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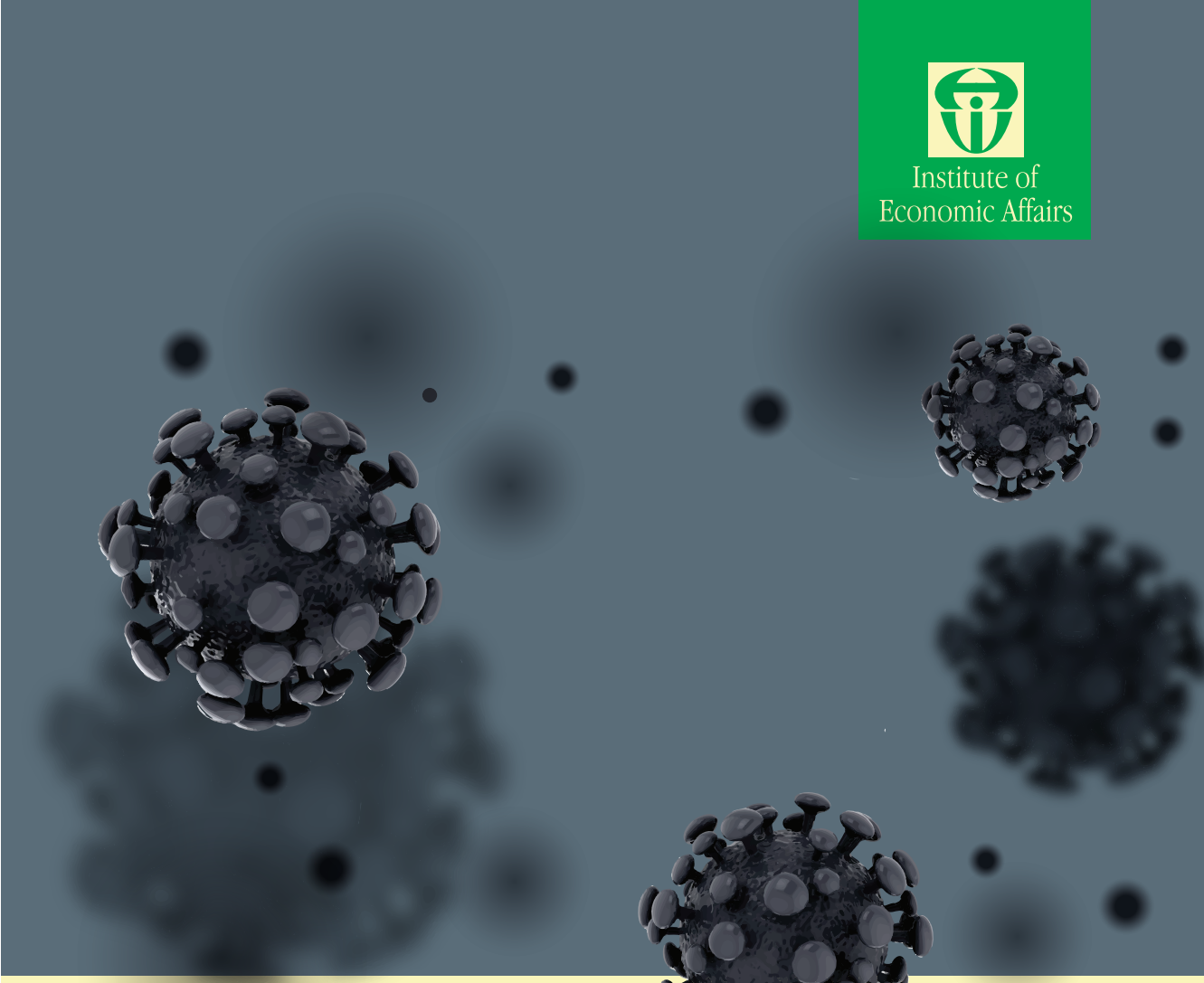

Covid-19 in Kenya: Indices on County Healthcare Capacity and Populations at Risk

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Acronyms and Abbreviation

CDC	Centre for Disease Control
CHV	Community Health Volunteers
CoG	Council of Governors
COVID-19	Corona Virus Disease
FELTP	Kenya Field Epidemiology and Laboratory Training Program
KEMRI	Kenya Medical Research Institute
KIPPRA	Kenya Institute of Public Policy and Research Institute
KNBS	Kenya National Bureau of Statistics
MOH	Ministry of Health
MTRH	Moi Teaching and Referral Hospital
NERC	National Emergency Response Committee
NHIF	National Health Organisation
PCR	Polymerase Chain Reaction
SARS-COV-2	Severe Acute Respiratory Syndrome Coronavirus-2
WHO	World Health Organisation

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Executive Summary

The virus, COVID-19 is burdening an already strained healthcare system in Kenya. Under the 2010 Constitution and after the 2013 election, healthcare is one of the 14 functions that has been devolved to the newly formed 47 counties. County governments are now at the frontline of delivering services to address the COVID-19 pandemic. However, healthcare capacity in the 47 counties is varied. Historical inequalities across regions, and in the health sector, date back to colonial times and despite seven years of devolution (2013-2020), convergence towards a uniform healthcare system across counties is far from a reality. This report offers some empirical evidence on which of the 47 counties in Kenya are best and least-well situated to deal with the Covid-19 virus. The purpose here is to assist policy makers in determining where limited resources, financial, human, and medical, can best be employed and where additional support may be provided by the national government to augment local resources.

The report presents data on two critical dimensions of countries specific circumstances: their healthcare capacity to respond to the virus and the risk to their population of contracting the disease. The data are presented in the form of two indices, specifically a healthcare capacity index and a population risk index. As the objective is cross-county comparisons, these are both relative measures. Another measure on county population size is also provided since the absolute size of a county's population may be a factor in how resources need to be deployed.

The analysis groups counties in four quadrants. The best situated counties are the ones that score highest in healthcare capacity and the lowest in population risk (high capacity/low risk quadrant). Conversely, the counties that score the lowest in capacity and highest in risk are the most vulnerable in relative terms (low capacity/high risk quadrant). The other quadrants are high risk and high capacity and low risk and low capacity. However, even counties with high capacity may not be as secure as they may seem since a large population size may overwhelm existing healthcare capacity if the disease spreads widely.

Seven counties -- Siaya, Vihiga, Kitui, Kwale, Homa Bay, Kilifi, and Uasin Gishu appear to be in the high risk/low capacity quadrant; hence they are the least prepared counties for an upsurge of virus cases. Other factors also disadvantage these counties. They all have relatively large populations of close to or over 1 million except for Vihiga. The low risk/low capacity quadrant contains 16 counties several of which could be problematic, despite their low risk, because their population size could overwhelm their limited capacity. Five counties have populations of over 1 million with another seven at or close to 900,000. The high risk/high capacity quadrant contains 17 counties, including

Kenya's busiest counties –Nairobi and Mombasa—again vulnerable due to their large population size, 4.4 million and 1.2 million, respectively, despite their high capacity. Only seven counties are in the most preferred low risk/high capacity quadrant. Most are of moderate size except for Kajiado with a population over 1 million.

The policy recommendations, based on this analysis, put forward in this report are four-fold;

1. **Testing should prioritize high risk counties:** In the absence mass testing, policy- makers allocating scare testing resources need to prioritize testing in high risk counties, including counties with high capacity where population size is significant

2. **Special measures for counties at the borders:** Testing and quarantine facilities need to be strengthened at border counties .to limit the spread of the disease. County borders are porous in Kenya, and border counties are significant vectors for transference of the disease from outside the country.

3. **Better coordination between the national and local government:** To effectively achieve the benefits of decentralization in a devolved structure of healthcare services, better coordination between national and local government is important. A step here would be to have representation of the Council of Governors, on the National Emergency Response Committee (NERC). Further, a special sub-committee of high-risk counties may be merited.

4. **Better public health messaging:** the most effective means to contain the spread of COVID-19, are social distancing, wearing masks, and rigorous programs for tracing and isolation. Given that risk is greater in some counties than others, strategic messaging targeted to counties in line with their specific evidence-based circumstances is important.

1

1.0 Introduction

In December 2019, the World Health Organisation (WHO) received reports about a disease with pneumonia-like symptoms from Wuhan, a city in China. The disease, COVID-19, is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-COV-2). On March 11, the WHO declared it a pandemic due to the disease's global spread and severity (WHO, 2020). Two days later, Kenya confirmed its first positive case of COVID-19, an announcement that triggered a debate about public health, and how prepared Kenya's health system was to protect its citizens from the virus.

COVID-19 is burdening an already strained health system in Kenya, much as it has strained health systems in more advanced economies. The 2010 Constitution of Kenya lists "the highest attainable standard of health" as a constitutional right. The same constitution also instituted a radical governance reform of Kenya, specifically the decentralization of significant government responsibilities from the national government to 47 newly established counties. Healthcare is, perhaps, the most important function that has been devolved, with major consequences for how the COVID-19 response will be managed.

Under decentralization, the responsibility of providing preventive and curative health services lies with the new county governments in Kenya. County governments now manage level one-to five (out of six levels) of all healthcare facilities and are now at the frontline of managing the response to COVID-19. The COVID-19 pandemic has hit Kenya seven years after decentralization was institutionalized and it is the first systematic test of the new governance structure of the healthcare sector. Historical inequalities across regions in Kenya date back to the colonial times, and this has also been perpetuated post-independence. The result has been a very uneven healthcare system across Kenya (Wanyande, 2016). Despite seven years of decentralized government, and strategic priority given to the healthcare sector by both the national and sub-national level governments, convergence toward a uniform healthcare system across counties is far from a reality in Kenya. Different counties are at very different levels of capacity to respond to the pandemic. Sub-national or county level capacity to respond to the COVID-19 is only one factor in how counties will be able to respond to the spread of the disease. The other factor is the risk to each county's population of being infected by the disease based on characteristics that determine its epidemiological burden. Policy-makers in Kenya will need to consider both of these factors to determine how best to respond to the pandemic.

The purpose of this report is to provide guidance to Kenyan policy-makers, through empirical evidence, on country healthcare system capacity and population risk to COVID-19. It does this by

constructing two indices, one on healthcare capacity (the capacity index), for measuring the relative capability of counties to respond to the virus, and a population risk index (risk index) for the relative risk faced by the residents of the county. The indices provide tools for policymakers for assessing sub-national risk and capacity and also for making decisions regarding county support.

