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Kisumu County Hospital Patient Demographic Analysis: Looking Toward Universal Health Coverage

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SIT Study Abroad

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SIT Kenya: Urbanization, Health, and Human Rights

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Acknowledgements

This study would not have been possible without the help of Mr. Otieno, Head of the Records Department at Kisumu County Hospital. I met with Mr. Otieno nearly every day for the first two weeks of my project, and he was instrumental in helping me access the data necessary for this study. The data collection component of this study was rather haphazard and unpredictable, but Mr. Otieno supported me with the utmost kindness and commitment. In those long hours spent waiting for hospital employees to arrive and outpatient records to download, I formed a dear friend whom I hope to visit again one day in the future. I would also like to thank Maurice Ombok, entomologist at KEMRI, for his guidance in shaping this project in its earliest stages and his patience with me as we worked together to analyze and map results. Anyone who has ever worked with ArcMap will recognize patience as the key ingredient of a successful mapping project. I also owe a great deal of gratitude to Megan Powell and Zoé Haskell-Craig, not only for their help in collecting data from KCH and drafting code to aid in my analysis, but also for their support and encouragement throughout the semester. Finally, I would like to thank SIT staff for they have done for my fellow students and me this semester, organizing lectures, coordinating homestays, guiding our ISP research, and facilitating an unforgettable four months in Kenya. Asante sana!

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Abstract

Universal health coverage is priority sought after by developed and developing nations alike, and Kenya sits on the list of countries seeking to achieve this goal in the coming years. The definition of "coverage" can vary by country, but three criteria are commonly found in the discussion of UHC globally: access, affordability, and quality. Affordability is determined by the state's healthcare financing system; quality refers to the services provided by health facilities; and access, at least in part, concerns the geographic placement of health services providers in relation to the population they intend to serve. This geographic element is the focus of this study. Using out-patient records from Kisumu County Hospital from July 2017 to June 2018, this study maps the geographic distribution of KCH patients and calculates the distances traveled to the health facility; the patient burden by gender, age, month, and diagnosis are also calculated. The results suggest that malaria consistently accounts for about 30 percent of KCH's diagnosis burden; Nyalenda Estate sends the largest number of patients among any singular location, at nearly 20 percent, and the majority of patients, 54 percent, live within two to five kilometers of KCH.

Figures and Maps

Introduction

In January 2016, the Sustainable Development Goals (SDGs) succeeded the Millennium Development Goals as the guiding force behind the United Nations Development Program. These 17 goals seek to continue the progress made by the Millennium Development Goals (MDGs) and expand the global development agenda into new areas, including climate change and sustainable consumption. While all goals are interconnected and the success of each is dependent upon the success of the others, the third SDG, "Good Health and Well-Being"[1] specifically addresses global health. Within this category, the UN has outlined 13 specific health-related targets, with concrete measurable goals. Among goals to reduce maternal mortality rates and end the epidemics of HIV, TB, and malaria lies the goal to "achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all"[2]

This commitment builds upon previous international commitments to universal health coverage, including a 2005 UN Resolution urging "…governments, civil society organizations and international organizations to promote the inclusion of universal health coverage as an important element on the international development agenda…."[3]

According to the World Health Organization (WHO), at least half of the world's population lacks access to "essential health services" and the out-of-pocket costs of healthcare forces 100 million people into extreme poverty.[4] The WHO defines universal health coverage as "all individuals and communities [receiving] the health services they need without suffering financial hardship."[5] In collaboration with the World Bank, the WHO has developed a framework to track progress in the implementation of UHC. This framework includes 16

[1] "Goal 3: Good Health and Well-being." *United Nations Development Programme*. (2015).
[2] Ibid.
[3] United Nations, General Assembly. Resolution 2012. Global Health and Foreign Policy, GA/RES/2012 (2012).
[4] "Universal Health Coverage (UHC)." *World Health Organization*. (2017).
[5] Ibid.

essential health services grouped into four categories: reproductive, maternal, newborn, and child health; infectious diseases; non-communicable diseases; and service capacity and access.[6]

This final category is measured by the following factors: basic hospital access, health worker density, access to essential medicines, health security. This study will explore health coverage in terms of basic hospital access in Kisumu county, using GIS and spatial analysis to understand the distance patients travel to seek care at Kisumu County Hospital and to explain the geographic nature of patients' health seeking patterns. Ultimately, this study aims to create a dataset consisting of patient locations, specified by geographic coordinates, and existing demographic data from the hospital's out-patient register in order to evaluate the status of health coverage in Kisumu county and make recommendations on measures to be taken to increase the likelihood of successful and sustainable UHC implementation.

Literature Review

Universal Health Coverage worldwide

Globally, universal health coverage has been achieved by nearly all Organization for Economic Cooperation and Development (OECD) member countries and significant evidence exists which shows that an increase in the percentage of population covered by public healthcare funds is positively correlated with increased life expectancy. UHC is commonly understood to be comprise of three main tenets, namely "population covered, range of services made available, and extent of financial protection from cost of health services."[7] Transition to universal health coverage have varied considerable in length, from 127 in Germany to 12 years in Korea, though cases in Asia demonstrate that implementation can be fast-tracked with government initiatives to subsidize care for certain groups.[8]

While much of the successful examples of UHC are found in high- and middle-income countries, research suggests that low-income countries can still make progress toward reaching their UHC goal, and lessons from OECD countries' experiences can inform implementation

[6] "Universal Health Coverage (UHC)." *World Health Organization*. (2017).
[7] Pearson, Mark, Francesca Colombo, Yuki Murakami, and Chris James. "Universal Health Coverage and Health Outcomes." *OECD*. (2016).
[8] Ibid.

strategies moving forward. Economic growth creates favorable conditions for UHC implementation, as a "1% increase in GDP per capita has been found to be associated with a 5.9% increase in the probability of adopting UHC."[9] The global recommendation, put forward but the WHO, suggests that governments devote at least 5% of GDP toward financing healthcare, and nations' health policies must include "adequate financial protection."[10] Out-of-pocket payments must be kept as low as possible so as not to deter poorer populations from accessing health services. Before implantation of UHC, a thorough assessment of health services must be conducted to determine which services are considered essential and are to be included in the UHC package. Research recommends breadth not depth of coverage, meaning that complete population coverage must be secured before services included in health package are expanded.[11]

UHC in sub-Saharan Africa

Regionally, sub-Saharan Africa has among the world's lowest levels of healthcare coverage. The region as a whole scored 42/100 according to a UHC service coverage index which evaluates countries' progress toward coverage based on 16 indicators of essential health service coverage. Sub-Saharan African lags behind Asia (64), Europe and Northern American (77), Latin American and the Caribbean (75), Oceania (74), and the global score of 64. Kenya independent scored above the regional average, with its health coverage falling between the 46th-61st percentile.[12]

UHC in Kenya

President Uhuru Kenyatta announced his Big Four development agenda in 2017, focusing on enhancing manufacturing, food security and nutrition, universal health coverage, and affordable housing.[13] The third component of his agenda, universal health coverage will be

[9] Ibid.
[10] Ibid.
[11] "Universal Health Coverage and Health Outcomes." (2016).
[12] Copley, Amy. "Monitoring Sub-Saharan Africa's Progress toward Universal Health Care Coverage." *Brookings*. (2018).
[13] "Big Four Action Plan." *The Presidency*. (2017).

piloted in four counties, Kisumu, Nyeri, Isiolo, Machakos. This pilot program will test not only the feasibility of Universal Health Coverage, but also its ability to work within the recently devolved federal system. The 2010 Constitution dramatically altered the structure of Government in Kenya, decentralizing power from one national government to 47 county governments. Health was one responsibility devolved to county jurisdiction, so the UHC pilot program is also a test of the new healthcare structure and its ability to provide quality care to all citizens.

