

Leveraging electronic medical and financial records to estimate financial costs of delivering health services in health facilities: a multi-site retrospective study in Burundi

Alain NDAYIKUNDA

alainndayikunda2014@gmail.com

Institut National de Santé Publique

Frank VERBEKE

Vrije Universiteit Brussel

Joseph NYANDWI

Institut National de Santé Publique

Manassé NIMPAGARITSE

Institut National de Santé Publique

Ronald BUYL

Vrije Universiteit Brussel

Research Article

Keywords: Unit costs, Health care services, Electronic medical records, electronic financial records, Burundi

Posted Date: September 4th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10655628/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background

In low- and middle-income countries, many challenges hinder achievement of universal health coverage. Among these challenges, the limited availability of information on costs of delivering healthcare services remains a major issue, despite recent progress by many of these countries in digitalizing their health systems. This study was conducted to estimate the annual financial cost of providing healthcare services using electronic medical and financial records. It also aimed to demonstrate that benefits of digitalization extend beyond improving quality of services delivery by supporting health economics analyses.

Methods

Cost data were collected in a retrospective costing study carried out in 34 health centers, 14 district hospitals, and 3 regional hospitals, covering a one-year time horizon from July 1st, 2024, to June 30th, 2025, from the perspective of the healthcare system. Data were analyzed using Excel 2016 and R version 4.3.2. The median annual total financial costs of delivering health services were estimated, as well as the unit costs of delivering curative, preventive, outpatient, and inpatient services.

Results

In Burundi, the median total yearly costs of providing services increase as the level of care rises, from €103 372 for a health center to €548 318 for a district hospital and €1,719 902 for a regional hospital. Financial costs at health centers are largely attributed to medicine and consumable costs, which account for 73.3%. In contrast, at district and regional hospitals, the financial costs of service delivery are largely attributed to personnel costs. Personnel costs account for 43% of financial costs at district hospitals and 48.4% at regional hospitals.

Conclusions

Findings from this study showed that total and unit costs of providing services increase as the level of care rises and suggest that reimbursement tariffs should be fixed according to the health facility level instead of a unique tariff for all health facilities. Findings also suggest that strategies aimed at improving health facility management efficiency should focus on improving medicines management in health centers whereas they should focus on personnel recruitment in hospitals. This study also showed that the benefit of digitalization extends beyond improving quality of health services delivery to support health economics analyses.

Background

To achieve the sustainable development goal related to health, the WHO recommends implementing universal health coverage (UHC), which ensure that means that all people have access to the full range of quality health services they need, when and where they need them, without financial hardship. However, many challenges continue to hinder achievement of that goal, especially in low- and middle-income countries [1–3]. According to the WHO, more than half of the world's population (4.6 billion people) didn't get access to healthcare in 2023 of whom 75% live in low- and middle-income countries (LMIC) [1, 4]. In addition, 1 billion people faced catastrophic health expenditure and 344 million people were exposed to impoverishing health expenditure in 2019.

To address these challenges, the health systems of LMIC must be transformed to become more adaptive and resilient [5]. Although efforts to strengthen the six health system pillars (health service delivery, health workforce, health information system, health financing, access to essential medicines and technology and leadership and governance) are necessary, interventions focused on improving health financing are likely to be more effective, since investment in the health sector is essential for achieving UHC [6]. Unfortunately, it is difficult to determine investment needed in LMIC because information on the costs of providing healthcare services is limited [7]. Existing costing studies in these countries often focus on a specific disease [8], service [9, 10], health facility or region [11], and therefore do not provide an overall picture of costs across the entire health system.

Today, many low- and middle-income countries have made significant progress in digitizing their health facilities, but the potential of digitalization remains unexploited in terms of performing medical-economic evaluations within the health system. Large volumes of data on health service utilization and resource consumption in healthcare facilities are generated by electronic medical records and electronic financial records. While these data offer a faster and more economical way to conduct very accurate costing studies, many countries continue to rely on traditional data collection methods for their costing studies, which are more expensive. To date, there are many costing studies of health services delivery in LMIC but a limited number used data from electronic medical records and electronic financial records [12–14].

The government of Burundi has committed to implement UHC, and has already taken initial steps towards developing a national health financing strategy [15]. However, the costing of that financing strategy has not yet been undertaken due to a lack of up-to-date data on unit costs of delivering health services in health facilities. This evidence gap represents a major challenge for the implementation planning of UHC in Burundi even though Burundi has made significant progress in digitizing its healthcare system with all national referral and regional hospitals already using medical and financial electronic records systems while 90% of district hospitals and 10% of health centers are also digitalized [16]. Despite the availability of a significant volume of data, their use for costing of healthcare services remains limited.

In this context, this study was carried out in digitalized public and faith-based health facilities in collaboration with the Ministry of Public Health in Burundi. The objective was to estimate the annual financial costs of delivering health services as well as unit costs of major health services using routinely collected electronic medical and financial data. It also aimed to show that benefits of digitalization extend beyond improving quality of healthcare services delivery by supporting health economics analyses.

Methods

Study context

Burundi is a low-income East African country, with an estimated GDP per capita of 219.4 USD in 2024. Its healthcare system is organized into three levels: peripheral, intermediate and central. The peripheral level comprises health centers, community hospitals and district hospitals. Health centers provide promotional, preventive and basic curative services. Community hospitals, recently been introduced into the healthcare system, provide day care almost identical to that of health centers due to limited technical capabilities. District hospitals offer more advanced and sometimes specialized care while regional hospitals, at intermediate level, provide more specialized care. The central level comprises national referral hospitals and specialized centers that provide highly specialized care [17].

In Burundi, public funding for the health sector remains low as the share of recurrent government expenditure allocated to the health sector was only 5.7% in 2022. Therefore, health financing is heavily dependent on external funding, which accounted for 45.8% of Burundi's health expenditure in 2022 [18].

This study was carried out in digitalized public and faith-based health centers, district hospitals, and regional hospitals. These health facilities were selected as they provide basic care under the universal health coverage program in Burundi. Only health facilities that had been digitalized for at least one year were included to ensure data availability and reliability. By the end of 2024, all national hospitals, all regional hospitals, 77.5% of district hospitals, and 8% of health centers were digitalized in Burundi [19].

Study design

A retrospective health facility costing study was conducted from the perspective of the healthcare system. It was carried out for a one-year time horizon from July 1st 2024 to June 30th 2025, corresponding to a fiscal year for the health system in Burundi. A 0% discount rate was applied as the time horizon is one year [20].

Sample size and sampling procedure

Sample size was calculated using standard formula for determining sample size when the variable of interest is a continuous quantitative variable, such as cost in this study [21–23] :

$$n_0 = \frac{Z^2 \sigma^2}{d^2} = \left(\frac{Z^* \sigma}{d} \right)^2$$

Where Z is 1.96 for a 95% confidence level, σ is the standard error and d the margin of error.

However, data on σ are largely unavailable. No previous study has estimated these parameters for Burundi. Through our literature review, we identified one study that estimated standard deviation in Ethiopia [24]. Another study carried out in India [25] reported estimates of the means along with their confidence intervals, which allowed the calculation of corresponding standard deviations and coefficients of variation. Based on those data, we found that the largest sample size is 62 health facilities. The total number of health facilities in our population N is 102 health facilities. After adjustment for a finite population [23], with $n = no / (1 + (no/N))$, the final sample size n becomes 39 health facilities.