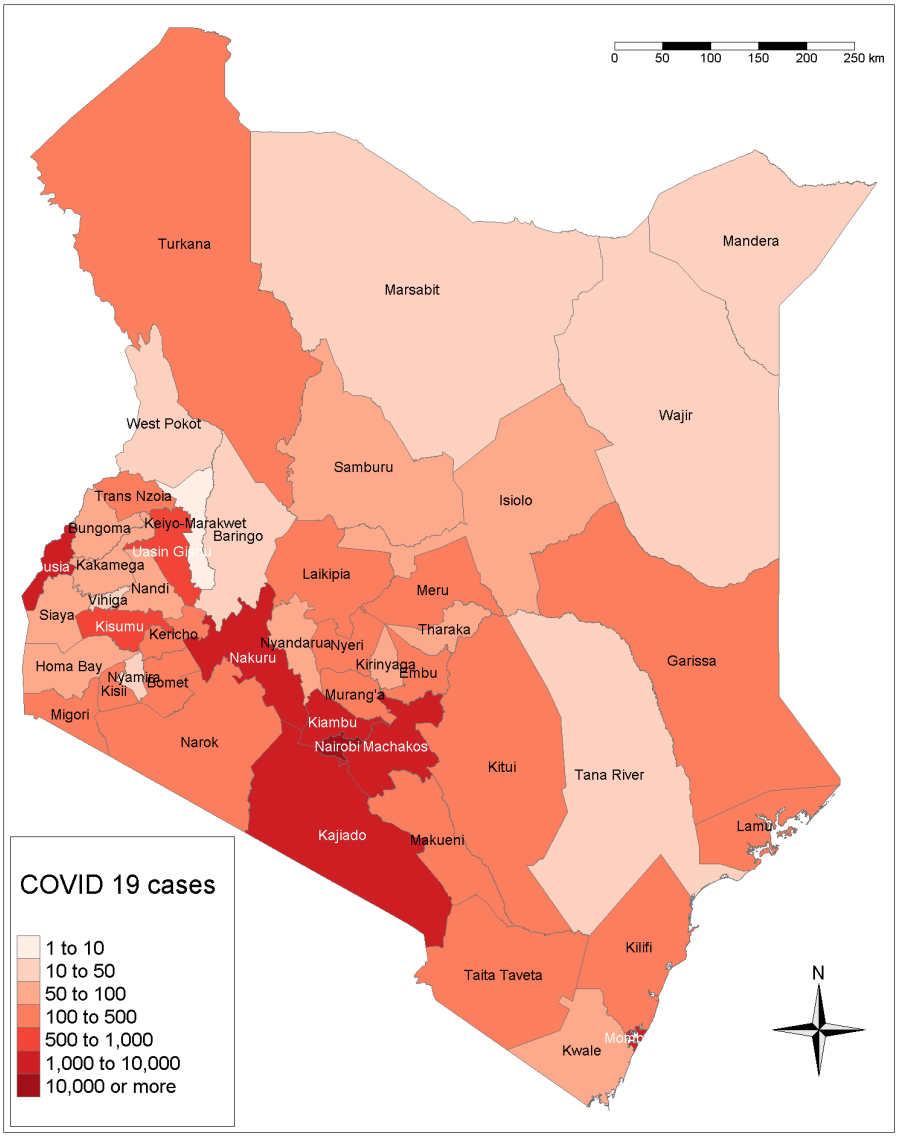
This report is structured in three parts. The first section is this introduction, which also offers some background, including the current status of the disease in Kenya, and an overview of the healthcare system post-decentralization. Section 2, which is the key contribution of this report, discusses the construction of the indices and results. The capacity index, which focuses on the healthcare system, includes 14 factors such as the number of healthcare workers, budget allocated to health services, available beds and cots, and the number of facilities per square kilometre. The population risk index, composed of seven factors, focuses on the people's demographic traits such as their age and HIV prevalence, among others. Section 3 summarizes current policies the Government of Kenya (GOK) has put in place and suggests certain adjustments, in light of the insights from the analysis in Section 2, to respond to COVID-19.

1.1 The status of the pandemic in Kenya as of September 30, 2020

The status of COVID-19 as of September 30th[1] is given in Figure 1. As of this date, 54,7946 tests have been conducted (1,152 per 100,000 population); the number of cases that tested positive amounted to 38,529 (81 per 100,000 population) and the number of fatalities was 711, at a 1.8 per cent fatality rate. The top four counties with the highest percentages of total cases were Nairobi (53.5per cent), Mombasa (7.5per cent), Kiambu (7.1per cent), and Kajiado (5.1per cent), which together equal 73.2 per cent of all cases in the country.

[1]Data on COVID-19 in Kenya is as of 30th of September, 2020 when this report was finalized

Figure 1: Status of COVID-19 in Kenya, as September 30, 2020



Summary as at 30th September 2020

- Number of tests: **547, 946** (1152 per 100,000 population)
- Number of cases: **38,529** (81 per 100,000 population)
- Number of recoveries: **24,908**; Recovery rate: **64.6%**
- Number of fatalities: **711**; Fatality rate: **1.8%**

Source: Author's Computation

The Ministry of Health reported that capacity to test in Kenya for COVID-19 as at June 2020 is 7,300 samples per day for both the public and private laboratories (Ministry of Health, 2020). As of September 30, 2020 (exactly 229 days since the first case was reported in Kenya), only 547,946 tests had been conducted, a daily average of 2,392 tests, a number significantly below stated capacity.

1.2 Healthcare services in Kenya post-2013

In March 2013, 47 county governments took control over healthcare systems in their jurisdictions, the consequence of a far-reaching decentralization program mandated in the 2010 Constitution. There are three forms of decentralization: (1) deconcentrating, where the national government places staff at the local level but retain decision-making power; (2) delegating, where management of some public functions is transferred to a semi-autonomous or parastatal organizations; (3) devolution which is "the transfer of authority and responsibility (political, administrative, and financial) from central to lower levels of government for a range of public functions" (Williamson and Mulaki, 2015).

There are elements of all three forms of decentralization in Kenya's management of the healthcare system. The dominant structure under which the healthcare sector is managed is devolution, although some aspects of deconcentrating (for example, seconded staff to county facilities) and delegation (for example, the National Hospital Insurance Fund county offices that are answerable to headquarters) continue to exist. The shift of fiscal and administrative responsibility of the sector to sub-national government, closer to people who receive those services and who can politically hold local politicians accountable for their performance through elections, is seen to boost efficiency of those services, and lead to greater accountability of politicians (and bureacrats), for that sector's performance.

Table 1 shows the demarcation of responsibilities of the national and county government for the healthcare sector under devolution as per the Fourth Schedule of the Constitution of Kenya (2010). Under devolution, the national government is responsible for regulation, policy formulation and monitoring, while the counties are responsible for the management of service delivery at the front line. Preventive and curative services are moved to the control of county governments. These include county health facilities and pharmacies, ambulance services, promotion of primary healthcare as well as human resources. The national government focuses on, policy development, management of national referral health facilities, and technical assistance to counties (Republic of Kenya, 2010). For COVID-19 management, the devolved responsibilities that are particularly relevant are the management of county health facilities and pharmacies, disease surveillance and response, and disaster management.

Table 1: Division of labour between national and county government

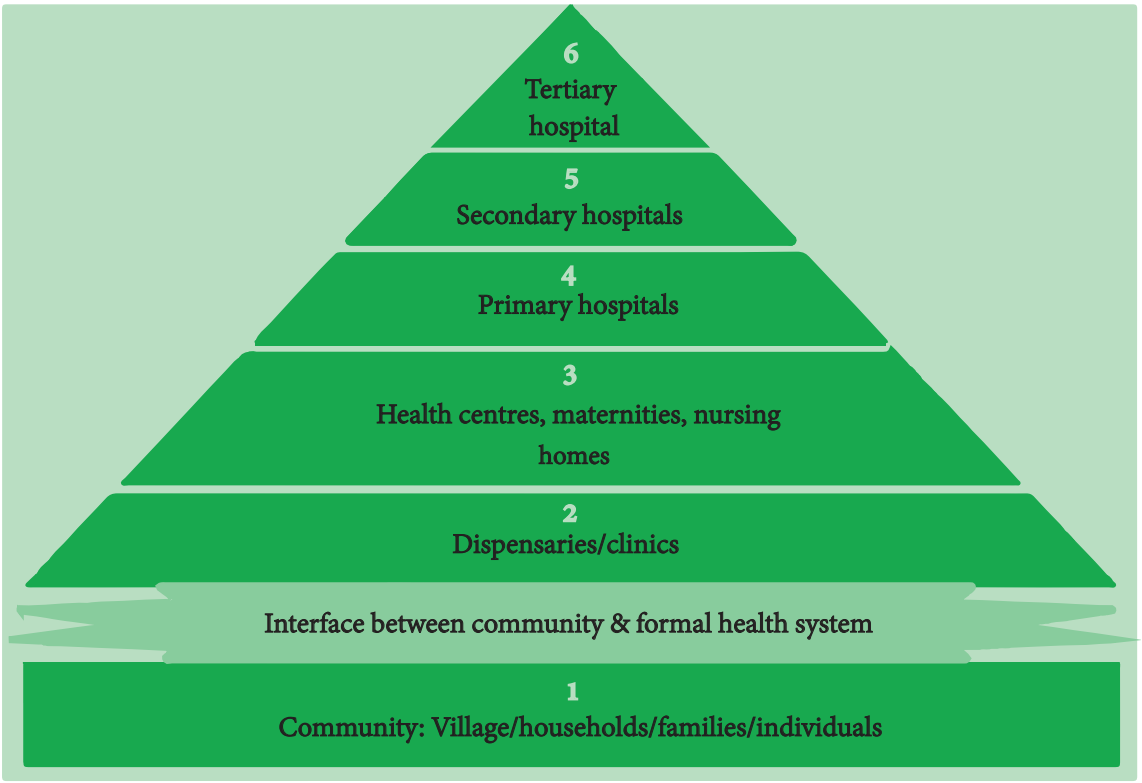
National government	County government
• Health information, communication and technology	• County health facilities and pharmacies
• Health policy	• Ambulance services
• Financing	• Promotion of primary healthcare
• National referral hospitals	• Public health and sanitation
• Quality assurance and standards	• Licensing and control of agencies that sell food to the public
• National public health laboratories	• Disease surveillance and response
• Public-private partnerships	• Veterinary services (excluding regulation of veterinary professionals)

• Monitoring and evaluation	• Cemeteries, funeral homes, crematoria, refuse dumps, solid waste disposal
• Planning and budgeting for national health services	• Control of drugs of abuse and pornography
• Services from the Kenya Medical Supplies Agency (KEMSA), National Hospital Insurance Fund (NHIF), Kenya Medical Training College (KMTC) and the Kenya Medical Research Institute (KEMRI)	• Disaster management
• Ports, boundaries and trans-boundary areas	
• Major disease control (malaria, TB, leprosy)	

Source: Republic of Kenya (2010)

The devolved health system is organized in six levels: level one and two are for primary care and community health for preventive medicine; and levels three to six, for curative and referral services. Levels one to five are managed by the county governments. Facilities at level six are owned and managed by the national government and are solely for referral services (Ministry of Health of Kenya, 2014b). The community level focuses on organizing appropriate demand for services, while primary care and primary referral services respond to this demand (Figure 2).

Figure 2: Health service levels in Kenya



Source: Ministry of Health

The majority of the healthcare facilities (estimated to be about 80 per cent) are level two and three facilities. These are focused on primary healthcare, and include community health facilities, dispensaries and health centres. Levels four and five comprise secondary health facilities which provide specialized services such as surgeries (Ministry of Health, 2005). Level six facilities-the national referral hospitals-are highly-specialized tertiary hospitals which also provide healthcare but have additional roles of training and research. These facilities include: Mathari Teaching and Training Hospital, Kenyatta University and Training Hospital, Kenyatta National Hospital and the National Spinal Injury Referral Hospital in Nairobi County. The others are Moi Teaching and Referral Hospital in Eldoret (KMPDC, 2019). The distribution of the facilities shows that the GOK, national and counties, owns the largest share (43 per cent) of the facilities, followed by the private sector (38 per cent), and then faith-based organizations (11 per cent). Non-Governmental Organizations and other institutions own the rest (8 per cent) (Ministry of Health of Kenya, 2014a).

2

2.0 Healthcare Capacity and Population Risk Indices

This section of the report addresses the question of which of Kenya's 47 counties are best and least- well situated to deal with the COVID-19 virus. The purpose here is to assist policy-makers in determining where additional support may be provided by the national government to augment local county resources. For this purpose, data are presented here on two critical dimensions of the counties' specific circumstances: their healthcare capacity to respond to the virus and the risks to their populations of contracting the disease. In each case the data are presented in the form of an index. Thus, a healthcare capacity index and a population risk index are the tools which will be used throughout this section to analyse the specific situation of each county[2].

2.1. The approach

It should be noted that both the healthcare capacity index and the population risk index are relative measures since the objective is to afford cross-county comparisons. This is accomplished by putting all data on either a per capita or other relative basis. However, since the absolute size of a county's population may also be a factor in considering where additional resources may best be deployed, this information is included as a separate measure as discussed further below. The healthcare capacity index (capacity index) is composed of 14 separate indicators, and the population risk index (risk index) for measuring the relative risks faced by the residents in each of the counties is composed of seven indicators. The specific indicators for each index are listed in Table 2.