In 2014 the Ministry of Health (MoH) published the Kenya Health Policy 2014-2030, which "gives directions to ensure significant improvement in overall status of health in Kenya in line with the Constitution of Kenya 2010, the country's long- term development agenda, Vision 2030 and global commitments."[14] The document outlines the post-devolution responsibilities/functions of the national and county governments concerning health. Functions assigned to the national government include "leadership of health policy development; management of national referral health facilities; capacity building and technical assistance to countries; and consumer protection."[15] County governments are responsible for "county health services; ambulance services; promotion of primary healthcare; licensing and control of undertaking that sell food to the public; cemeteries, funeral parlors, and crematoria; and refuse removal, refuse dump, and solid waste disposal."[16] This document also outlines the nation's policy commitments in relation to improving access to, quality of, and demand for health services. "Adequate physical access to health and related services"[17] is listed as a policy commitment, with "adequate" defined as living within five kilometers from a health facility. [18]

Kenya's Healthcare Delivery System

The healthcare service delivery system in the post-devolution era is structured hierarchically, with six levels of care, outlined as follows: community (level 1), dispensaries

[14] Kenya. Ministry of Health. "Kenya Health Policy 2014-2030." *Nairobi: Ministry of Health*. (2014).
[15] Ibid.
[16] Ibid.
[17] Ibid.
[18] Ibid.

(level 2), health centers (level 3), primary referral facilities (level 4), secondary referral facilities (level 5), and tertiary referral facilities (level 6). Primary care occurs at levels 1-3, and complicated cases are referred up the hierarchy. Ideally, by 2030, the healthcare delivery system will be consolidated into four levels/tiers: community services (level 1), primary services (level 2), country referral hospitals (level 3), and national referral hospitals (level 4). [19]

The National Health Policy document also reviews health investments as of 2014, in terms of financing, human resources, and infrastructure. Government spending on health was reported to be 6%-8% of total expenditures, and the health sector continues to be funded primarily by private sector sources, including donors and out-of-pocket funding. Human resources as a health investment fell below WHO recommendations. Nationwide, an average of 20.7 doctors and 159.3 nurses are employed for every 100,000 persons, while the WHO recommends 21.7 doctors and 228 nurses as the "standard for optimal delivery of services."[20] Geographically, poorer regions are home to fewer health facilities and fewer healthcare personnel, as preferences tend to lean toward more developed areas. In Kisumu County, the geographic focus of this study, there are 21 hospitals (level 4-6), an average of 2.0 per 100,000 persons, and 145 health centers and dispensaries, an average of 14.1 per 100,000 persons.[21]

Currently, the Ministry of health is using a geographic information system (GIS) to locate and display all health facilities and community units in Kenya and describe services offered at each facility/unit. This GIS enables users to narrow facilities by county, sub-county/constituency, and ward. Within each ward, all health facilities are displayed with their name, status (operational/non-operational), and type (medical clinic, dispensary, primary care hospital, laboratory). Data from each ward is available for export to an excel file, which provides further information on the facilities, including owner, regulatory body, number of beds, number of cots, and a unique identification code assigned. In Kisumu Country, there are 205 health facilities among the seven sub-counties: Seme, Kisumu West, Kisumu Central, Kisumu East, Nyando, Muhuronhi, and Nyakach.[22]

[19] Ibid.
[20] "Kenya Health Policy 2014-2030." (2014).
[21] Ibid.
[22] "Kenya Master Health Facility List." *Ministry of Health.* 2018.

Justification

In light of both the United Nation's and Kenya's commitments to Universal Health Coverage, research evaluating the status of Kisumu County in terms of healthcare coverage is necessary to inform package options and implementation strategy. Furthermore, President Uhuru Kenyatta is planning to launch UHC in the four pilot counties (including Kisumu) on December 13th, 2018. The pilot will run from the launch date to October 2019, and will be followed by the rollout period, November 2019 to December 2021, when UHC will be expanded to the rest of Kenya's 47 counties. [23]

Objectives

This study analyzes the geographic distribution of patients who seek care Kisumu County Hospital by mapping patients' residence sand calculating the distance patients travel to the hospital. In addition to determining the burden KCH faces in terms distance traveled, this study also evaluates patient burden by month, diagnosis, and gender. The main accomplishment of this study is the creation of a dataset of KCH out-patients from July 2017 – June 2018, with locations and geographic coordinates, enabling the dataset to be mapped and utilized for further research on the status of Kisumu County's progress toward the goal of providing adequate physical access to health service providers.

Methodology

Given this study's intent to map and analyze distance to Kisumu County Hospital traveled by all out-patient regardless of age, gender, or diagnosis, the time period was limited to twelve months to ensure the dataset was manageable given the four-week ISP period. As 2018 has not yet come to a close, this study focuses on the twelve-month period from July 2017 to June 2018. The dataset was created, cleaned, and analyzed using Microsoft Excel version 15.37. All maps were created using ArcGIS Online, geographic coordinates were identified using Google Maps, and additional analyses was conducted using RStudio.

[23] "Future of NHIF in question as UHC package is revealed." *Standard Digital*. (2018).

The method of data collection for this study was anything but methodical, so a narrative of the quest for data seems more apt to explain the process.

As the bright blue gates, painted with the words "Kisumu County Hospital," swung open wide, I found myself caught in a crowd of nursing students arriving for their shift, so I hurriedly stepped across the threshold and started toward the far side of the campus, feigning the confidence that I knew where I was going. First on the day's agenda was an eight o'clock meeting with Dr. Ayugi, Medical Superintendent at KCH. Naturally, with such a title, the doctor's tight schedule afforded me only a minute or two of discussion, but the meeting sufficed to explain in brief detail both the objective of the project and the data desired from the hospital. Following our short meeting, I was referred to Mr. Otieno in the Records Department, the man whom Dr. Ayugi deemed most appropriate to handle my request. As the acquisition of data seemed the most daunting and uncertain step of the project, as sense of optimism and hope accompanied the mention of "Records Department."

However, my expected method of data collection disintegrated with every step I took into this shrine of statistics, this den of data, this hallowed hall of hospital records. The already narrow hallway was made narrower with mountains of files and the hurrying back and forth of the staff, who were in the process of removing all paper records from the building in preparation for its renovation. In the back office, I found Mr. Otieno, the expert in health records who would become my good friend over the course of the project, as well as the key to unlocking the data required for my study. I explained my project in great detail, stating the specific criteria for the data I was hoping to analyze. During the design phase of my project, as I was writing my proposal, I fell under the impression that the data I needed for my study, i.e. patients' age, gender, diagnosis, and residence, would be found in a singular registry book sitting atop the reception desk, a format particularly conducive to collecting larger quantities of patient information at once. However, Mr. Otieno broke the news that such a book does not exist; out-patient information is stored in a digital database and in-patient information is stored in individual patient files, many of which lined the hallway just outside his office.

The unknown whereabouts of the Information Technology manager rendered access to the database temporarily a nonstarter, and the sheer volume of in-patient files proved another

complication. My original proposal sought to gather data on every patient treated at KCH from July 2017-June 2018, but for in-patients alone, Mr. Otieno estimated over 600 records per month. 7,200 files, entered manually and individually, was simply not feasible given the time constraints of the project. We set out to draft a new methodology and decided that a random sample of 100 files per month for the 12-month period of July 2017-June 2018 would be comprehensive enough for my purposes, but feasible enough for my time frame. Mr. Otieno requested that I return the following morning, to allow him adequate time to retrieve the necessary records.

I arrived the next morning, research assistant in tow, to find Mr. Otieno in his office surround by stacks of patient files. In the hospital's empty conference room, we combed through the files, taking photographs of only the necessary information printed on the top half on a patient's record.

The in-patient files given to me by Mr. Otieno initially totaled 309 in number, yet 181 files were from the month of April. The rest included a random sample of files from March, May, June, July, and August 2018. Though my new plan involved gathering a random sample of 100 files per month for a 12-month period, I soon realized the slim probability that such a sample could be collected. Unfortunately, this study has taken place in the middle of major renovation of the Records Department, comprising the organization of and access to patient records. The stacks given to me were not organized by date, making it impossible to search specifically for files from any given month. The shelves and hallways overflowed with paperwork ready for migration to a temporary storage location, and just outside the building I noticed hundreds of files strewn about in the bed of a pick-up truck.

Recognizing the obstacle I would face if I choose to proceed with my plan and seeking to be realistic in light of my time-frame, Dr. Wandiga and I decided instead to focus on obtaining access to the hospital's out-patient database, and abandon the previous week's work regarding in-patient records. The next step, therefore, was to track down the elusive IT manager. After three days in pursuit, contact was finally made, and on the fourth day, I had in my possession over 70,000 out-patient records from July 2017 to June 2018. Each record contained the following information: patient number, name, age, gender, diagnosis, residence, date, time

registered, time seem, and the hospital employee by whom the patient was registered. For the purposes of this study, however, only patient age, gender, diagnosis, residence, and date are relevant, so all other fields were removed once the data was converted to an Excel sheet. (Patient number was also kept in case reference to the original data was required.)