Burundi has 56 health districts. To improve geographic representativeness and comply with the guidelines from the WHO District Health System Operational Assessment Tool [26], the sample size was increased to **51 health facilities**. The WHO recommend sampling health facilities in at least 30% of districts in a country with between 40 and 59 health districts and to ensure that all strata are represented. The sampling strategy is shown in Fig. 1.

Data source

Data were obtained from several sources, such as the OpenClinic GA hospital information system widely used in Burundi [27] and the QUICK SOFT accounting management software deployed in Burundi hospitals. These data were supplemented by data from DHIS2, the national health data warehouse, health facility activity reports and inventories. Finally, additional data were obtained from the human resources department of the Ministry of Public Health.

Data collection, tools and quality assurance

Data collection was conducted using an MS Excel tool designed for that purpose. The data collection tool was adapted from a data collection tool previously used in an Indian study [25]. This tool enabled the collection of data regarding the costs and outputs of healthcare provision in targeted health facilities. The data collection tool has ten sections covering:

- identification of the health facility,
- population covered,
- health facility's services/departments,
- information on the health facility's activities between July 1, 2024, and June 30, 2025,
- health facility's human resources and their deployment across various departments,
- staff salaries and bonuses,

- health facility's medical and non-medical equipment and the departments in which this equipment is used,
- details of the costs of medications used at the health facility and the departments in which they were used,
- details of the health facility's overhead costs,
- time spent by staff on activities in the various departments.

Prior to data collection, research assistants with public health background were trained on the data collection tool and study procedures. The data collection tool was pretested in a district hospital and a health center to assess its clarity and completeness. During data collection, researchers collected data under supervision of three senior researchers. All costs were recorded in BIF and converted to euros at the average exchange rate of 3121,8 BIF per 1 Euro for the fiscal year 2024–2025 [28].

Overall, the data were collected through data extraction from the Open Clinic GA, QUICK SOFT, and DHIS2 software programs. These data were then supplemented by a literature review and interviews with health facility managers and staff regarding the time spent on various services provided within the health facility.

The collected financial data are divided into nine costs categories:

- personnel costs,
- medications and consumables costs,
- transportation costs,
- hygiene costs,
- office and IT supplies costs,
- communications costs,
- water and electricity costs,
- maintenance costs,
- other costs.

Only financial costs, amounts effectively spent to acquire resources directly related to health services provision, were collected. Financial costs differ from economic ones which refer to the costs incurred in producing a healthcare service, whether or not they have been paid [29][30]. Thus, capital costs were not included in this study because they vary from year to year, which could introduce bias into the estimates.

Personnel costs

In Burundi, the government recruits and pays basic staff who are assigned to public and confessionnal health facilities. These staff members are supplemented by locally recruited staff in each health facility, as health facilities operate autonomously. Costs related to salaries, bonuses and other employee

benefits were included in personnel cost. All staff are considered, including medical staff (doctors, nurses and nursing assistants), administrative staff and supporting staff (e.g. cashiers). Data on expenditure relating to locally recruited staff were obtained from payroll records while average salaries per staff category were used to estimate costs of staff appointed by the government. These average salaries were obtained from the department in charge of human resources at the Ministry of health.

Medicines, reagents and consumables costs

The costs of medicines, medical consumables, laboratory reagents, and radiology consumables were obtained from the health facilities pharmacy management module in OpenClinic GA. Details on quantities purchased by the pharmacy, those provided to patients and those requisitioned by each ward pharmacy from the central pharmacy were also available in OpenClinic GA. The data from this software regarding the medication costs bought by the health facility were validated using accounting records.

Transport costs

Transportation costs were calculated by adding up fuel costs, insurance costs, and vehicle repair costs (spare parts, etc.). Overall, vehicle logbooks were unavailable. Interviews were conducted with the administrative and financial managers of the health facilities to determine the level of transportation used by each department.

Hygiene

The category of hygiene-related costs covers costs for cleaning supplies, hygiene supplies and costs associated with the incineration of certain types of waste. Some health facilities had gardening and/or waste disposal contracts, and the annual expenses associated with these contracts are included in hygiene expenses.

Office and IT supplies

This category includes the costs of office supplies and IT supplies purchased by health facilities during the study period.

Communications costs

The communication costs included in the study comprise landline telephone costs, prepaid cards provided to health facility managers, internet costs, as well as the costs associated with employees' mobile phone networks.

Water and electricity

This category covers expenses related to the payment of water and electricity bills. It also includes expenses related to water storage systems (water tanks) purchases and installation, as well as expenses related to photovoltaic equipment.

Maintenance

Within the maintenance category we considered expenses related to infrastructure corrective maintenance, preventive maintenance of biomedical equipment, and repairs to non-biomedical equipment. In Burundi, digitalized health facilities use a computerized maintenance management system named OpenClinic GMAO that centralizes all maintenance-related activities within the facility. All maintenance operations are planned and reported in this application as well as their costs. Furthermore, the system handles infrastructure management and provides information on health facilities infrastructures including their floor areas.

Other overhead costs

This category includes expenditures that are not categorized elsewhere. Examples include bank account fees, security costs, and food and beverages served during management committee meetings or at official celebrations.

Data quality assessment and missing data handling

During initial analysis, the completeness of the database was assessed, and missing data were identified for each variable in the database. To handle the missing data observed in the database, multiple imputations by chained equation was performed using MICE package in R software.

Data analysis

Total costs calculation

Microsoft Excel 2016 and R version 4.3.2 were used to analyze the data. Median estimates were calculated, and the interquartile range was determined because the cost distributions were skewed. This also helped minimize the effect of outliers.

Total costs per health facility were calculated separately for health centers, district hospitals and regional hospitals, as these facilities operate at different levels and have different cost structures. For each health facility, annual total costs were calculated as the sum of personnel costs, medication and consumables costs, office and IT supplies costs, transportation costs, communication costs, hygiene costs, maintenance costs, and other overhead costs.

Costs of curative, preventative, outpatient and inpatient services

To get costs of curative, preventive, outpatient and inpatient services, the step-down allocation approach was used as proposed by WHO and others in their methodology guidelines [29–31].

Firstly, the final products were defined. We defined the final product as preventive services, curative services, OPD services and IPD services.

Secondly, the cost centres were identified depending on the healthcare facility level (health center or hospital). Three types of cost centres were considered: direct cost centres (or final cost centres), intermediate cost centres, and indirect cost centres, as recommended in costing studies of health services [29][32]. Direct cost centres represent the points of care delivery for patients. In this study, direct cost centres included outpatient care services, inpatient care services, preventive care services, and curative care services. Intermediate cost centres referred to clinical support services involved in diagnosis and treatment. In this study, they were identified as laboratory services, medical imaging, and pharmacy services. Indirect cost centres were centres that do not participate in either diagnosis or treatment but ensure an appropriate environment for healthcare provision. In this study, they were identified as maintenance, laundry, administration, sterilization, and sanitation/incineration services.

Thirdly, the full cost of each input was identified. Health facilities in Burundi use a standard financial reporting template that includes a section dedicated to financial management. Using that template, different budget lines related to health facility expenditures were easily identified and grouped in the 9 costs categories.

