Global Scientific JOURNALS

GSJ: Volume 9, Issue 10, October 2021, Online: ISSN 2320-9186
www.globalscientificjournal.com

Effects of Covid-19 Prevention Measures on Supply Chain Performance in Pharmaceutical Distribution Firms in Rwanda

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Abstract

Supply disruptions during the first year of Covid-19 pandemic have been common, but few literatures about Rwanda have statistically evidenced the association between covid-19 prevention measures and the performance of pharmaceutical distribution. This study aimed at analyzing the effects social distancing practices, Covid-19 screening practices and the use of personal protective equipment on supply chain performance in pharmaceutical distribution firms in Rwanda during the first year of the pandemic. A cross-sectional exploratory study directed questionnaires to 102 staff from wholesale pharmacies in Kigali and the multiple regression model was run to test predicted hypotheses about variables. The high association between decreased supply chain performance and increased social distancing practices implemented was detected (n=102, β= 0.857, t=16.8, p=0.000). However, a very low association between decreased supply chain performance and increased number of people screened for covid-19 (n=102, β= 0.128, t=1.965, p=0.078) as well as increased use of personal protective equipment (n=102, B = -0.093, t= -1.423, p= 0.158) were noticed. This study recommends other interventions to attenuate their effects on supply chain while implementing social distancing practices. Further studies should consider assessing the relationship between other covid19 prevention measures and the performance of supply chain in diverse sectors.

Keywords: *Covid-19 Prevention Measures, Social Distancing Practices, Personal Protective Equipment, Covid-19 Screening, Supply Chain Performance, Pharmaceutical Distribution*

1. Introduction

COVID-19 has been so far the most human threatening global pandemic having impact on supply chain management (Shlomo, 2020), (UNDP, 2020) . From March 2020, the World Health Organization urged strict controls measures that included restrictions on travels and social gatherings, mandatory wearing of personal protective equipment, intensive covid-19 screening including testing and tracing suspected contacts (Dabo Guan, June 2020). Ultimately, various literatures have demonstrated that covid-19 prevention measures contributed to increased disruptions of pharmaceutical supply chain systems in several ways by affecting delivery lead-times, product prices and availability as well as order fulfilment. (Naveen Donthu, 2020), (Balfour, 2020).

The issue of availability of products and its distribution to the consumers was cross cutting. Some companies reported the difficult in adapting to the technology with equipment breakdown, internet shortage and it took longer than usual to process the requests from their clients (Joshua et.al, 2020). In United States, the panic buying coupled with limited staffing size in offices forced some pharmaceutical firms to temporarily shut down their businesses and

many of others have adopted online business practices. (Sydney Strong, 2020).

During lockdowns, supply chain disruptions were reported in several countries. The example of China, which is leading the global pharmaceutical production and distribution (Popp, 2011), (Horner, 2020), has experienced import issues and could not succeed with timely acquisition of raw materials required to meet production required for global demand (Sutter, 2020). In addition, the migration of laborers was a big problem at the extent of affecting business operations.

In India, about 60 % of antiretroviral drugs manufacturing firms opinioned that their decreased production were associated to challenges in raw materials importation processes. (Bharat Bhushan Rewari, 2020), (Philippe J Guerin, 2021). In Africa, the pharmaceutical industry highly depends on imports. Experts reports suggest that about 80 % of pharmaceutical products used in Africa come from oversees and the greater part from China and India. (Adebisi, 2020). As result of the pandemic, African pharmaceutical companies experiences issues in order fill capability by foreign suppliers. The prolonged lead times are attributed to export restrictions in countries of origin and lockdowns in countries of import. China and India continue to produce to respond to increased demand pressures from Africa market. (Karishma Banga, 2020).

With no doubt, the increased demand of personal protective equipment during early stage of Covid-19 was opposed to its decreased availability and distribution of products. In early 2020, the WHO has forecasted the need of 89 million of medical masks, 76 million of examination gloves and 1.6 million of goggles. Ultimately, the leading manufacturers changed their focus from general supplies to PPEs (Pandey, 2020), (WHO, 2020). A case of India, the critical component of pharmaceutical industry has been laid in infection control strategy, but with the Covid-19 prevention, the demand of PPEs has attracted attention from manufacturers where the Indian pharmaceutical market is to increase from nearly US$34.3 billion in 2020 to more than US$ 45 billion by 2025 million'. However, two-thirds of the active pharmaceutical ingredients and intermediaries come from China. (Pandey, 2020).

