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Measuring disparities in access to district and referral hospitals in the city of Kigali, Rwanda

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Abstract

The study focused on the identification of theoretical and methodological constructs that can be used to analyse and improve the spatial performance of public health service delivery systems and the development of a corresponding spatial-analysis and GIS-based planning approach using the city of Kigali as a case study. Access to health care as a multi-tiered system was measured by using five dimensions of access, namely geographic accessibility, availability, affordability, acceptability and accommodation. Geo-statistical analysis was performed to measure and evaluate access to the district and referral health care. For geographic access, the travel time for every trip is approximated for the two main modes of transport (walking and public transport). To realistically represent the friction of distance, the street network was categorised into several road classes for which different travel speeds are estimated for each transport mode on the basis of local knowledge. A factor analysis model was used for availability, affordability, acceptability, and accommodation dimensions. Different indicators were evaluated in various units and scales and standardized to see how satisfaction levels varied with each dimension. Based on the type of indicator, for the cost or benefit, the score was zero (0) or one (1). One (1) was considered a positive impact, while zero (0) was considered a negative impact. Summary scores were developed for all indicators by combining more than one indicator into a single value. The created summary score also ranges from 0 to 1, and the higher the score, the better the access attainment. To find areas that need intervention, the comparison of all five indicators and the scores of access for each indicator was made. The dimensions of geographic accessibility and availability appeared to be the most problematic. The district health care dimensions have revealed a low performance level in geographic accessibility (0.64) and a high-performance level in affordability (0.94). The referral health care dimensions have revealed a low performance level of geographic accessibility (0.17) and a high-performance level of acceptability (0.92). Health planners and policy makers will commonly require such a planning method, particularly in the developing world where spatial contexts are highly dynamic as a result of rapid urbanisation.

Keywords: Measuring access, factor analysis model, health care, indicator

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1. Introduction

Rwanda has made impressive gains in health, placing the country as one of the few in Africa to have achieved the United Nations Millennium Development Goals (MDGs) health targets (Ministry of Health, 2015). In the last two decades, Rwanda's health system has witnessed an increase in the number of health facilities (Ministry of Health, 2012b). This was translated into significant improvements in geographical accessibility to medical services in the country. The City of Kigali is among the places in Rwanda where achievements in the health sector have been tangible over the past 20 years (Abbott et al., 2017). However, access disparities are witnessed in the city's peripheries and rural neighbourhoods.

Access to the District and referral health care within an acceptable distance from residence remains a concern in Rwanda. This is highlighted by the low quality of service in health institutions, a lack of medical human resources, insufficient modern equipment, and financial limits in managing and providing health care (Ministry of Health, 2012a). Health care provision is one of many basic elements of social services to be provided and that can have an influence on the spatial distribution of the population (Russell, 1996). Access to health care in the city of Kigali has become more inequitable, less accessible and less affordable, especially for the poor (Jaganyi et al., 2018). Some of the most affected include the unemployed, low-income dwellers, the homeless and families with no health insurance (Huerta Munoz and Källestål, 2012) argued that the adoption of poor health policies, inaccessibility to basic health interventions, and health inequities remain high in cities. It is therefore incumbent upon governments to make the most efficient use of available resources and monitor trends in health equity and access to health care. Accordingly, the government of Rwanda put in place Community Based Health Insurance (CBHI) to allow the poor and low-income city dwellers working in the informal sector to have access to health care. The CBHI is used by a large population, which can be placed into two categories depending on their level of income. The first category includes people who pay for the health insurance contribution by themselves, while the second category includes people whose contribution is paid either by the government or by development partners. For those who do not pay by themselves, the cost of medical services can be quite high as they have to contribute a certain percentage of the cost of the health care service they receive. Unfortunately, the cost keeps rising for community health workers, health posts, health centres, districts, and referral health care (Ministry of Health, 2012c). One of the underlying factors in such a situation is that the growth of the city does not go hand in hand with the expansion of social services, including health care, which are already heavily strained.

Many studies have focused on physical accessibility to define spatial equity in service provision (Abatemarco et al., 2020; Manjia et al., 2018; McGrail and Humphreys, 2014; Shah et al., 2017). However, there are other dimensions that can influence access to health care services and which have not yet been holistically addressed. Therefore, the aim of this study was to use the five dimensions of access to health care to assess and measure variations in access to the district and referral public health care among users of community-based health insurance.

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2. Methods and data sources

2.1. Study area

The city of Kigali is located in the central part of the country. It is the capital and largest city of Rwanda and the one of the five provinces of the country of Rwanda. The city is divided into three districts, namely Gasabo, Nyarugenge, and Kicukiro. These districts comprise 35 sectors, which are subdivided into 161 cells. These cells are also divided into 1061 villages.