[2]On the capacity index, see the related article by Bitton, A. et. al. (2017) 'Building resilient health systems: a proposal for a resilience index'. *The British Medical Journal.]*

Table 2: List of healthcare capacity and population risk indicators

Capacity Indicators	
Indicator 1	Per Capita Health Expenditure (Recurrent)
Indicator 2	Doctors per 100,000 population
Indicator 3	Nurses per 100,000 population
Indicator 4	Clinical Officers per 100,000 population
Indicator 5	Public Health Workers per 100,000 population
Indicator 6	Medical Workers per 100,000 population
Indicator 7	Primary Health Facilities per 100,000 population
Indicator 8	County and Sub County Health Facilities per 100,000 population
Indicator 9	Total Beds and Cots Facilities per 100,000 population
Indicator 10	Number of Medical Labs per 100,000 population
Indicator 11	Facilities for Improved Water and Sanitation (per cent of population with access)
Indicator 12	Facilities for Hand Washing near Toilets (per cent of population with access)
Indicator 13	Facilities for Communication (per cent of population with mobile phones)
Indicator 14	Total Health Facilities per 100 Km^2
Risk Indicators	
Indicator 1	per cent Population (60+ years)
Indicator 2	per cent Urban population
Indicator 3	Mortality Rate (Deaths per 100,000 population)
Indicator 4	Morbidity Rate (Cases per 100,000 population)
Indicator 5	HIV prevalence (per cent)
Indicator 6	Distance to the nearest Airport (Nairobi or Mombasa)
Indicator 7	Visitors to Game Parks and Museums

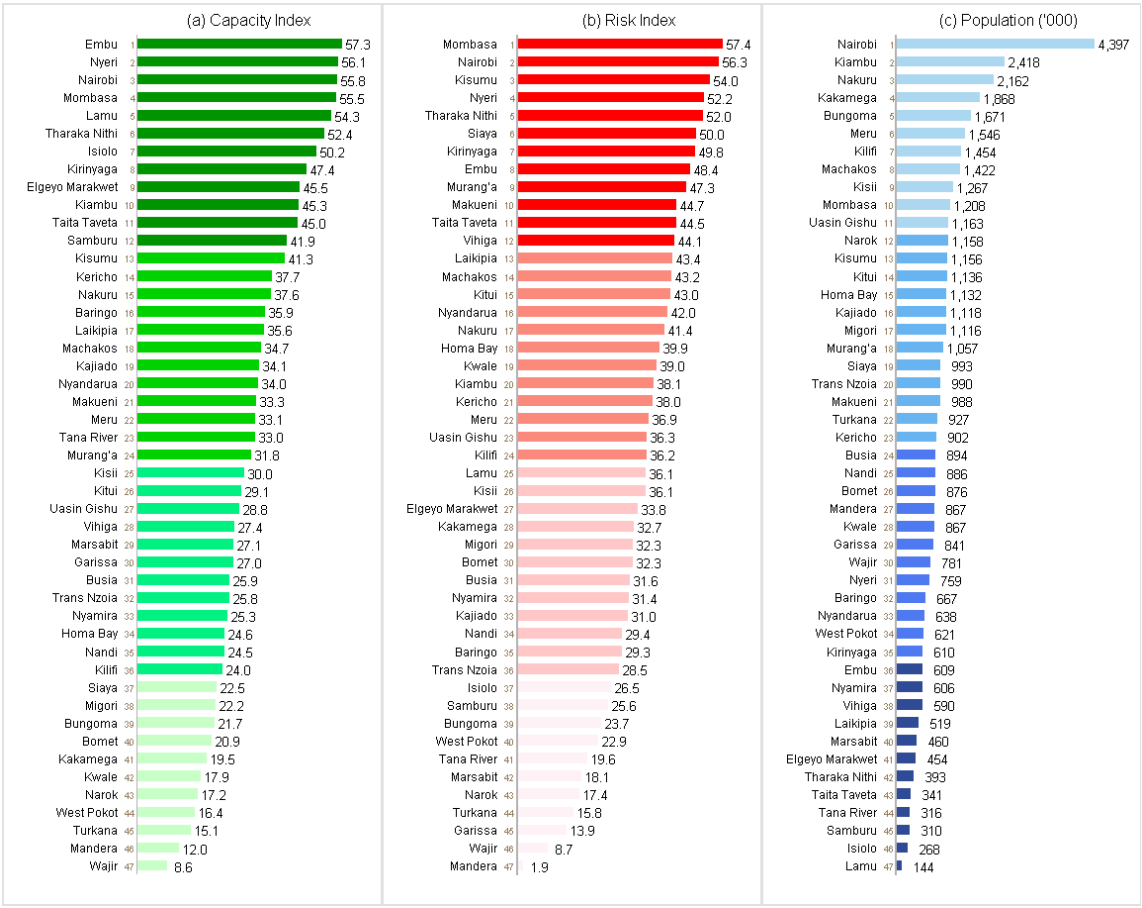
Source: Author's Computation

For each index, the relative scores on all the subcomponent indicators are shown in the Annex to this report. The indicators for each index are then equally weighted to develop the final indices. The Annex presents the specific methodology used to develop the capacity and risk indices as well as the detailed tables and data sources. A useful extension of the current analysis would be to accord a higher risk of infection to border counties, perhaps based on conditions of the countries on the other side of the borders – Sudan, Ethiopia, Somalia, Tanzania, and Uganda.

2.2 Results of counties' capacity and risk

The diagram below shows how the 47 counties rank on healthcare capacity, population risk, and population size, in thousands.

Figure 3: Summary of the capacity and risk index ranking



Source: Author's Computation

According to these computations, the best situated counties are the ones that score highest in health capacity and lowest in population risk. Conversely, the counties that score lowest in capacity and highest in risk are the most vulnerable in relative terms. As shown in the healthcare capacity index, the first column in **green**, the counties of Embu, Nyeri, Nairobi, Mombasa, and Lamu are best endowed with health facilities and/or health professionals on a per capita basis while Turkana, Mandera, and Wajir suffer from very limited relative healthcare capacity.

In the population risk index, in **red**, Mombasa, Nairobi, Kisumu, Nyeri, and Tharaka Nithi face the greatest risks per capita while Garissa, Wajir, and Mandera face relatively low risk. These results are hardly surprising. Kenya's capital and the country's richest county (Nairobi) and other cities (Mombasa, Nakuru and Eldoret in Uasin Gishu County) have the most health facilities and healthcare

professionals (Ministry of Health of Kenya, 2015). Although these counties are best equipped, they are also the most at risk because of their urbanized nature and could find their facilities overwhelmed by extremely high caseloads. Also, like many cities in Lower Middle-Income Countries these urban cities are undergoing an epidemiological transition: a change in disease patterns where morbidity and mortality and infectious epidemics are falling, while deaths from chronic, non-communicable and degenerative diseases are increasing (Onyango and Onyango, 2018). Even under these conditions, the underlying incidence of disease complicates patients' outcomes when they are affected by COVID-19. Major cities are also international tourist destinations, with visitors arriving through airports, thereby facilitating the entry and spread of COVID-19 throughout the population.

An adequate number of healthcare workers per 10,000 population is a crucial component to disease response (Nuzzo et al., 2019). Therefore, Mandera with only 4 doctors and 90 nurses and Wajir with 14 doctors and 54 nurses, unsurprisingly, have low scores for healthcare capacity, a result further undermined by relatively fewer beds and cots (860 in Mandera and 506 in Wajir). In sharp contrast, Nairobi has a population of 4.4 million (KNBS, 2019) which is about five times that of Mandera and Wajir, yet it has 413 doctors and over 1,000 nurses. Nairobi also has over 8,500 beds and cots, which is 10 to 20 times more than the capacity of Wajir and Mandera[3]. Embu's position as a high capacity county is due to the relatively high numbers of medical professionals and facilities. The Embu County government spends more money on health on a small population of just about 600,000 as compared to other counties.

Table 3: Distribution of COVID-19 cases as of 30th September 2020

NE Quadrant (High Population Risk & High Health Capacity)

County	Overall Score (Capacity)	Overall Score (Risk)	COVID-19 Cases	Population (2019)	COVID-19 Cases per 100,000 population
1. Nairobi	56.39	55.72	20,650	4,397,073	469.6
2. Mombasa	54.95	58.02	2,902	1,208,333	240.2
3. Kiambu	45.31	38.14	2,747	2,417,735	113.6
4. Machakos	34.67	43.17	1,323	1,421,932	93.0
5. Nakuru	37.62	41.37	1,131	2,162,202	52.3
6. Kisumu	41.34	54.03	551	1,155,574	47.7
7. Kericho	37.74	38.04	357	901,777	39.6
8. Nyeri	56.07	52.23	295	759,164	38.9
9. Laikipia	35.64	43.37	268	518,560	51.7
10. Murang'a	31.85	47.30	193	1,056,640	18.3
11. Taita Taveta	45.00	44.46	174	340 ,671	51.1
12. Makueni	33.28	44.67	167	987,653	16.9
13. Embu	57.31	48.37	161	608,599	26.5

[3]Further, Mandera and Wajir are border counties with Somalia, a country that has reported over 3,588 COVID-19 cases as of Sep 30, hence this is likely to increase the cross-border risks of the importation of the virus.

14. Meru	33.06	36.90	139	1,545,714	9.0
15. K irinyaga	47.42	49.82	87	610,411	14.3
16. Nyandarua	34.04	42.04	59	638,289	9.2
17 .Tharaka Nithi	52.38	51.98	53	393,177	13.5
Sub-Total	**41.34**	**44 .67**	**31,257**	**21,123,504**	**148**

NW Quadrant (High Population Risk & Low Health Capacity)

County	Overall Score (Capacity)	Overall Score (Risk)	COVID-19 Cases	Population (2019)	COVID-19 Cases per 100,000 population
1. Uasin Gishu	28.79	36.34	605	1,163,186	52.0
2. Kitui	29.14	43.04	303	1,136,187	26.7
3. Kilifi	23.97	36.20	228	1,453,787	15.7
4. Kwale	17.87	38.96	82	866,820	9.5
5. Siaya	22.47	49.99	81	993,183	8.2
6. Homa Bay	24 .60	39.89	68	1,131,950	6.0
7. Vihiga	27.39	44 .10	36	590,013	6.1
Sub-Total	**24 .60**	**39.89**	**1,403**	**7,335,126**	**19.1**

Source: Author's Computation

SW Quadrant (Low Population Risk & Low Health Capacity)

County	Overall Score (Capacity)	Overall Score (Risk)	COVID-19 Cases	Population (2019)	COVID-19 Cases per 100,000 population
1.Busia	25.86	31.63	1,246	893,681	139.4
2. Migori	22.16	32.30	464	1,116,436	41.6
3. Carissa	27.03	13.93	390	841,353	46.4
4. Kisii	30.04	36.08	326	1,266,860	25.7
5. Narok	17.23	17.44	264	1,157,873	22.8
6. Turkana	15.08	15.76	216	926,976	23.3
7. Trans Nzoia	25.80	28.47	178	990,341	18.0
8. Bomet	20.87	32.29	143	875,689	16.3
9. Kakamega	19.50	32.70	84	1,867,579	4.5
10. Nandi	24 .47	29.40	74	885,711	8.4
11. Bungoma	21.74	23.69	61	1,670,570	3.7
12. Wajir	8.64	8.67	41	781,263	5.2
13. Mandera	11.97	1.90	29	867,457	3.3
14. Nyamira	25.26	31.39	27	605,576	4.5
15. Marsabit	27.07	18.06	24	459,785	5.2
16. West Pokot	16.43	22.86	17	621,241	2.7
Sub-Total	**21.95**	**26.08**	**3,584**	**15,828,39 1**	**22.6**

SE Quadrant (Low Population Risk & High Health Capacity)

County	Overall Score (Capacity)	Overall Score (Risk)	COVID-19 Cases	Population (2019)	COVID-19 Cases per 100,000 population
1. Kajiado	34.13	30.98	1,973	1,117,840	176.5
2. Lamu	54.34	36.12	118	143,920	82.0
3. Isiolo	50.21	26.45	61	268,002	22.8
4. Samburu	41.85	25.65	56	310,327	18.0
5. Baringo	35.90	29.35	43	666,763	6.4
6. Tana River	32.99	19.65	25	315,943	7.9
7. Elgeyo Marakwet	45.49	33.84	9	454,480	2.0
Sub-Total	**41.85**	**29.35**	**2,285**	**3,277,275**	**69.7**

Source: Author's Computation

To their benefit, Wajir and Mandera, with populations of 780,000 and 867,000 respectively, also rank at the bottom of the population risk index. As noted earlier, these counties are also examples of populations at somewhat greater risk than these numbers would indicate due to their border locations. They have a small percentage of the population aged 65 and above, considered a "vulnerable population" for COVID-19 (United Nations, 2020); have low mortality and morbidity rates; and also, no special attractions for visitors such as game parks.