Fourthly, the total costs of the inputs were assigned to the different cost centers. Thanks to digitalization, most costs were directly allocated to specific cost centres. The costs associated with resources used across multiple services were allocated proportionally, based on allocation keys that depended on the nature of the costs to be allocated. For example, staff time was used to allocate personnel-related costs. The value of each department's equipment was used to allocate security expenses, and the same key was used to allocate maintenance expenses. This is because security is often enhanced where there is more expensive equipment to be protected. The floor area of the buildings was used to allocate hygiene costs. Costs related to laundry and transportation were allocated according to each department based on data from administrative and financial managers interviews. Finally, the number of staff in each department was used to allocate administrative expenses.

Finally, all costs were allocated to final cost centres. Here, digitalization also played an important role, as many costs could be directly allocated to the final cost centres. For the costs remaining in each cost centre, a top-down cost allocation process was adopted, first from indirect cost centres to intermediate and final cost centres, and subsequently from intermediate cost centres to final cost centres.

Unit costs calculation

Unit costs were calculated using the average cost method, in which total costs were divided by the number of output units. This method has already been used in other studies on costing of hospital services [24, 33, 34]. The per-capita unit cost was calculated by dividing the total cost of providing health care services in a given year by the covered population. The unit costs per curative visit, per preventive visit, per outpatient visit and per hospital admission were calculated by dividing the total cost of providing the relevant service by the number of patients who used that service. Finally, the cost per day of hospitalization was calculated by dividing the total cost of inpatient services by the total number of days of hospitalization at the healthcare facility.

Sensitivity analysis

A univariate sensitivity analysis was performed to estimate the impact of a $\pm 20\%$ change in each of the main variables while the others remained unchanged. This analysis was performed varying each cost category individually. Findings were summarized using tornado plots.

Results

This study was carried out in 51 health facilities in Burundi. Those facilities included 34 health centers, 14 district hospitals, and 3 regional hospitals.

Background characteristics of the health facilities

Table 1 presents the characteristics of health facilities in the sample. In terms of human resources, Table 1 shows that the median number of staff increases across all levels, ranging from 14 at a health center to 315 at a district hospital. Furthermore, the same table indicates that the median proportion of staff on local contracts is higher at health centers (69.3%) compared to other health facilities at higher levels. Regarding the percentage of clinical staff, the median proportion remains comparable across the three levels of health facilities, ranging from 66.6% to 70.7%. The median population covered by a health center is 17,818 people. The population covered is higher for a district hospital, at 272 889 people.

Results from Table 1 also show that curative activity increases as the level of care provided rises, except for curative consultations, where health centers record a higher number of curative visits than district hospitals, 23 948 visits for health centers compared to 22 026 for district hospitals. In contrast, the trend is reversed for preventive care, where health centers have a higher median number of visits compared to other health facilities, with 15 709 visits per year.

Table 1
Background characteristics of the health facilities

Characteristics	Health center (n = 34)	District hospital (n = 14)	Regional hospital (n = 3)
	Median (IQR)	Median (IQR)	Median (IQR)
Staff	14 (5)	104 (61)	315 (86)
Percentage of staff under local contract	69.3 (51.5)	47 (17.9)	53 (10)
Percentage of clinical staff	66.6 (6.2)	70.7 (5.2)	68.6 (6.6)
Population covered	17 818 (12 914)	272 889 (66 142)	NA
Number of beds	9 (2)	125 (27)	362 (89)
Number of deliveries	289 (226)	2 218 (714)	4 535 (1 787)
Number of outpatient visits for curative care	23 948 (10 355)	22 026 (7 999)	42 728 (13 176)
Total inpatient admissions	284 (320)	7 569 (3 454)	10 611 (2 384)
Total inpatient bed-day	566 (603)	58 354 (44 920)	68 090 (12 997)
Preventive care attendance a year	15 709 (7 240)	7 270 (2 909)	5 318 (2 266)

Costs of delivering essentials health services

Table 2 summarizes the costs of providing services in health centers, district hospitals, and regional hospitals. Results show that the median total costs of providing services for a healthcare system increase as the level of care rises, from € 103 372 for a health center to € 1 719 902 for a regional hospital.

Personnel and medicines are the two most costly categories at every level of care. Median personnel costs are the highest at all levels, accounting for € 17 896 for health centers, € 230 611 for district hospitals, and € 934 897 for regional hospitals. The wide interquartile ranges (IQR) suggest a substantial variability in costs across health facilities within the same level of care.

Table 2
Annual financial costs (in €) of delivering essentials health services

Cost category	Health center (n = 34)	District hospital (n = 14)	Regional hospital (n = 3)
	Median (IQR) in €	Median (IQR) in €	Median (IQR) in €
Personnel	17 896 (13 293)	230 611 (188 317)	934 897 (375 079)
Medicine and consumables	74 979 (33 246)	199 995 (151 795)	444 184 (30 783)
Transport	4 116 (1 958)	38 005 (21 985)	57 108 (33 761)
Hygiene	431 (589)	7 147 (6 591)	13 012 (14 585)
Office and IT supplies	1 391 (1 670)	12 945 (15 025)	40 148 (15 446)
Communication	545 (197)	3 307 (1 686)	5 262 (1 501)
Water and electricity	368 (441)	14 061 (11 536)	42 256 (16 862)
Maintenance	534 (473)	15 379 (14 789)	13 772 (845)
Other costs	977 (563)	34 448 (29 427)	175 808 (88 488)
Total costs	103 372 (42 824)	548 318 (418 076)	1 719 902 (553 088)

Contribution of each cost category to the total annual financial cost

Table 3 shows that financial costs at health centers are largely attributed to medicine costs, which account for 73.3%. In contrast, at district and regional hospitals, the financial costs of service delivery are largely attributed to personnel costs. Personnel costs account for 43% of financial costs at district hospitals and 54.4% at regional hospitals.

Table 3
Contribution of each cost category to the total annual financial cost

Cost category	Health center (n = 34)	District hospital (n = 14)	Regional hospital (n = 3)
	Median (IQR) (%)	Median (IQR) (%)	Median (IQR) (%)
Medicines and consumables	73.3 (6.9)	34.2 (7.5)	24.2 (9.9)
Personnel	16.9 (6.9)	43 (6.8)	54.4 (5.4)
Transport	3.7 (1.6)	6.1 (4.2)	3.7 (0.8)
Hygiene	0.3 (0.6)	1.1 (1)	0.8 (0.5)
Office and IT supplies	1.3 (1.3)	2.3 (0.9)	2.3 (0.1)
Communication	0.5 (0.2)	0.6 (0.6)	0.3 (0)
Water and electricity	0.3 (0.4)	2.3 (1.2)	2.4 (0.4)
Maintenance	0.5 (0.4)	2.3 (2.1)	0.9 (0.3)
Other indirect costs	0.8 (0.7)	6 (3.7)	8.1 (4.8)

Costs attributed to curative, preventive, outpatient, and inpatient care services

Overall, results in Table 4 show that the costs of curative services are higher at all levels compared to preventive services. In a health center, the median cost of curative services is € 65 729 and increases across all levels of care, reaching €1 673 419 for a regional hospital. However, the gap between the costs of curative and preventive services is small in a health center compared to hospitals. This gap increases as the level of care rises.

