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Nature and Trends in the Public Transportation Systems in Kenya in the Wake of Covid-19 Pandemic: The Role of ICT

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***Abstract* - The COVID-19 pandemic continues has had devastating effects on people across the world and their way of life. Both the number of confirmed infection cases and deaths are still growing rapidly globally. The response to the pandemic had locked millions of people in their homes and disrupted every part of the economy including the transportation industry. The effects of the pandemic on public transportation extend beyond providing a service and the current health related risks to financial viability and sustainable mobility. This paper sought to carry out a survey to establish the role of ICT on nature and trends on effects of COVID-19 intervention protocols on Transportation in North Rift and Western Region, Kenya. The study adopted a survey design where mixed method was used to collect data. A sample of 120 respondents was derived from the stakeholders from the organized public transport sector (PSV operators, school transport operators, PSV supply chains, frequent travelers, and policy makers in the transportation sector). The findings revealed that majority of the public transport operators supported COVID-19 intervention protocols by providing temperature guns (92%) ,Sanitizers and sanitizing the travelers (89%), reducing the capacity of each vehicle (90%), observed curfew times (88%) by stopping bookings early and operating within stipulated timelines, A majority (98%) of the Matatu's had adjusted the fare upwards in response to the reduced capacity, a good number (67%) were struggling in the business with 46% facing difficulties coping and 79% said that the cost of business had risen. Minority of Sacco's (30%) had adopted use of technology in reservations and payment of goods & services, adoption of ICT in management of Sacco's is costly (70%), while only (5%) had tracking systems for goods and services but had to deal with resultant challenging business realities of reduced revenues and rising cost of business, loan defaults, and members disposing off assets to fend off banks. The study recommends Technological approaches such online booking systems, cashless payment methods and Sacco management systems should be adopted by all matatu Sacco's.**

Keywords: COVID -19, ICTs, Pandemic, Transportation Systems, Sustainable mobility.

I. INTRODUCTION

Kenya confirmed its first case of COVID-19 on March 12, 2020. Since then, the number of cases continued to increase to 175,337 cases and 3,410 deaths (as of June 13, 2021). One and a half years into the pandemic, the country had experienced three waves characterized by increased cases and deaths: first wave, during July to August 2020; second wave, from November to December 2020; and third wave, during March to April 2021. The Ministry of Health (MoH) projected additional waves as mutation and emergence of variants continued to be detected in the country. The fight against COVID-19 required a united and sustained response as infections were continuing to spread. As the government instituted various measures as part of the COVID-19 response, the disease continued to negatively impact the country's socioeconomic conditions and public health, including straining the health system and the related loss of lives.

The COVID-19 pandemic continues to pause serious devastating effects on people's way of life globally. COVID-19 has affected the entire transportation systems in most countries nearly all transport systems have been unsustainable. The rapid spread of the virus, which became a worldwide pandemic in a few weeks, has been attributed to the hypomobility of our current lifestyle (Ahmed & Dey, 2020; Tirachini, 2020). The nature and the way the government restrictions were introduced impacted negatively on various countries' economy (Tirachini, 2020). It was noted in several trending studies that both the number of confirmed infection cases (..) and deaths have been caused by coronavirus disease (COVID-19) (Zhang & Hayashi, 2020), (Abou-Chadi et al., 2020), (Jingchen Dai et al., 2021).

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The nature of responses and approaches used to control the pandemic has locked millions of people in their homes, the persistent lockdowns disrupted every part of the economy including the transportation industry. According to Charlene & Sabrina (2020), currently most people are starting to think about the effect of the COVID-19 virus or, more precisely, the social-distancing response to the pandemic on future travel patterns. The protocols that have been put in place to control the virus infections puts a lot of emphasis on social distancing among other measures (Charlene et al., 2020). In complying with such measures there is need to adjust the seating arrangements to address the social distancing. By applying this measures you are reducing the required capacity of a given vehicle but increasing the number of people who need to move around thereby creating a transport crisis (Elhenawy, 2020). The effects of the measures put in-place have also contributed to more use of technology. Most travelers have resorted to use their mobile phones a lot to keep them busy, for example pay bills and chatting online (Adolph et al., 2020).

