Determining health-care facility catchment areas in Uganda using data on malaria-related visits

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Objective To illustrate the use of a new method for defining the catchment areas of health-care facilities based on their utilization.
Methods The catchment areas of six health-care facilities in Uganda were determined using the cumulative case ratio: the ratio of the observed to expected utilization of a facility for a particular condition by patients from small administrative areas. The cumulative case ratio for malaria-related visits to these facilities was determined using data from the Uganda Malaria Surveillance Project. Catchment areas were also derived using various straight line and road network distances from the facility. Subsequently, the 1-year cumulative malaria case rate was calculated for each catchment area, as determined using the three methods.
Findings The 1-year cumulative malaria case rate varied considerably with the method used to define the catchment areas. With the cumulative case ratio approach, the catchment area could include noncontiguous areas. With the distance approaches, the denominator increased substantially with distance, whereas the numerator increased only slightly. The largest cumulative case rate per 1000 population was for the Kamwezi facility: 234.9 (95% confidence interval, CI: 226.2–243.8) for a straight-line distance of 5 km, 193.1 (95% CI: 186.8–199.6) for the cumulative case ratio approach and 156.1 (95% CI: 150.9–161.4) for a road network distance of 5 km.
Conclusion Use of the cumulative case ratio for malaria-related visits to determine health-care facility catchment areas was feasible. Moreover, this approach took into account patients' actual addresses, whereas using distance from the facility did not.

Abstracts in عربي, 中文, Français, Русский and Español at the end of each article.

Introduction

Knowledge of a health-care facility's catchment area is important for assessing health service utilization, for calculating population-based rates of disease and for performing other important analyses. Different approaches to defining catchment areas have been developed, mostly in the field of health service research.[1–5] One simple way of establishing the boundaries of a catchment area is to use distance from the facility – either the straight-line distance, the distance patients have to travel or the distance travelled by patients in a given time.[6,7] Under this approach it is assumed that people will visit the closest facility, which implies that distance is the overriding factor influencing attendance. However, distance is only one of many factors that influence the choice of health-care facility; others are the services available and the perceived quality of care.[4,6]

Another approach, termed the patient-flow method, is based on the proportion of patients visiting or admitted to a health-care facility who come from a particular administrative area, such as a census tract or a postal code area: if the proportion exceeds a set minimum, that administrative area is included in the facility's catchment area.[5,8] With this approach, the catchment area is not limited by the distance between a patient's residence and the facility. However, an arbitrary threshold is usually imposed on the minimum proportion of patients who must come from a particular area for it to be included in the catchment area. For example, postal code areas that account for less than 1% of admissions to a facility may be excluded from the catchment area.[9] Consequently, some individuals who live in an area not considered part of a facility's catchment area may regularly attend the facility. The likelihood that these minority "users" would be regarded as living outside the catchment area increases with the size of the administrative area. Another limitation is that an area may be excluded from the catchment area even though a large proportion of its population, or even the entire population, uses the facility because the proportion of patients attending the facility from that area does not exceed the minimum.[3] In this case, the chance of exclusion increases as the area's population decreases.

Here we propose a new method for defining the catchment area of a health-care facility that builds and improves on the patient flow approach: the catchment area is defined using a statistical measure – the cumulative case ratio, which is the ratio of the observed to the expected utilization of the health-care facility for a particular condition by patients in an administrative area. We illustrate our method by using data on the utilization of malaria-related services to define the catchment areas of six health-care facilities in Uganda. Then, for each facility, we compare the cumulative rate of confirmed malaria cases in the catchment area derived using this approach with the rate in areas derived using the straight line or road network distance from the facility.

Methods

In this analysis we used data on outpatients attending health-care facilities for suspected malaria collected by the Uganda

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Malaria Surveillance Project, in which a sentinel-site approach to monitoring the malaria burden in the country was adopted. The surveillance programme was implemented in a staggered fashion: it started in July 2006 and the final site opened in August 2008. We selected six sites to represent the diversity of malaria epidemiology in Uganda. They were all government, level-IV health centres that provided care free of charge, including diagnostic testing and medications, as has been described previously,[10] and all had the laboratory equipment and trained staff needed for malaria diagnosis, case management and data collection. The data collected for each patient presenting to outpatient clinics included the patients' demographic characteristics and parish of residence, the results of malaria diagnostic tests, the diagnosis and the treatments prescribed. The parish is the second smallest administrative unit in Uganda and each parish contains 5000 to 6000 inhabitants. A standardized case report form was used and data were entered electronically at each site by a data officer, who was supported by the Uganda Malaria Surveillance Project.