It is not just the relative capacity and risk measures across counties that should be taken into account when making decisions for policy purposes. Decisions should also consider the total size of the populations that could be affected in each county as shown in the third bar graph in blue. The COVID-19 pandemic could well overwhelm capacity across all counties in Kenya, even for those relatively better endowed with medical staff and facilities. Table 3 and Figure 1 present, in tabular and visual forms respectively, the circumstances of each county with respect to capacity, risk, and population size. The table assigns the 47 counties to one of four categories based on their scores shown in Figure 3 relative to the median values for the capacity and risk indices: (1) relatively high risk and low healthcare capacity, (2) relatively low risk and high capacity, (3) relatively high risk and high capacity, and (4) relatively low risk and low capacity. For each county, Table 3 also shows its population size and the number of reported cases of the virus as of September 30.

Figure 4 is a scatter plot diagram of much of this same information designed to better illustrate the situation of each county. In this diagram capacity, risk and population size are all represented. Scores on the health capacity index are plotted along the X axis, and scores on the risk index along the Y axis. The two dotted lines are positioned at the median scores for the two indices, the horizontal line for the population risk index and the vertical line for the health capacity index. Population size for each county is represented by the size of the circle.

The diagram is divided into four quadrants, each representing the categories of Table 3. The Northwest (NW) quadrant shows counties with relatively high risk and low health capacity, or those that appear to be most vulnerable to the COVID-19 virus. The Southeast (SE) quadrant shows counties with

relatively low risk and high capacity. Counties in the Northeast (NE) quadrant have both relatively high risk and high health capacity, while those in Southwest (SW) quadrant have relatively low risk and low capacity.

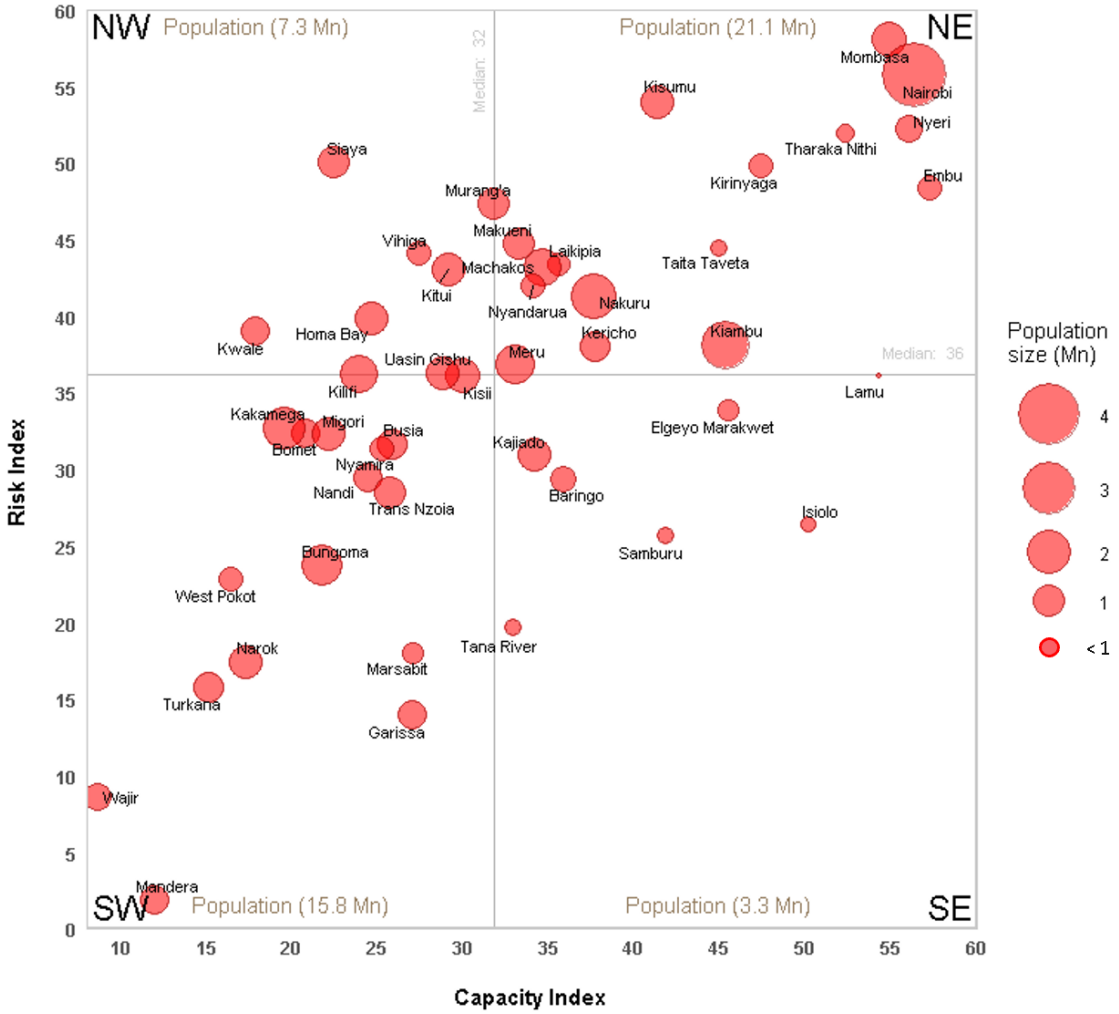
From the seven counties - Siaya, Vihiga, Kitui, Kwale, Homa Bay, Kilifi, and Uasin Gishu - appear to be in the high risk/low capacity NW quadrant (the last two barely so), hence the least prepared counties for an upsurge of virus cases. Other factors also disadvantage these counties. They have quite a large population of close to or over 1 million except for Vihiga (590,000 people).

The SW low risk/low capacity quadrant contains 16 counties several of which could be problematic, despite their low risk, because their population size could overwhelm their limited capacity. Five counties have populations of over 1 million with another seven at or close to 900,000. Mandera, with its population of 867,000 is perhaps the best example here.

Kenya's busiest counties –Nairobi and Mombasa— are at the extreme corner of the NE quadrant with high healthcare capacities although also vulnerable due to their urbanized nature in addition to their population size, 4.4 million and 1.2 million, respectively. In fact, the 17 counties in this quadrant include some of the largest in the country, including Nakuru and Kiambu (just above 2 million people), Meru (1.5 million) and Machakos (1.4 million) all of which face similar trade-offs regarding capacity versus risk and population size.

Only seven counties are in the most preferred low risk/high capacity SE quadrant, including the outlier Lamu (143,000 people), which is on the very edge of the quadrant, most are of moderate size except for Kajiado with a population over 1 million.

Figure 4: Healthcare capacity compared to population risk indices



Source: Author's Computation

2.3 The current distribution of cases

On April 6, 2020, the GOK identified four counties as hotspots of the disease—specifically, Nairobi, Mombasa, Kilifi and Kwale. Although Kilifi and Kwale were subsequently found to be relatively small players in the development and spread of the virus, the hotspot designation was accompanied by policy actions that were then applied more broadly throughout the country. The four counties were placed on partial lockdown for at least 21 days (subsequently further extended by another 21 days). Also, after the issuance of the president's directive, cessation of movement by road, rail or air in and out of the hotspot counties was expeditiously enforced – with the exemption of ferrying of foodstuffs and other essential products such as medical equipment and drugs. More broadly, on 26 April 2020, the previous nationwide dusk-to-dawn curfew was extended by another 21 days. These measures were aimed at slowing down the rate of infection so as not to overwhelm the health system (The Presidency, 2020).

As can be seen from Table 4 and Figure 1, by September 30, 2020, Kenya had recorded 38,529 cases of COVID-19 with Nairobi and Mombasa leading with 20,0650 and 2,902 cases respectively. In contrast, Kilifi and Kwale, the earlier hotspots, no longer ranked in the top tier of the total cases or cases per capita.

Table 4: Cases by counties by September 30, 2020

County	Cases	Shares (Percent)	Cases per 100 population	Population (2019)
1. Nairobi	20,650	53.596	469 .631	4,397,073
2. Mombasa	2,902	7.532	240 .166	1,208,333
3. Kiambu	2,747	7.130	113.619	2,417,735
4. Kajiado	1,973	5.121	176.501	1,117,840
5. Machakos	1,323	3.434	93.042	1,421,932
6. Busia	1,246	3.234	139.423	893,681
7. Nakuru	1,131	2.935	52.308	2,162,202
8. Uasin Gishu	605	1.570	52.012	1,163,186
9..Kisumu	551	1.430	47.682	1,155,574
10. Migori	464	1.204	41.561	1,116,436
11. Garissa	390	1.012	46.354	841,353
12. Kericho	357	0.927	39.589	901,777
13. Kisii	326	0.846	25.733	1,266,860
14. Kitui	303	0.786	26.668	1,136,187
15. Nyeri	295	0.766	38.859	759,164
16. Laikipia	268	0.696	51.682	518,560
17. Narok	264	0.685	22.800	1,157,873
18. Kilifi	228	0.592	15.683	1,453,787
19. Turkana	216	0.561	23.302	926,976
20. Murang'a	193	0.501	18.265	1,056,640
21. Trans Nzoia	178	0.462	17.974	990,341
22. Taita Taveta	174	0.452	51.076	340,671
23. Makueni	167	Q.433	16.909	987,653
24. Embu	161	0.418	26.454	608,599
25. Bomet	143	0.371	16.330	875,689
26. Meru	139	0.361	8.993	1,545,714
27. Lamu	118	0.306	81.990	143,920
28. Kirinyaga	87	0.226	14.253	610,411
29. Kakamega	84	0.218	4.498	1,867,579
30. Kwale	82	0.213	9.460	866,820
31. Siaya	81	0.210	8.156	993,183
32. Nandi	74	0.192	8.355	885,711

33. Homa Bay	68	0.176	6.007	1,131,950
34. Bungoma	61	0.158	3.651	1,670,570
35. Isiolo	61	0.158	22.761	268,002
36. Nyandarua	59	0.153	9.243	638,289
37. Samburu	56	0.145	18.045	310,327
38. Tharaka Nithi	53	0.138	13.480	393,177
39. Baringo	43	0.112	6.449	666,763
40. Wajir	41	0.106	5.248	781,263
41. Vihiga	36	0.093	6.102	590,013
42. Mandera	29	0.075	3.343	867,457
43. Nyamira	27	0.070	4.459	605,576
44. Tana River	25	0.065	7.913	315,943
45. Marsabit	24	0.062	5.220	459,785
46. West Pokot	17	0.044	2.736	621,241
47. Elgeyo Marakwet	9	0.023	1.980	454,480
Total	**38,529**	**1 00.000**	**81 .004**	**47,564,296**

Source: Ministry of Health and KNBS

3

3.0 Government Actions and Policy Recommendations

The last section established that there are large variations in county healthcare capacity and population risk to COVID-19. The analysis raises the following questions. How can these results be used to inform policy? Should preference be given to the counties with low capacity and high risks? Or should priority be given to high risk and high capacity counties, in light of population density, such as Mombasa and Nairobi? This chapter will list the interventions and recommendations that can augment the existing policies.

3.1. Policies already implemented by GOK

Below is a list of policies already in implementation by the GOK to address the COVID-19 pandemic:

Establishment of a task force-National Emergency Response Committee (NERC)

Through an executive order, the president of Kenya established the National Emergency Response Committee on 28 February 2020. The committee, comprised of government officials, international donors, scientists drawn from various disciplines, and civil society organizations, is tasked with the role of monitoring the risk posed by the fast-spreading virus. It also has the duty to advise the Ministry of Health on appropriate means of response (Ministry of Health, 2020).