Results in Table 4 also show that costs attributable to outpatient care are high for health centers, reaching € 101 919, compared to € 2 721 for inpatient care services. In contrast, the costs associated with inpatient care are the highest in hospitals compared to outpatient care. The median cost of inpatient care reaches € 296 321 for a district hospital, compared to €913 010 for regional hospitals.

Table 4
Costs (in Euros) attributed to curative, preventive, outpatient and inpatient care services

Costs	Health center (n = 34)	District hospital (n = 14)	Regional hospital (n = 3)
	Median (IQR) in €	Median (IQR) in €	Median (IQR) in €
Curative and preventive services costs			
Curative services costs	65 729 (23 390)	500 511 (394 827)	1 673 419 (506 284)
Preventive services costs	42 616 (21 457)	39 504 (13 685)	46 453 (46 804)
OPD and IPD services costs			
OPD services costs	101 919 (41 614)	223 734 (159 977)	806 862 (256 443)
IPD services costs	2 721 (2 568)	296 321 (202 322)	913 010 (296 645)
Total costs	103 372 (42 824)	548 318 (418 076)	1 719 902 (553 088)

Considering the proportions attributable to each type of service, Figs. 2 and 3 show a relative balance between curative (41.6%) and preventive (58.4%) care costs for a health center, while the largest part of the hospital budget covers curative care, accounting for 93.9% of district hospitals' budgets and 96.1% of regional hospitals' budgets.

The same figures show that health centers allocate 97.9% of their budget to outpatient care, compared to 42% for district hospitals and 43.1% for regional hospitals.

Unit costs of health services

Overall, results in Table 5 show that unit costs increase as the health facility level increases. For example, for an outpatient visit, the unit cost ranges from €2.7 (IQR = €0.7) for a health center to €10 (IQR = €8.5) for a health district and €15.1 (IQR = €5) for a regional hospital. The median financial costs of an inpatient admission is €6.9 for a health center whereas it costs €49 for a district hospital and €101.7.

Table 5
Median unit financial costs of health services by health facility level (in Euros)

Unit costs	Health center (n = 34)	District hospital (n = 14)	Regional hospital (n = 3)
	Median (IQR) in €	Median (IQR) in €	Median (IQR) in €
Cost per capita	5,6 (3,8)	2,5 (1)	NA
Cost per OPD visit	2,7 (0,7)	10 (8,5)	15,1 (5)
Cost per IPD admission	6.9 (3,1)	49 (14,4)	101,7 (18,4)
Cost per IPD day	4,0 (3.0)	5,7 (3,7)	10,1 (4,2)
Cost per curative visit	2,8 (0,7)	23,8 (10)	32,6 (9,6)
Cost per preventive visit	2,8 (0,9)	6,8 (2,1)	14,4 (7,6)

Distribution of financial costs in direct and indirect costs (in Euros)

Table 6 shows distribution of health facility annual financial costs into direct and indirect costs. Direct costs include salaries of medical staff and costs of drugs, whereas indirect costs include administrative and overhead costs such as transportation, communication, maintenance and other overhead costs.

Table 6
Distribution of financial costs in direct and indirect costs (in Euros)

Variables	Health center (n = 34)		District hospital (n = 14)		Regional hospital (n = 3)	
	Median	Mean	Median	Mean	Median	Mean
Direct costs						
Per capita	4,57	5,63	1,61	1,77	NA	NA
Per ambulatory visit	2,3	2,51	4,6	6,07	9,73	9,69
Per admission	2,27	2,43	33,27	37,77	80,58	73,33
Per inpatient day	1,64	1,54	3,67	4,93	7,97	9,32
Per curative visit	2,29	2,56	16,11	19,7	24,22	23,89
Preventive visit	2,36	2,5	1,38	4,55	7,73	6,47
Per bed day hospitalization	1,64	1,54	3,67	4,93	7,97	9,32
Total annual direct costs	86 400	96 609	375 657	463 983	967 428	1 044 537
Indirect costs						
Per capita	0,79	0,94	0,86	0,89	NA	NA
Per ambulatory visit	0,41	0,41	5,24	5,23	8,21	8,53
Per admission	0,56	0,81	14,36	14,15	27,97	26,95
Per inpatient day	0,33	0,55	1,88	1,83	3,44	3,49
Per curative visit	0,44	0,46	7,95	8,76	12,25	12,55
Preventive visit	0,39	0,39	4,92	6,26	6,67	8,28
Per bed day hospitalization	0,33	0,55	1,88	1,83	3,44	3,49
Total annual indirect costs	16 165	16 104	187 993	236 633	752 474	608 040

Findings from Table 6 show that direct costs were the largest component of the annual financial costs of the health facilities at all levels. Both direct and indirect financial costs increase as the health facility level increases.

Sensitivity analysis

The results of one-way sensitivity analyses are shown in tornado diagrams presented in Fig. 4.

Results showed that both total financial annual costs and unit costs were highly sensitive to medicines costs and personnel salary at all levels. Specifically in district hospitals, variation in transportation costs also result in important changes in both total financial annual costs and unit costs.

Discussion

Findings on financial costs of delivering health services

Significant heterogeneity was observed in the characteristics of health facilities in terms of the population served, activity volume and human resources. These differences are expected given the context of Burundi's health care system. Health centers provide primary care, while district and regional hospitals provide referral services that may be specialized. Background characteristics in other studies carried out in African countries also showed similar results, with significant disparities in terms of volume of activity and operational capacity between health centers and hospitals providing referral care [7][35].

Findings also revealed that drug-related costs are highest in health centers, whereas personnel-related costs are highest in district and regional hospitals. Within the context of Burundi's health system, the difference in the structure of financial costs can be explained by the fact that healthcare delivery in health centers relies on less-qualified staff, as the care provided is mainly basic and outpatient-based. Moreover, the high volume of outpatient activities at this level requires more drugs. In contrast, hospitals require more qualified and specialized staff to provide referral care. Also, more staff must be recruited at this level to ensure night shifts and continuous hospital service coverage. Our findings are consistent with results from studies carried out in Ethiopia [7] and Kenya [35], which also reported that personnel costs accounted for the largest share of financial costs in hospitals. Similarly, the high proportion of expenditures on drugs and consumables in health centers is consistent with findings from studies conducted in Ethiopia [7, 36] and in Nigeria [37]. In contrast, our findings differ from those reported in a study in Kenya [35] and another one in Ethiopia [24], which reported that personnel share accounted for the largest share in health centers. Distribution of expenditures may reflect more investment in direct patient care at the primary care level. However, the high proportion of personnel costs in hospitals merits further analysis to assess provider efficiency.

Our findings showed that the costs of curative care account for the largest share at all levels. In the context of Burundi, this finding is expected as most people seek care at health facilities only after they are already sick. However, cost analyses also showed that health centers allocate a significantly higher proportion of their budget to preventive care compared to hospitals. These results can be explained by fact that the primary mission of health centers, which serve as the first point of contact between the population and the health system, is to provide preventive care to the population. In fact, vaccination and family planning services are mostly provided in health centers. In contrast, hospitals allocate a large proportion of their budget to curative care. Similar findings have been observed in Ghana [34] where

researchers found that curative services account for 58% in the budget of health centers while another study in India reported that this was 65% for district hospitals [38].