Transport as an industry plays an extremely important role in sustainable development of a given country. In Kenya and globally, the various protocols introduced as a measure towards COVID-19 have affected the effectiveness of sustainable transport system as a service today (Zhang et al., 2020). The majority of towns who use local transport had been used to move with their goods and services in the process money circulates in the economy (Zhang & Hayashi, 2020). This culture has since changed due to COVID-19 pandemic. The Government of Kenya part of the measures were that all public transportation vehicles including Matatu's only be filled to half capacity and that everyone wear masks, resulting in increased fare costs, this affected both the commuters and matatu operators country wide (Pinchoff et al.,2021). Furthermore, Nation-wide travel bans due to COVID-19 resulted in dramatic drops in mobility in most matatu Sacco's (Pinchoff, 2021). The main question according to Charlene is that, will people switch to more individual modes of travel like bikes or private cars and shun crowded public transport service? To answer this question is yes some will even use technology such as online platforms for meetings to avoid traveling. A lot has to be done on the transport industry the adoption modern technologies to support both parties is the way to improve mobility now that the pandemic is here to stay (Charlene et al. , 2020).

The complete imploding of travel during the pandemic and possible reductions after the pandemic has resulted into many long-term economic implications. One example is large reductions in revenue generated through transport as an industry (Zietsman, 2020). This exacerbates the issues transportation agencies already face due to the new measures. Reduced travel will also result in a reduction in paid parking, tolls, fines, and other revenue-generating sources. Some state departments of transportation have already reported significant drops in their transportation funds (Zietsman, 2020). One of the biggest challenges for developing cities, however, is that most public transport is informal and the majority of owners are private Julia et al. (2020). In Nairobi, for instance, 70% of commuters rely on matatu's for daily travel. This mode of transport supports millions of people in the city, apart from the Sacco there is need to introduce other regulations to manage the industry where modern technologies such use of ICT's for both management and commuters(" Cities that Work, COVID-19," 2020).

The current pandemic has also resulted in the rapid diffusion of various online businesses. This trend is likely to continue and consequently more delivery-based services will replace shopping at stores and online working styles will become more popular (Zhang & Hayashi, 2020). It is worth exploring whether the development of a "smart" society will help transport systems and services to work in a more sustainable way (Collins, 2020). According to Zhang (2020), physical distancing practices may encourage more people to rely on private cars and taxis as a means of transport in their daily lives. The adoption of such kind preferred choices can only be enhanced when commuters embrace technology such as use of mobile phone apps to reserve or book for the service("Uptake in on-demand ride-hailing for intracity long distance trip making during COVID-19," 2021). It is prudent that the current and near-future potential effects are addressed in a relatively comprehensive and seamless way ("COVID-19 and transport: Findings from a world-wide expert survey ", 2021).

The scientific understanding of the SARS-CoV-2 virus transmission is continually evolving, e.g., initially airborne transmission was considered unlikely (Lewis, 2020), but this has later been disputed. The most recent guidance by the WHO states that a virus can spread through both large and small respiratory droplets, and transmission can also occur during a prolonged stay in an enclosed space where the air contains viral particles (World Health Organization, 2021a). Indeed, laboratory studies have shown the virus to be able to remain active while suspended in the air for over an hour (Kampf, Todt, Pfaender, Steinmann, 2020, Van Doremalen, Bushmaker, Morris, Holbrook, Gamble, Williamson, Tamin, Harcourt, Thornburg, Gerber, et al., 2020).

Therefore, a healthy passenger located further than 6 feet from an infected person can become infected due to the exposure to the virus suspended in the air over long distance. Furthermore, even when an infected passenger gets off the vehicle prior to a healthy passenger boarding the vehicle, it is possible for the healthy passenger to become infected by

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inhaling virus-containing respiratory droplets suspended in the air left by the infected passenger. However, airborne transmission over longer (i.e., non-contact) distance or time can only occur when the conditions are suitable (Morawska, Cao, 2020, World Health Organization). Examples of conditions where such transmission has been reported include diverse enclosed spaces that have inadequate ventilation or air exchange (Li, Leung, Tang, Yang, Chao, Lin, Lu, Nielsen, Niu, Qian, et al., 2007, Li, Qian, Hang, Chen, Hong, Liang, Li, Xiao, Wei, Liu, et al.). Hence, good ventilation is essential for reducing the transmission risk of passengers.