Hotspots, lockdown, social distancing and contact tracing

On April 6, 2020, the GOK identified four counties as hotspots due to the early detection of the disease in these counties, (discussed above) —specifically, Nairobi, Mombasa, Kilifi and Kwale. The initial policy response was directed at these counties in order to isolate and control the spread of the disease. Steps such as lockdowns and social distancing are the most appropriate public health interventions for a disease without a vaccine or a cure such as COVID-19 (Arinaminpathy, 2020). Social distancing works in parallel with contact tracing, which is finding cases of exposures, and people who had contact with a positive case.

The government used community policing, although minimally through its *Nyumba Kumi* initiative[4] where community health workers, public health officers, multi-agency teams were employed at road blocks in addition to utilizing technology in tracking contacts. Malls, churches and political rallies that flout the social distancing and curfew rules have been closed and offenders are prosecuted. The government issued a clarion call for staying at home, social distancing and observance of basic hygiene among other measures.

Initially, the Ministry of Health relied on self-reporting by sick individuals but this proved ineffective due to stigma attached to COVID-19 and people under-reporting infection (Nanyingih, 9 May 2020). The Ministry of Health involved community health volunteers (CHVs), -- 63,350 in total in Kenya-- to help in active contact tracing and community surveillance. Sample collection and handling of the viruses to the lab is a specialized skill which the Ministry of Health left to the team from Kenya Field Epidemiology and Laboratory Training Program (FELTP) and public health officers. FELTP is an elite team of 'disease trackers' trained by a Center of Disease Control -USA (CDC)run a programme established in 2004 (Mwangangi, 2020).

Health education

The Ministry of Interior and National Coordination and the Ministry of Health collaborated with mobile phone service operators including Safaricom, Telkom and Airtel to disseminate information on COVID-19 to all subscribers.

Expansion and enhancement of testing capabilities

The government has extended COVID-19 testing capabilities across the country. There are testing centres at the Moi Teaching and Referral Hospital (MTRH) in Eldoret and the National Influenza Centre at Kenyatta National Hospital. Testing is also conducted at KEMRI Centres in Kilifi, Busia, Nairobi and Kisumu. These centres have the capability to carry out Polymerase Chain Reaction (PCR) tests, the gold standard test for COVID-19 (Gorse, Donovan and Patel, 2020; The World Health Organisation, 2020). There are also private partners such as the Aga Khan Hospital and Lancet laboratories, implementing the PCR tests. Together, these, with the MTRH, cover a scope of 22 counties.

Isolation and quarantining

Emergency response centers have also been established. Mbagathi Hospital has been designated as the main isolation centre for patients who test positive for COVID-19 by NERC. Other isolation centres include Kenyatta University Teaching Research and Referral Hospital and Kenya Medical

[4]This is a community policy strategy established in 2013 anchored at the household level targeted at ensuring safe and sustainable neighborhoods.

Training Colleges across the country. Each county was also instructed to prepare a Level four and five hospitals to be utilized for purposes of COVID-19 cases should need arise.

Covid-19 Emergency Response Fund

On 30 March 2020, the president established the COVID -19 Emergency Response Fund. The team in charge of the fund is tasked with mobilizing financial resources for emergency responses for containing the spread, and impact of the pandemic. Apart from the contributions from the National Treasury of Kenya, the Emergency Response Fund has been receiving donations from corporate entities, development partners and multinational institutions, among other sources.

Capacity building for county governments

Counties rely on the NERC's counsel for assistance on how they can respond to the pandemic. The national government has also trained healthcare workers on case definition, triage, sample collection and transportation (Irimu, 2020). The collaboration extends to preparation of isolation and quarantine facilities (IGC, 2020).

3.2. Policy recommendations and global lessons

Countries have to consider their institutional setting, and the political consequences of their actions to balance choices between saving lives and protecting livelihoods, in determining where they land on that spectrum (IGC, 2020). Kenya can learn from other countries' experience to minimize economic and social harm when implementing lock-downs, testing and contact tracing. Below are some additional proposals on policy based on some of the analysis on Section 2.

Testing should prioritize high risk counties

The WHO recommends an "urgent enough escalation in testing, isolation and contact tracing" as the "backbone of the response" (WHO, 2020). The GoK reported that the country had the capacity to run 7,300 PCR tests per day. Yet testing rates have been very low as referenced in section 1.1. The daily average is 2,932 tests per day which is far below the capacity claimed by the national government. This is likely to underestimate the real rate of infection across the country. Several explanations are offered for this, including: challenges in accessing testing kits occasioned by shortages and the interruption of global supply chains (Kavanagh, et al., May 2020); inadequate contact tracing and logistical difficulties in getting the samples from the people to the lab (Mwau, 2020)and the prohibitive costs at private labs.

In the absence of randomized mass testing, and in the face of scarcity of testing resources, policy makers cannot accurately determine the rate of infection and populations at risk. Testing in high risk and high population centres, then needs to be prioritized. The counties in the Northwest quadrant of Figure 4 of this report have elevated risk and low capacity and these are the counties that are critical to monitor because the rise in infections will quickly overwhelm the weak systems. Even counties with

somewhat lower risk or higher capacity but close to the NW borders, especially if their populations are large, such as Kisii and Kakamega in the SW quadrant and Meru and Nakuru in the NE quadrant should receive more attention for testing.

Evidence from South Korea, Taiwan, and Germany indicate that early testing, isolation and contact tracing is the best mechanism for limiting the number of infections and the burden on the health system. Kenya, like other countries in Africa, benefits from an existing infrastructure that was put in place to address other viruses such as the hemorrhagic fevers (Ebola) and other avian flus such as the H5N1 in 2009 as set up by the WHO and the CDC. These systems are being adapted to make testing and contact tracing a priority (Waijenburg & Frankema, 2020). The bigger challenge for Kenya and other developing counties is sourcing the necessary materials critical for testing on the global market in a period of excess demand (The New Humanitarian, 2020).

Special measures for counties at the borders

Kenyan borders are generally porous with lethargic control of movements in Amudat, West Pokot (Uganda), Migori (Tanzania), Turkana (Sudan), Busia (Uganda) and Marsabit (Somalia). Special measures need to be taken to test people at the borders for COVID-19 and isolate infected people. Counties in the Southwest quadrant in Figure 4 (low population risk and low capacity) are also counties that are on Kenya's borders. Evidence is emerging that truck drivers have tested positive in Kenya from neighboring countries (Owino, 2020). Mandera and Wajir counties have had a disproportionately large number of infections in spite of their distance from the epicenters of Mombasa and Nairobi.

Better coordination between the national and local government

Provision of health services is a shared responsibility between the county and national governments, and a smooth working relationship between these two levels of government will ensure better outcomes for infection control. Challenges in primary health services still exist in the counties in Kenya. Most of the announcements on the COVID-19 containment policy have been made by the Ministry of Health with little participation of the Council of Governors(CoG). The CoG internally has established a cross-sector COVID-19 Secretariat to coordinate countries' response but there is little regular coordination with the national government. The asymmetrical power that exists between the county governments and the national government has added to the challenges of effective policy response.

Kenya can learn from the challenges and responses of other countries with federal structures. Their management of the crisis varies from the USA to Pakistan to Germany (Cooke, 2020); (Younus, 2020). In a devolved structure of healthcare management, in order to effectively achieve the benefits of devolution, better coordination between national and local government is important, despite devolution. This is particularly critical in the face of an infectious virus, where individual actions are the key to preventing spread. In these circumstances, the advantage of a devolved structure is that county governments are closer to the people, thereby closer to those being infected and better able

to monitor, deliver services, and communicate, in order to limit the spread of the disease. Effective communication between the national and local government would benefit both levels of governments: 1) for counties to share granular data on the spread of the disease, and 2) for the national government to effectively share the latest knowledge on the disease with the counties.

A further challenge is coordination on resources, particularly medical equipment such as ventilators, which are in scare supply and which, with coordination, can be employed optimally in line with the spread of the disease. For counties to be able to respond to this health emergency, the national government also needs to support counties as much as they can, ensuring funds are readily available for counties to respond and to reduce some of the bottlenecks that govern financial transfers.

Better public health messaging

Currently, the Ministry of Health makes daily press briefings stating the number of confirmed infections, fatalities, tests and recovered patients. Based on these briefings, there is no statement on what this implies in terms of the trajectory of the disease, what the stage of infections in Kenya may be, or a way out of the lockdowns. Little explanation is offered for policy decisions and how the different regulations being implemented, in line with the general guidance provided by WHO, are being applied in Kenya. The directive "flattening the curve" is insufficiently informative to firms, workers and even public administrators; policy-makers should be targeting their decisions based on specific information and guidance regarding the cycle of the epidemic.

Also, clarity is needed from the MoH on guidelines on clinical ethics for healthcare workers who are being forced to ration medical supplies, such as ventilators[5]. This vacuum creates room for "moral injury" in the health workforce, where health workers may well lapse into depression and other forms of mental anguish after decisions they have made about patients (Atwoli, 2020). Both businesses and the general public need to be guided by sensible epidemiological advice and in recognition that specific milestones are being pursued. A coherent and published summary of the policy should include the sources and forms of evidence that the government is using to inform its responses and any amendments to the policy.

Such an approach would also identify the specific roles to be performed by county governments and the national government. Greater use of evidence to inform policy, as provided in this report, would require different policy approaches for counties in different risk and capacity categories. For example, counties at risk due to a greater proportion of the elderly in their populations will require more attention to their particular needs as well as special ways of communicating with them through targeted messaging. Similarly, on the capacity side, for counties with poorer means of communication through cellular technology, largely rural counties, the national government will need to find other

[5]Bayer, 2011 for guidelines on these decisions

means of messaging, perhaps using farmer cooperatives or other organizations. In all cases, public health announcements should be communicated to the public coherently and clearly to build trust. Evidence from Ebola and earlier health outbreaks suggests that trust in government is key for compliance with public health messaging (Blaira, Morseb, & Tsaib, 2017).

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Annex: Methodology

This Annex discusses the methodology developed for this report. In general, it is based on the development of indices designed to indicate the circumstances in each of Kenya's 47 counties with respect to the capacity to deliver healthcare services to treat COVID-19 and the populations at risk in each county. The methodology for developing such indices is well established as represented by the Global Health Security Index (GHSI) prepared by Johns, Hopkins, NTI, and the Economist, 2019. As noted in the text, the specific measures developed here differ from the GHSI in two respects. First, they are at the county level for Kenya rather than at the national level and are constrained by data availability. Second, as noted, the approach pursued here is to develop two separate indices to guide policymakers. The health capacity index, has 14 indicators as shown below:

Table A-1 : List of healthcare system capacity indicators and corresponding sources of data

NO#	Description	Source of data
Indicator 1	Per Capita Health Expenditure (Recurrent)	County Budget Implementation and Review Reports *(a publication by the Office of the Controller of Budget)*
Indicator 2	Doctors per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 3	Nurses per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 4	Clinical Officers per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 5	Public Health Workers per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 6	Medical Workers per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 7	Primary Health Facilities per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 8	County and Sub County Health Facilities per 100,000 population	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 9	Total Beds and Cots Facilities per 100,000 population	Health human resource for Health, 2017 (*a publication by KIPPRA)*
Indicator 10	Number of Medical Labs per 100,000 population	Statistical Abstract, 2019 *(a publication by Kenya National Bureau of Statistics)*

Indicator 11	Facilities for Improved Water and Sanitation (per cent of population with Water and Sanitation	Health human resource for Health, 2017 *(a publication by KIPPRA)*
Indicator 12	Facilities for Hand Washing near Toilets (per cent of population with access)	Kenya Integrated Household Budget Survey *(a publication by KNBS)*
Indicator 13	Facilities for Communication (per cent of population with mobile phones	Kenya Population and Housing Census: Volume IV *(a publication by KNBS)*
Indicator 14	Total Health Facilities per 100 Km^2	Health human resource for Health, 2017 and Statistical Abstract, 2019 *(publications by KIPPRA and KNBS)*

Source: Author's Computation

The population risk index has seven indicators as shown below;

Table A-2: List of population risk indicators and corresponding sources of data

NO#	Description	Source of data
Indicator 1	per cent Population (60+ years)	Kenya Population and Housing Census, 2019
Indicator 2	per cent Urban population	Kenya Population and Housing Census, 2019
Indicator 3	Mortality Rate (Deaths per 100,000 population)	Statistical Abstract, 2019
Indicator 4	Morbidity Rate (Cases per 100,000 population)	Statistical Abstract, 2019
Indicator 5	HIV prevalence (per cent)	National AIDS Control Council (NACC)
Indicator 6	Distance to the nearest city (Nairobi or Mombasa)	Google map
Indicator 7	Visitors to Game Parks and Museums	Statistical Abstract, 2019

Source: Author's Computation

The indicators used for each index are combined to form the index itself in a three-step process. S**tep 1** is the calculation of the values of the indicator for each county. This step required relevant data at the county level which reflects county healthcare capabilities and the risk to their populations, all on a per capita basis.