Given that this study is an analysis of the geographic distribution of Kisumu County Hospital patients, location is the crucial piece of information. However, the name of a village alone is not an adequate reference to display the data in a geographic information system; for this, spatial data, or geographic coordinates, is required. The following explains the process by which I identified the geographic coordinates for each patient's residence.

I sorted the data alphabetically according to residence, and then compiled a list of all unique residences; though there are over 70,000 records in the dataset, there are only about 500 different locations. With no way to identify the exact coordinates of each patients' home, I planned to use a landmark in each location as the reference point for all patients with that location listed. Most often I used a primary school as the landmark, though when none could be found I used other types of building such as police stations, health centers, and markets. Once I had complied the list of unique residences, I went through one at a time and entered the location in Google Maps. When I located the chosen landmark, I identified the spatial reference by right-clicking on the map, choosing "What's here?", and copying the coordinates listed under the landmark title. In the excel sheet I entered the latitude, longitude, and landmark source, and then copied those three cells to all patient records from that location. Once this stage was completed to an extent sufficient for this study, I began the analysis.

Results

In total, 73,984 patient records were extracted from the out-patient database at Kisumu County Hospital. Of those records, 47.37 percent were male (n=35,045) and 52.63 percent were female (n=38,939). When broken down by age (Figure 2), 12.08 percent of patients were under the age of five (n=8934), 16.16 percent were between the ages of five and 18 (n=11,956), 71.69 percent were over the age of 18 (n=53,039), and 0.07 percent were out of range (n=55). Figure 3 shows patient load by month throughout the 12-month study period. The average number of patients per month was 6,165, while the minimum was 774, reported in October 2017, and the maximum was 12,773, reported in June 2018.

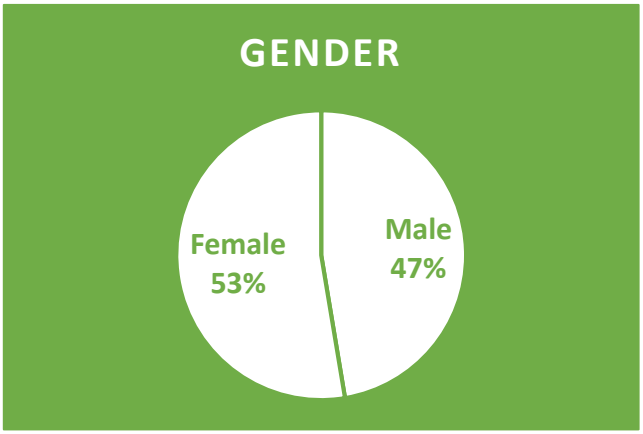


Figure 1: Gender distribution (total patients extracted)

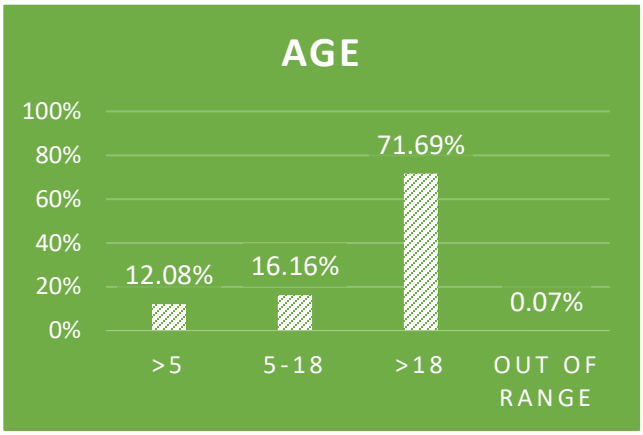


Figure 2: Age distribution (total patients extracted)

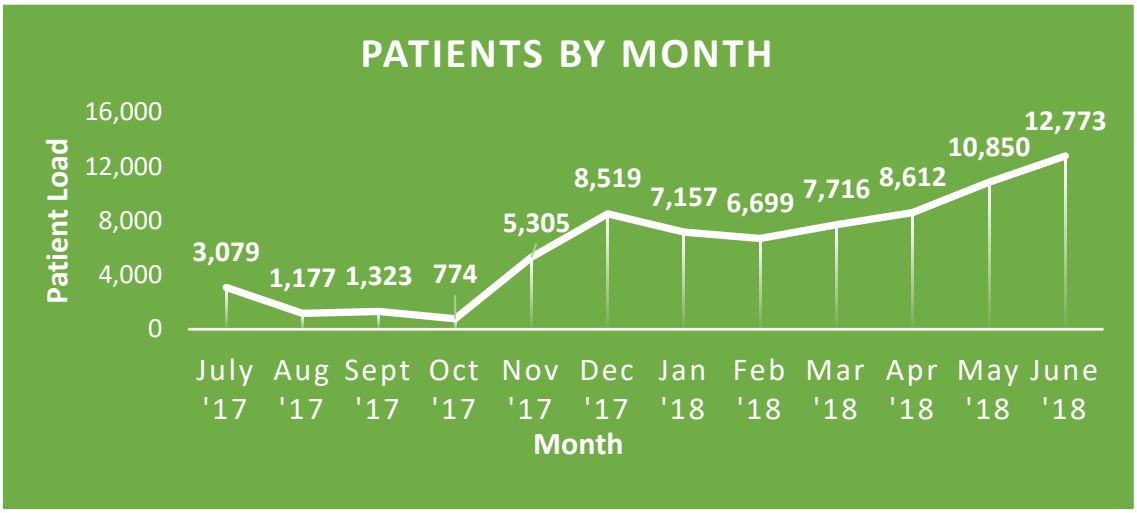


Figure 3: Patient load by month (total patients extracted)

Among the original data extracted, 4.81 percent (n=3,557) of records were not assigned a location. Therefore, only 95.19 percent (n=70,427) of the total patient load was used for the

location analysis. The distance from each patient location to Kisumu County Hospital was measured, and the results are as follows: 3.44 percent (n=2,425) of patients live less than one kilometer from KCH, 4.76 percent (n=3,353) live within one to two kilometers, 54.05 percent (n=38,065) live within two to five kilometers, 15.28 percent (n=10,758) live within five to ten kilometers, and 22.46 percent (n=15,824) live further than ten kilometers from KCH.