We determined which parishes should be included in the catchment area of each facility using three different parameters: the straight-line distance from the facility, the road network distance from the facility and the cumulative case ratio for malaria-related visits. To derive catchment areas based on straight-line distance, we used distances of 5, 10, 20 and 30 km. These distances were selected because the 2009 Uganda Malaria Indicator Survey[11] found that 96% of respondents lived within 9 km of a health-care facility and because the 2009 Uganda National Household Survey[12] reported that the average distance of a household from a government hospital was 20 km. The catchment area included all parishes that fell within circles centred on the facility with radii of 5, 10, 20 and 30 km, respectively. To derive catchment areas based on the road network distance, we used road distances of 5, 10, 20 and 30 km along the road networks surrounding each facility. The catchment area included all parishes located within a road distance of 5, 10, 20 or 30 km, respectively, from the facility. In addition, parishes were included if they were located less than 2 km from the nearest road. A parish that did not lie entirely within the distance circle or within the road network distance was included in the catchment area only if over 50% of its surface area lay within the relevant limit. Otherwise, it was excluded.

The cumulative case ratio was defined as the ratio of the observed to the expected number of malaria-related visits to a facility from a parish. Malaria-related visits included all visits between 1 January 2010 and 31 December 2012 by patients who had suspected or confirmed malaria or who tested negative for the disease. We used malaria-related visits because we wanted to include all users of malaria-related services, not only confirmed cases. The expected number of malaria-related visits to a facility from a particular parish was calculated by multiplying the parish's population by the cumulative case rate for that facility. A parish was included in the catchment area if the upper limit of the 95% confidence interval for the cumulative case ratio for that parish was 1 or greater because a ratio less than 1 indicated that the parish contributed significantly fewer malaria-related visits than expected for its population.

Catchment areas were derived for each of the six sentinel sites using the three parameters and the cumulative case rate for each catchment area, however derived, over a 1-year period was calculated. The numerator was the total number of malaria cases confirmed between 1 January 2010 and 31 December 2012 from all parishes included in the catchment area. The denominator was the total population of all parishes included in the catchment area, which was derived using population estimates from the 2002 Uganda Population and Housing Census. During this period, an average of 98% of all patients with malaria symptoms were tested for malaria: the proportion ranged from 97% to 100% over the six sites.

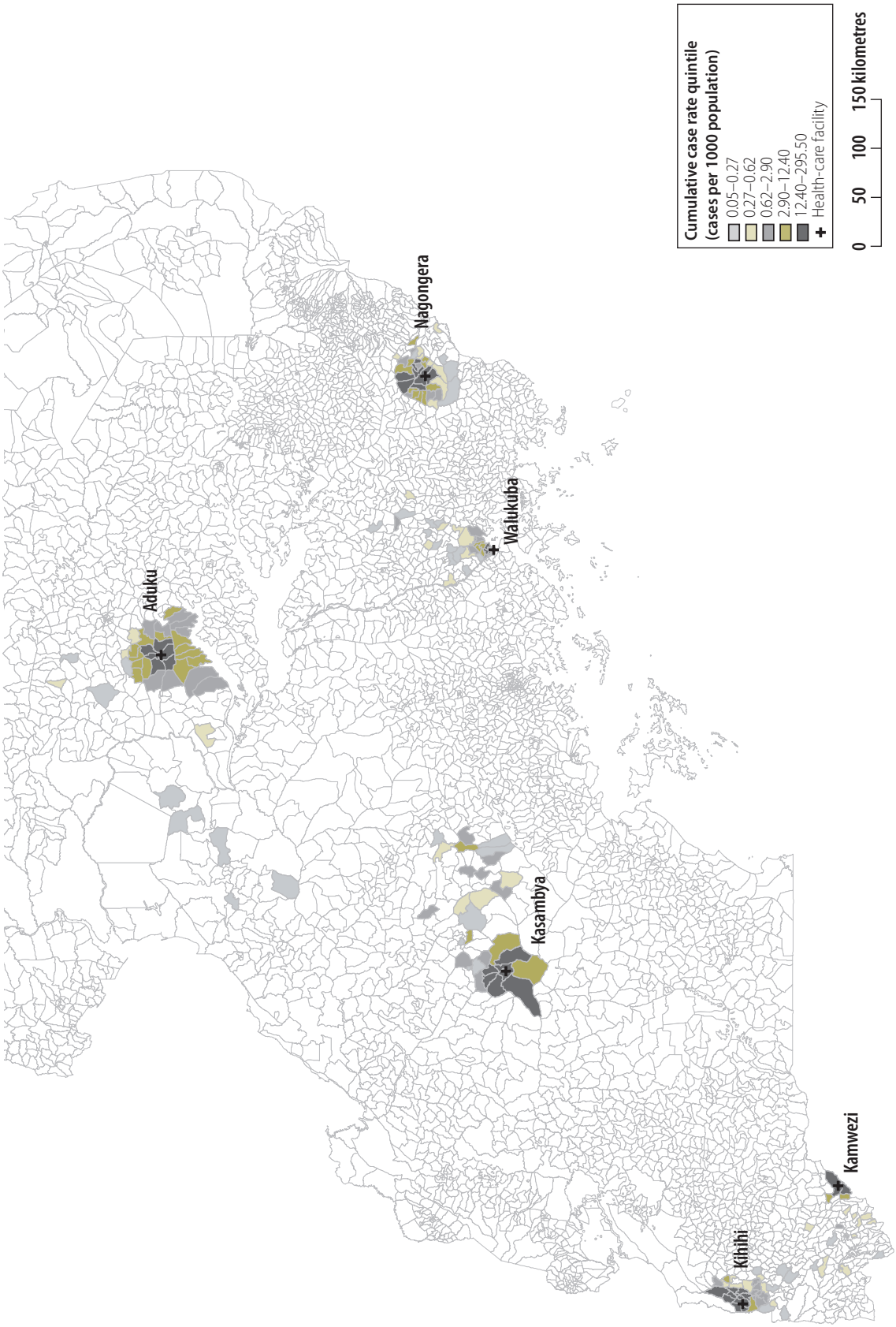
Catchment areas were plotted on mapping files obtained from the Uganda Bureau of Statistics and the geographical coordinates of all parishes were recorded using zone 35 north of the Universal Transverse Mercator coordinate system. All analyses were performed using R software v2.14.0 and ArcGIS 10 (esri, Redlands, USA).