Our results reveal that unit costs increase as the level of health facilities rises. This can be explained the higher complexity of the cases treated. These estimates are consistent with data from two studies conducted in Ethiopia which reported that per OPD and IPD cost increase as the level increase [36]. Also, another study found that per patient costs increase as the level increases [7].

We noted substantial variability of unit costs among health facilities of the same level. This can be explained by differences in management efficiency as well as by additional transportation costs for health facilities located in remote areas. Similar variability in unit costs has also been reported in a study carried out in Ethiopia [36].

Policy implications of findings

This study has important policy implications for health financing reforms and UHC implementation in Burundi. First, with the current evidence, it is clear that strategies for efficiency management in health facility should focus on improving medicines management in health centers whereas they should focus on personnel recruitment in hospitals.

Second, in the context of UHC implementation, the fact that unit costs of health services increase for higher health facility levels, highlights the need for a level specific reimbursement tariff rather than applying the same tariff for all the health facilities. This is particularly important for Burundi where many prepayment mechanisms use a unique reimbursement tariff regardless the healthcare level and where many health facilities are reporting that tariffs do not cover service delivery costs.

Third, findings from this study provide an evidence-based benchmark for budgeting the health financing strategic plan and for estimating resources needed to deliver the essential health packages to the population.

Fourth, the results suggest that health policy makers should consider increased focus of health financing on strengthening preventive care. Particularly, important investments in preventive services in health centers could reverse the current trend of allocating more resources on curative care over preventive care.

Finally, this study demonstrated the feasibility of using electronic medical and financial records to carry out rapid and low-cost costing study. This provided a practical experience that health policy makers should build on to institutionalize routine costing exercises and produce annual cost estimations to support UHC implementation.

Methodological consideration

Beyond our findings on costs of delivering health services in health facilities in Burundi, this study demonstrates that electronic medical and financial records data can be leveraged to estimate costs of providing health services. It showed that the benefit of digitalization extends beyond improving quality of health services delivery to support health economics analysis. Compared with traditional data collection approaches, which are often very expensive and time-consuming, using data routinely collected through electronic medical and financial records offers a more efficient methodological alternative.

Strengths and limitations of the study

This study has several strengths. First, the main strength of the study was to demonstrate that an electronic hospital information system and an electronic financial system can be leveraged to produce cost data on a large scale, quickly and at low cost. Second, it included a large sample of health facilities whereas most costing studies often focus on a single healthcare facility. Third, the direct allocation of several expenses to their respective cost centres in digitalized health facilities allowed for more accurate estimates. Indeed, allocation performed in most costing studies is based on assumptions that may affect accuracy of results.

This study was not without limitations. First, the costs of staff supervision and training were unavailable and therefore have not been included. Also, capital costs were not included to avoid bias considering that they do not occur on yearly basis. That may have resulted in an underestimation of unit costs. Furthermore, some routinely collected data had missing values, which to some extent may have introduced inaccuracies in estimations. Finally, the study was carried out in digitalized health facilities only. The sample is representative for district and regional hospitals, with respectively 29% and 60% of hospital for each hospital level, but may be not representative for health centers, despite applying a valid sampling technique, as only 6% of health centers are digitalized. Therefore, caution is required when extrapolating results.

Conclusion

There is limited evidence on the costs of providing health care services in health care systems in low- and middle-income countries. This study provides new evidence in this area as it is the first study of its kind in Burundi. Findings showed that the total and unit costs of providing services increase as the level of care rises. This reflects the complexity of the services delivered at different levels and suggest that reimbursement tariffs should be fixed according the health facility level instead of a unique tariff for all health facilities. Strategies aimed at improving efficiency health facility management should focus on improving medicines management in health centers whereas they should focus on personnel recruitment in hospitals.

Using existing electronic medical and financial records for costing purpose, health systems have access to faster and more economical ways for conducting costing studies. The benefit of digitalization extends beyond improving quality of health services delivery by also supporting health economics analyses.

Abbreviations

UHC

Universal health coverage

WHO

World Health Organization

LMIC

Low- and Middle-Income Countries

GDP

Gross Domestic Product

DHIS2

District Health Information Software 2

MICE

Multiple Imputation by Chained Equations

IPD

Inpatient Department

OPD

Outpatient Department

IQR

Interquartile Range

Declarations

Ethics approval and consent to participate

The study was approved by the National Ethics Committee of Burundi (Decision No. CNE/29/2025).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was received for this research.

Author Contribution

AN participated in study design, conducted data curacy to complete data extracted from OpenClinic, performed data analysis, prepared the initial draft of the manuscript, reviewed the manuscript.

FV participated in study design, performed data extraction from OpenClinic, supervised data curacy to complete data extracted from OpenClinic, provided guidance on data analysis, substantially contributed in results verification and interpretation, closely reviewed the manuscript.

RB, JN and MN participated in study design, supervised data curacy to complete data extracted from OpenClinic, provided guidance on data analysis, substantially contributed in results verification and interpretation, closely reviewed the manuscript.

All authors have read and approved the final manuscript

Acknowledgement

The authors wish to express their gratitude to the Ministry of Health steering committee for their valuable contributions during the study design. We are also grateful to the managers and staff of the participating health facilities for their collaboration during data collection. Finally, we would like to thank the data collection team for their field work.

Data Availability

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

References

1. Kodali PB. Achieving universal health coverage in low-and middle-income countries: challenges for policy post-pandemic and beyond. Risk Manag Healthc Policy. 2023;;607–21.
2. DARRUDI A, KHOONSARI MHK. Challenges to Achieving Universal Health Coverage Throughout the World: A Systematic Review. J Prev Med Public Heal. 2022;55:125.
<https://doi.org/10.3961/jpmph.21.542>.
3. Langat EC, Ward P, Gesesew H, Mwanri L. Challenges and opportunities of universal health coverage in Africa: a scoping review. Int J Environ Res Public Health. 2025;22:86.
4. Lozano R, Fullman N, Mumford JE, Knight M, Barthelemy CM, Abbafati C, et al. Measuring universal health coverage based on an index of effective coverage of health services in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396:1250–84.
5. Debie A, Nigusie A, Gedle D, Khatri RB, Assefa Y. Building a resilient health system for universal health coverage and health security: a systematic review. Glob Heal Res Policy. 2024;9:2.