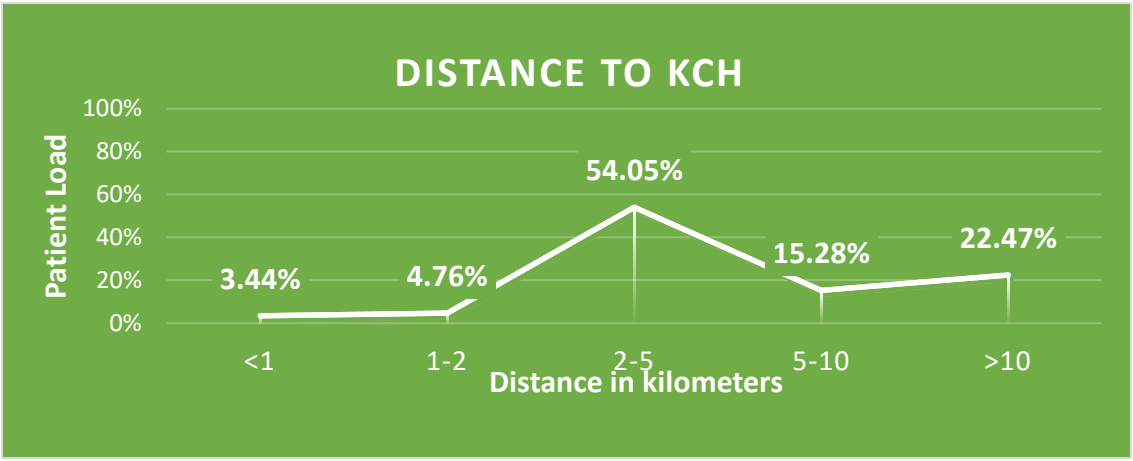
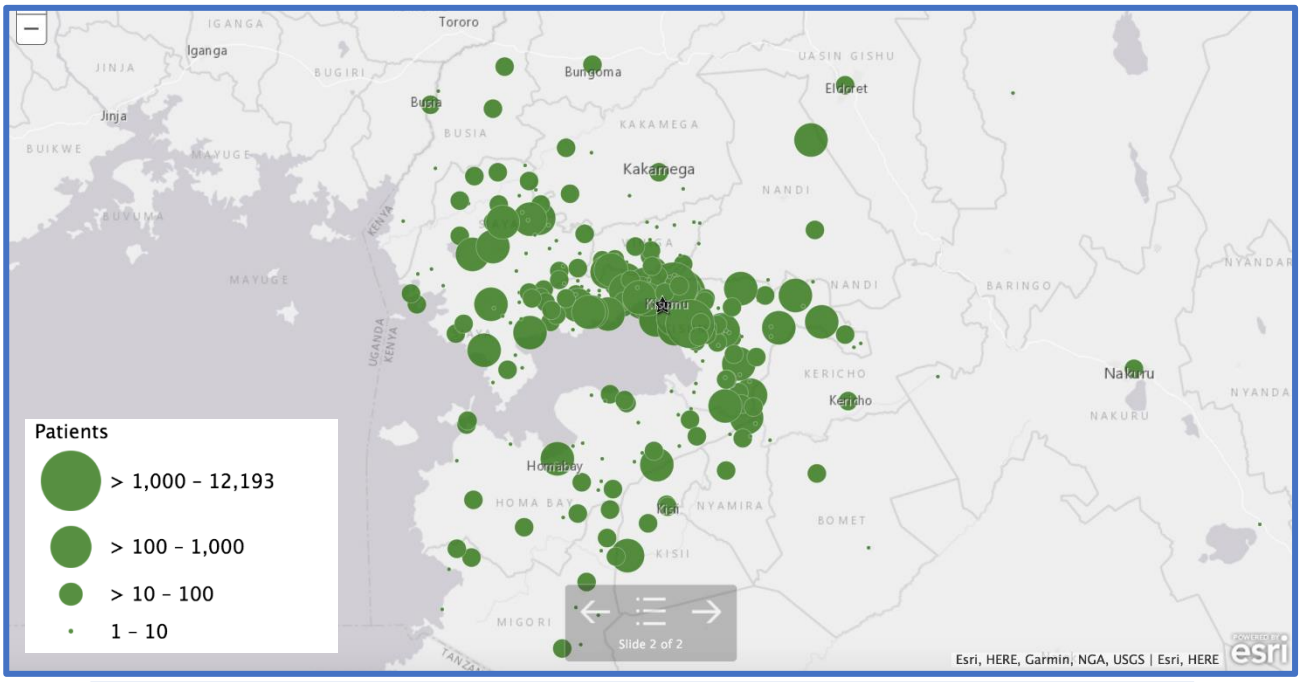


Figure 4: Distance to Kisumu County Hospital from patient residences



Map 1: Geographic distribution of patients by number of patients per residence (Lake region)

Map 1 show the geographic distribution of patients by number of patients per residence. Out of the 70,427 records with locations assigned, there were 441 unique residences. Among that list of 441 locations, 39.68 percent (n=175) were home to between one

and ten patients, 39.23 percent (n=173) were home to 10-100 patients, 17.91 percent (n=79) were home to 100-1,000 patients, and 3.17 percent (n=14) were home to greater than 1,000 patients.

The five most commonly reported residences were Nyalenda, Manyatta, Nyamasaria, Mamboleo, and Bandani. Nyalenda was named as the residence for 17.31 percent (n=12,193) of patients, Manyatta accounted for 10.30 percent (n=7,254), Nyamasaria accounted for 8.86 percent (n=6,237), Mamboleo accounted for 2.52 percent (n=1,772), and Bandani hosted 2.30 percent (n=1,617). Map 2 provide a closer look at the geographic distribution of patients by number of patient per residence, with the top 5 residences highlighted.

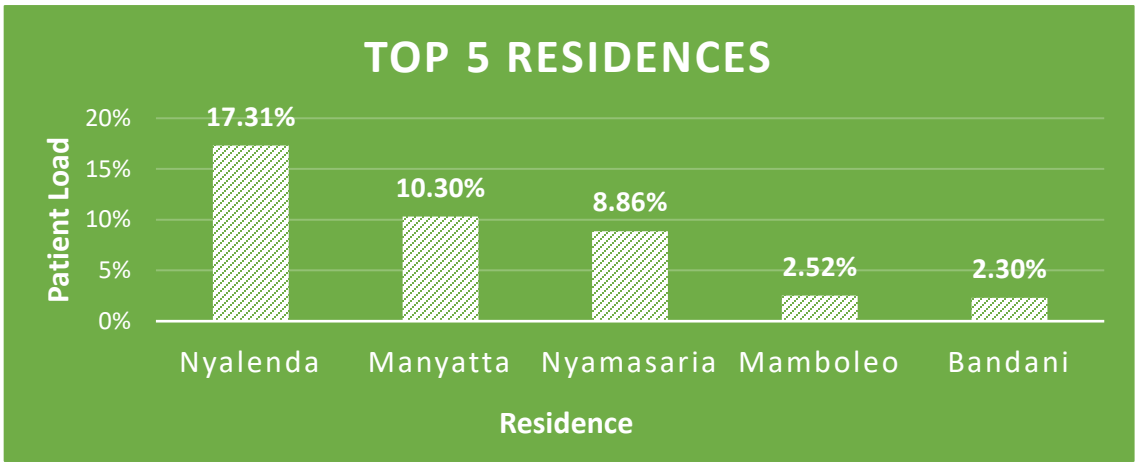
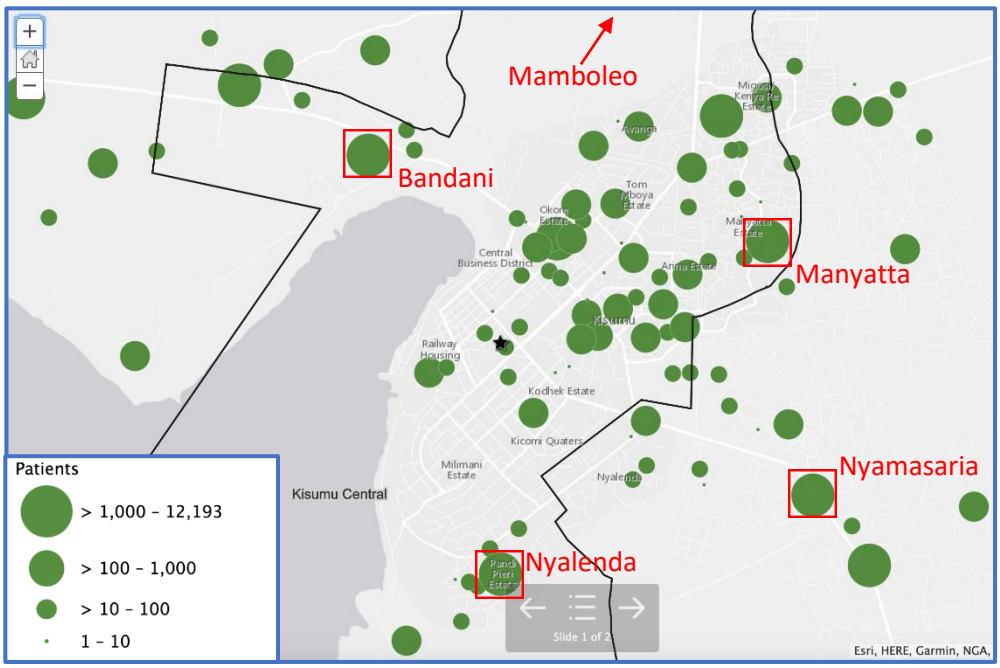


Figure 5: Top five residences by number of patients



Map 2: Geographic distribution of patients by number of patients per residence (Kisumu town)

Among the original dataset (73,984 patients), 30.40 percent (n=22,490) of records included both a location and a diagnosis. Only this subset was used for the diagnosis analysis. Among this subset, 46.34 percent (n=10,422) of patients were male and 53.66 percent (n=12,068) were female. Age distribution generally matched that of the original dataset, as 5.37 percent (n=1,208) of patients were under five years of age, 19.05 percent (n=4,285) were between the ages of five and 18, 75.50 percent (n=16,981) were over the age of 18, and 0.07 percent (n=16) were out of range. The three most commonly reported diagnoses were malaria at 34.52 percent (n=7,763 of patients, respiratory tract infection/upper respiratory tract infection at 6.82 percent of patients (n=1,533), and urinary tract infection, at 5.01 percent (n=1,126) of patients. These three diagnoses combined accounted for 46.34 percent (n=10,420) of all patients with location and diagnosis. Figure 6 shows the monthly distribution of malaria, RTI (respiratory tract infection), and UTI (urinary tract infection) cases as a percentage of total cases with diagnosis and location.