Results

Fig. 1 displays the cumulative case rate per 1000 population in each parish for all malaria cases confirmed during 2012 at one of the six Uganda Malaria Surveillance Project health-care facilities. The figure also shows the locations of the six facilities and the variation in disease burden and geographical spread. No catchment area definition was applied. It can be seen from the figure that the parishes with the highest cumulative case rates either contained a facility or was adjacent to one. Over 40% of parishes had a cumulative case rate of 1 per 1000 or less in 2012. Fig. 2 shows the catchment area of the Nagongera health-care facility, as determined using the three parameters: straight-line distance, road network distance and cumulative case ratio for malaria-related visits. The largest geographical area was obtained using a straight-line distance of 30 km, whereas the smallest was obtained using the cumulative case ratio. In addition, use of the cumulative case ratio led to the inclusion of noncontiguous parishes. Figures illustrating the corresponding catchment areas for the other five health-care facilities are shown in Appendix A (available at: http://surveillance.mcgill.ca/users/kzinszer/WHObulletin/index.php).

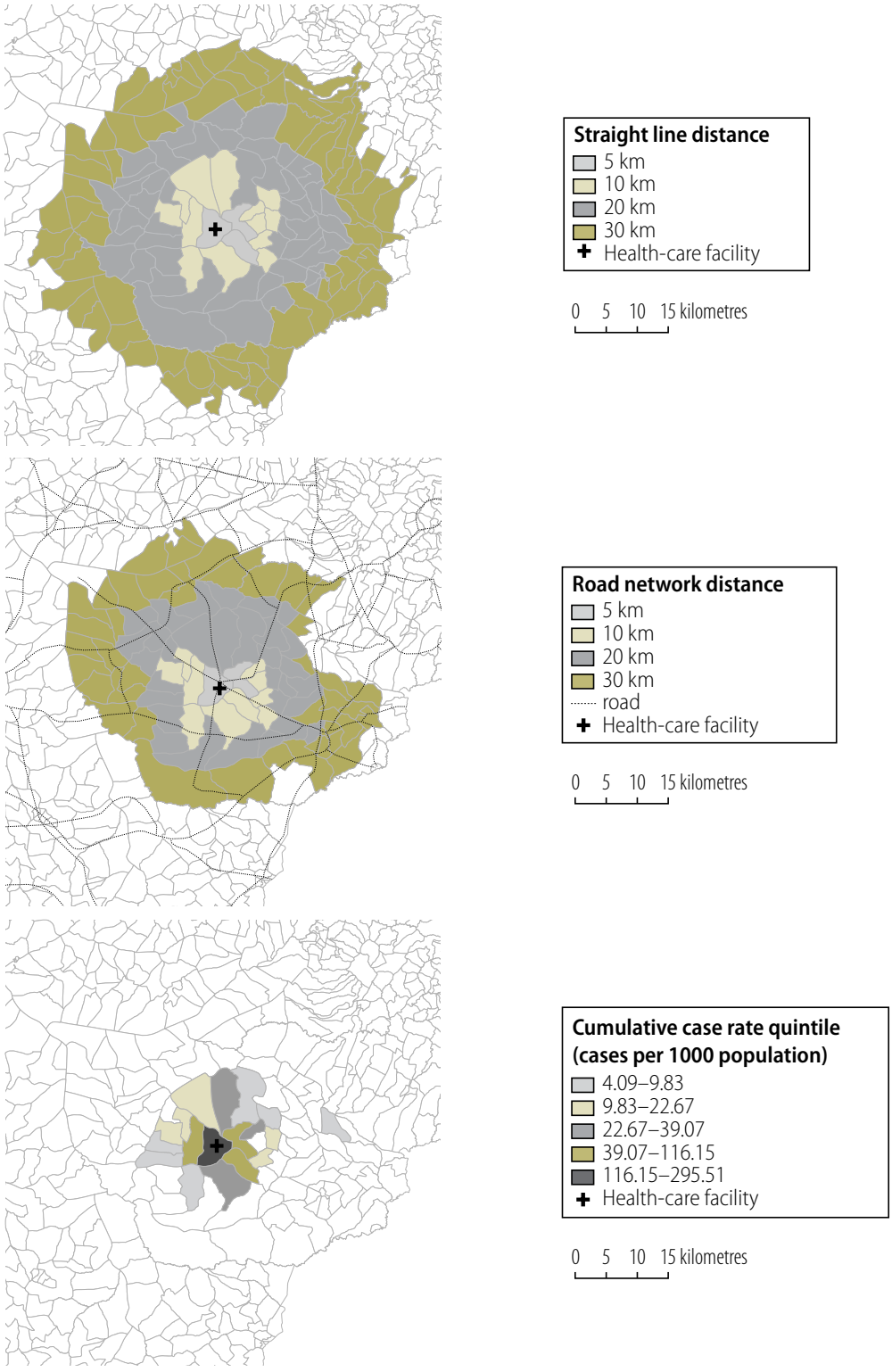
As shown in Table 1, the cumulative rate of confirmed malaria cases varied considerably for most sites according to the way in which the catchment area was defined. In particular, the rate decreased with increasing distance from the facility for both straight line and road network distances and, generally, was highest when the catchment area was defined using a distance of 5 km. The largest rates were observed for the catchment area of the Kamwezi health-care facility: 234.9 per 1000 when defined using a straight-line distance of 5 km, 193.1 per 1000 when defined using the cumulative case ratio and 156.1 per 1000 when defined using a road network distance of 5 km. Although the denominator in the cumulative case rate calculation became much larger as distance increased, there was no corresponding increase