6. Mahajan SL, Tandon S, Mahajan K, Kahlon A. Health financing trends and universal health coverage. *J Community Med Public Health*. 2020;4:2228–577.
7. Alebachew A, Abdella E, Abera S, Dessie E, Mesele T, Mitiku W, et al. Costs and resource needs for primary health care in Ethiopia: evidence to inform planning and budgeting for universal health coverage. *Front Public Health*. 2023;11:1242314.
8. Hellebo AG, Zuhlke LJ, Watkins DA, Alaba O. Health system costs of rheumatic heart disease care in South Africa. *BMC Public Health*. 2021;21:1303.
9. Mahomed O, Mthethwa J. Estimating the cost of oral health services for 2018/19 financial year at public health facilities in two KwaZulu-Natal districts, South Africa: a retrospective study. *J Int Oral Health*. 2022;14:40–6.
10. Twea P, Watkins D, Norheim OF, Munthali B, Young S, Chiwaula L, et al. The economic costs of orthopaedic services: a health system cost analysis of tertiary hospitals in a low-income country. *Health Econ Rev*. 2024;14:13.
11. Banda P, Yokobori Y, Ashida S, Masiye F, Kaonga O, Higashi H. Unit costs of health services provided at hospitals and health centres in two provinces of Zambia. *GHM open*. 2024;4:69–79.
12. Okeke C, Akpolo R, Uzochukwu B, Obi F, Ogbe O, Abba S, et al. Comparative assessment of operational costs and funding gaps in rural and urban primary healthcare (PHC) facilities in Kaduna State, Nigeria. *Discov Public Health*. 2026;23:629.
13. Mohan S, Chagoma N, Walker S, Arega CA, Chalkley M, Collins J et al. Estimating System-Wide Healthcare Costs Using a Health System Model: Application to the Thanzi La Onse Model of Malawi: S. Mohan. *Appl Health Econ Health Policy*. 2026;:1–19.
14. Amara A, Ghardallou M, Bannour I, Gara A, Limam M, Khairi H, et al. Health facility cost of caesarean delivery at tertiary level hospital in Tunisia using time-driven activity-based costing. *BMC Pregnancy Childbirth*. 2025;25:979.
15. République du Burundi. Ministère de la Santé Publique et de Lutte contre le Sida. Stratégie nationale de financement de la santé en vue de la couverture sanitaire universelle au Burundi 2025–2030. Bujumbura: Ministère de la Santé Publique et de la lutte le Sida du BURUNDI; 2025.
16. République du Burundi. Ministère de la Santé Publique. Plan National de Développement de l'Informatique de Santé, PNDIS II (2025–2027). Bujumbura: Ministère de la Santé Publique; 2025.
17. République du Burundi. Ministère de la Santé Publique. Normes sanitaires pour la mise en oeuvre de la stratégie sectorielle 2021–2027. Bujumbura: Ministère de la Santé Publique; 2022.
18. République du Burundi. Ministère de la Santé Publique et de Lutte contre le Sida. Rapport des comptes nationaux de la Santé Année 2021–2022. Bujumbura; 2025.
19. République du Burundi. Ministère de la Santé Publique. Annuaire des statistiques sanitaires 2024. Bujumbura: Ministère de la Santé Publique; 2025.
20. Husereau D, Drummond M, Augustovski F, de Bekker-Grob E, Briggs AH, Carswell C, et al. Consolidated health economic evaluation reporting standards (CHEERS) 2022 explanation and elaboration: a report of the ISPOR CHEERS II good practices task force. *Value Health*. 2022;25:10–31.

21. Sapra RL. How to calculate an adequate sample size? How to practice academic medicine and publish from developing countries? A practical guide. Springer; 2021. pp. 81–93.
22. Johnston KM, Lakzadeh P, Donato BMK, Szabo SM. Methods of sample size calculation in descriptive retrospective burden of illness studies. *BMC Med Res Methodol*. 2019;19:9.
23. Cochran WG. Sampling techniques. Johan Wiley Sons Inc.; 1977.
24. Feyisa D, Yitbarek K, Daba T. Cost of provision of essential health Services in Public Health Centers of Jimma zone, Southwest Ethiopia; a provider perspective, the pointer for major area of public expenditure. *Health Econ Rev*. 2021;11:34.
25. Prinja S, Gupta A, Verma R, Bahuguna P, Kumar D, Kaur M, et al. Cost of delivering health care services in public sector primary and community health centres in North India. *PLoS ONE*. 2016;11:e0160986.
26. World Health Organization (WHO). Tools for Assessing the Operationality of District Health Systems. Brazzaville; 2003.
27. KARARA G, VERBEKE F, MUGISHO E NDABANIWEE. OpenClinic GA open source hospital information system enabled universal health coverage monitoring and evaluation in burundian hospitals. *Stud Health Technol Inf*. 2017;245:738–42. <https://doi.org/10.3233/978-1-61499-830-3-738>.
28. Banque de la République du Burundi. République du Burundi. Banque de la République du Burundi. Cours de change moyen des principales monnaies. Bujumbura; 2026.
29. Conteh L, Walker D. Cost and unit cost calculations using step-down accounting. *Health Policy Plan*. 2004;19:127–35.
30. Walker D, Kumaranayake L. Allowing for differential timing in cost analyses: discounting and annualization. *Health Policy Plan*. 2002;17:112–8.
31. Shepard DS, Hodgkin D, Anthony YE. Analysis of hospital costs: a manual for managers. World Health Organization; 2000.
32. World Health Organization (WHO). International workshop on hospital cost analysis. Cairo, Egypt; 1999.
33. Solanki HK, Yadav K, Rai SK, Krishnan A, Pandav CS. Cost of Delivery Care Services from Provider's Perspective at a Sub-district Hospital in Northern India. *Prev Med Res Rev*. 2025;2:267–72.
34. Dalaba MA, Welaga P, Matsubara C. Cost of delivering health care services at primary health facilities in Ghana. *BMC Health Serv Res*. 2017;17:742.
35. Olago A, Suharlim C, Hussein S, Njuguna D, Macharia S, Muñoz R, et al. The costs and financing needs of delivering Kenya's primary health care service package. *Front Public Heal*. 2023;11:1226163.
36. Agarwal A, Mann C, Abdella E, Mitiku W, Alebachew A, Berman P. Recurrent costs in primary health care in Ethiopia: facility and disease specific unit costs and their components in government primary hospitals and health centers. *BMC Health Serv Res*. 2020;20:389.

37. Ogundeji Y, Abubakar H, Ezeh U, Hussaini T, Kamau N, Love E, et al. An assessment of primary health care costs and resource requirements in Kaduna and Kano, Nigeria. *Front Public Heal.* 2023;11:1226145.

38. Prinja S, Chauhan AS, Bahuguna P, Selvaraj S, Muraleedharan VR, Sundararaman T. Cost of delivering secondary healthcare through the public sector in India. *PharmacoEconomics-open.* 2020;4:249–61.