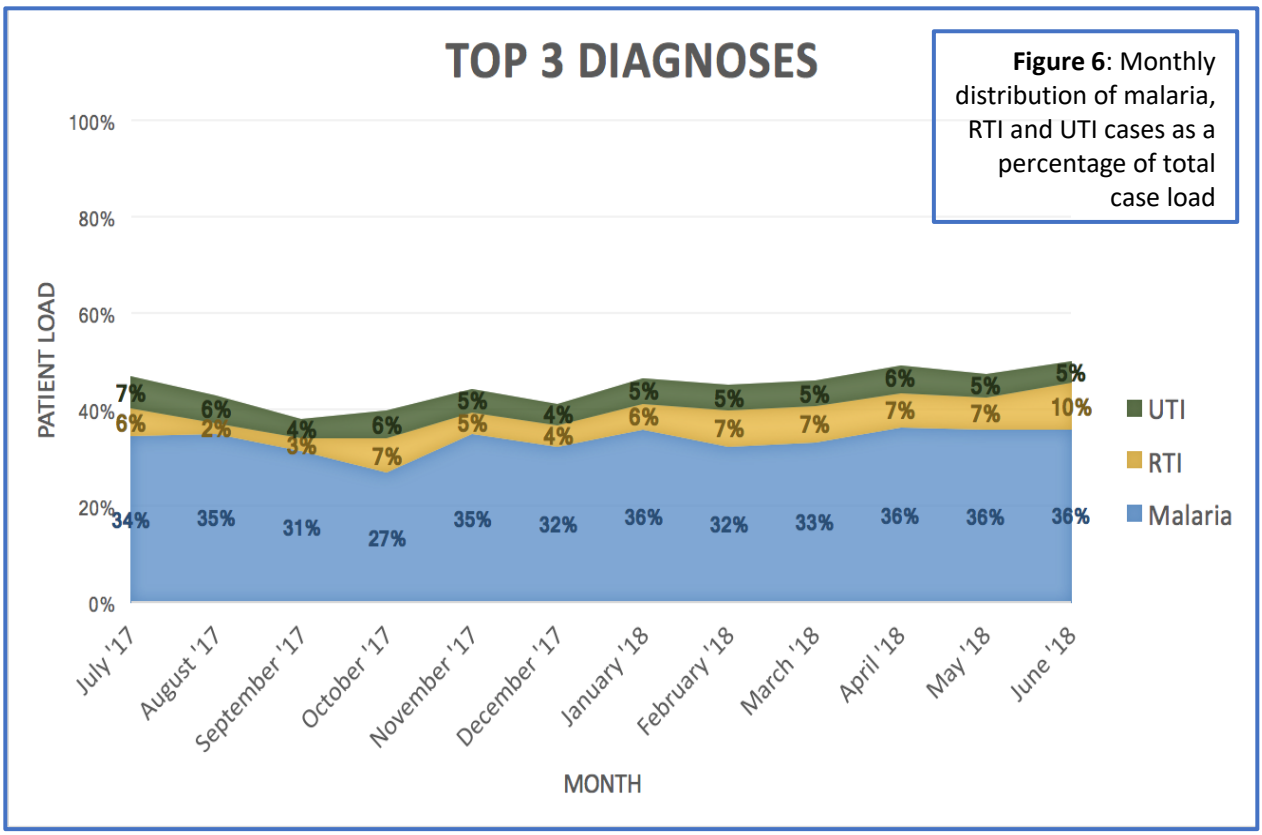


Figure 6: Monthly distribution of malaria, RTI and UTI cases as a percentage of total case load

Figures 7, 8, and 9 display the statistics for malaria patients, by gender, age, and monthly distribution, respectively.

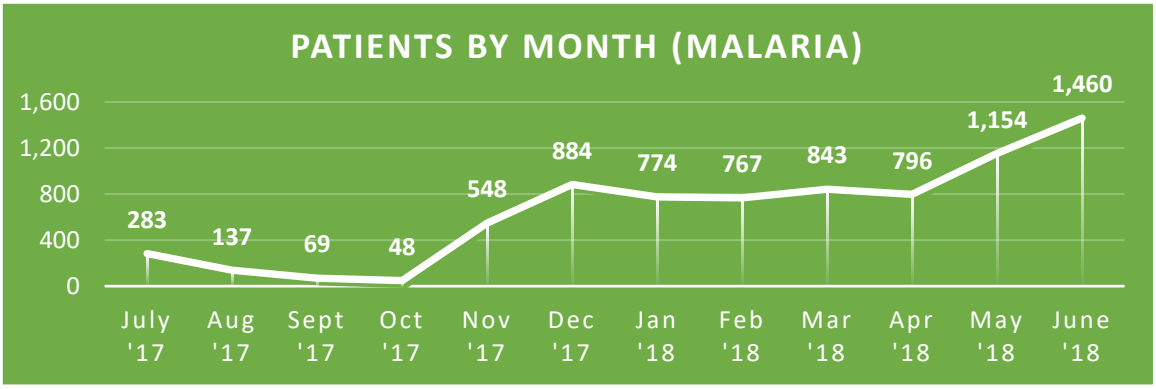


Figure 7: Patient load by month (malaria patients)

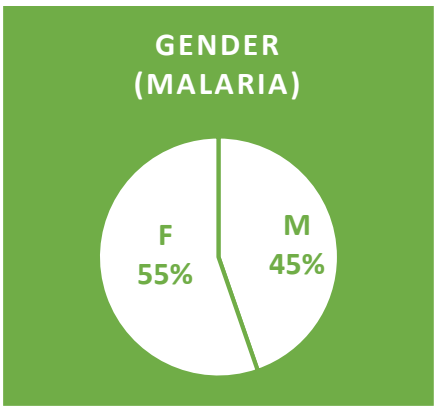


Figure 8: Gender distribution (malaria patients)

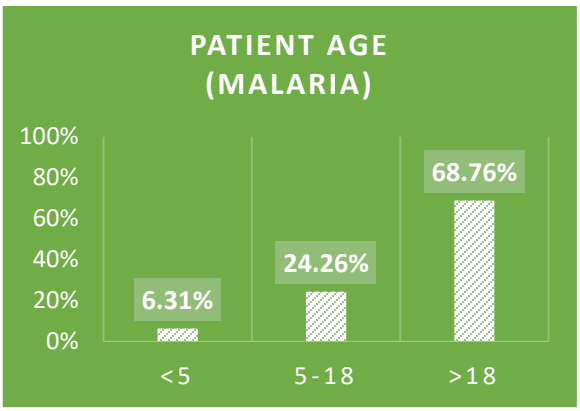


Figure 9: Age distribution (malaria patients)

Figures 10, 11, and 12 display the statistics for RTI patients, by gender, age, and monthly distribution, respectively.