During initial response to Covid19, Rwanda has been known of the great efforts put in covid-19 control (WHO, 2020). As reported in January 2021 by Lowy Institute from Australia, Rwanda has been ranked the first country in Africa and the sixth globally in preventing Covid-19 (Africa News, 2021), (Lowy Institute, 2021). From when the first positive case of Covid-19 was confirmed on March 14, 2020. (WHO, 2020), the country leadership has enforced preventive measures, which focused on enforcing social distancing, Covid-19 screening and testing as well as the usage of personal protective equipment (WHO, 2020). In Rwanda, Social distancing practices were characterized by temporary closure of non-essential businesses, compulsory social distancing imposing open business to decrease staff size in offices at 30%, lockdowns characterized with movements ban and travel restrictions with overhanging curfew hours, mandatory handwashing with soap or rub with alcohol based hand sanitizer and wearing facemasks in public places. (WHO, 2020), (Rwanda Primature, 2020). To control movements and travels, Rwanda has closed its borders completely, except for goods, cargo and returning citizens with about 2 weeks of quarantine (Rwanda Primature, 2020).

As result, the leading pharmaceutical manufacturers changed their focus from general supplies to PPEs (Pandey, 2020). In India, the domestic manufacture of PPE contributed to increment of US$34.3 billion in 2020.

In addition, the price increment was a generalized issue during covid-19. A cross sectional study in Europe showed the average increase of 71.6% in Denmark, 43.1% in Netherlands and 37.5% in Sweden. The global market price increase with the first 2 months hiked 4%. (Ando, 2020). The Control mechanisms have also affected supply chain. Thomas (2020) affirms that many African countries, including Rwanda have charged fines from their public as a way of enforcing covid-19 prevention measures (Thomas Herman, 2020).

Even though some literatures affirm that the supply of health commodities trough the distribution channels was disrupted (Analytica, 2020)A very few scholars have so far used statistical models to explain the association between covid-19 prevention measures and the nature of supply chain disruption.

2. The problem statement

Supply disruptions during the first year of Covid-19 pandemic have been common, but few literatures about Rwanda have statistically evidenced the association between covid-19 prevention measures and the performance of pharmaceutical distribution.

Worldwide, several scholars have evidenced the association between covid-19 lockdowns and increased disruptions of pharmaceutical supply chain systems by affecting delivery lead-times and order fulfilment. (Naveen Donthu, 2020), (Balfour, 2020). In the first year of pandemic with generalized lockdowns and cross border movement restrictions, China has experienced import issues and could not succeed with timely acquisition of raw materials required to meet production required for global demand (Sutter, 2020). In addition, the migration of laborers was a big problem and this has affected the operational capacity of firms (Joshua et.al, 2020). In early 2020, the total production of antiretroviral drugs was decreased by 40 % as manufacturing firms in India experienced problems importing the raw materials (Philippe J Guerin, 2021).

Prolonged lead-times leading to order cancellation were reported in many African countries. (Bharat, 2020). In Nigeria, out of 226 pharmaceutical distributers 60% reported that their customers have cancelled the purchase orders and contracts due to inability to meet customer requirements (Adebisi, 2020). In Nigeria 40% of pharmaceutical distributers reported that the market has innovated new products, especially the ones reserved for covid-19 prevention, the market created a kind of competition and some companies experienced transient overstock and possible damages (Theophilus, 2021).

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Even though some literatures affirm that the supply of health commodities trough the distribution channels was disrupted (Analytica, 2020); a very few scholars have so far used statistical models to explain the association between covid-19 prevention measures and the nature of supply chain disruption.

3. Research objectives and hypotheses

This research had the purpose to determine the effects of covid-19 prevention measures on supply chain performance, in Rwanda's wholesale pharmaceutical distribution firms in Kigali city during the period from March 2020 to March 2021.

Further, the three specific objectives were developed as follow: First, to determine the effect of social distancing practices on supply chain performance in pharmaceutical distribution firms in Rwanda; Secondly, to determine the effects of covd-19 screening practices on supply chain performance in pharmaceutical distribution firms in Rwanda and third, to evaluate the effects of used personal protective equipment on supply chain performance pharmaceutical distribution firms in Rwanda.

The researcher has estimated the following hypotheses for the research: **1)** The social distancing practices affected the supply chain performance in pharmaceutical distribution firms in Rwanda**; 2)** Covid-19 testing and screening practices affected the supply chain performance in pharmaceutical distribution firms in Rwanda **and 3)** The number of used personal protective equipment do not affect supply chain performance in pharmaceutical distribution firms in Rwanda.

4. Review of Literatures

This research has built on previous and existing literatures in areas of covid19 preventions and areas of supply chain management. The investigator has conducted critical examination of the existing relevant literatures on the topic under investigation.