Step 2 is converting these values into a score for each indicator for each county using the formula below;

$$Score = \frac{Value - Min}{Max - Min} * 100$$

The denominator defines the range of values across all counties for the indicator while the numerator the specific value for county X above the minimum value, that is the position of that county in the range, and the multiplication by 100 converts the relative position of the county into a score from 0 to 100. For example, if all the values for an indicator cover an 80-point range from 10 to 90, and county X has a value of 70, it's score would be 75 (60 divided by 80) on a scale of 0 to 100.

Thus, this formula converts the raw value of each indicator into a score from 0 to 100 where the highest value receives a score of 100 and the lowest value a score of zero. In the case of the healthcare capacity index where the highest value of an indicator such as the number of doctors, nurses or health facilities per capita, is regarded as favorable, a score of 100 indicates that a county rank at the very top among the 47 counties. In contrast, a score of 0 for an indicator does not mean that the county totally lacks any capacity with respect to that indicator, but that it had the lowest value among the 47 counties.

For the population risk index, the approach is the same, but the ranking has a different meaning. For this index, a high value for a component indicator, such as HIV prevalence, is unfavorable or a high risk. Applying the formula above, the county with the highest HIV rate per capita among the counties would receive a score of 100 and the lowest would receive a score of 0, that is, the lowest risk to the population from that specific indicator.

Step 3 is weighting all indicators equally to form the final index, one for capacity and one for risk. In this fashion, counties can be compared on a relative basis both as to how they rank under each index and how each separate indicator within the index affects the results.

Further details of this methodology are displayed below. Tables A-3 a and b shows the scores for each of the 47 counties for the 14 indicators comprising the healthcare capacity index. Table A-3-a shows the results of collecting the raw data on healthcare capacity for each indicator by county. Table A-3-b has the summary score of the index Table A-4 a and b shows the scores for the seven individual indicators for population risk. Table A-4-a shows the results of collecting the raw data on population risk for each indicator by county while Table A-4-b has the summary score for the index.

TableA-3-a: Raw results for the health care system capacity indicators

Indicator	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 6	Indicator7	Indicator 8	Indicator 9	Indicator 10	Indicator 11	Indicator 12	Indicator 13	Indicator 14
County	Per Capita Health Recurrent Expenditure (Ksh) 2016/17 to 2018/19	Doctors per 100,000 population (Year = 2017)	Nurses per 100,000 population (Year = 2017)	Clinical Officers per 100,000 population (Year = 2017)	Public Health Workers per 100,000 population (Year = 2017)	Medical Workers per 100,000 population (Year = 2017)	Primary Health Facilities per 100,000 population (Year = 2017)	County & Sub County Health Facilities per 100,000 population (Year = 2017)	Total Beds and Cots Facilities per 100,000 population (Year = 2017)	Number of Medical Labs per 100,000 population (Year = 2018)	% of population with access to Improved Water and Sanitation (Year = 2017)	% Households by Availability of Place for Washing Hands near the Toilet Facility (Year = 2015/16)	% Population Owning a Mobile Phone (Year = 2019)	Total Health Facilities per 100 Km^2 (Year = 2017)
1 Embu	9,677.52	11.19	109.31	12.20	16.95	190.00	32.88	1.36	251.66	8.81	98.40	15.40	57.00	7.16
2 Nyeri	8,837.34	13.00	109.52	12.06	18.77	121.00	48.93	1.34	244.24	8.18	55.20	20.10	64.10	11.28
3 Nairobi	3,540.27	9.96	24.44	4.68	5.43	252.00	20.85	1.06	206.32	18.39	91.90	43.60	69.10	128.98
4 Mombasa	6,695.57	8.23	53.71	8.40	11.78	245.00	31.01	1.47	155.06	11.78	86.30	18.60	61.80	170.91
5 Lamu	13,156.00	7.38	79.74	20.67	28.06	146.00	42.83	2.22	129.22	5.17	70.00	21.80	45.20	0.97
6 Tharaka Nithi	9,166.67	12.13	84.89	10.32	12.90	139.00	45.15	2.06	219.83	5.42	96.30	13.80	51.30	7.14
7 Isiolo	9,754.65	10.70	80.23	12.34	12.34	137.00	22.22	1.23	253.04	6.17	70.70	47.90	38.20	0.22
8 Kirinyaga	7,930.16	5.22	71.06	8.42	19.36	88.00	48.49	1.35	181.01	8.92	85.00	20.60	61.30	20.03
9 Elgeyo Marakwet	9,094.50	5.94	78.62	14.17	43.19	74.00	24.00	1.83	184.20	1.83	72.90	9.90	51.40	3.73
10 Kiambu	4,689.09	8.68	53.35	7.31	12.22	102.00	21.74	1.37	158.01	8.19	90.30	41.10	66.00	20.56
11 Taita Taveta	2,260.75	9.41	75.28	15.78	17.91	98.00	22.77	0.61	103.81	7.89	98.80	37.60	54.90	0.45
12 Samburu	7,303.53	4.44	54.60	7.85	13.65	97.00	67.23	4.44	370.60	1.36	31.50	6.80	27.20	1.00
13 Kisumu	5,930.19	9.66	66.99	8.50	10.28	81.00	18.07	2.06	243.26	1.70	96.30	18.90	49.40	10.79
14 Kericho	6,135.48	9.17	53.48	8.81	15.37	54.00	24.42	1.79	229.30	1.79	79.00	15.80	43.40	9.03
15 Nakuru	5,387.66	6.58	59.75	8.97	10.97	107.00	22.44	1.27	161.05	8.93	62.10	18.60	52.70	6.48
16 Baringo	8,891.30	5.90	65.94	14.74	16.29	80.00	35.69	0.62	119.78	4.34	71.30	7.20	35.00	2.13
17 Laikipia	1,380.10	6.67	55.80	6.06	20.01	127.00	25.67	1.62	162.14	7.48	42.30	23.20	51.50	1.42
18 Machakos	1,057.16	6.48	48.56	7.15	8.33	102.00	29.25	0.88	170.07	7.74	83.50	16.20	56.40	6.77
19 Kajiado	4,772.67	2.33	32.67	5.62	9.79	39.00	28.98	1.26	146.46	10.37	84.30	30.80	54.60	1.43
20 Nyandarua	2,553.35	8.89	70.81	8.10	16.04	83.00	27.15	0.64	110.03	1.59	81.10	12.10	55.00	5.33
21 Makueni	6,460.36	5.27	45.09	7.55	15.72	62.00	34.75	0.93	161.12	3.31	88.00	4.60	49.00	4.22
22 Meru	5,076.64	4.58	50.01	6.17	10.41	90.00	19.43	0.93	153.35	6.63	48.70	35.00	50.30	4.38
23 Tana River	4,413.44	1.66	42.89	8.31	19.62	50.00	48.54	1.99	279.96	0.33	60.30	17.70	31.60	0.40
24 Murang'a	5,049.29	6.97	51.17	5.80	19.54	54.00	27.86	1.06	88.13	3.29	65.60	8.80	57.40	11.85
25 Kisii	6,005.09	5.71	61.58	9.57	11.26	52.00	14.79	1.85	198.57	3.62	41.30	2.70	43.80	15.65
26 Kitui	5,585.61	4.05	49.76	5.76	10.80	76.00	39.68	1.26	133.26	2.25	56.80	11.10	42.90	1.46
27 Uasin Gishu	4,447.13	5.05	30.38	6.22	13.52	77.00	8.92	0.63	77.62	9.20	83.40	14.30	51.40	3.12
28 Vihiga	4,997.39	5.29	42.36	8.71	15.20	57.00	17.76	1.71	69.69	2.05	43.20	15.70	43.10	20.21
29 Marsabit	7,409.87	6.34	46.71	7.75	9.39	124.00	23.47	1.17	145.29	0.94	26.00	14.60	29.00	0.15
30 Garissa	7,054.04	7.65	32.22	9.28	10.03	86.00	18.80	1.88	92.64	3.64	45.10	6.30	30.30	0.37
31 Busia	4,572.71	3.94	46.20	7.87	6.72	49.00	14.24	0.81	145.89	2.55	61.60	23.50	38.40	7.65
32 Trans Nzoia	4,581.34	4.60	41.74	6.49	12.03	139.00	24.16	0.94	70.82	5.02	36.10	7.20	40.40	9.62
33 Nyamira	6,825.39	2.65	47.84	5.46	12.58	51.00	22.18	1.32	165.54	0.99	40.40	5.00	45.40	15.83
34 Homa Bay	4,448.81	3.55	48.90	6.37	9.11	51.00	24.13	1.37	166.08	1.46	25.10	17.50	41.10	8.88
35 Nandi	4,949.58	1.63	42.02	6.87	15.13	49.00	24.21	0.58	86.14	2.79	71.00	10.60	42.50	7.48
36 Kilifi	4,200.16	4.62	31.70	5.99	7.87	45.00	19.64	0.72	72.36	5.34	70.00	17.20	39.40	2.25
37 Siaya	4,532.69	1.56	39.67	4.98	4.15	52.00	9.76	1.04	48.40	10.18	43.70	22.80	44.10	4.11
38 Migori	3,669.77	2.60	34.37	6.69	10.22	45.00	21.09	1.21	199.07	3.44	37.90	5.20	37.50	9.18
39 Bungoma	3,898.90	4.16	41.77	6.21	6.83	49.00	13.72	0.74	112.89	3.17	39.30	21.20	36.80	7.71
40 Bomet	3,631.21	1.93	48.36	10.81	11.95	35.00	15.93	0.68	109.92	3.30	30.60	8.40	40.90	5.82
41 Kakamega	666.75	3.87	47.33	7.63	6.00	64.00	15.98	0.76	126.08	2.89	32.40	8.10	40.90	10.18
42 Kwale	5,807.27	1.70	31.46	7.41	8.02	48.00	17.37	0.49	59.75	2.55	33.70	12.80	36.70	1.78
43 Narok	3,085.71	3.28	27.27	4.56	9.12	42.00	15.60	0.73	114.29	3.65	42.10	7.50	34.30	1.00
44 West Pokot	5,627.47	1.83	40.37	8.34	10.01	75.00	16.51	0.50	106.59	1.50	27.30	3.40	21.10	1.12
45 Turkana	2,523.76	1.64	16.87	3.94	8.77	24.00	19.61	1.42	183.09	0.77	31.90	18.70	16.60	0.28
46 Mandera	4,776.39	0.44	10.01	3.23	4.23	31.00	13.90	0.89	95.65	0.89	40.90	14.30	25.30	0.51
47 Wajir	5,131.94	1.85	7.13	0.79	7.66	60.00	17.16	0.66	66.81	0.79	6.20	3.10	27.90	0.24
Max	13,156.00	13.00	109.52	20.67	43.19	252.00	67.23	4.44	370.60	18.39	98.80	47.90	69.10	170.91
Q3	6,760.48	7.52	60.66	8.89	15.54	102.00	29.12	1.45	183.65	7.61	82.25	20.35	52.10	9.40
Mean	5,481.76	5.54	50.72	8.11	12.88	85.09	25.51	1.25	151.66	4.74	59.06	16.54	44.33	12.15
Median	5,049.29	5.22	48.36	7.63	11.78	75.00	22.44	1.21	146.46	3.44	60.30	15.40	43.40	5.33
Q1	4,200.16	2.65	39.67	6.06	9.11	50.00	17.37	0.74	103.81	1.79	39.30	8.10	36.80	1.12
Min	666.75	0.44	7.13	0.79	4.15	24.00	8.92	0.49	48.40	0.33	6.20	2.70	16.60	0.15
STD	2,445.79	3.12	21.37	3.42	6.52	49.41	11.72	0.66	65.77	3.67	24.09	10.63	11.82	29.89
CV	0.45	0.56	0.42	0.42	0.51	0.58	0.46	0.53	0.43	0.77	0.41	0.64	0.27	2.46