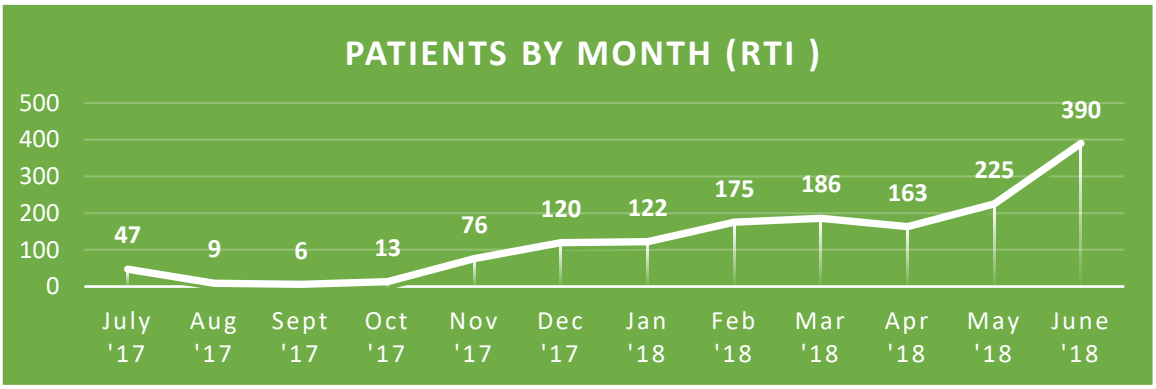


Figure 10: Patient load by month (RTI patients)

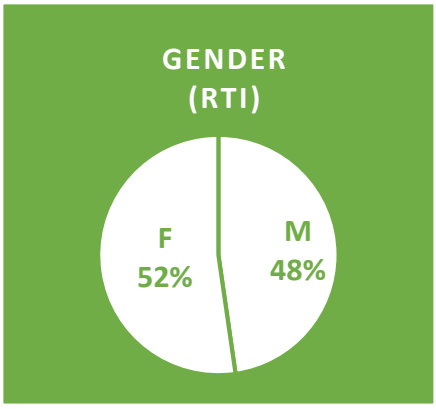


Figure 11: Gender distribution (RTI patients)

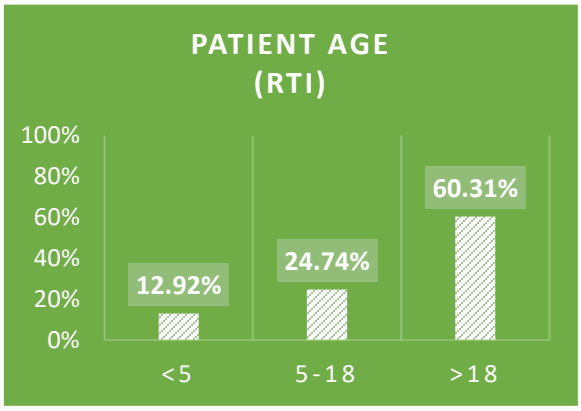


Figure 12: Age distribution (RTI patients)

Figures 13, 14, and 15 display the statistics for UTI patients, by gender, age, and monthly distribution, respectively.

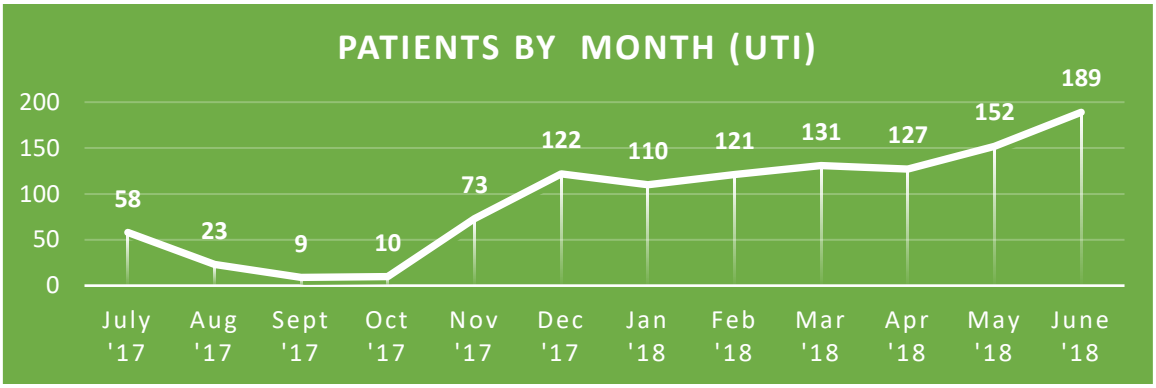


Figure 13: Patient load by month (UTI patients)

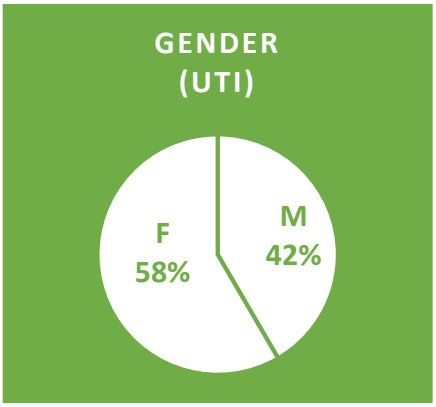


Figure 14: Gender distribution (UTI patients)

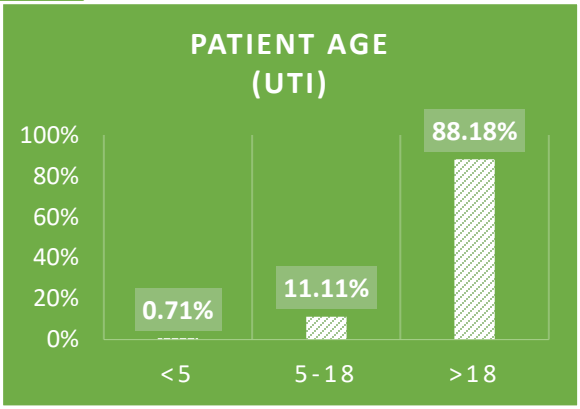


Figure 15: Gender distribution (RTI patients)

Across all three diagnoses, the majority lived within the two to five kilometer range. Among the 7,763 malaria patients, 61.05 percent (n=4,739) lived within two to five kilometers of Kisumu County Hospital. Among the 1,532 RTI patients, 62.27 percent (n=954) lived within two to five kilometers of KCH. Among the 1,125 UTI patients, 54.84 percent (n=617) lived within two to five kilometers of KCH.

Figure 16 shows the distance traveled to Kisumu County Hospital, specific to malaria patients. At 61.05 percent, the majority of patients traveled between two and five kilometers to KCH. Nearly 70 percent of patients live within five kilometers, and nearly 30 percent live outside of the five kilometer range.

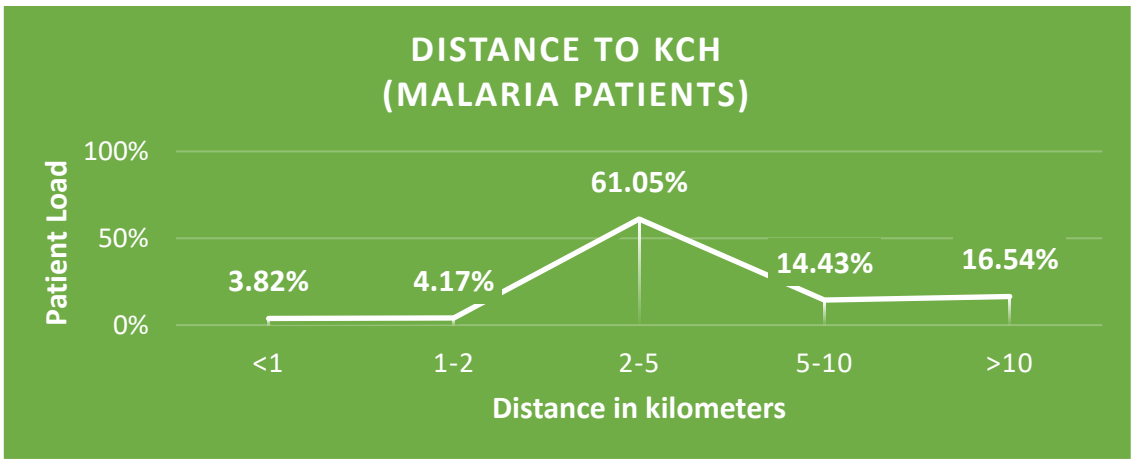


Figure 16: Distance traveled to KCH (malaria patients)

Figure 17 shows the distance traveled to Kisumu County Hospital, specific to RTI patients. Again, the majority of patients traveled between two and five kilometers to KCH, specifically 62.27 percent of patients. Nearly 72 percent of patients live within five kilometers, and about 28 percent live outside of the five kilometer range.