Fig. 1. **Cumulative rate of confirmed malaria cases in parishes containing patients who attended six health-care facilities, Uganda, 2012**



Source of shapefile: Uganda Bureau of Statistics, Kampala, Uganda.

Fig. 2. **The Nagongera health-care facility's catchment area as determined using the three parameters: straight-line distance,[a] road network distance[b] and cumulative case ratio for malaria-related visits,[c] Uganda, 2012**



[a] Catchment areas were defined as lying within a straight-line distance from the facility of 5, 10, 20 and 30 km, respectively.
[b] Catchment areas were defined as lying within a road network distance from the facility of 5, 10, 20 and 30 km, respectively.
[c] A parish was included in the catchment area if the upper limit of the 95% confidence interval for the cumulative case ratio for the parish (i.e. the ratio of observed to expected malaria-related visits from the parish) was 1 or greater.
Source of shapefile: Uganda Bureau of Statistics, Kampala, Uganda.

Table 1. **Cumulative rate of confirmed malaria cases at six health-care facilities in Uganda,[a] by catchment area definition, 2012**

Catchment area definition	Cumulative rate of confirmed malaria cases, CCR (95% CI)[b]					
	Aduku facility	**Kamwezi facility**	**Kasambya facility**	**Kihihi facility**	**Nagongera facility**	**Walukuba facility**
Straight-line distance,[c] km						
5	89.2 (82.0–97.0)	234.9 (226.2–243.8)	218.3 (211.6–225.1)	121.9 (117.5–126.4)	119.9 (115.7–124.3)	20.3 (19.6–20.1)
10	45.9 (43.7–48.2)	71.8 (69.3–74.3)	116.2 (112.9–119.6)	59.2 (57.3–61.1)	43.4 (42.1–44.7)	14.8 (14.3–15.3)
20	13.3 (12.8–14.0)	22.0 (21.2–22.8)	39.5 (38.4–40.7)	21.3 (20.7–22.0)	12.1 (11.7–12.4)	8.2 (7.9–8.5)
30	7.2 (6.8–7.5)	8.2 (7.9–8.5)	21.8 (21.2–22.5)	11.0 (10.7–11.4)	6.1 (5.6–6.7)	4.8 (4.6–5.0)
Road network distance,[d] km						
5	0 (NA)	156.1 (150.9–161.4)	218.3 (211.6–225.1)	128.9 (124.3–133.6)	143.3 (137.8–148.9)	5.5 (5.1–6.1)
10	48.5 (46.0–51.1)	130.0 (125.6–134.5)	218.3 (211.6–225.1)	81.1 (78.6–83.8)	49.3 (47.8–50.9)	22.9 (22.2–23.7)
20	17.6 (16.8–18.5)	45.8 (44.2–47.4)	49.0 (47.7–50.5)	41.6 (40.3–43.0)	17.2 (16.7–17.7)	11.9 (11.5–12.3)
30	11.7 (11.2–12.2)	32.0 (30.9–33.2)	33.0 (32.0–33.9)	22.8 (22.1–23.5)	9.0 (8.7–9.2)	7.5 (7.3–7.8)
Cumulative case ratio[e]	38.1 (36.3–40.0)	193.1 (186.8–199.6)	67.2 (65.3–69.1)	87.6 (84.0–90.3)	38.4 (37.3–39.6)	43.3 (41.9–44.7)

CCR, cumulative case rate; CI, confidence interval; NA, not applicable.

[a] Data on the health-care facilities were collected by the Uganda Malaria Surveillance Project.