4.1 Covid-19 prevention

The World Health Organization first defined COVID-19 as a disease caused by a new strain of coronavirus. 'CO' stands for corona, 'VI' for virus, and 'D' for disease. Formerly, this disease was referred to as '2019 novel coronavirus' or '2019-nCoV.' The COVID-19 virus is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) and some types of common cold. (Bender, 2020). Covid-19 prevention measures are referred to the strategies put in place to limit the spread of the virus among the community. (Rahmet GÜNER, 2020). Social distancing practices include full or partial lockdowns with closing businesses, workplaces, educational and worship places, limiting international travels, restrictions of mass gatherings and meetings, stay at home restrictions for the entire regions and countries. Social distancing is particularly advised in locations that have community transmission and may consider installation of quarantine areas and isolation areas (Paschal Awingura, 2021). Screening involves testing asymptomatic individuals who do not have known or suspected exposure to COVID-19 in order to make individual decisions based on the test results. The

experts recommend some practices in screening, which involve symptom screening, testing, and contact tracing as strategies to identify people infected with SARS-CoV-2 so that actions can be taken to slow and stop the spread of the virus. Temperature screening at entry and exit points of public environment is also important as it help identifying the cases eligible for testing and further investigations (CDC, 2021). Personal Protective Equipment (PPE) recommended for covid-19 prevention are facemasks worn in public place for all people. Health care providers should in addition use PPE that includes surgical masks, particulate filter respirators (such as P2 or N95), gloves, goggles, glasses, face shields, gowns and aprons (WHO, 2021), (CDC, 2021).

4.2. Supply Chain Performance

Many scholars have in common defined supply chain as the channels followed to convert raw materials into products and deliver the product to the end user, as well as reverse practices. (Lambert & Pohlen, 2001). It includes manufacturer, suppliers, transporters, warehouses, wholesalers, retailers, other intermediaries and even customers themselves (Căescu, 2011). Every organization has the supply chain function, whether visible or not, which assures customer service (Chopra, 2007). Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption. (Oliver, 1982). Gunasekaran et al. (2001) stated that supply chain performance measurement is an important aspect of successful effective supply chain management (Gunasekaran, 2001). Holmberg (2000) and Pyburn (1992), asserted the supply chain performance as the progress based on mutually agreed goals and metrics (Nedaa Agami, 2012). The disruptions to the distribution channel of medicines throughout the supply chain can potentially undermine health outcomes of the public by influencing the availability, cost and quality of medicines, thus, the continuous performance management is key part in supply chain management (Musyoki, 2017). Recommended performance indicators in pharmaceutical distribution include order lead-time, sales price; inventory turnover rate and order fill (Aronovich, 2010).

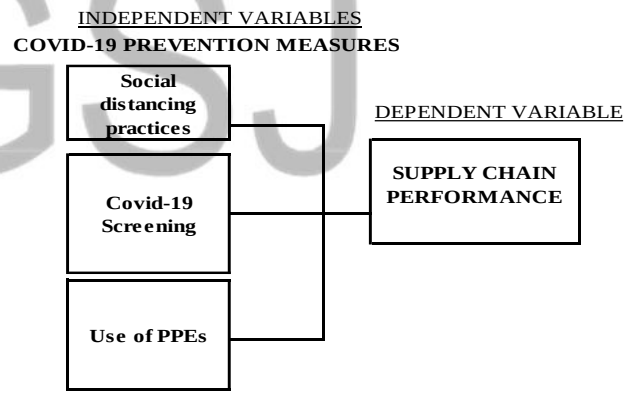
4.3. Empirical review

Bhushan et al, 2020 elaborated that lockdown is associated with decreased production with 76% of respondents from local manufacturers agree that they experienced shipment delays, long lead times and rising costs of final products on the local markets. (Bhushan, 2020). Bizoza (2020) argued that even though the government of Rwanda has put much effort to contain the spread of the virus, the implemented measures have affected the fair business practices for traders affecting inventory turnover rates (Alfred Bizoza, 2020). Thomas et.al,(2020) stated that that the prices of medicines was relatively is stable and is remarkably low, with median price ratios (MPRs) of 1.0 in comparison to the international procurement price matrix (Thomas P. C., 2020). However, during a few months that followed COVID-19 declaration as pandemic there was sharp increment of market prices for medicines and related products and the government tried to regulate market price, but regulating some items that are imported from abroad remained challenging (Theogene, 2021).

The **Figure 1** of conceptual framework indicates the way that covid-19 prevention measures are linked with the supply chain performance.