Source: Author's Computation

Table A-3-b: Summary results for the healthcare capacity index

Indicator	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 2e	Indicator7	Indicator 8	Indicator 9	Indicator 10	Indicator 11	Indicator 8	Indicator 9	Indicator 10	
County	Per Capita Health Recurrent Expenditure (Ksh) 2016/17 to 2018/19	Doctors per 100,000 population (Year = 2017)	Nurses per 100,000 population (Year = 2017)	Clinical Officers per 100,000 population (Year = 2017)	Public Health Workers per 100,000 population (Year = 2017)	Medical Workers per 100,000 population (Year = 2017)	Primary Health Facilities per 100,000 population (Year = 2017)	County & Sub County Health Facilities per 100,000 population (Year = 2017)	Total Beds and Cots Facilities per 100,000 population (Year = 2017)	Number of Medical Labs per 100,000 population (Year = 2018)	% of population with access to Improved Water and Sanitation (Year = 2017)	% Households by Availability of Place for Washing Hands near the Toilet Facility (Year = 2015/16)	% Population Owning a Mobile Phone (Year = 2019)	Total Health Facilities per 100 Km^2 (Year = 2017)	Overall Score (Capacity)
1 Embu	72.15	85.53	99.80	57.39	32.77	72.81	41.08	22.02	63.09	46.97	99.57	28.10	76.95	4.11	**57.31**
2 Nyeri	65.42	100.00	100.00	56.69	37.43	42.54	68.61	21.63	60.78	43.45	52.92	38.50	90.48	6.52	**56.07**
3 Nairobi	23.01	75.81	16.91	19.56	3.27	100.00	20.45	14.58	49.01	100.00	92.55	90.49	100.00	75.44	**55.79**
4 Mombasa	48.27	61.99	45.49	38.28	19.54	96.93	37.89	24.98	33.11	63.42	86.50	35.18	86.10	100.00	**55.55**
5 Lamu	100.00	55.26	70.92	100.00	61.23	53.51	58.15	43.78	25.08	26.79	68.90	42.26	54.48	0.48	**54.34**
6 Tharaka Nithi	68.06	93.03	75.95	47.92	22.40	50.44	62.14	39.95	53.21	28.17	97.30	24.56	66.10	4.09	**52.38**
7 Isiolo	72.77	81.64	71.40	58.10	20.98	49.56	22.80	18.95	63.51	32.34	69.65	100.00	41.14	0.05	**50.21**
8 Kirinyaga	58.16	38.02	62.43	38.36	38.96	28.07	67.87	21.80	41.16	47.59	85.10	39.60	85.14	11.64	**47.42**
9 Elgeyo Marakwet	67.48	43.77	69.82	67.28	100.00	21.93	25.85	33.98	42.15	8.29	72.03	15.93	66.29	2.10	**45.49**
10 Kiambu	32.21	65.56	45.14	32.76	20.66	34.21	21.98	22.45	34.02	43.53	90.82	84.96	94.10	11.95	**45.31**
11 Taita Taveta	12.76	71.39	66.56	75.40	35.23	32.46	23.74	3.07	17.20	41.87	100.00	77.21	72.95	0.18	**45.00**
12 Samburu	53.14	31.78	46.36	35.49	24.32	32.02	100.00	100.00	100.00	5.72	27.32	9.07	20.19	0.50	**41.85**
13 Kisumu	42.14	73.37	58.46	38.75	15.70	25.00	15.68	39.77	60.48	7.57	97.30	35.84	62.48	6.23	**41.34**
14 Kericho	43.79	69.50	45.27	40.35	28.72	13.16	26.58	32.93	56.15	8.06	78.62	28.98	51.05	5.20	**37.74**
15 Nakuru	37.80	48.89	51.39	41.15	17.47	36.40	23.17	19.80	34.96	47.60	60.37	35.18	68.76	3.71	**37.62**
16 Baringo	65.85	43.41	57.44	70.15	31.09	24.56	45.90	3.41	22.16	22.22	70.30	9.96	35.05	1.16	**35.90**
17 Laikipia	5.71	49.58	47.53	26.52	40.63	45.18	28.73	28.64	35.30	39.59	38.98	45.35	66.48	0.74	**35.64**
18 Machakos	3.13	48.09	40.46	31.96	10.69	34.21	34.87	10.09	37.76	41.01	83.48	29.87	75.81	3.88	**34.67**
19 Kajiado	32.88	14.98	24.94	24.29	14.44	6.58	34.40	19.60	30.44	55.61	84.34	62.17	72.38	0.75	**34.13**
20 Nyandarua	15.11	67.26	62.20	36.74	30.43	25.88	31.26	3.78	19.13	6.95	80.89	20.80	73.14	3.03	**34.04**
21 Makueni	46.39	38.46	37.07	33.99	29.62	16.67	44.29	11.26	34.99	16.49	88.34	4.20	61.71	2.38	**33.28**
22 Meru	35.31	32.90	41.88	27.04	16.03	28.95	18.03	11.21	32.57	34.90	45.90	71.46	64.19	2.48	**33.06**
23 Tana River	30.00	9.70	34.93	37.82	39.61	11.40	67.96	38.20	71.87	0.00	58.42	33.19	28.57	0.15	**32.99**
24 Murang'a	35.09	51.92	43.02	25.21	39.41	13.16	32.48	14.64	12.33	16.38	64.15	13.50	77.71	6.85	**31.85**
25 Kisii	42.74	41.91	53.18	44.13	18.19	12.28	10.06	34.51	46.61	18.20	37.90	0.00	51.81	9.08	**30.04**
26 Kitui	39.38	28.70	41.63	24.98	17.02	22.81	52.75	19.59	26.34	10.62	54.64	18.58	50.10	0.77	**29.14**
27 Uasin Gishu	30.27	36.66	22.71	27.30	24.00	23.25	0.00	3.68	9.07	49.09	83.37	25.66	66.29	1.74	**28.79**
28 Vihiga	34.67	38.62	34.41	39.83	28.30	14.47	15.16	30.94	6.61	9.51	39.96	28.76	50.48	11.75	**27.39**
29 Marsabit	53.99	46.92	38.66	34.97	13.41	43.86	24.95	17.41	30.07	3.36	21.38	26.33	23.62	0.00	**27.07**
30 Garissa	51.14	57.35	24.50	42.67	15.05	27.19	16.95	35.30	13.73	18.30	42.01	7.96	26.10	0.13	**27.03**
31 Busia	31.27	27.81	38.16	35.62	6.56	10.96	9.12	8.22	30.26	12.27	59.83	46.02	41.52	4.39	**25.86**
32 Trans Nzoia	31.34	33.11	33.80	28.64	20.17	50.44	26.14	11.53	6.96	25.97	32.29	9.96	45.33	5.55	**25.80**
33 Nyamira	49.31	17.55	39.76	23.49	21.59	11.84	22.74	21.23	36.36	3.66	36.93	5.09	54.86	9.18	**25.26**
34 Homa Bay	30.28	24.74	40.79	28.07	12.68	11.84	26.08	22.28	36.53	6.23	20.41	32.74	46.67	5.11	**24.60**
35 Nandi	34.29	9.43	34.08	30.56	28.12	10.96	26.22	2.44	11.71	13.63	69.98	17.48	49.33	4.29	**24.47**
36 Kilifi	28.29	33.26	24.00	26.16	9.52	9.21	18.38	5.98	7.44	27.76	68.90	32.08	43.43	1.23	**23.97**
37 Siaya	30.95	8.86	31.78	21.09	0.00	12.28	1.44	13.99	0.00	54.53	40.50	44.47	52.38	2.32	**22.47**
38 Migori	24.04	17.17	26.61	29.66	15.53	9.21	20.86	18.27	46.77	17.20	34.23	5.53	39.81	5.29	**22.16**
39 Bungoma	25.88	29.57	33.83	27.23	6.85	10.96	8.22	6.55	20.02	15.69	35.75	40.93	38.48	4.43	**21.74**
40 Bomet	23.74	11.86	40.27	50.38	19.96	4.82	12.02	4.98	19.09	16.44	26.35	12.61	46.29	3.32	**20.87**
41 Kakamega	0.00	27.29	39.27	34.41	4.72	17.54	12.10	7.03	24.11	14.17	28.29	11.95	46.29	5.87	**19.50**
42 Kwale	41.16	10.00	23.76	33.28	9.89	10.53	14.48	0.00	3.53	12.29	29.70	22.35	38.29	0.96	**17.87**
43 Narok	19.37	22.61	19.67	18.95	12.72	7.89	11.44	6.17	20.45	18.37	38.77	10.62	33.71	0.50	**17.23**
44 West Pokot	39.72	11.07	32.46	37.96	15.00	22.37	13.02	0.37	18.06	6.47	22.79	1.55	8.57	0.57	**16.43**
45 Turkana	14.87	9.55	9.52	15.85	11.81	0.00	18.33	23.76	41.80	2.41	27.75	35.40	0.00	0.08	**15.08**
46 Mandera	32.91	0.00	2.81	12.24	0.19	3.07	8.54	10.23	14.67	3.09	37.47	25.66	16.57	0.21	**11.97**
47 Wajir	35.75	11.18	0.00	0.00	8.97	15.79	14.13	4.41	5.71	2.55	0.00	0.88	21.52	0.05	**8.64**
Max	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	**57.31**
Q3	48.79	56.30	52.29	40.75	29.17	34.21	34.64	24.37	41.98	40.30	82.13	39.05	67.62	5.42	**41.60**
Mean	38.55	40.58	42.58	36.78	22.36	26.79	28.45	19.35	32.05	24.39	57.08	30.62	52.82	7.03	**32.82**
Median	35.09	38.02	40.27	34.41	19.54	22.37	23.17	18.27	30.44	17.20	58.42	28.10	51.05	3.03	**31.85**
Q1	28.29	17.55	31.78	26.52	12.68	11.40	14.48	6.55	17.20	8.06	35.75	11.95	38.48	0.57	**23.97**
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**8.64**
STD	19.58	24.84	20.87	17.21	16.70	21.67	20.10	16.75	20.41	20.33	26.02	23.51	22.51	17.50	**12.61**
CV	0.51	0.61	0.49	0.47	0.75	0.81	0.71	0.87	0.64	0.83	0.46	0.77	0.43	2.49	**0.38**

