458.9-75,288.0) | 672.7 (504.6-840.8) | 513.5 (279.0-738.1) |  |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 6** Mean and median annual cost for comorbid (diabetes mellitus and hypertension) patients at five public facilities in Kenya (2017 US$)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Care seeking episode** | **Cost category** | **n** | **Mean KES (95% CI)** | **Median KES (IQR)** | **Mean US$ (95% CI)** | **Median US$ (IQR)** | **As a % of total direct costs** |
| Sick visit | **Direct healthcare costs** |  |  |  |  |  |  |
|  User charges | 39 | 4,720 (3,405.9-6,034.1) | 5,200 (1,300-6,500) | 46.3 (33.4-59.2) | 51.0 (12.7-63.7) | 15.2 |
|  Medicines | 39 | 17,880 (4,641.7-31,118.3) | 7,670 (3,120-15,600) | 175.3 (45.5-305.1) | 75.2 (30.6-152.9) | 57.7 |
| **Direct non-healthcare costs** |  |  |  |  |  |  |
|  Transport | 39 | 7,913.3 (3,726.5-12,100.2) | 5,200 (2,600-9,100) | 77.6 (36.5-118.6) | 51.0 (25.5-89.2) | 25.5 |
|  Food | 39 | 486.7 (22.5-950.8) | 0 | 4.8 (0.2-9.3) | 0 | 1.6 |
| **Subtotal (direct costs)** | 39 | 31,000 (16,546.6-45,453.4) | 20,800 (10,660-32,760) | 303.9 (162.2-445.6) | 203.9 (104.5-321.2) |  |
| **Indirect costs** | 39 | 7,515.4 (6,110.2-8,920.6) | 6,856.5 (4,063.1-8,888.0) | 73.7 (59.9-87.5) | 67.2 (39.8-87.1) |  |
| **Direct + Indirect costs** | 39 | 38,515.4 (23,247.1-53,783.7) | 29,688.0(15,563.4-41,037.2) | 377.6 (227.9-527.3) | 291.1 (152.6-402.3) |  |
|  |  |  |  |  |  |  |  |
| In-patient admission | **Direct healthcare costs** |  |  |  |  |  |  |
|  User charges | 9 | 15,273.9 (287.2-30,834.9) | 9,990 (1,000-14,660) | 149.7 (2.8-302.3) | 97.9 (9.8-143.7) | 56.0 |
|  Medicines | 6 | 4,545.8 (166.7-8,924.9) | 3,598.5 (680-8,500) | 44.6 (1.6-87.5) | 35.3 (6.7-83.3) | 11.1 |
| **Direct non-healthcare costs** |  |  |  |  |  |  |
|  Transport | 21 | 2,633.3 (592.3- 4,674.4) | 1,200 (800-2,400) | 25.8 (5.8-45.8) | 11.8 (7.8-23.5) | 22.5 |
|  Food | 11 | 2,331.8 (589.9-5,253.5) | 600 (300-2,000) | 22.9 (5.8-51.5) | 5.9 (2.9-19.6) | 10.4 |
| **Subtotal (direct costs)** | 21 | 11,699.5 (2,885.6-20, 513.4) | 2,750 (1,180-15,960) | 114.7 (28.3-201.1) | 27.0 (11.6-156.5) |  |
| **Indirect costs** | 22 | 4,633.5 (3,108.5-6,158.5) | 4,248.7 (1,660.4-6,187.4) | 45.4 (30.5-60.4) | 41.7 (16.3-60.7) |  |
| **Direct + Indirect costs** | 22 | 15,801.2 (6,790.6-24,811.9) | 7,149.1 (4,060.4-20,634.9) | 154.9 (66.6-243.3) | 70.1 (39.8-202.3) |  |
|  |  |  |  |  |  |  |  |
| Medicine collection | **Direct healthcare costs** |  |  |  |  |  |  |
|  Medicines | 78 | 16,269.2 (10,291.7-22,246.8) | 7,200 (3,600-15,000) | 159.5 (100.9-218.1) | 70.6 (35.3-147.1) | 88.4 |
| **Direct non-healthcare costs** |  |  |  |  |  |  |
|  Transport | 14 | 8,965.7 (4,969.6-12,961.8) | 7,200 (4,800-14,400) | 87.9 (48.7-127.1) | 70.6 (47.1-141.2) | 8.7 |
|  Food | 7 | 5,760 (3,876.6-7,643.4) | 7,200 (4,800-7,200) | 56.5 (38.0-74.9) | 70.6 (47.1 (70.6) | 2.8 |
| **Subtotal (direct costs)** | 79 | 18,162.5 (12,069.3-24,255.8) | 9,120 (4,320-18,000) | 178.1 (118.3-237.8) | 89.4 (42.4-176.5) |  |
| **Indirect costs** | 94 | 8,205.7 (6,515.2-9,896.2) | 5,860.2 (3,809.1-9,962.4) | 80.4 (63.9-97.0) | 57.5 (37.3-97.7) |  |
| **Direct + Indirect costs** | 94 | 23,470.0 (17,351.3-29,588.6) | 14,522.6 (6,022.2-25,785.0) | 230.1 (170.1-290.1) | 142.4 (59.0-252.8) |  |
|  |  |  |  |  |  |  |  |
| Diagnostic visit | **Direct healthcare costs** |  |  |  |  |  |  |
|  Test cost | 71 | 3,643.9 (2,132.2-5,155.7) | 1,800 (1,800-3,600) | 35.7 (20.9-50.5) | 17.6 (17.6-35.3) | 70.3 |
| **Direct non-healthcare costs** |  |  |  |  |  |  |
|  Transport | 14 | 6,274.3 (4,030.7-8,517.8) | 7,200 (2,400-9,600) | 61.5 (39.5-83.5) | 70.6 (23.5-94.1) | 23.9 |
|  Food | 6 | 3,560 (1,390.9-5,729.1) | 3,600 (2,400-3,600) | 34.9 (13.6-56.2) | 35.3 (23.5-35.3) | 5.8 |
| **Subtotal (direct costs)** | 72 | 5,110.0 (3,282.5-6,937.4) | 1,800 (2,400-4,080) | 50.1 (32.2-68.0) | 17.6 (23.5-40.0) |  |
| **Indirect costs** | 93 | 5,220.8 (4,221.9- 6,219.6) | 4,102.2 (2,695.7-6,153.2) | 51.2 (41.4-61.0) | 40.2 (26.4-60.3) |  |
| **Direct + Indirect costs** | 93 | 9,176.9 (7,078.3-11,275.4) | 5,609.1 (4,102.2-10,060.2) | 90.0 (69.4-110.5) | 55.0 (40.2 - 98.6) |  |
|  |  |  |  |  |  |  |  |
| Scheduled clinics | **Direct healthcare costs** |  |  |  |  |  |  |
|  User charges | 73 | 3,292.6 (2,909.4-3,675.7) | 3,000 (2,640-4,200) | 32.3 (28.5-36.0) | 29.4 (25.9-41.2) | 15.6 |
|  Medicines | 72 | 12,839.2 (7,966.7-17,711.6) | 7,200 (3,300-13,200) | 125.9 (78.1-173.6) | 70.6 (32.4-129.4) | 59.8 |
| **Direct non-healthcare costs** | 94 | 16,432.2 (12,120.0- 20,744.5) | 10,560 (5,640-17,400) | 161.1 (118.8 -203.4) | 103.5 (55.3-170.6) |  |
|  Transport | 82 | 4,013.3 (3,125.5- 4,901.0) | 2,400 (1,200-4,800) | 39.3 (30.6-48.0) | 23.5 (11.8 -47.1) | 21.3 |
|  Food | 10 | 5,076 (134.9-10,017.1) | 2,640 (1,800-4,800) | 49.8 (1.3-98.2) | 25.9 (17.6 (47.1) | 3.3 |
| **Subtotal (direct costs)** | 94 | 16,432.2 (12,120- 20744.5) | 10,560 (5,640-17,400) | 161.1 (118.8-203.4) | 103.5 (55.3-170.6) |  |
| **Indirect costs** | 94 | 4,632.5 (3,985.5-5,279.4) | 3,516.1 (2,695.7-5,860.2) | 45.4 (39.1-51.8) | 34.5 (26.4-57.4) |  |
| **Direct + Indirect costs** | 94 | 21,064.7 (16,336.1-25,793.2) | 15,255.1 (8,769.4-24,164.3) | 206.5 (160.2-252.9) | 149.6 (86.0-236.9) |  |
|  |  |  |  |  |  |  |  |
| Overall costs | **Direct healthcare costs** |  |  |  |  |  |  |
|  User charges | 77 | 8,837.2 (6,958.2-10,716.1) | 7,500 (5,500-9,400) | 86.6 (68.2-105.1) | 73.5 (53.9-92.2) | 12.9 |
|  Medicines | 81 | 41,187.2 (27,764.2-54,610.1) | 21,900 (10,300-42,700) | 403.8 (272.2-535.4) | 214.7 (101.0-418.6) | 63.3 |
| **Direct non-healthcare costs** |  |  |  |  |  |  |
|  Transport | 84 | 12,873.2 (9,710.5-16,035.9) | 8,340 (3,800-15,300) | 126.2 (95.2-157.2) | 81.8 (37.3-150) | 20.5 |
|  Food | 24 | 7,438.3 (2,701.2-12,175.4) | 2,300 (725-10,100) | 72.9 (26.5-119.4) | 22.5 (7.1-99.0) | 3.3 |
| **Subtotal (direct costs)** | 94 | 59,161.8 (45,440.9-72,882.8) | 42,750 (17,162-65,550) | 580.0 (445.5-714.5) | 419.1 (168.3-642.6) |  |
| **Indirect costs** | 94 | 24,137.9 (21,314.9-26,960.9) | 20,571.8 (15,090.0- 29,984.8) | 236.6 (209.0-264.3) | 201.2 (147.9-294.0) |  |
| **Direct + Indirect costs** | 94 |  83,299.8 (68,223.5-98,376.0) | 63,970.6 (37,833.6- 100,271.8) | 816.7 (668.9-964.5) | 627.2 (370.9-983.1) |  |