According to (Corwin, Zarif, Berdichevskiy, & Pankratz, 2020), Safety in mobility has long meant avoiding car crashes or preventing crime on buses and subways. Corwin et al (2020) observed that as people begin to travel again, a "safe" trip would likely also mean one that is sanitary and hygienic. A wide range of measures are expected to be deployed where people gather to travel together: health checks or thermal scans before boarding a shared vehicle or entering a terminal, improved cleaning procedures, reconfigured seating and partitions to create physical distancing, embracing use of mobile money or cashless systems to reduce the exchange of cash money (John Matley et al., 2020)

In line with this background this study addressed the nature and trends in the public transportation in North Rift and Western region of Kenya. Transportation in north rift and western region use public transport as their preferred mode of transport. The majority of commuters use small vans as their main mobility for both goods and services. The matatu's are managed by Sacco's this as per the public transport Act. The Sacco's play an important role in transport sector. Apart from the daily management of the matatu's, they also help to regulate the new transport rules introduced by the government through National Transport and Safety Authority (NTSA). Public transport in Kenya was seriously affected by COVID - 19 protocols, matatu owners and commuters were all affected by the new norms of operation. Technological approaches such online booking systems and applications are the new ways matatu Sacco's are adopting. The reforms are expected to improve road safety and adherence to COVID-19 restrictions .The findings of this study will guide all the stakeholders in the transport industry and the government on the true impact of the pandemic in Kenya.

II. PROBLEM STATEMENT

There is no formal way of monitoring the compliance with the set government protocols to control COVID-19 with regards to stakeholders' perception on the COVID-19 transport intervention protocols in western region, Kenya.

III. OBJECTIVE

Establish the status, nature and trends in the public transportation between the January 2020 to 2021.

IV. MOTIVATING RATIONALE

Transportation, as the movement of people, goods and services from one place to another represents the pulse of an economy and plays and extremely important role in sustainable development. When people move, they take goods (especially FMCGs) and services with them and in the process money circulates in the economy. Therefore, it is virtually impossible to interrupt transportation industry without disrupting the economy. The only time that transportation ceases, is when the economy is at a standstill as the COVID-19 pandemic has demonstrated across the world! Research shows that the spread of this deadly and highly contagious virus has scared many people across the world into self-isolation and even working from their homes (Haas, Faber, & Hamersma, 2020; Mogaji, 2020). This has led to reduced movement of people, goods and services (Beck & Hensher, 2020) over the past 4 months with people only moving when it is absolutely essential. Passenger air traffic went down by 90% while the number of public transport commuters declined by 80% in some of the cities (Budd & Ison, 2020). The dwindling commuter demand has made transport operators reduced their services.

Public transport is an essential part of urban life, and many peoples in lower level income countries are using it to meet their daily needs. Traveling is a natural need of a human to fulfill their basic activities and needs of daily life (Lopez, 2003). The 2019 coronavirus disease (COVID-19) pandemic is a global concern after its first outbreak in Wuhan city of China and the largest by its coverage and death as compared to 2012, the first epidemic in Saudi Arabia (Mahase, 2020). The virus continues to spread and was declared as an emergency health condition by the World Health Organization. Currently globally, there are 30,367,850 confirmed cases, 950,821 deaths, and 22,052,941 recoveries, and in Ethiopia, there are 1060 deaths (Cucinotta and Vanelli, 2020). The virus is too contagious and transmits to humans through respiratory droplets, physical contact, and surface contact, and patients were both symptomatic and asymptomatic. The incubation period of the virus was a 1-week (2–14 days) period, which was a base for the quarantine period of duration for suspected cases and confirmed cases (WHO, 2020; Rehman, 2020).

The hypermobility of modern society has contributed to the rapid spread of the disease from Wuhan, China to virtually every corner of the world (Cartenì, Francesco, & Martino, 2020; Editorial, 2020). When the WHO declared it a pandemic at the beginning of March 2020, most governments took the

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step of restricting movement to reduce the spread (De Vos, 2020). Many developed countries such as the United Kingdom initially opted for a herd immunity approach to slow down the spread of the virus, while others such as New Zealand opted for a full scale shutdown of social and economic activity (Beck & Hensher, 2020). However, Kenya seems to have adopted the blended model where Nairobi and Mombasa were partially locked down while the rest of the country continued to function but subject to a 7pm to 4am curfew. The partial lockdown only affected movement of people in and out of the "red zones" but did not affect movement within the cities and movement of goods. The reduced movement has had a negative knock-on disruptive effect on other transportation-allied sectors such as the energy (fewer vehicles means less fuel sales), hospitality, finance (vehicles bought through hire purchase can't be paid), vehicle sales and leasing services, vehicle spares (grounded vehicles do not need servicing), and vehicle maintenance and the associated supply chains. Consequently, these half measures have adversely affected the public transportation operators who move people in and out of the red zones.