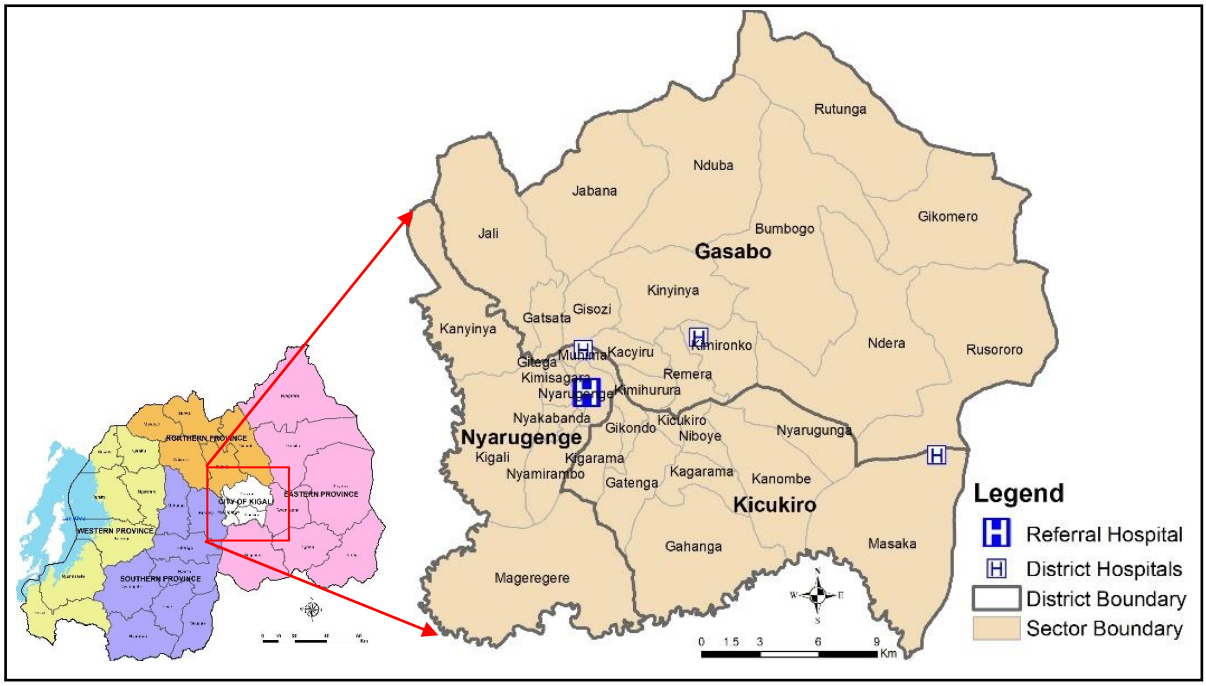

Figure 1: Location of Public District and Referral health care surveyed in the City of Kigali

2.2. Healthcare facilities in Rwanda

The Rwandan healthcare services provision is a pyramid with three levels: central, intermediate and peripheral. A package of activities has been defined for each level: the peripheral level comprises mainly of services provided through health centres, community health workers and health posts (ministry of Health, 2015). Community health workers have clear guidelines detailing what they are asked to do and how. At the health centre level, the minimum package of activities (MPA) is also defined. These include promotional, preventive, and curative activities. District hospitals receive patients referred by health centres, and there is a clear complementary package of activities (CPA) for this level. Finally, the district hospitals refer patients to national referral hospitals, where there is also a complementary package of activities for national referral hospitals (Ministry of Health, 2012b).

Since February 2022, Kigali has possessed four referral hospitals. These hospitals are Kigali University Teaching Hospital (known also as CHUK), King Faisal Hospital, Kanombe Military Hospital, and Ndera Psychiatric Hospital. It is worth noting that these four (4) referrals hospitals also serve the whole country. There are also five district hospitals (DHs) which receive cases

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referred by health centres, which have also been increasing in the City of Kigali. Gasabo District is the most privileged with two DHs, while other districts have only one DH each. In 2016, the former Kacyiru Police Hospital was handed over to the Ministry of Health, making it the second district hospital in Gasabo District, in addition to Kibagabaga District Hospital (Ministry of Health, 2017a).

In the city of Kigali, in the period from 2009 to 2018, there was an increase in the number of health centres (HCs). In the Rwandan health system, the health centre is used by the great majority of the population. As already stated, an increase in the number of HCs translates into an improvement in geographical accessibility to health care. Nyarugenge district had the highest rise in the number of health centres, from 8 in 2009 to 14 in 2018. The construction of new health centres in Rwanda is particularly important considering that the country is predominantly hilly, which tends to contribute to low utilisation of some essential health services. For example, at a national level, only 44% of women receive the four recommended antenatal care consultations during their pregnancy (NISR, 2018). However, the distance to the health care facility remains a major barrier to attending antenatal visits (Manzi et al., 2014).

The Rwanda Ministry of Health is promoting health Posts (HPs) as one of the mechanisms to improve geographical accessibility to health services (Ministry of Health, 2017a) and intends to further increase the number of HPs in the coming years from the current 479 HPs nationally, with the aim of having at least one HP in each of the 2148 cells (the second lowest administrative entity) that do not have a health facility. The health posts are expected to help reduce the workload of health centers and, more importantly, reduce the walking distance to the health facilities from 50 minutes (at national level) to 25 minutes. It is in this context that from 2009 to 2018, the Rwanda Ministry of Health increased the number of HPs in the City of Kigali, from zero to 70 HPs. It is in this context that from 2009 to 2018, the Rwanda Ministry of Health increased the number of HPs in the City of Kigali, from zero to 70 HPs (Manirakiza et al., 2019). The results of this study were based on three district healthcare facilities, namely Masaka, Muhima, and Kibagabaga, and one referral hospital due to data availability and time constraints.

2.3. Data collection

This study was conducted on members of CHBI referred to district and referral health care. We used the list of people using CHBI referred to the district and referral health care in one year from July 2012 to June 2013. The data was collected from Muhima, Kibagabaga, and Masaka district hospitals. Interviews were conducted with members of households that use community-based health insurance (CBHI) from the three cells selected. We also interviewed an administrative professional who worked in the above three districts and one referral hospital. Each CHBI section at the district level has a list of CHBI members referred to district health care from all health centres in the district and a list of CHBI members referred to referral health care from the district health care. Based on the limitations of time and financial resources, we collected data from 300 households using CBHI, referring to district and referral health care from three selected cells within the city of Kigali. We also gathered information from personnel in charge of administration and human resources at the sampled district and from referral healthcare. We ended with a guided interview with the head of each CHBI office at the district level. The sample of three sectors, namely Muhima (Nyarugenge district), Kimironko (Gasabo

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district) and Masaka (Kicukiro district), was drawn from a list of 35 sectors available in three districts, where in each district we selected one sector. Finally, we chose one cell in each selected sector as per Figure 2. Random sampling was used to select 70 members of households referred to the district and 30 members of households referred to referral health care in each cell selected. The SPSS software was used to select our sample (a total of 100 members of households).