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**Table 7** Medicines costs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Drug name** | **n** |  **Mean KES (95% CI)** | **Median KES (IQR)** | **Mean US$ (95% CI)** | **Median US$ (IQR)** |
| Metformin | 16 |  8,384.4 (2,509.2-14,259.6) |  3,172.2 (897.6-13,198.8) |  82.2 (24.6-139.8) |  31.1 (8.8-129.4) |
| Metformin + Insulin | 15 |  15,636.6 (2,723.4-28,539.6) |  10,404.0 (4,804.2-15,004.2) |  153.3 (26.7-279.8) |  102.0 (47.1-147.1) |
| Metformin + Glibenclamide | 63 |  12,678.6 (6,201.6-19,155.6) |  3,835.2 (1,438.2-12,484.8) |  124.3 (60.8-187.8) |  37.6 (14.1-122.4) |
| Metformin + Glibenclamide + Nifedipine | 18 |  17,554.2 (336.6-34,771.8) |  8,160.0 (0.0-14,881.8) |  172.0 (3.3-340.9) |  80.0 (0.0-145.9) |
| Metformin + Glibenclamide + Enalapril | 15 |  18,635.4 (3,131.4-40,402.2) |  3 ,600.6 (0.0-16,320.0) |  182.7 (30.7-396.1) |  35.3 (0.0-160.0) |
| Metformin + Glibenclamide + Hydrochlorothiazide | 21 |  13,935.6 (1,122-26,270) |  5,395.8 (1,438.2-13,198.8) |  136.6 (11.0-257.5) |  52.9 (14.1-90.0) |
| Metformin + Nifedipine + Hydrochlorothiazide  | 11 |  16,218.0 (1,530.0-30,895.8) |  5,457.0 (1,438.2-13,198.8) |  159.0 (15.0-302.9) |  53.5 (14.1-129.4) |
| Insulin + Other anti-hypertensives†  | 3 |  9,560.0 (1,315.8-20,430.6) |  8,400.0 (5,880-14,400) |  93.7 (12.9-200.3) |  82.4 (57.6-141.2) |