Source: Author's Computation

Table A-4-a: Raw results for the population risk indicators

Indicator	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 6	Indicator 7
County.	% Population (60+ years) 2019	% Urban population (Year = 2015/16)	Mortality Rate Deaths per 100,000 population (Year = 2018)	Morbidity Rate First Attendance Cases per 100,000 population (Year = 2018)	HIV prevalence adults (15 to 49 yrs) Overall Prevalence (Year = 2017)	Average Distance to Airport (Year = 2020)	Visitors to Game Parks and Museums (Year = 2018)
1 Mombasa	2.82	100.00	496	61,951	4.10	0	2,661.1
2 Nairobi	2.01	100.00	501	52,989	6.10	0	1,190.8
3 Kisumu	6.24	53.78	597	69,239	16.30	314	236.9
4 Nyeri	7.17	38.05	673	130,158	3.70	152	1.6
5 Tharaka Nithi	9.07	31.99	474	144,989	3.20	196	2.0
6 Siaya	7.69	36.70	624	81,047	21.00	415	0.0
7 Kirinyaga	5.28	38.20	910	127,412	3.10	73	0.0
8 Embu	8.11	32.16	607	109,155	2.80	131	1.8
9 Murang'a	10.54	30.52	547	96,246	4.20	86	0.0
10 Makueni	8.74	30.36	498	109,648	4.20	134	0.0
11 Taita Taveta	7.74	32.58	531	94,030	4.10	199	14.1
12 Vihiga	9.83	41.58	671	73,293	5.40	370	0.0
13 Laikipia	6.23	37.23	475	111,431	2.70	196	0.5
14 Machakos	7.47	52.38	508	77,465	3.80	62	0.0
15 Kitui	7.90	29.50	466	115,739	4.50	175	0.0
16 Nyandarua	7.17	33.26	439	92,383	3.50	158	13.2
17 Nakuru	4.49	48.68	463	97,143	3.40	167	38.5
18 Homa Bay	5.74	45.09	341	56,413	20.70	425	0.0
19 Kwale	5.09	36.05	311	93,396	3.80	37	9.2
20 Kiambu	4.71	55.77	458	72,909	4.00	46	0.0
21 Kericho	4.91	45.03	434	115,354	2.90	271	0.0
22 Meru	7.08	26.40	475	73,365	2.40	227	6.4
23 Uasin Gishu	4.02	46.22	620	89,218	3.90	321	0.0
24 Kilifi	5.19	45.32	488	68,593	3.80	349	16.4
25 Lamu	5.38	44.12	306	82,877	3.00	240	6.0
26 Kisii	8.31	34.83	259	72,958	4.40	121	0.0
27 Elgeyo Marakwet	5.46	34.09	308	123,301	1.60	356	0.0
28 Kakamega	6.29	30.10	505	74,687	4.50	386	0.0
29 Migori	4.30	37.63	289	67,294	13.30	379	0.0
30 Bomet	4.80	28.81	317	112,265	1.90	231	0.0
31 Busia	5.75	28.60	477	70,486	7.70	460	0.0
32 Nyamira	6.82	30.27	296	77,627	4.20	304	0.0
33 Kajiado	2.95	46.56	174	66,761	3.90	77	8.2
34 Nandi	5.37	29.22	263	98,413	2.00	319	0.0
35 Baringo	4.94	32.72	241	76,737	1.30	302	6.8
36 Trans Nzoia	4.81	36.29	380	43,784	4.30	390	26.7
37 Isiolo	3.97	46.37	243	62,433	3.20	275	0.0
38 Samburu	3.84	36.10	115	75,691	1.80	346	0.5
39 Bungoma	4.98	31.01	397	46,090	3.20	415	0.0
40 West Pokot	3.67	24.37	176	75,064	1.60	427	0.7
41 Tana River	4.18	33.56	181	49,277	1.30	321	0.0
42 Marsabit	3.74	36.89	146	63,103	1.40	532	0.0
43 Narok	3.19	23.85	105	44,061	2.70	154	0.0
44 Turkana	3.24	32.93	197	49,836	3.20	606	0.0
45 Garissa	2.18	40.05	77	42,593	0.80	368	0.0
46 Wajir	1.98	44.01	60	40,480	0.10	709	0.0
47 Mandera	1.88	33.25	57	41,005	0.20	1,053	0.0
Max	10.54	100.00	909.56	144,989.09	21.00	1,053.30	2,661.10
Q3	7.12	44.58	499.77	96,694.87	4.20	374.45	6.20
Mean	5.47	39.63	386.76	80,221.07	4.45	282.33	90.24
Median	5.19	36.10	434.17	75,063.96	3.50	274.70	0.00
Q1	3.97	31.01	242.64	62,433.15	2.40	152.20	0.00
Min	1.88	23.85	57.06	40,479.60	0.10	0.00	0.00
STD	2.10	14.80	185.83	26,059.03	4.42	192.53	417.08
CV	0.38	0.37	0.48	0.32	0.99	0.68	4.62

Source: Author's Computation

Table A-4-b Summary results for the population risk indicator scores

Indicator	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5	Indicator 7	Indicator 8	
County.	% Population (60+ years) 2019	% Urban population (Year = 2015/16)	Mortality Rate Deaths per 100,000 population (Year = 2018)	Morbidity Rate First Attendance Cases per 100,000 population (Year = 2018)	HIV prevalence adults (15 to 49 yrs) Overall Prevalence (Year = 2017)	Average Distance to Airport (Year = 2020)	Visitors to Game Parks and Museums (Year = 2018)	**Overall Score (Risk)**
1 Mombasa	10.79	100.00	51.45	20.55	19.14	100.00	100.00	**57.42**
2 Nairobi	1.45	100.00	52.10	11.97	28.71	100.00	100.00	**56.32**
3 Kisumu	50.33	39.31	63.28	27.52	77.51	70.24	50.00	**54.03**
4 Nyeri	61.13	18.64	72.28	85.81	17.22	85.55	25.00	**52.23**
5 Tharaka Nithi	82.97	10.69	48.96	100.00	14.83	81.44	25.00	**51.98**
6 Siaya	67.12	16.87	66.53	38.82	100.00	60.62	0.00	**49.99**
7 Kirinyaga	39.28	18.84	100.00	83.18	14.35	93.09	0.00	**49.82**
8 Embu	71.94	10.91	64.53	65.71	12.92	87.56	25.00	**48.37**
9 Murang'a	100.00	8.75	57.51	53.36	19.62	91.83	0.00	**47.30**
10 Makueni	79.25	8.55	51.76	66.18	19.62	87.31	0.00	**44.67**
11 Taita Taveta	67.64	11.47	55.62	51.24	19.14	81.13	25.00	**44.46**
12 Vihiga	91.80	23.28	72.04	31.40	25.36	64.86	0.00	**44.10**
13 Laikipia	50.28	17.57	48.97	67.89	12.44	81.42	25.00	**43.37**
14 Machakos	64.57	37.47	52.93	35.39	17.70	94.15	0.00	**43.17**
15 Kitui	69.48	7.42	47.98	72.01	21.05	83.37	0.00	**43.04**
16 Nyandarua	61.13	12.35	44.85	49.66	16.27	85.03	25.00	**42.04**
17 Nakuru	30.14	32.61	47.67	54.22	15.79	84.16	25.00	**41.37**
18 Homa Bay	44.59	27.90	33.28	15.25	98.56	59.63	0.00	**39.89**
19 Kwale	37.03	16.02	29.80	50.63	17.70	96.51	25.00	**38.96**
20 Kiambu	32.62	41.92	47.09	31.03	18.66	95.66	0.00	**38.14**
21 Kericho	34.95	27.81	44.24	71.64	13.40	74.26	0.00	**38.04**
22 Meru	59.99	3.35	48.99	31.47	11.00	78.48	25.00	**36.90**
23 Uasin Gishu	24.70	29.37	65.98	46.64	18.18	69.54	0.00	**36.34**
24 Kilifi	38.25	28.19	50.50	26.90	17.70	66.84	25.00	**36.20**
25 Lamu	40.38	26.62	29.17	40.57	13.88	77.21	25.00	**36.12**
26 Kisii	74.26	14.42	23.67	31.08	20.57	88.54	0.00	**36.08**
27 Elgeyo Marakwet	41.38	13.45	29.39	79.25	7.18	66.25	0.00	**33.84**
28 Kakamega	50.96	8.21	52.60	32.73	21.05	63.32	0.00	**32.70**
29 Migori	27.94	18.10	27.22	25.66	63.16	64.04	0.00	**32.30**
30 Bomet	33.66	6.51	30.48	68.69	8.61	78.06	0.00	**32.29**
31 Busia	44.63	6.24	49.20	28.71	36.36	56.29	0.00	**31.63**
32 Nyamira	57.02	8.42	28.00	35.54	19.62	71.13	0.00	**31.39**
33 Kajiado	12.30	29.83	13.67	25.15	18.18	92.73	25.00	**30.98**
34 Nandi	40.33	7.05	24.14	55.43	9.09	69.73	0.00	**29.40**
35 Baringo	35.38	11.65	21.63	34.69	5.74	71.35	25.00	**29.35**
36 Trans Nzoia	33.80	16.33	37.89	3.16	20.10	62.98	25.00	**28.47**
37 Isiolo	24.08	29.57	21.77	21.01	14.83	73.92	0.00	**26.45**
38 Samburu	22.60	16.09	6.84	33.69	8.13	67.19	25.00	**25.65**
39 Bungoma	35.76	9.40	39.84	5.37	14.83	60.63	0.00	**23.69**
40 West Pokot	20.70	0.68	13.95	33.09	7.18	59.46	25.00	**22.86**
41 Tana River	26.52	12.75	14.57	8.42	5.74	69.52	0.00	**19.65**
42 Marsabit	21.51	17.12	10.47	21.65	6.22	49.47	0.00	**18.06**
43 Narok	15.14	0.00	5.66	3.43	12.44	85.43	0.00	**17.44**
44 Turkana	15.73	11.92	16.44	8.95	14.83	42.47	0.00	**15.76**
45 Garissa	3.42	21.27	2.37	2.02	3.35	65.11	0.00	**13.93**
46 Wajir	1.10	26.47	0.38	0.00	0.00	32.71	0.00	**8.67**
47 Mandera	0.00	12.35	0.00	0.50	0.48	0.00	0.00	**1.90**
Max	100.00	100.00	100.00	100.00	100.00	100.00	100.00	**57.42**
Q3	60.56	27.22	51.93	53.79	19.62	85.49	25.00	**43.74**
Mean	41.49	20.72	38.67	38.03	20.82	73.20	13.83	**35.25**
Median	38.25	16.09	44.24	33.09	16.27	73.92	0.00	**36.20**
Q1	24.08	9.40	21.77	21.01	11.00	64.04	0.00	**28.47**
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.90**
STD	24.23	19.43	21.80	24.93	21.13	18.28	22.37	**12.50**
CV	0.58	0.94	0.56	0.66	1.02	0.25	1.62	**0.35**

Source: Author's Computation

Table A-5 and Table A-6 below show the correlations of each individual indicator with its respective index. In this diagram, each individual indicator is positively correlated with its index.

Table A-5: Correlation of individual indicators for capacity with overall capacity index

Indicator 1	Per Capita Health Expenditure (Recurrent)	0.5
Indicator 2	Doctors per 100,000 population	0.8
Indicator 3	Nurses per 100,000 population	0.6
Indicator 4	Clinical Officers per 100,000 population	0.8
Indicator 5	Public Health Workers per 100,000 population	0.7
Indicator 6	Medical Workers per 100,000 population	0.5
Indicator 7	Primary Health Facilities per 100,000 population	0.3
Indicator 8	County and Sub County Health Facilities per 100,000 population	0.5
Indicator 9	Total Beds and Cots Facilities per 100,000 population	0.7
Indicator 10	Number of Medical Labs per 100,000 population	0.3
Indicator 11	Facilities for Improved Water and Sanitation (per cent of population with access)	0.5
Indicator 12	Facilities for Hand Washing near Toilets (per cent of population with access)	0.6
Indicator 13	Facilities for Communication (per cent of population with mobile phones)	0.8
Indicator 14	Total Health Facilities per 100 Km^2	0.4

Source: Author's Computation

Table A-6: Correlation of individual indicators for risk with overall population risk index

Indicator 1	per cent Population (60+ years)	0.6
Indicator 2	per cent Urban population	0.4
Indicator 3	Mortality Rate (Deaths per 100,000 population)	0.8
Indicator 4	Morbidity Rate (Cases per 100,000 population)	0.6
Indicator 5	HIV prevalence (per cent)	0.4
Indicator 6	Distance to the nearest city (Nairobi or Mombasa)	0.7
Indicator 7	Visitors to Game Parks and Museums	0.5

Source: Author's Computation

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