The interviewee was a person over the age of 18 years (considered an adult). To find the location of patients from households referred to district and referral health care, the committee of community health workers at the sector level and cell level were interviewed. As they know very well the location of all patients, the category of insurance they use and the type of health care they visit, Table 1 shows the total number of patients referred to the district and referral health care for each cell selected.

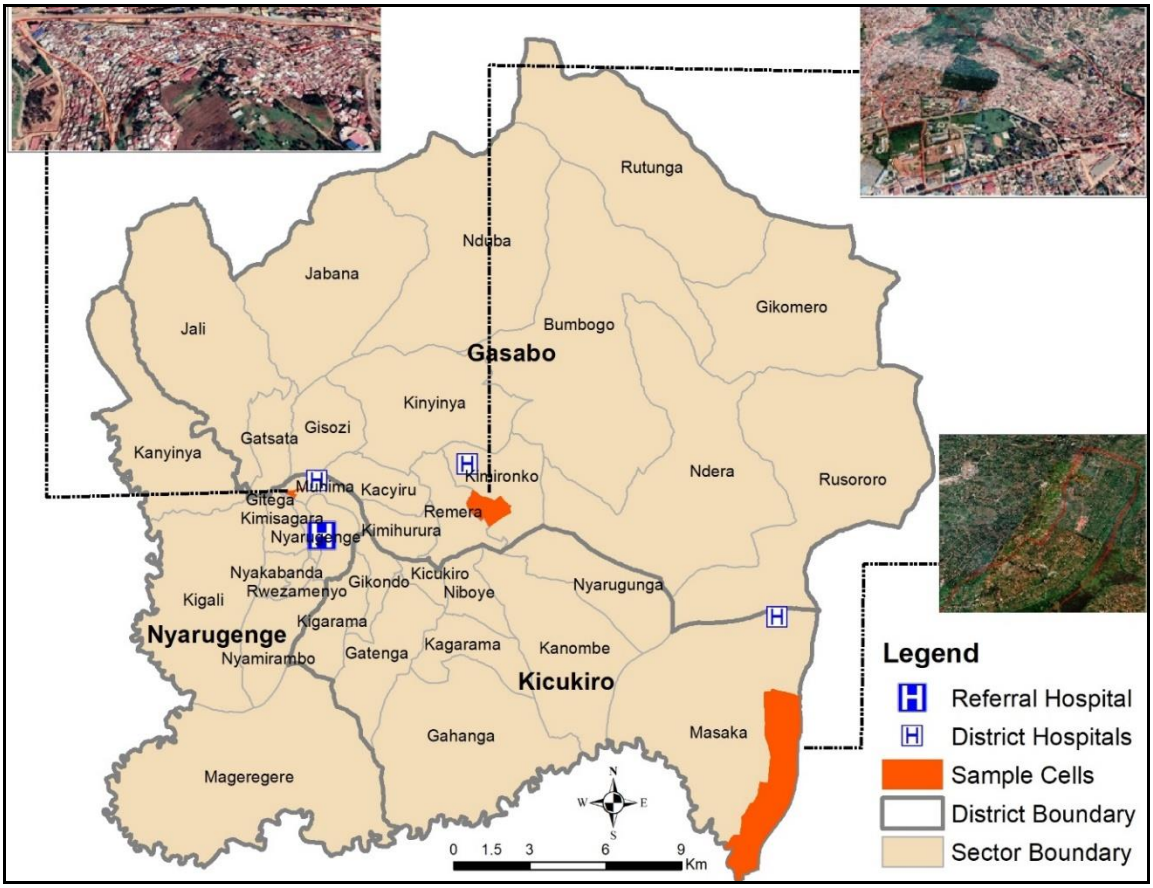

Figure 2: Localisation of sample cells in the city of Kigali

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Table 1: Sample patients referred to the district and referral healthcare using CBHI

District	District health care facility	Sector selected	Cell selected	Patients referred to DHC	Selected Patients	Patients referred to RHC	Selected patients
Nyarugenge	Muhima	Muhima	Tetero	3991	70	152	30
Gasabo	Kibagabaga	Kimironko	Nyagatovu	441	70	49	30
Kicukiro	Masaka	Masaka	Ayabaraya	215	70	44	30
Total				4647	210	245	90

As for the administration of the interview, the selection of one person in charge of administration and human resources from each district and referral health care facility was completed. The convenience sampling method was used to ensure the proper choice of personnel to be part of the interview. Moreover, to get more information on CBHI, a guided interview was conducted with three heads of CBHI offices at the district level. During semi-structured interviews, the questionnaire was the principal instrument used. Two categories of the questionnaire were designed. The first category comprised yes-or-no and multiple-choice closed questions, while the second category was open questions. To help understand the concept of access, the five dimensions of access were evaluated. There are a huge number of studies that examine different factors that hinder access to healthcare (Corscadden et al., 2018; Hierink et al., 2022; Ouma et al., 2021). The most frequently mentioned factors were the availability of medical personnel, the ease of obtaining health services, actual use rates, service use in relation to some standards of need, and consumer satisfaction level with services (Gusmano et al., 2014). In this study, availability, accessibility, and affordability, along with other socioeconomic characteristics of people like acceptability and adequacy, were used to measure access (Brabyn and Skelly, 2002; Christie and Fone, 2003; Tanser et al., 2006) viewed road network analysis as a more accurate method for assessing geographic accessibility in terms of travel distance. They emphasised that the evaluations of catchments and service areas are commonly used in accessibility analysis. The details of the five dimensions emphasised in this study are summarised in Table 2. To measure geographic accessibility, we used travel distance indicators of accessibility computed from Network Analysis in ArcGIS 10.8. Also, the patients' satisfaction about the mode of transport, travel time, travel distance from or to the district, and referral health care was captured. Figure 4 and Figure 5 show the variation in access to health services using the Network Analysis. The Rwandan norm stipulates that less than or equal to 10 km of travel distance is considered a well-served area, and more than 10 km is not well-served (Ministry of Health, 2017b). To evaluate the availability dimension, reports from the district health care facility and Ministry of Health were analysed. Then, from a structured interview, the staffs in charge of administration of each district and referral health care visited were asked regarding the number of patients' beds, their qualification, and the number of medical staff and drugs availability. The CHBI patients were asked about their satisfaction and perceptions of patients' beds, medical staff, and availability of drugs. Referring to medical human resources norms established by the Ministry of Health, the district health care facility needs 20 generalist doctors, 116 nurses, and 34 midwives (Ministry of Health, 2017b).