[b] Per 1000 population.

[c] Catchment areas were defined as lying within a specified straight-line distance from the facility.

[d] Catchment areas were defined as lying within a specified road network distance from the facility.

[e] A parish was included in the catchment area if the upper limit of the 95% CI for the cumulative case ratio for the parish (i.e. the ratio of observed to expected malaria-related visits from the parish) was 1 or greater.

in the numerator. Hence, generally, the cumulative case rate decreased as the size of the catchment area increased. Table 2 shows the number of parishes included in each catchment area. When catchment areas were defined using a straight-line distance of 30 km, they included an average of 105 parishes; in contrast, when defined using the cumulative case ratio, they included an average of 10 parishes. The catchment area of the Aduku health-care facility did not contain any parishes when defined using a road network distance of 5 km (i.e. less than 50% of each parish's area lay within the defined distance).

Discussion

The differences observed between different estimates of the cumulative rate of confirmed malaria cases in catchment areas generally occurred because the numerator and denominator in the case rate calculation increased differentially with the distance used to define the catchment area. For example, the catchment area and its population were largest when a straight-line distance of 30 km was used; consequently, the denominator was also large. When a straight-line distance of 5 km was used, the numerator was only slightly smaller but the denominator was much smaller. Clearly the distance between a patient's residence and the health-care facility was important but doubling the distance did not double the number of cases. Defining a catchment area according to distance from the facility has the advantage of simplicity but this approach does not take into account where patients actually live. Moreover, although distance is important, it is not the only factor influencing a patient's choice. Use of the cumulative case ratio is not affected by distance since it uses patients' actual addresses. As Fig. 2 demonstrates, this can result in catchment areas made up of noncontiguous parishes.

The main limitation of our approach follows from the assumption that the reason the number of malaria-related visits from a particular parish was lower than expected was primarily because utilization of the health-care facility by the parish's population was low. However, lower than expected utilization could have been due to a low incidence of symptoms characteristic of malaria in the parish. If the purpose of defining a catchment area is to estimate

Table 2. **Parishes, population and malaria cases in health-care facility catchment areas, by catchment area definition, Uganda, 2012**

Catchment area definition	Health-care facility catchment area																	
	Aduku			Kamwezi			Kasambya			Kihihi			Nagongera			Walukuba		
	No. of parishes	Catchment population	No. of confirmed malaria cases	No. of parishes	Catchment population	No. of confirmed malaria cases	No. of parishes	Catchment population	No. of confirmed malaria cases	No. of parishes	Catchment population	No. of confirmed malaria cases	No. of parishes	Catchment population	No. of confirmed malaria cases	No. of parishes	Catchment population	No. of confirmed malaria cases
Straight-line distance,[a] km																		
5	1	5 684	507	2	9 089	2135	2	14 486	3162	6	20 966	2555	3	22 026	2642	21	172 600	3502
10	6	32 598	1496	12	40 508	2907	5	35 092	4078	16	59 528	3522	16	93 007	4037	28	244 546	3628
20	27	139 962	1868	41	132 247	2907	18	113 946	4505	46	180 423	3845	66	358 412	4324	61	445 316	3653
30	72	266 648	1907	99	356 499	2907	44	206 739	4517	95	350 006	3855	139	711 399	4326	179	775 551	3718
Road network distance,[b] km																		
5	0	0	0	4	18 568	2898	2	14 486	3162	6	20 270	2613	2	15 720	2252	11	86 513	480
10	5	27 888	1353	6	22 034	2864	2	14 486	3162	11	42 701	3465	13	75 639	3732	19	156 834	3595
20	19	102 761	1811	18	63 488	2907	13	91 252	4475	22	85 097	3541	46	247 685	4263	39	307 017	3648
30	38	158 889	1856	26	90 743	2907	24	136 991	4516	43	167 690	3826	88	477 334	4273	102	486 053	3655
Cumulative case ratio[c]	8	40 848	1557	3	14 787	2855	9	66 794	4487	11	42 923	3758	18	110 422	4242	8	79 643	3449

[a] Catchment areas were defined as lying within a specified straight-line distance from the facility.
[b] Catchment areas were defined as lying within a specified road network distance from the facility.
[c] A parish was included in the catchment area if the upper limit of the 95% confidence interval for the cumulative case ratio for the parish (i.e. the ratio of observed to expected malaria-related visits from the parish) was one or greater.

a facility's utilization rate, this assumption may not be of concern since areas of low utilization are excluded. However, if the purpose is to obtain a population-based estimate of disease burden, the assumption may introduce an error and additional data on the background level of the disease in question would be required to assess the potential level of that error. There are also limitations inherent in using health-care utilization data to calculate population-based estimates of disease burden. Although attendance at a health-care facility is influenced by several factors associated with the individual patient, it is also affected by the characteristics of the facility, such as its capacity, which will limit the number of cases that can be seen. In addition, we had no information on "competing" facilities, whose presence may have influenced attendance at the six facilities we studied. Consequently, we may have underestimated the true cumulative case rate of malaria in the catchment areas since our analysis included only cases at Uganda Malaria Surveillance Project facilities.