†Atenolol + Losartan + Amlodipine

**Fig.1** Source of medicines

**Impact on household income and coping strategies**

Costs for DM care services was catastrophic to three quarters (n=123) 75.5% (95% CI, 68.3-82.1) of patients at the 10% annual household income threshold. Moreover, comorbid patients (n=94) realised higher catastrophic costs 79.8% (95% CI, 71.5-88.1) compared to diabetes only patients (n = 69) 69.6% (95% CI, 58.4-80.7). Alternatively, when transport costs were excluded, (n=103) 63.2% (95% CI, 55.7-70.7) of patients incurred catastrophic costs. Among patients experiencing catastrophe, patients in the lowest wealth quintile incurred higher direct costs with few resources to meet the healthcare costs (Figure 2). However, Figure 3 shows a decreasing percentage of patients experiencing catastrophic costs if the 10% annual income threshold is increased. Patients had to borrow (23.3%) from friends/family, sell an asset (29.9%) and use savings (36.8%) to pay for DM care costs.

**Fig.2** Relationship between catastrophic costs and socio-economic status



 **Fig. 3** Percentage experiencing total costs greater than threshold

**Productivity and social impact of diabetes mellitus**

Patients were asked to report any work days missed due to DM illness in the last three months before the survey. Of the 163 patients, 33% reported to miss a median of 21 (IQR, 7-60) working days. Forty five percent of the respondents reported disrupted social life due to DM, affecting sexual life (n = 11); job loss (n = 48); divorce (n = 4) and separation from spouse (n = 6).