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Table 2: Access to healthcare and its indicators of reference

Dimensions	Short explanation	Indicators	Literature	Methods used
Geographic Accessibility	The patient's geographic location in relation to the location of the facilities.	-Travel distance -Mode of transport	(Higgs, 2004; Khakh et al., 2019; McGrail and Humphreys, 2014; Obrist et al., 2007; Penchansky and Thomas, 1981)	-Network analysis -Factor analysis -GIS based measure, -Descriptive statistics
Availability	The extent to which a system provides facilities (the structural form) and services (the process) that meet people's needs.	-Human resources (number of medical doctors, number of nurse) -Equipment (number of patients' bed) -Drugs availability	(Ibrahim, 2013; Obrist et al., 2007; Penchansky and Thomas, 1981)	Statistical analysis -Descriptive statistics
Affordability	The cost of services fits the clients' income and ability to pay.	- Services cost -CBHI category -Income	(Obrist et al., 2007; Penchansky and Thomas, 1981; Peters et al., 2008)	Statistical analysis, - Multiple linear regression -Descriptive statistics
Acceptability	Patients' views about health care services and interaction with service providers.	-Perceptions of patients -Information provision -Attitudes of medical staffs towards patients.	(Higgs, 2004; Khakh et al., 2019; Obrist et al., 2007; Penchansky and Thomas, 1981)	Statistical analysis -Multiple regression -Descriptive statistics
Accommodation	The level at which services are fixed to satisfy clients' expectations and needs.	-Waiting time - Opening hours - Cleanness	(Higgs, 2004; Khakh et al., 2019; Obrist et al., 2007; Penchansky and Thomas, 1981)	Statistical analysis -Multiple regression -Descriptive statistical

Several indicators were analysed using statistical methods and spatial analysis using ArcGIS 10.8 software. In statistical analysis, the results of descriptive analysis (mean, standard deviation, sum, percentages, frequencies, graphs, maximum, range, and minimum) were used to know and compare the satisfaction level of patients referred to the district and referral health care facility based on service cost, information provision, and the attitudes of medical personnel towards patients, waiting time, and cleanness indicators. The cross-tabulation table was also used to know the differences and relationships between the indicators. Access was also evaluated through proximity analysis using network analysis based on travel distance indicator. It was used to find the time and distance from the location of the population to the district and referral health care location. This helped to calculate the population served and not served.

2.4. Standardization of indicators used to evaluate access

Different indicators used in this study were evaluated in several units and scales (refer to Table 2). To normalise our indicators, they were standardised to see the variation in satisfaction level with each indicator under dimension. The transformation into a linear scale, which converts the original indicator scores to standardised scores, was used to easily compare all dimensions of

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access. Based on the types of indicators used in this study, maximum standardisation is considered, and the formula for this transformation method is used by Sharifi et al. (2004),

$$cost\ indicator = 1 - \frac{\text{score} - \text{lowest score}}{Highest\ score} \quad (1)$$

$$Benefit\ indicator = \frac{\text{score}}{Highest\ score} \quad (2)$$

We used maximum standardisation because the indicators are measured on a ratio scale and the standardised values are proportional to the original values. Based on the type of indicator, the cost or benefit, the score was 0 or 1. One (1) was considered a positive impact and zero (0) a negative impact. Later, to develop summary scores, the standardised use of all the indicators was carried out. These summary scores helped to gauge the level of realisation towards the targets. These scores were developed for all dimensions of access by combining more than one indicator into a single value. The summary scores help to aggregate a large number of indicators and make the data easier to understand. This was found to be very important for planners and policy makers because it showed very clearly which dimensions needed more attention than others. The selected indicators were standardised and given values between 0 and 1, which means that the higher the score, the better the access attainment. Using a spider chart, a comparison between the district and referral health care was made by using ranking measures (from poor to good or poor access). This ranking also shows clearly the dimension of access, which needs more attention and improvement than others.

2.5. Evaluation of overall dimensions of access

Perceived satisfaction levels of respondents across indicators were used to develop summary scores for all dimensions. While developing such summary scores for all dimensions, equal weights were applied to each indicator. A total of 12 indicators measured on a 5-point Likert scale were used as per Figure 3. Finally, after standardising all the indicators used, their scores were compared using a spider chart.