Accurate identification of a facility's catchment area is important for: understanding the population served; for planning and evaluating service delivery, including the accessibility of services; and for deriving population-based health indicators, such as disease burden. Conversely, an erroneous view of the catchment area can lead to inefficient and inadequate services, misspecification of the catchment population and potentially flawed decision-making on other facilities, such as deciding where to locate a new facility. Despite its limitations, the cumulative case ratio approach is more likely to produce an accurate estimate of the true catchment area than an approach using the straight line or road network distance because it is based on where patients actually live. In contrast, the distance approaches can lead to the inclusion of parishes where there are no cases of malaria.

The first consideration in using the cumulative case ratio approach to estimate a facility's catchment area is to choose the basic administrative unit. It is best to use the smallest unit possible. The geographical location of patients must be recorded at the facility level and population data with the same geographical resolution must be obtained. Another consideration is the time period during which the catchment

area is defined since catchment areas are affected by factors that vary over time, such as changes in the capacity of or the services provided by the facility or the opening or closing of other health-care facilities nearby. After exploring this issue, our findings (not reported) suggest that data from the most recent 2 or 3 years are sufficient for establishing current catchment areas. The use of a longer period would provide an insight into the stability of the catchment area over time. Catchment areas should be reassessed periodically. A final consideration is whether the catchment area should be based on all admissions to the facility or on the utilization of a particular service.

Our analysis demonstrates how population-based measures of disease burden, such as the malaria case rate, are dependent on the method used to define the catchment areas of health-care facilities. The cumulative case ratio approach to defining catchment areas we propose identified administrative units in which the utilization of a health-care facility was substantially lower than expected, thus enabling those units to be excluded from the facility's catchment area. Our approach is simple and reproducible and is based on using a statistical measure to decide which administrative units should be included in catchment areas. ■

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ملخص

تحديد مناطق مستجمعات مرافق الرعاية الصحية في أوغندا باستخدام البيانات الخاصة بالزيارات ذات الصلة بالملاريا

الغرض إيضاح استخدام طريقة جديدة لتحديد مناطق مستجمعات مرافق الرعاية الصحية بالاستناد إلى استخدامها.

الطريقة تم تحديد مناطق مستجمعات لست مرافق رعاية صحية في أوغندا باستخدام نسبة الحالات التراكمية: نسبة الاستخدام الملاحظ إلى المتوقع لأحد المرافق من أجل حالة معينة بواسطة المرضى من مناطق إدارية صغيرة. وتم تحديد نسبة الحالات التراكمية للزيارات ذات الصلة بالملاريا إلى هذه المرافق باستخدام البيانات المستمدة من مشروع ترصد الملاريا في أوغندا. وتم كذلك اشتقاق مناطق المستجمعات باستخدام العديد من المسافات المستقيمة وشبكة الطرق من المرفق. وفيما بعد، تم حساب نسبة الحالات التراكمية للملاريا لمدة عام لكل منطقة مستجمع، وفق ما تم تحديده باستخدام الطرق الثلاث.

النتائج اختلفت نسبة الحالات التراكمية للملاريا لمدة عام على نحو كبير باختلاف الطريقة المستخدمة لتحديد مناطق المستجمعات. وباستخدام نهج نسبة الحالات التراكمية، من الممكن أن تتضمن منطقة المستجمع مناطق غير متاخمة. وباستخدام نهج المسافة، ازداد القاسم المشترك بشكل كبير مع المسافة، في حين زاد البسط على نحو طفيف فقط. وكانت أكبر نسبة حالات تراكمية لكل 1000 نسمة في مرفق كامويزي: 234.9 (فاصل الثقة 95 ٪، فاصل الثقة: من 226.2 إلى 243.8) لمسافة مستقيمة قدرها 5 كيلو مترات و193.1 (فاصل الثقة 95 ٪، فاصل الثقة: من 186.8 إلى 199.6) بالنسبة لنهج نسبة الحالات التراكمية و156.1 (فاصل الثقة 95 ٪، فاصل الثقة: من 150.9 إلى 161.4) بالنسبة لمسافة شبكة طرق حجمها 5 كيلو مترات.

الاستنتاج كان استخدام نسبة الحالات التراكمية للزيارات ذات الصلة بالملاريا لتحديد مناطق مستجمعات مرافق الرعاية الصحية مجدياً. وعلاوة على ذلك، وضع هذا النهج في الحسبان العناوين الفعلية للمرضى، في حين لم يراع استخدام بعد المسافة عن المرفق هذا الأمر.