**Discussion**

This study has estimated patient costs for adults with DM that sought care at five public healthcare facilities in two counties in Kenya. The study’s main finding is that patient cost for DM are driven by medicines expenses. Similar findings have been reported by recent studies in Kenya and South Africa [19](#_ENREF_19),[37](#_ENREF_37). Costs due to medicine have been shown to reduce adherence to medication and demand for health services by patients with NCDs[38](#_ENREF_38). Additionally, past studies conducted in LMICs have shown that social health insurance schemes do not comprehensively cover the costs for medicines[39](#_ENREF_39) and that OOP costs, which is majorly contributed by medicines, are a hindrance to attainment of universal health coverage in many low resource settings [40](#_ENREF_40),[41](#_ENREF_41). Indeed, any reductions or removal of medicines costs is likely to increase access to DM health care services, but additional resources will be required to cover any concomitant increase in service utilization.

The incidence of catastrophic costs documented in this study is arguably high and suggests that DM care in the sampled health facilities is unaffordable to majority of patients especially those in the lowest wealth quintile whose capacity to pay is limited compared to those in higher socio-economic group. This is a concern given the high poverty rates in Kenya (36.1%) and that only 19% of Kenya’s population have a form of health insurance [42](#_ENREF_42),[43](#_ENREF_43). Furthermore, a past study has shown that families with a member with an NCD incurs three times higher costs compared to families without a member with an NCD[17](#_ENREF_17). Our study has also shown that DM patients reporting hypertension comorbidity incur higher costs overall compared to diabetes only patients. This places additional financial burden on families of these patients, similar to findings of previous studies [18](#_ENREF_18),[44](#_ENREF_44).

Our results suggest that transport cost offers an access barrier to DM patients given that it takes a significant proportion of total direct costs in all care seeking episodes. In part, the high transport costs reported in this study can be attributed to poor quality of care in public healthcare facilities. For instance, 48.9% of the patients reported lack of medicines and diagnostic facilities as a reason for not visiting nearest facilities. This phenomenon has been observed from studies in Uganda and Zambia [45](#_ENREF_45),[46](#_ENREF_46). Past studies in Kenya highlight that transport costs are a key access barrier especially to poor patients[41](#_ENREF_41),[47](#_ENREF_47). Moreover, 36% of patients in the overall sample reported a sick visit outside of scheduled clinic appointments incurring an annual mean cost of KES 38,597 (US$ 378.4). Failure in health-care delivery has been shown to increase the risk of catastrophe, exacerbate socioeconomic iniquities and reduces the probability of comprehensive treatment [48](#_ENREF_48). These findings suggest that there is a need for policy makers to develop mechanisms to improve quality of care for diabetic patients in public health facilities since this has serious cost implications on patients. Additionally, since more than three quarters (76.7%) of the patients reported attending their routine scheduled clinics monthly, introducing mechanisms to minimize facility visits for example by enhancing and supporting self-care by patients is likely to reduce transport costs.

The indirect costs due DM care in this study are noteworthy. For instance, of the 163 patients enrolled in the study, 48 (29.5%) had to stop working because of DM and 54 (33%) reported a median loss of 21 working days over the past 90 days period, which is equal to one month’s wage in the informal sector in Kenya. Similarly, the overall mean indirect costs in all care seeking episodes was KES 23,174 (US$ 227.2) and were primarily contributed by long waiting times at health facilities. It has been shown that long-waiting times while receiving care reduce demand for chronic care services [49](#_ENREF_49). To achieve optimal efficiency and increase demand for service delivery for patients with chronic illnesses like diabetes, there is urgent need to re-design health service delivery for these patients with a view to making care more patient-centred to meet the unique needs of these patients.

**Limitations**

This study had several limitations. First, it was not nationally representative hence may not be generalizable to the entire country. Second, our study relied on the diagnosis reported by patients hence could not distinguish between type 1 and type 2 diabetes. Third, use of an official minimum wage to estimate productivity losses for all patients could have potentially overestimated indirect costs among patients who were unemployed prior to their illness or underestimated indirect costs among those who were employed [34](#_ENREF_34). Fourth, recall bias is a concern in patient cost surveys and fifth, our study only focused on OOP costs associated with seeking care and did not include costs associated with those who did not seek care. These costs would be important in giving a more precise estimate of OOP healthcare expenditure due to DM. These limitations notwithstanding, the findings presented are potentially useful as inputs in costing and/or cost-effectiveness models that require patient cost and suggest there are significant OOP costs associated with DM management in public facilities in Kenya, which offer a barrier to access to care.

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