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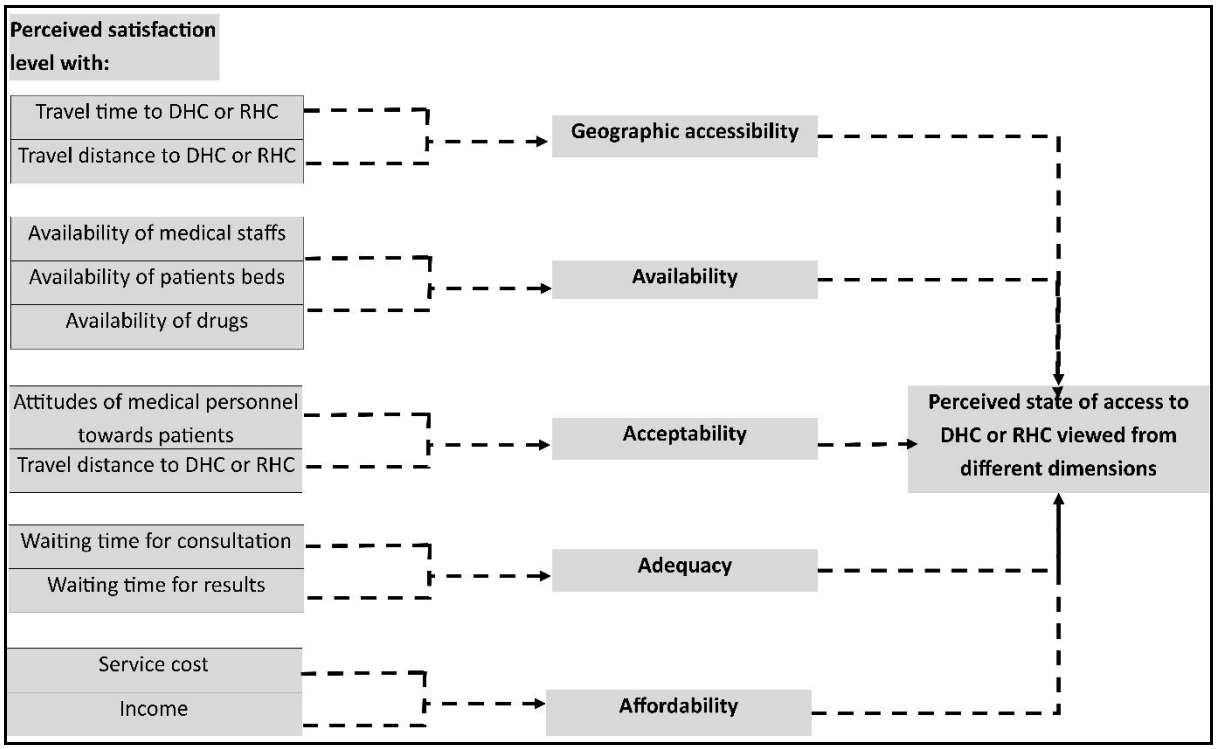

Figure 3: Summary scores for dimensions of access to DHC and RHC

3. Results and discussion

3.1. Measuring dimensions of access to district and referral healthcare

The maps in Figure 4 and Figure 5 show that the northern and eastern parts of Gasabo district, which are located in rural areas served by Kibagabaga district health care facility, are not well served while the urban area is well served. Surprisingly, the western and southern parts of Kicukiro district, the most urban area and a small part of the rural area served by Masaka secondary health care facility, are not well served, while the rural area is well served. The southern rural area part of Nyarugenge district served by Muhima district health care is not well served, while the urban part is well served. Considering referral health care, the North Eastern and South Eastern parts of Kigali city are not well served, while all urban areas are well served. Table 3 shows in detail the number of people well served and not well served. From Table 3, it is clear that Muhima secondary health care has the highest percentage of the population served (82%). This is due to its geographical location near the city center, dominated by urban informality and low-income people. In contrast, Masaka secondary health care has a low percentage (25%). This can be explained by its location, which is characterised by rural livelihood settings. In addition, the results show that all three public district and referral health care still serve a population that is bigger than the threshold (200.000 people) suggested by Rwandan norms (Ministry of Health, 2017a).

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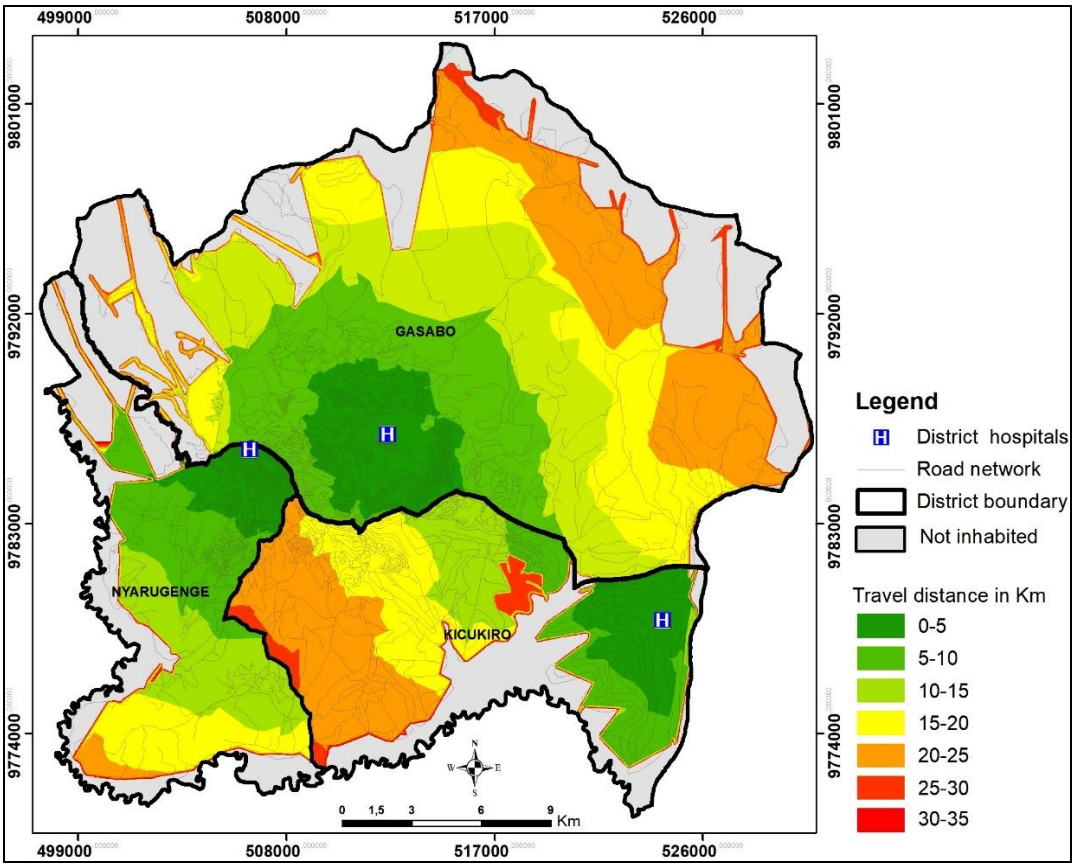