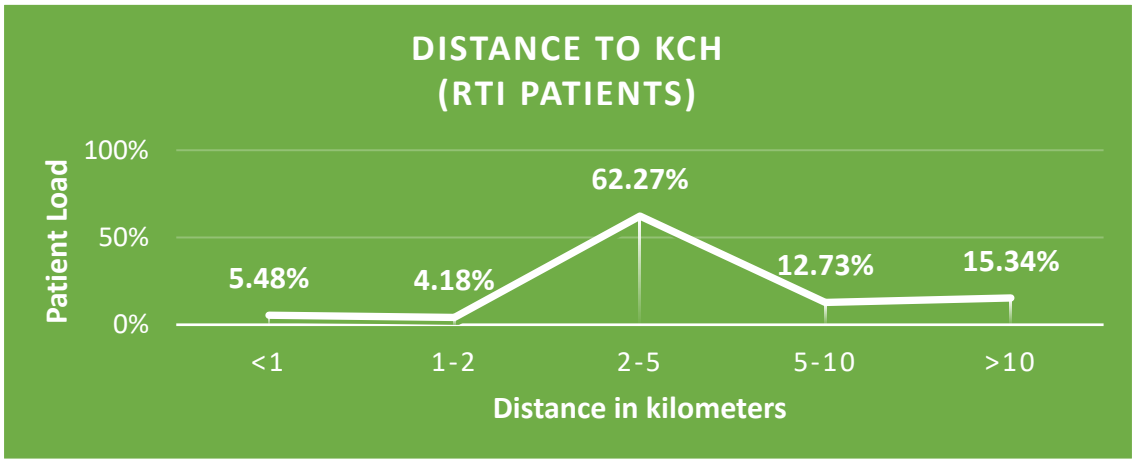


Figure 17: Distance traveled to KCH (RTI patients)

Figure 18 shows the distance traveled to Kisumu County Hospital, specific to UTI patients. Just over 50 percent of patients traveled between two and five kilometers to KCH, specifically 54.84 percent. About 65 percent of patients live within five kilometers, and nearly 35 percent live outside of the five kilometer range.

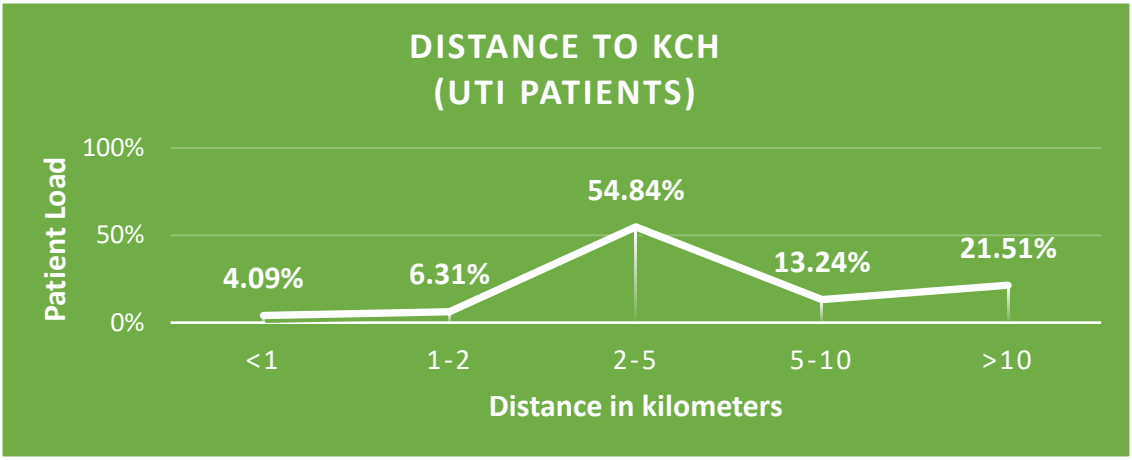


Figure 18: Distance traveled to KCH (UTI patients)

Discussion

According to these findings, the top three diagnoses, when combined, contributed 46 percent (n=10,420) of the total diagnosed case from July 2017 to June 2018. Malaria was found to contribute 35 percent of overall diagnoses cases, and 75 percent of cases among the top three diagnoses subset were malaria cases. Figure 6 shows that malaria burden remained constant throughout the study period, consistently accounting for 27-36 percent of Kisumu County Hospital's out-patient case load. An unpublished report in Kisumu asserts that one-third of all out-patient consultations are malaria patients. Despite malaria contributing about 30 percent of out-patient cases nationwide, Kisumu County is situated in a malaria-endemic zone; Kisumu and the rest of the lake region is characterized by "high malaria transmission all year long," and a prevalence rate of 20-40 percent.[24]

The majority of patients, as shown by Figure 4, traveled between two and five kilometers to seek care at Kisumu County Hospital. The three most common locations listed as patient residences were Nyalenda, Manyatta, and Nyamasaria, all of which fall within the range of two to five kilometers from KCH. Nyalenda sits 2.42 kilometers away, Manyatta sits 3.18 kilometers away, and Nyamasaria sits 3.77 kilometers away. The position of these locations as

[24] "Malaria by Numbers: Why Kenya Is Not Winning the Fight." *Internews in Kenya*. (2012).

the most common residences is not unexpected, as they are among the most populous neighborhoods of Kisumu County. Nyalenda is Kisumu's second largest informal settlement, and is comprised of Nyalenda A and Nyalenda B; however, the location is referred to simply as "Nyalenda" in records in the KCH database. According to the 2009 census, Nyalenda A and Nyalenda B host a combined 60,669 individuals in 16,631 households. The census reported a population density of 8,953 individuals per square kilometer for Nyalenda A and 6,886 individuals per square kilometer for Nyalenda B.[25] In comparison Kisumu City host a population of 404,160 with a population density of 1,392 individuals per square kilometer. [26]

Given the fact that Nyalenda residents account for nearly 20 percent of total KCH patients in this study's twelve-month period, it follows that this location warrants specific research, regarding the health concerns facing this community, the health service providers available, and the financial capacity of this population to pay for services. This data will better inform the Universal Health Coverage implementation strategy and the creation of the healthcare package available to residents.

Kenya's Ministry of Health has declared five kilometers the furthest distance a Kenyan citizen should travel to the nearest health service provider. This standard, the National Health Policy suggests, constitutes adequate access to healthcare, and therefore the data collected in this study must be analyzed against this target. As Figure 4 shows, 62.25 percent (n= 43,843) of KCH patients live within five kilometers of the hospital, yet 37.75 percent (n=26,584) live further than five kilometers. As Figures 16, 17, and 18 show, there is little difference in the distance distribution among the malaria, RTI, or UTI patients, when compared with the overall distance distribution shown in Figure 4. Among malaria, RTI, and UTI patients, the majority live within the two to five kilometer range. About 70 percent of malaria patients, 72 percent of RTI patients, and 65 percent of UTI patients live within five kilometers of KCH; and about 30 percent of malaria patients, 28 percent of RTI patients, and 35 percent of UTI patients live further than five kilometers from KCH.

[25] "Kisumu millennium development goals multi-sector household survey." *New York: Earth Institute, Columbia University* (2012).
[26] Ibid.

Malaria and RTI are the two most common diagnoses, and about 70 percent of patients with these diagnoses live within five kilometers from KCH while 30 percent live further than five kilometers. However, when looking at the distance distribution among all patients, about 62 percent of patients live within five kilometers while 38 percent live further than five kilometers. Therefore, patients with less common diagnoses, or those not among the top two, are traveling further distances, increasing the percentage of patients traveling further than five kilometers. An uncommon diagnosis might explain the far distance a patient travels, as specialized care for uncommon diagnoses may not be available at the patient's nearest facility, forcing him/her to travel to facility better equipped to treat his/her case.

Though strong trends can be detected explaining the movement of KCH patients to the hospital, this data alone is not sufficient to evaluate the degree to which the five kilometer UHC target has been met. While nearly 38 percent of KCH patients traveled more than five kilometers to the health facility, the assumption that KCH was the nearest health facility for this group of patients cannot be made with any certainty. These patients may live within five kilometers from a different health facility, and therefore would meet the UHC target; however, even if a closer facility exists, they chose to seek treatment at KCH. This begs the question "why?". Why might a UTI patient choose to travel a further distance to KCH rather than seek care at their nearest facility? Are rural facilities less equipped than KCH to serve certain types of patients? What are the push and pull factors, pushing patients away from closer facilities and pulling them toward KCH? The answers to these and other similar questions are necessary to provide a more accurate evaluation of where Kisumu County stands in terms of physical accessibility to healthcare.