The socio-technical conceptualization of transportation resilience gains particular relevance when we consider social shocks to transportation systems that disrupt markets without causing physical infrastructure damage. Such disruptions typically stem from changes in societal behavior, preferences, or external factors that have a significant impact on the transportation industry (Chan et al., 2022a, Schwanen, 2021). For instance, global health crises like the coronavirus pandemic can lead to a noticeable decrease in travel demand as individuals opt to avoid unnecessary trips (Shortall et al., 2022). Measures such as social distancing and heightened public health concerns can disrupt the use of public transportation, air travel, and other modes, subsequently causing disturbances in the market (Chan et al., 2021b, Gutiérrez et al., 2021, Tsoi and Loo, 2023). These challenges prompt the need for adaptation by embracing technology, both in the social sphere (e.g., teleworking) and the technical sub-system (e.g., on-demand transport services) (Hörcher et al., 2022

V. MATERIAL AND METHOD

Data for this study was collected from a sample of 120 respondents from the organized public transport sector based in Eldoret, Bungoma, Kakamega and Kisumu towns. This is a well-organized and controlled group of operators popularly known as shuttles that operate 11 seater vans that ply specific routes and usually charge travelers a fixed and regulated fare for each trip. A survey questionnaire was administered to both the managers and clerical staff and a focus group discussion with the managers was held. Descriptive statistics was used to survey the data. A regression analysis was done to build a multiple regression model ($Y = \beta + b1X1 + b2X2 + ... + A$) that could be used to predict the effects of the protocols on the aspects of public transportation business. The Collinearity tests that were carried out on the data shows that there was no collinearity among the variables in the study.

A descriptive statistical analysis shows that a majority of operators were willing and supported the statutory COVID19 protocols by providing temperature guns (92%), sanitizers and sanitizing the travelers (89%), reducing the capacity of each vehicle (90%), observed curfew times (88%) by stopping bookings early. However, it was also noted that the protocols were hurting the business. Again though a majority (98%) of the respondents had adjusted the fare upwards in response to the reduced capacity, a good number (67%) were struggling in the business with 46% facing difficulties coping and 79% said that the cost of business had risen.

A regression analysis was done to establish the effects of the protocols on the cost of doing business in the sector. The results are shown in table 1.0 below.

Table 1: Effects of COVID-19 protocols

Coefficient's							
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
	(Constant)	2.709	.619		4.372	.000		
	Does each vehicle have temperature gun	-.569	.304	-.282	-1.868	.070	.789	1.268
	Does your crew sanitize passengers before entering the vehicle	.113	.204	.085	.553	.584	.757	1.322
	Is it affordable to sanitize each passenger	-.464	.124	-.555	-3.737	.001	.814	1.228

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	Do you provide running water and soap for washing hands	.060	.141	.067	.426	.672	.726	1.377
	Are your crew also required to have covid 19 documents	-.483	.404	-.171	-1.196	.239	.875	1.143
	How often do you need to renew it	.058	.161	.053	.359	.722	.818	1.223
a. Dependent Variable: Has covid 19 requirements increased the cost of your business								

A further regression analysis was done to establish how the COVID-19 protocols had affected their ability to meet their financial obligations. The results are in the table 2 below.

Table 2: Effect of COVID-19 protocols on Transport sector

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	5.131	2.030		2.527	.015		
	Did you adjust fares after COVID 19	-3.112	2.048	-.294	-1.519	.136	.538	1.858
	After adjusting fares we are not affected	.440	.493	.136	.893	.377	.862	1.159
	Do you enforce social distancing in your vehicles	1.091	1.360	.174	.802	.427	.426	2.350
	Were members servicing their loans	-.528	.235	-.390	-2.252	.030	.670	1.493
a. Dependent Variable: Current situation affect your ability to meet financial obligations								

The findings showed that majority of the sector were affected by the protocols as shown in the table above.