Figure 4: Network based on travel distance to the district hospitals

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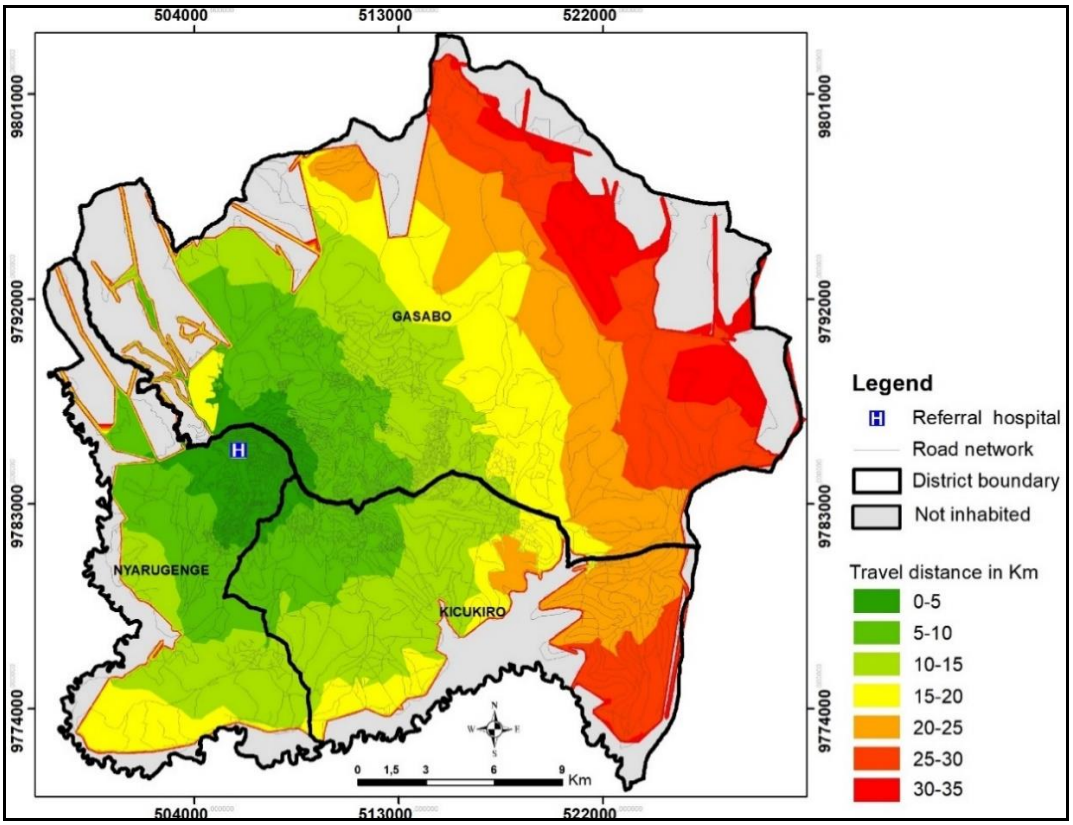

Figure 5: Network based on travel distance to the referral hospital

Table 3: Population distribution within different travel distance using network analysis

Name	Total population per district	Travel distance (Km)	% of population per breaks	Population served and not served	% of population served and not served
Muhima	284.860	0-5	67	234.366	82
		5-10	15		
		10-15	10	50.494	18
		15-20	5		
		20-25	3		
Kibagabaga	530.907	0-5	32	302.274	57
		5-10	25		
		10-15	14	228.633	43
		15-20	16		
		20-25	9		
		25-30	3		
Masaka	319.661	0-5	10	78.996	25
		5-10	15		
		10-15	14	240.665	75
		15-20	18		
		20-25	35		
		25-30	8		
CHUK	1.135.428	0-5	26	699.213	62
		5-10	36		
		10-15	13	436.215	38
		15-20	10		

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20-25	8
25-30	4
30-35	3

The results show low patient satisfaction regarding medical staff availability. This is caused by a larger number of patients visiting the district and referral health care than the medical staff. In contrast, the results show the high satisfaction of patients with bed availability. That is explained by the large number of beds available to help indoor patients at both health care facilities. Finally, the high satisfaction of patients with drug availability was revealed because of drug cost, which seems to be low (Saksena et al., 2011) link this to patients with CHBI who pay 10% of the total drug cost. However, staff declared limited access to special and expensive drugs, a lack of specialist medical staff, generalist doctors, and a lack of drugs and patient beds on community-based health insurers. That is explained by the low percentage of contributors and the expensive health services sometimes delivered. This has resulted in some patients referred to CHBI purchasing drugs from private pharmacies.

Table 4: Perceptions of patients on the availability of staff, drugs, and patients' beds in %

Indicators	Likert scale	Muhima	Kibagabaga	Masaka	Overall DHC	RHC
Availability of medical staffs	Very satisfied	17	19	20	19	16
	Satisfied	16	19	23	19	22
	Neutral	21	21	16	21	21
	Unsatisfied	30	24	21	24	23
	Very Unsatisfied	16	17	20	17	18
Availability of patients beds	Very satisfied	47	49	54	50	49
	Satisfied	29	18	10	19	9
	Neutral	10	9	13	11	4
	Unsatisfied	7	16	11	11	37
	Very Unsatisfied	7	8	12	9	1
Availability of drugs	Very satisfied	53	31	47	45	42
	Satisfied	20	19	27	21	21
	Neutral	10	16	19	15	18
	Unsatisfied	9	27	4	13	10
	Very Unsatisfied	8	7	3	6	9

From Table 4, the low satisfaction percentage of patients regarding the availability of medical staff, patients' beds, and drugs presents a big issue and affects the CHBI patients. This needs special attention and improvement from the government. Health service cost and income indicators were used to measure the dimension of affordability.