Figures

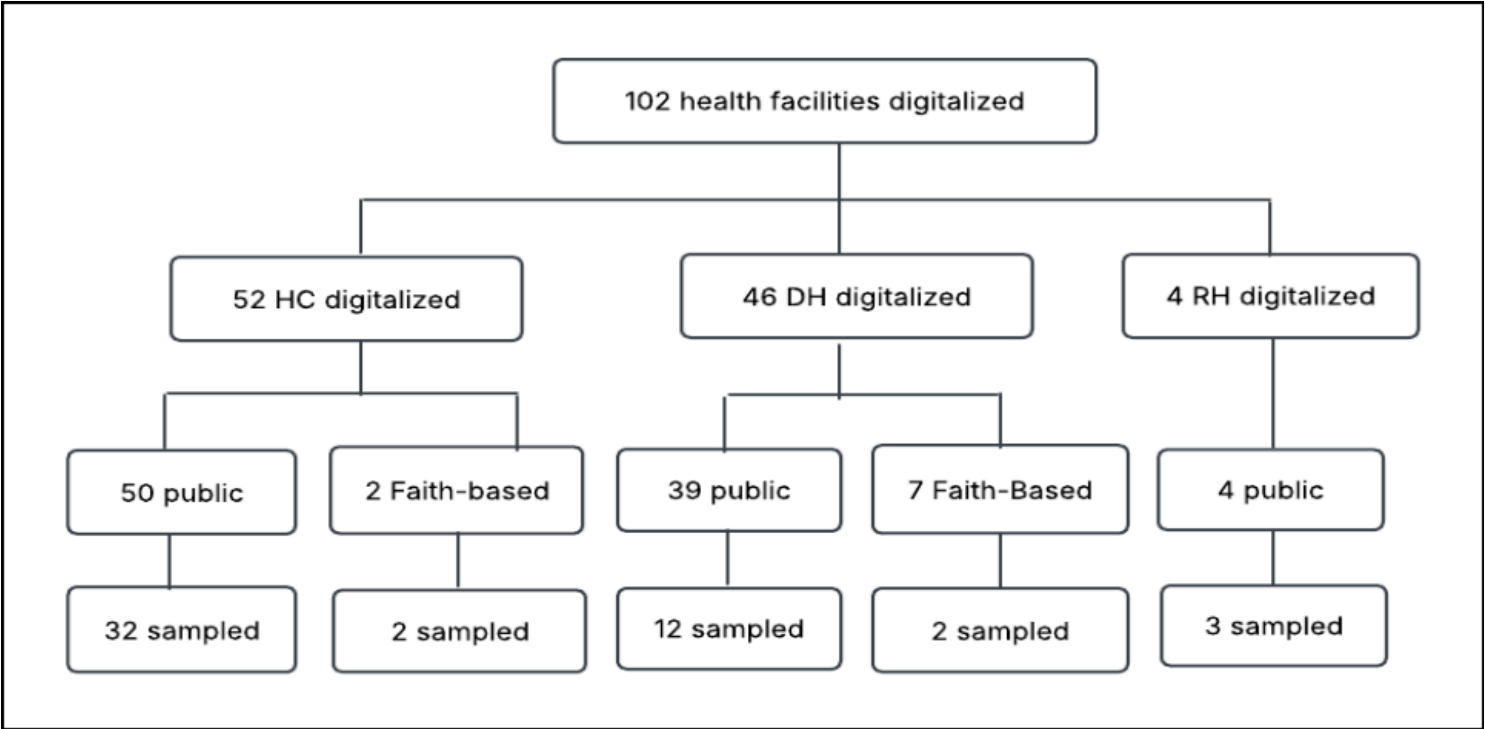


Figure 1

Sampling strategy

HC = health centers, DH = district hospital, RH = regional hospital

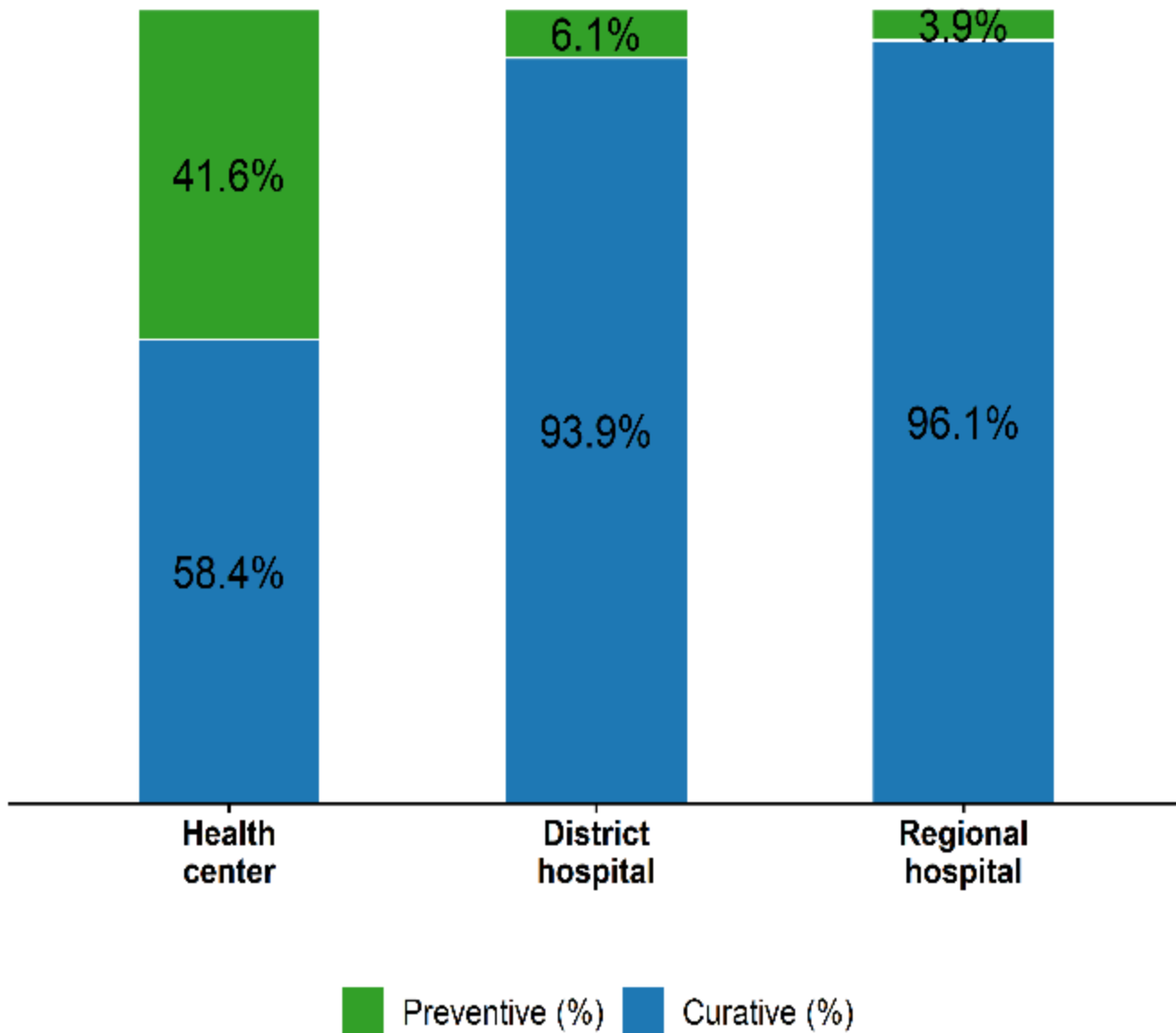


Figure 2