摘要

使用与疟疾相关的就诊数据确定乌干达医疗设施挂钩区

目的 阐述使用新方法根据其使用情况定义医疗设施的挂钩区。

方法 使用累计病例比率（来自较小行政区的病人为特定病情对设施使用的观测值与预期值之比）确定乌干达六个医疗设施的挂钩区。使用乌干达疟疾监测项目的数据确定这些设施疟疾相关就诊的累计病例比率。还使用设施的各种直线和路网距离来推导挂钩区。随后对使用三种方法确定的每个挂钩区计算一年累计疟疾病例率。

结果 定义挂钩区的方法不同，得到的一年累计疟疾病例率差别很大。使用累计病例率方法，挂钩区可能包含非邻接区。使用距离方法，分母随距离显著增加，而分子仅略有增加。喀维茨（Kamwezi）设施的每千人口累计病例率最大：五公里直线距离估算为 234.9（95% 置信区间，CI：226.2-243.8），累计病例率方法估算为 193.1（95% CI：186.8-199.6），五公里路网距离估算为 156.1（95% CI：150.9-161.4）。

结论 使用疟疾相关就诊的累计病例比率确定医疗设施的挂钩区是可行的。此外，这种方法考虑了病人的实际地址，而使用设施距离的方法则没有。

Résumé

Détermination des zones desservies par les établissements de soins de santé en Ouganda en utilisant les données relatives aux consultations liées au paludisme

Objectif Illustrer l'utilisation d'une nouvelle méthode de définition des zones desservies par les établissements de soins de santé en fonction de leur utilisation par les patients.

Méthodes Les zones desservies par 6 établissements de soins de santé en Ouganda ont été déterminées en utilisant le rapport cumulatif des cas: c'est-à-dire le rapport des utilisations observées sur les utilisations attendues d'un établissement par les patients provenant de petites zones administratives et consultant pour une maladie particulière. Le rapport cumulatif de cas pour les consultations liées au paludisme a été déterminé à l'aide des données du Projet de Surveillance du Paludisme en Ouganda. Les zones desservies ont également été obtenues en utilisant différentes distances en ligne droite et différentes distances de réseau routier à partir de l'établissement. Ensuite, le taux cumulatif des cas de paludisme a été calculé pour chaque zone desservie, telle que déterminée à l'aide des trois méthodes.

Résultats Le taux cumulatif des cas de paludisme de la première année variait considérablement en fonction de la méthode utilisée pour définir les zones desservies. Avec l'approche des rapports cumulatifs des cas, la zone desservie pouvait inclure des zones non contiguës. Avec les approches des distances, le dénominateur augmentait considérablement avec la distance, alors que le numérateur n'augmentait que légèrement. Le plus grand taux cumulatif des cas pour 1 000 habitants a été obtenu pour l'établissement de Kamwezi: 234,9 (intervalle de confiance à 95%, IC: 226,2–243,8) pour une distance en ligne droite de 5 km, 193,1 (IC à 95%: 186,8–199,6) pour l'approche de rapport cumulatif des cas et 156,1 (IC à 95%: 150,9–161,4) pour une distance de réseau routier de 5 km.

Conclusion Il est possible d'utiliser le rapport cumulatif des cas pour les consultations liées au paludisme afin de déterminer les zones desservies par les établissements de soins de santé. En outre, cette approche prend en compte les adresses réelles des patients, alors que ce n'est pas le cas lorsque l'on utilise les distances à partir des établissements de soins de santé.

Резюме

Определение районов охвата обслуживанием учреждениями здравоохранения в Уганде с использованием данных о посещениях в связи с малярией

Цель Проиллюстрировать использование нового метода определения районов охвата обслуживанием учреждениями здравоохранения, основанного на интенсивности их использования.

Методы Районы охвата обслуживанием шестью учреждениями здравоохранения в Уганде были определены с использованием совокупного коэффициента случаев заболеваний, т. е. коэффициента случаев вероятного использования учреждений для конкретного состояния пациентов из небольших административных районов. Совокупный коэффициент заболеваний для посещений данных учреждений в связи с малярией определялся с использованием данных Проекта по исследованию малярии в Уганде (Uganda Malaria Surveillance Project). Районы охвата обслуживанием также определялись с использованием различных расстояний по прямой и по дорожной сети до учреждения. Затем годовой совокупный коэффициент случаев заболеваний малярией вычислялся для каждого района охвата обслуживанием установленным образом с использованием трех методов.

Результаты Годовой совокупный коэффициент случаев заболеваний малярией варьировался в зависимости от метода, использовавшегося для определения районов охвата обслуживанием. При применении подхода, предполагающего использование совокупного коэффициента случаев заболеваний, в районы охвата обслуживанием могли быть включены районы, состоящие из нескольких несмежных участков. При применении подходов, предполагающих учет расстояния, знаменатель вместе с увеличением расстояния увеличивался существенно, в то время как числитель увеличивался лишь незначительно. Наибольший совокупный коэффициент случаев заболевания на 1000 человек популяции был выявлен для учреждения в районе Камвези (Kamwezi): 234,9 (доверительный интервал (ДИ) 95 %, 226,2–243,8) для расстояния по прямой в 5 км, 193,1 (ДИ 95 %, 186,8–199,6) при применении подхода, предполагающего использование совокупного коэффициента случаев заболеваний, и 156,1 (95 % CI: 150,9–161,4) для расстояния по дорожной сети в 5 км.