Table 5: Patients' perceptions of service costs from surveyed district and referral hospitals in %

Services cost	Muhima	Kibagabaga	Masaka	Overall DHC	RHC
Very satisfied	89	90	93	91	73
Satisfied	3	3	1	3	7
Neutral	2	3	1	2	7
Unsatisfied	3	1	3	2	3
Very Unsatisfied	3	3	2	2	10

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From Table 5, it can be seen that the high satisfaction increases from urban to rural areas and from referral to the district health care facilities. CBHI was used by all patients interviewed, and they paid 10% of the total service cost. A slight variation in the percentages of patients results in a higher cost of services at referral health care than at district health care. The high satisfaction with services and the cost decrease from DHC to RHC. That is explained by the high cost of treatment services, drugs, and hospitalisation services, which are higher in referral than district health care.

Table 6: Perceptions of patients on the acceptability dimension in %

Indicators	Likert scale	Muhima	Kibagabaga	Masaka	Overall DHC	RHC
Attitudes of medical personnel towards patients	Very satisfied	51	46	81	60	59
	Satisfied	31	33	14	26	29
	Neutral	12	10	3	8	8
	Unsatisfied	6	5	2	4	4
	Very Unsatisfied	0	6	0	2	0
Information provision	Very satisfied	49	44	70	54	55
	Satisfied	34	40	24	33	30
	Neutral	10	9	6	8	9
	Unsatisfied	1	3	0	3	2
	Very Unsatisfied	6	4	0	2	4

Consider the perceptions of patients about interpersonal relationships with medical staff. The acceptability indicator was measured. The patients referred were asked questions regarding their feelings about information provision and the attitudes of medical personnel towards patients. From Table 6, 85% of patients are satisfied with the provision of information and attitudes of medical personnel towards patients. That might be linked to the extensive Ministry of Health and the city of Kigali's regular staff training and monitoring.

Table 7: Patients' perceptions of accommodation dimensions in %

Indicators	Waiting time	Muhima	Kibagabaga	Masaka	Overall DHC	RHC
Waiting time for consultation	< 10 min	43	55	71	30	30
	10-30 min	29	31	14	35	60
	30min -1hour	4	6	6	14	10
	>1hour	23	7	9	20	0
	No answers	1	0	0	1	0
Waiting time for results	1Hour	69	14	30	65	80
	Half day	14	31	47	20	17
	Entire day	6	20	17	6	3
	>1 day	11	33	6	9	0
	No answers	0	2	0	0	0
Cleanness	Very clean	74	67	97	79	100
	Clean	20	24	2	15	0
	Neutral	4	6	1	4	0
	Dirty	2	1	0	1	0
	Very dirty	0	2	0	1	0

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In Table 7, accommodation dimension was evaluated by referring to the cleanliness, the waiting time for consultation and results. Waiting time for consultation and waiting time for results decreased from the district to referral health facilities. This was explained by the ease of getting an appointment to visit health facilities and the provision of medicine supply. Cleanness increased from the district to referral health care. This was due to the use of advanced health-care technologies in referral rather than district health-care settings. In addition, the low percentage of the district's health care in terms of cleanness might be explained by the insufficient cleanness budget and the lack of regular monitoring of health service delivery.

3.2. Evaluation of overall dimensions of access results

A general overview of the district's health care dimensions has revealed a low performance level of geographic accessibility (0.64) and a high performance of affordability (0.94) as per Figure 6.1. However, the performance levels of the district health care dimensions differ among the three district health care facilities.

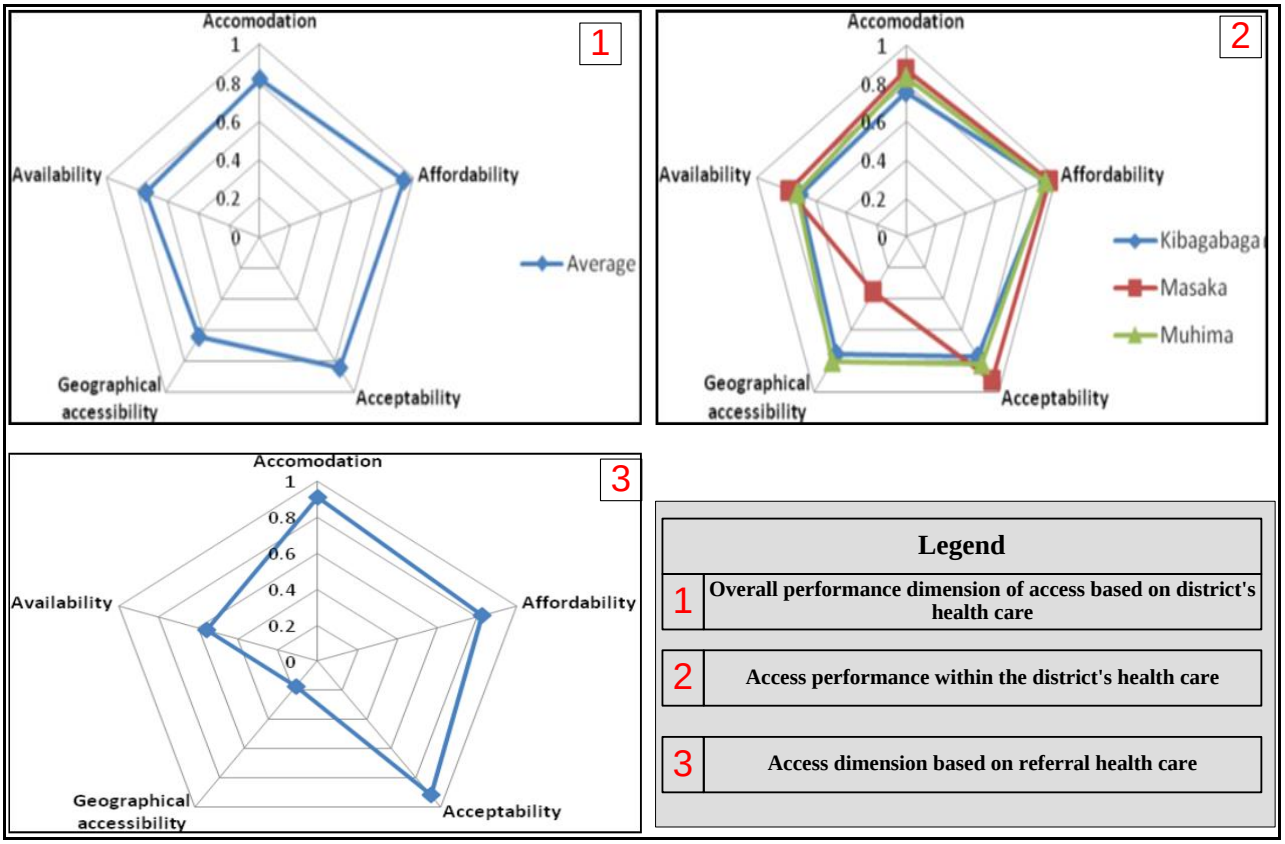

Figure 6: Overall performance and access performance at both district and referral healthcare