Distribution of costs to curative and preventive services

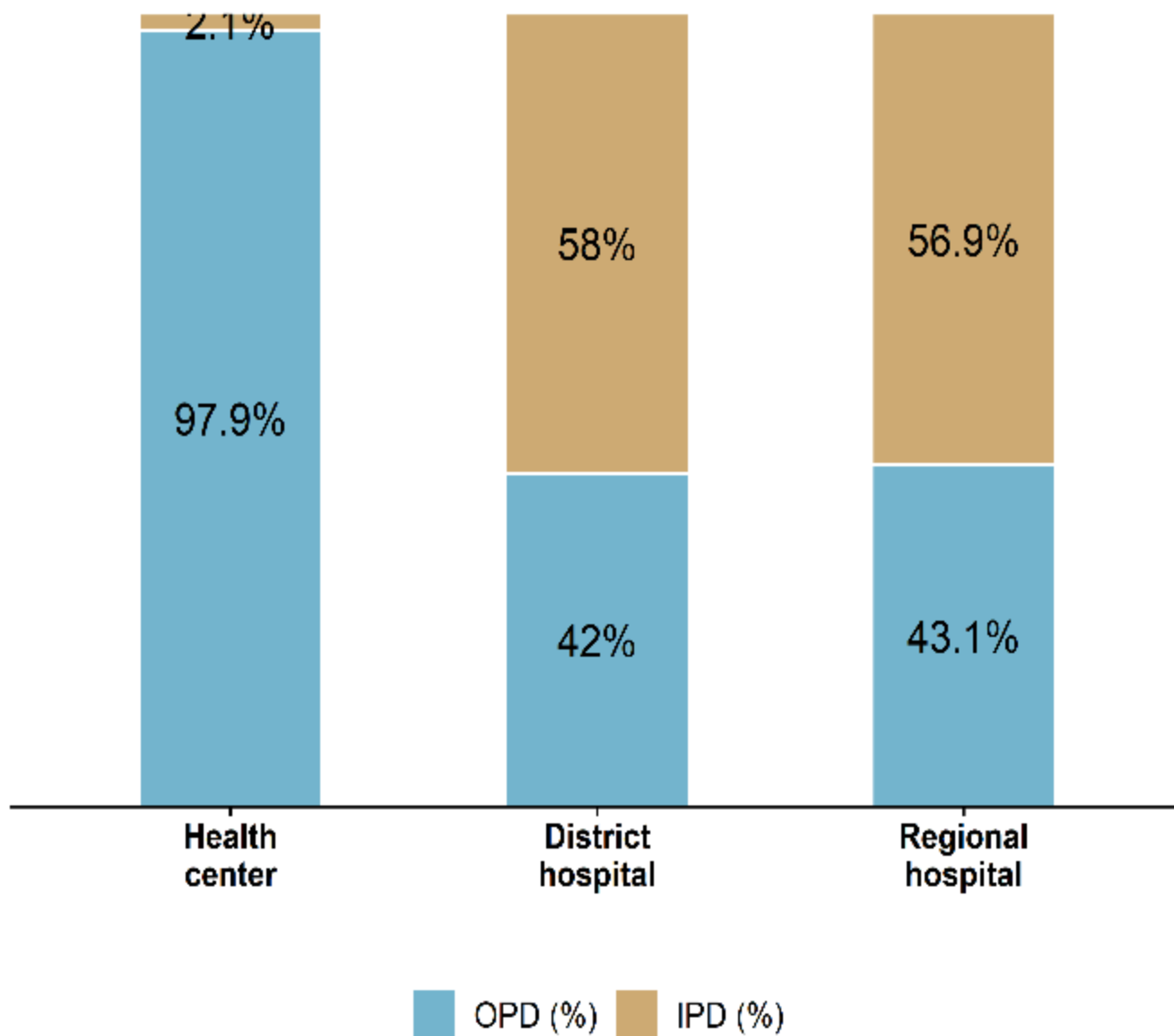


Figure 3

Distribution of costs to OPD and IPD services

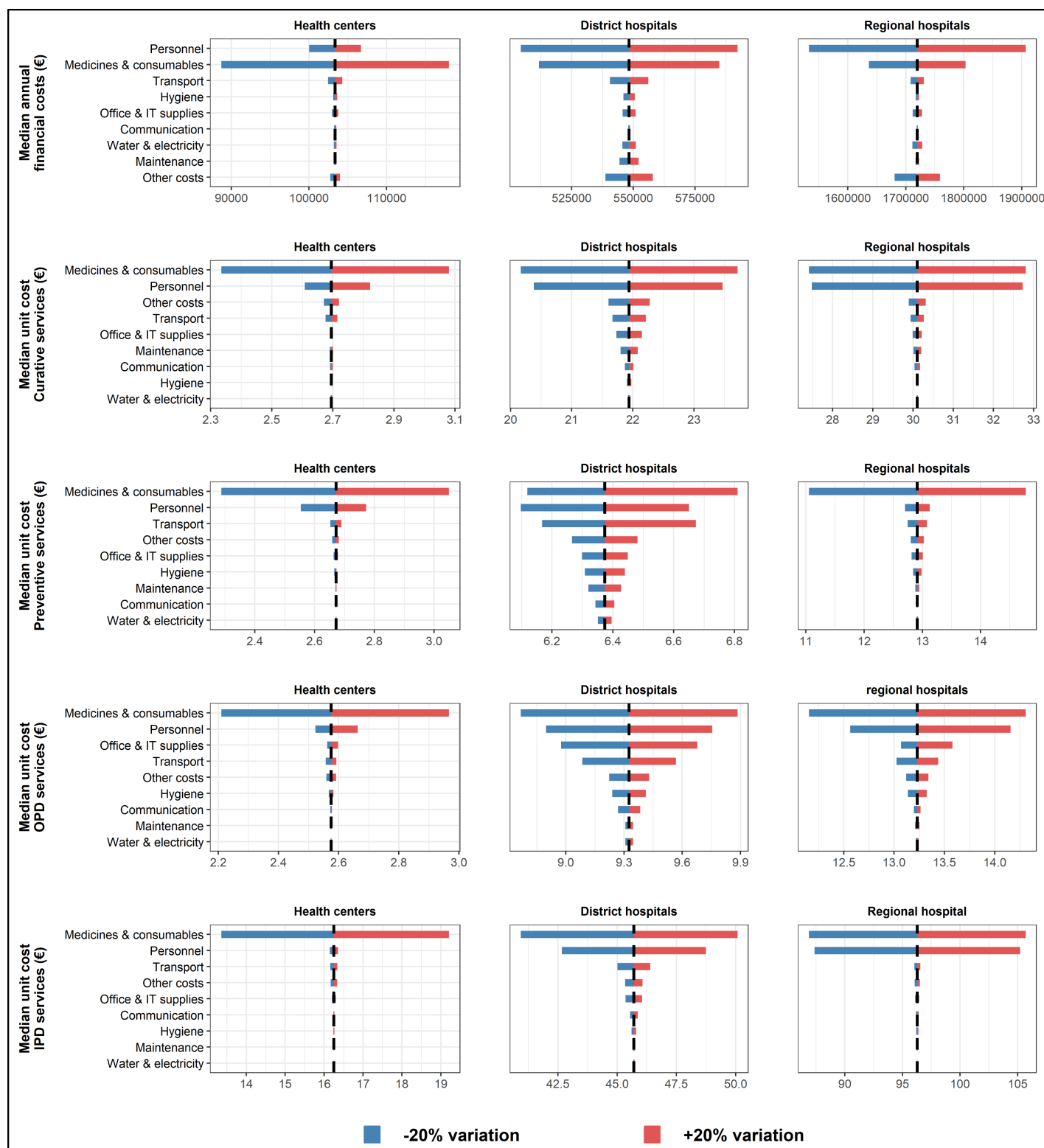


Figure 4

Sensitivity analysis