The study also sought to find the factors that influence spread of COVID -19 in public transportation in Kenya.

Table 3: Factors that influence spread of COVID-19 in public transportation in Kenya

Crosstab				
A. What are the factors that influence spread of C19 in public transportation in Kenya?		Gender		Chi Sq. Value
		Male	Female	
Congestion in Waiting areas	% within Congestion in Waiting areas	41 (81)	5 (13)	0.500
Congestion in public transport vehicles	% within Congestion in public transport vehicles	40 (78)	5 (10.0)	0.001
Use of air conditioners in the vehicles	% within Use of air conditioners in the vehicles	12 (67.6)	5 (23.4)	5.100
Lack of proper policies in maintenance of travel protocols	% within Lack of proper policies in maintenance of travel protocols	14 (78.3)	3 (21.7)	1.735
Ventilation in public transport vehicles	% within Ventilation in public transport vehicles	13 (63.7)	5 (26.3)	4.633
Lack of use of PPEs in public transport vehicles	% within Lack of use of PPEs in public transport vehicles	12 (60.7)	5 (26.3)	4.633
Vehicle fumigation	% within Vehicle fumigation	15 (65.8)	5 (31.3)	6.739

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Handling cash	% within Handling cash	25 (82.2)	4 (13.8)	0.038

The study sought to find out what are the factors that influence spread of COVID-19 in public transportation in Kenya. The findings show that majority through handling of cash (82.2%), Congestion in public transport vehicles (81%)

Table 4: government of Kenya COVID-19 guidelines and protocols for public transport operators

Crosstab				
C. What are the governments of Kenya COVID-19 guidelines and protocols for public transport operators?		Gender		Chi sq. Value
		Male	Female	
Public education	% within Physical education	30 (83.3)	6 (16.7)	1.313
Physical distancing	% within Physical distancing	45 (83.0)	7 (12.0)	
Face Mask	% within Face Mask	43 (84.5)	7 (13.5)	0.309
Routine Sanitation	% within Routine Sanitation	43 (84.0)	7 (13.5)	0.309
Rapid Health screening	% within Rapid Health screening	35 (70.7)	7 (16.3)	2.057
Hand washing	% within Hand washing	42 (83.3)	7 (12.7)	0.473

The study also sought to find out, what are the government of Kenya COVID-19 guidelines and protocols for public transport operators. The findings show that majority of the factors in table 1.4 above were all used as guideline for COVID-19 at (83.0%) on Physical distancing ,awareness and public education (83%) , Face Mask(84.5%) , Routine Sanitation (84.0%) and Hand washing (84%).

Table 5: Monitoring the COVID protocols in your area of operations

Crosstab				
H. Who is responsible for monitoring the COVID protocols in your area of operations		Gender		Total
		Male	Female	
Police	% within Police	25 (86.2)	4 (13.8)	0.038
County Security	% within County Security	15 (71.4)	6 (28.6)	7.420
Ministry of health county government	% within Ministry of health county government	15 (71.4)	6 (28.6)	7.420
Ministry of health - central government	% within Ministry of health central government	19 (73.1)	7 (26.9)	8.861
Transport operators	% within Transport operators	43 (89.6)	5 (10.4)	2.483
Clients	% within Clients	39 (88.6)	5 (11.4)	0.539

The study also sought to find out who is responsible for monitoring the COVID protocols in your area of operations. The findings show that the majority of respondents (86.6%) show that the operators are more responsible as compared to the ministry of health (28.6%).

VI. CONCLUSION

The COVID19 intervention protocols for the transport industry by the Ministry of health and the World Health Organization have been received positively in spite of the challenges the operators were facing. However, to sustain the business and protect jobs of public transport operators, the government may have to assist them with soft loans and a review of the requirements.

VII. RECOMMENDATIONS

The stakeholders should consider attending counseling sessions to reduce psychological trauma. The findings of this study will guide all the stakeholders in the transport industry and the government on the effect of COVID-19 on transportation system in Kenya. Technological approaches such online booking systems, cashless payment methods and Sacco management systems should be adopted by all matatu Sacco's to reduce spread of the virus through handling of cash. Management of Matatu's is by the Sacco's as per public transport Act. Sacco's also regulate the new transport rules introduced by the government through National Transport and Safety Authority (NTSA), we have gaps on how the two roles are implemented, there is a need for an independent body to perform this role.

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