The geographical accessibility dimension and the availability dimension performed poorly for all district health care. Geographical accessibility has the lowest score (0.34) for Masaka district health care (Figure 6.2). The reason behind it can be related to its geographic location in a rural part of the city. An overview of the referral health care dimensions has revealed a low performance level of geographic accessibility (0.17) and a high-performance level of

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acceptability (0.92) refer to Figure 6.3. Affordability, acceptability, and accommodation scored higher values as compared to geographic accessibility and availability dimensions for tertiary health care. These scores should be explained by the availability of medical staff, availability of drugs and patients' beds, and travel distance for people living in rural areas.

4. Discussion

This study used multiple dimensions of access to health care services to assess spatial disparities in situations where the database is limited. The used dimensions include geographic accessibility, availability, affordability, acceptability, and accommodation. Based on the indices developed, the analyses in this paper have identified areas of relatively lower and higher access to health care services, and also areas of smaller or larger urban-rural disparity. For instance, the northern and eastern parts of Gasabo District, which are located in rural areas served by Kibagabaga District Hospital, are not well served while the urban area is well served. Surprisingly, the western and southern parts of Kicukiro district, the most urban area and a small part of the rural area served by Masaka secondary health care facility, are not well served, while the rural area is well served.

This study also revealed that the geographic accessibility (travelling time and distance to nearest district/referral hospitals) does not encompass all aspects associated to health care access. The availability of medical staffs and patient beds or the supply of care provided by the health facility, availability of drugs, should also be taken into account. This has a planning implication on improving existing health services, organizing and engaging stakeholders that offer these services, providing skilled personnel, products and services corresponding with the needs of poor people, and sufficient supplies that cover the existing demand (Obrist et al., 2007). Since the extent to which a population access the health care also depends on financial, organisational and social or cultural barriers that may limit the utilisation of health services, other relevant dimensions for measuring access to health care services embrace the cost of drugs and health services delivered, attitude of medical staffs towards the patients, cleanliness and waiting time for consultation and results. Combining these dimensions can allow to better understand the causes of poor or good performance of a health system in different settings (Verma and Dash, 2020). Additionally, this combination enables to identify factors that prevent the achievement of a desirable level of effective coverage of the population with essential health services in Rwanda (Huerta Munoz and Källestål, 2012).

This study provides a more comprehensive and realistic analysis method that takes into consideration multidimensions of access to health care rather than only one aspect which is sorely based on availability or accessibility coverage. The present research may contribute to a deeper understanding of the performance of the health system and identification of potential gaps. Thus, the results from study are salient for decision-making in improving health planning and evidence-based policy development. Considering the policies of the government to increase the general level and quality of service for all and eliminate urban/rural disparities in access to health services; and given that the government has financial constraints in pursuing the above goals, there is a definite imperative for targeting and prioritizing the spatial allocation of the limited resources in the areas of the most needs which are unserved and with low performance in terms of access to health care facilities and services.

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We wanted to generate a composite map that included all indicators as well as geographic accessibility. The socio-economic factors employed to create a composite map cannot, however, be spatialized due to the nature of the study. Empirical Bayesian kriging, random forests, and neural network interpolation models are a few interpolation machine learning techniques that may be utilized, however as we just noted, these techniques perform best when all the input variables are spatial. Given the great prediction of the model, further research might test these techniques using either a geographically weighted random forest or a geographically weighted neural network.

5. Conclusion

This study focused on public health care services and tends to help understand the variation of access to health care facilities within the City of Kigali. While evaluating the district and referral health service variations, the results revealed a significant variation in the dimensions of access. By measuring relevant indicators under each dimension of access, it was realized that the perceived importance of different factors or dimensions of access was related to the socioeconomic characteristics of an individual to a large extent. This dimension was found not to be a problematic issue in this study as a result of the high priority given to the implementation of existing health policies related to geographical accessibility and the availability of public health care facilities. A low percentage of respondents stated the physical distance to the DHC and RHC to be far. This could not be linked directly with the absence of health facilities within the city administrative boundary, but rather was due to the user's personal preference to visit facilities in the city of Kigali. Affordability in general was perceived as a less problematic issue in the study area. This is the result of the free or nominal cost of primary health care services, including medicine supply, in public facilities. However, a low percentage of total respondents were discontent with the total cost of the district and referral health care. This could be linked to the low affordability of health care services among low socioeconomic class respondents. Also, it can be assumed that people tend to emphasize negative issues when asked about their satisfaction with the present situation of access to the DHC or RHC. The results of this study can help the government in deciding where new health infrastructure can be developed to meet the needs of the population in newly developed areas and to improve health infrastructure service in the city of Kigali. Also, health planners and policy makers will require the developed method, particularly in the developing world where spatial contexts are highly dynamic as a result of rapid urbanisation. Future research should include other types of health care, such as private health care or traditional health care, to assess and improve multiple aspects of access to the health care system and its users in the city of Kigali. The research considered one type of public health insurance, which is community-based health insurance. In the future, other research should include other public insurance like Rwanda Social Security Board, Military Medical Insurance, and private insurance to see the access variation within different types of insurance.

Declaration of conflicting interests

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