Вывод Использование совокупного коэффициента случаев заболеваний для посещений в связи с малярией оказалось оправданным. Более того, этот подход принимает во внимание фактические адреса пациентов, в то время как подходом, предполагающим использование расстояния до учреждения, это не предусмотрено.

Resumen

Definir las áreas de captación de los centros de salud en Uganda mediante datos de visitas relacionadas con el paludismo

Objetivo Ilustrar el uso de un nuevo método para definir las áreas de captación de los centros de salud basado en su uso.

Métodos Se determinaron las áreas de captación de seis centros de salud en Uganda mediante el cociente de caso acumulativo: el cociente entre el uso observado y el uso previsto de un centro para una condición particular por parte de pacientes de pequeñas áreas administrativas. Se determinó el cociente de caso acumulativo de las visitas relacionadas con el paludismo a dichos centros utilizando los datos del Proyecto de vigilancia de la malaria en Uganda. También se obtuvieron las áreas de captación en base a varias distancias lineales y de red vial respecto al centro de salud. Posteriormente, se calculó la tasa acumulativa de casos de malaria de un año para cada área de captación, determinada mediante los tres métodos.

Resultados La tasa acumulativa de casos de malaria de un año varió considerablemente con el método utilizado para definir las áreas de captación. Mediante el enfoque de la tasa acumulativa de casos, el área de captación podría incluir áreas no contiguas. Con los enfoques basados en la distancia, el denominador aumentó sustancialmente con la distancia, mientras que el numerador solo aumentó ligeramente. La mayor tasa acumulativa por 1000 habitantes se dio en el centro

de Kamwezi: 234,9 (intervalo de confianza del 95 %, IC: 226,2–243,8) para una distancia lineal de 5 km, 193,1 (IC del 95 %: 186,8–199,6) para el enfoque de la tasa acumulativa de casos y 156,1 (IC del 95 %: 150,9–161,4) para una distancia de red vial de 5 km.

Conclusión El uso de la tasa acumulativa de casos para las visitas relacionadas con el paludismo a fin de determinar las áreas de captación de centros de salud fue factible. Además, este enfoque tuvo en cuenta las direcciones reales de los pacientes, mientras que el enfoque basado en la distancia respecto al centro no las consideró.

References

1. Alexandrescu R, O'Brien SJ, Lyons RA, Lecky FE; Trauma Audit and Research Network. A proposed approach in defining population-based rates of major injury from a trauma registry dataset: delineation of hospital catchment areas (I). *BMC Health Serv Res* 2008;8:80. doi: http://dx.doi.org/10.1186/1472-6963-8-80 PMID:18402693
2. Jones S, Wardlaw J, Crouch S, Carolan M. Modelling catchment areas for secondary care providers: a case study. *Health Care Manag Sci* 2011;14:253–61. doi: http://dx.doi.org/10.1007/s10729-011-9154-y PMID:21455707
3. Gilmour SJ. Identification of hospital catchment areas using clustering: an example from the NHS. *Health Serv Res* 2010;45:497–513. doi: http://dx.doi.org/10.1111/j.1475-6773.2009.01069.x PMID:20050933
4. Diesfeld HJ. The definition of the hospital catchment area and its population as a denominator for the evaluation of hospital returns in developing countries. *Int J Epidemiol* 1973;2:47–53. doi: http://dx.doi.org/10.1093/ije/2.1.47 PMID:4774785
5. Baker LC. Measuring competition in health care markets. *Health Serv Res* 2001;36:223–51. PMID:11327175
6. Schuurman N, Fiedler RS, Grzybowski SC, Grund D. Defining rational hospital catchments for non-urban areas based on travel-time. *Int J Health Geogr* 2006;5:43. doi: http://dx.doi.org/10.1186/1476-072X-5-43 PMID:17018146
7. Boscoe FP, Henry KA, Zdeb MS. A nationwide comparison of driving distance versus straight-line distance to hospitals. *Prof Geogr* 2012;64:188–96. doi: http://dx.doi.org/10.1080/00330124.2011.583586
8. Shortt NK, Moore A, Coombes M, Wymer C. Defining regions for locality health care planning: a multidimensional approach. *Soc Sci Med* 2005;60:2715–27. doi: http://dx.doi.org/10.1016/j.socscimed.2004.11.016 PMID:15820582
9. Garnick DW, Luft HS, Robinson JC, Tetreault J. Appropriate measures of hospital market areas. *Health Serv Res* 1987;22(1):69-89.
10. Sserwanga A, Harris JC, Kigozi R, Menon M, Bukirwa H, Gasasira A et al. Improved malaria case management through the implementation of a health facility-based sentinel site surveillance system in Uganda. *PLoS One* 2011;6:e16316. doi: http://dx.doi.org/10.1371/journal.pone.0016316 PMID:21283815
11. *Uganda malaria indicator survey 2009.* Kampala: Uganda Bureau of Statistics & Calverton: Macro International, Inc.; 2010.
12. *Uganda national household survey 2009/2010.* Kampala: Uganda Bureau of Statistics; 2010.