Limitations

As mentioned above, 4.91 percent of the original dataset extracted from Kisumu County Hospital was not assigned a location. Several circumstances left a record un-located, for example, nearly 100 records listed "Prison" or "Prisoner" as the residence. More than 300 records listed "NBU" for Newborn Unit as the residence and more than 500 listed "Street" or "Street boy." These terms and their variations rendered the records containing them unable to

be geographically located, and therefore these patients were left out of the analysis. Another factor limiting the accuracy of the dataset is time. The time required to access the database from KCH was longer than expected, leaving only one week for the process of assigning coordinates to residences. In that time period, 441 unique residences were identified and located, and their coordinates were assigned to the corresponding records. However, several residences remain that were not located. Residences with only one or two patients were given lowest priority, and most of the 4.91 percent without a location were those residences with fewest patients. Given more time, these residences would have been located and included in the dataset, providing a more accurate picture of patient distribution.

Other limitations lie in the manner in which patient information was entered into the out-patient database at KCH. As noted in the Results, 0.07 percent (n=55) of total patients were classified as "out of range" in the age category. The decided maximum possible age for this study was 110, and 55 patients were listed as being outside that range. Values in this category ranged from 126 to 929. Additionally, as noted in the Results, 30.40 percent of total records contained both a location and a diagnosis. A more accurate picture of KCH's case burden by diagnosis would naturally be achieved with 100 percent of records listing the patient's diagnosis.

While 62.25 percent of patients lived within five kilometers from Kisumu County Hospital, 38.75 percent lived outside that range, as discussed above. This study did not set a limit for the furthest possible distance a patient could reasonably travel or did not establish any "out of range" locations. However, such a limit should be established, in order to remove outliers from the analysis. For example, several records listed Mombasa, Kilifi, or Nairobi as the residence, yet no patient could reasonably be expected to travel from those locations to Kisumu County Hospital for care. Other factors are clearly involved in such cases; a patient may have been on holiday in Kisumu when he/she fell ill, or a patient may have listed his/her family/ancestral home as the residence though he/she currently resides in/near Kisumu.

Recommendations

As alluded to above, further research is strongly recommended to provide a more accurate assessment of the status of Universal Health Coverage and physical accessibility to health services in Kisumu County. This study measured the distance from patient residences to Kisumu County Hospital, however, measuring the distance from patient residences to nearest health facilities will prove of greater relevance to UHC evaluation. Kenya's Ministry of Health currently operates a Geographic Information System locating health facilities in Kenya. Distance measurements can be easily calculated by layering the health facility location data with the patient location data from this study and utilizing geoprocessing tools in ArcMap.

Distance calculations are necessary to evaluate Universal Health Coverage from the physical access perspective, yet UHC encompasses more than geographic proximity alone. Adequate access in terms of quality of services is also included in UHC. Insight into this component can be gathered by mapping KCH patient locations and KCH's intended catchment area. This analysis will reveal if and to what extent Kisumu County Hospital is overburdened and serving patients outside of its designated catchment area. An overburden of patients results in a shortage of staff and compromises the quality of services provided.

Conclusion

The development agendas of both the United Nations and Kenya specifically highlight the achievement of Universal Health Coverage as a priority in the coming years. UHC is a crucial pillar of economic development, as it expands access to quality services, creating a healthier and more productive population, and prevent families from financial ruin by exorbitant out-of-pocket costs. Nations seeking to reach this goal in the next decade will be force to do so in the context of a rapidly urbanizing population; the future of UHC must provide coverage able to keep pace and adapt to the changes urbanization inevitably brings. This challenge acts as a call for further research to inform implementation strategies and build coverage plans tailored to target populations.

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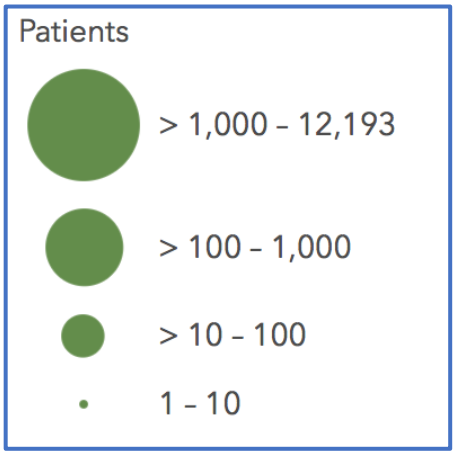
Appendix

ArcGIS Online map

http://urichmond.maps.arcgis.com/apps/View/index.html?webmap=0b850ca1fcc445979aad126aa17e2f96

This interactive map allows users to view the geographic distribution of patients, and zoom in and out of different region in and around Kisumu. Use the + and – signs in the upper-right-hand corner to zoom. This map uses proportional symbols, with larger circles corresponding to higher number of patients. Within the map, users can turn on and off different layers, by checking and unchecking the box next to the layer title on the right-hand side of the page. (Click the layer icon in the upper-right-hand corner to make the layer box visible). Each location is selectable, and once selected, a pop-up will appear listing the source (the landmark used to locate the residence), the number of patients, the residence (as listed in the KCH database), and the latitude and longitude of the source. Kisumu's sub-counties are outlined in black and labeled, and Kenya's counties are outlined in red. Kisumu County Hospital is symbolized by a black star, and a layer showing health facilities in Kenya is also able to be displayed and selected. For further analysis, distance from patient locations to health facilities in this layer can calculated and used to provide a stronger evaluation of progress toward the five-kilometer goal. The symbol legend is captured below.



Kisumu County Approval Letter

COUNTY GOVERNMENT OF KISUMU

Telegrams: "PRO.(MED)"
Tel: 254-057-2020105
Fax: 254-057-2023176
E-mail: kisumucdh@gmail.com

When replying please quote:

County Director of Health,
Kisumu.
P.O. Box 721-40100,
KISUMU.

DEPARTMENT OF HEALTH

RE: GN 133 VOL. IX (398) **Date: 31st October 2018**

School for International Training,

P.O Box 7286-40100,

Kisumu.

RE: PERMISSION TO CONDUCT FIELD STUDY IN KISUMU COUNTY AND ITS ENVIRONS

The following students are hereby authorized to conduct their internships and/or independent study projects within the County Government of Kisumu, its health facilities and surrounding communities. Their topics will contribute towards the implementation and review plans for the County as the SIT partners with us under its program theme: Urbanization, Health and Human Rights.

Name	Passport Number	Area of Interest
Nicolas Fernandez	535423215	Devolution Progress
Zoe Haskell	556579644	Health Projects and NGOs
Lola Flomen	GJ0303381	Neglected Tropical Diseases
Megan Powell	535733391	Tuberculosis
Anna Petty	543661310	Emergency Medicine
Emma Stevens	513627843	Maternity
Lauren Scheffey	583913775	Health Facility/GIS Mapping
Arden Saravis	553421657	Adolescent Girls

SIT IRB Approval Letter

SIT Study Abroad
a program of World Learning
1 Kipling Road, PO Box 676, Brattleboro, Vermont 05302-0676 USA
Tel 802 258-3212 | Toll Free 888 272-7881 | Fax 802 258-3296 | www.sit.edu/studyabroad | www.worldlearning.org

2nd November 2018.

RE: TO WHOM IT MAY CONCERN

Lauren Scheffey holder of US Passport # **583913775** is a student attending the Fall 2018 School for International Training (SIT) Study Abroad Kenya program with the permission of her home university/college.

School for International Training (SIT) Kenya is situated in Kisumu and runs two programs i.e. ***Spring*** running from ***January to May*** and ***Fall*** running from ***September to December*** (15-weeks) and ***Summer*** running from ***May to July*** (7-week) respectively.

The program involves delivery of modules under the theme: ***Urbanization, Health and Human Rights*** by subject matter experts in the three fields. SIT Kenya takes students to the ***Kenya Medical Research Institute (KEMRI)*** for lab tours, field visits and experiential sessions with Scientists from diverse research areas. The students also visit County health facilities, Non-Governmental Organizations to learn from the professionals. Additionally, students receive language classes in Kiswahili and are placed in Kenyan host families for intercultural immersion.

As part of their final month, SIT Kenya students are required to choose to conduct an independent project study (ISP) or internship experience in their topics of interest. Her study titled: ***"An analysis of the geographic nature of health-seeking behavior in Kisumu County"***, has been approved by SIT Local Review Board in Kisumu, Kenya and any assistance you accord her in the process of conducting her field work will contribute to her final study report that counts towards her credit awards from this program.

We thank you in advance for your support.

Yours Sincerely,

Steve Wandiga, PhD.
Academic Director
Phone: +254733214308
Email: steve.wandiga@sit.edu