4.5. Conceptual framework

Figure 1. Conceptual framework indicating illustrating the linkage between covid-19 prevention measures and supply chain performance



Source: Conceptualized by the researcher (2021)

The pressure to comply with social distancing requirements have been associated with the supply chain performance in a way that the travel limitations, lockdowns and business closures caused limited the access to essential businesses, the import processes were very affected and ultimately affecting availability of products for client. The long import processes explain the limited availability of products in stores and thus, the change in the order fill rates, inventory turnover and lead times as well as sales prices generally for targeted supplies. In addition, due to randomized mass screening for covid-19, a number of people fearing to be screened usually abandoned to go in public places to seek essential services, pharmaceutical firms. Business holder concentrated on availing personal protective equipment and less

focus was put on investing in availing other essential pharmaceutical items. This can also be linked with the shortage of products in pharmaceutical distribution firms.

5. Materials and Methods

A cross-sectional exploratory study has used a questionnaire directed to selected respondents. The study population was 137 wholesale pharmacies operating in Kigali city, each represented by one staff in strategic role. The probability sampling technique was adopted and the sample size of 102 respondents was distributed proportionally in tree districts of Kigali city. The details of sample size distributions are indicated in **Table 1.**

Data was collected with a questionnaire directed to selected respondents and data was coded and entered in SPSS v.23. To analyze our data, Frequencies and mean were evaluated to understand the distribution of respondents per different criteria. Inferential parameters run are Pearson correlation and multiple linear regression model, to examine the association between variables. Pearson correlation and a multiple linear regression model were analyzed to detect the association between variables and test hypotheses.

Table 1. Sample size distribution

District of operations	Number of registered companies	Number of respondents	Percentages
Gasabo	38	28	27.45%
Nyarugenge	79	58	56.86%
Kicukiro	20	16	15.69%
Total	**137**	**102**	**100.00%**

Source: Primary data (2021)

6. Results and Discussion

6.1. Respondents' perceptions on supply chain performance

This research model has analyzed the mean and standard deviation, in order to describe the statistical level of agreements from respondents on their views on covid-19 prevention measures and supply chain performance.

As indicated in **table 2,** the respondents have in common the strong agreement that the inventory turnover rates of products in stock, the order lead times, the sales prices and the order fill rates were affected during the covid-19 pandemics.

Table 2. Respondents' perceptions on supply chain performance during Covid-19 pandemic

Statement	Number of received responses					N	Mean	Standard deviation
	SD	D	U	A	SA			
The inventory turnover rate during covid-19 was affected	1	1	0	44	56	102	4.50	0.656
The order lead times during covid-19 was affected	0	1	2	36	63	102	4.58	0.588
The sales prices during covid-19 was affected	0	0	0	39	63	102	4.62	0.488
The order fill rates during covid-19 was affected	0	3	2	47	50	102	4.41	0.68
Legend: SD- Strongly disagree; D-Disagree; U-Undecided; A-Agree, SA-Strongly Agree								

Source: Primary Data (2021)

6.2. Respondents' perceptions on social distancing and supply chain performance

The **table 3** describes that at the highest mean of 4.62 and lowest mean of 4.41 correspond to Licket scale of scale of 4.30-5.00; which indicate that respondents have strong agreement that when social distancing practices were implemented, the inventory turnover rates of products in stock, the order lead times, the sales prices and the order fill rates were affected. There is strong evidence that the countrywide implementation of social distancing practices has influenced the supply chain decisions on sales volumes, inventory strategy, order processing mechanisms and market prices.

Table 3. Respondents 'perceptions on social distancing practices and supply chain performance

Statement	Number of received responses					N	Mean	Standard deviation
	SD	**D**	**U**	**A**	**SA**			
The more people implement social distancing practices, the more inventory turnover rates of products in stock were affected	1	1	0	51	49	102	4.43	0.63
The more people implement social distancing practices, the more order lead times affected	0	1	2	44	55	102	4.5	0.59
The more people implement social distancing practices, the more sales prices on products were affected	0	0	0	61	41	102	4.4	0.49
The more people implement social distancing practices, the more order fill rates during covid-19 were affected	0	2	1	43	56	102	4.5	0.62

Legend: **SD- Strongly disagree; D-Disagree; U-Undecided; A-Agree, SA-Strongly Agree**

Source: Primary Data (2021)

6.3. Perceptions on supply chain performance and Covid-19 screening practices

The **table 4** describes the highest mean of 1.68 and lowest mean of 1.66 which correspond to Licket scale of 1.00- 1.79. The scales indicate that respondents have a strong degree of disagreement that when more people were screened of Covid19, the inventory turnover rates of products in stock, the order lead times, the sales prices and the order fill rates were affected. Therefore, there was a very weak or lack of evidence that the countrywide screening of covid-19 is associated with the supply chain decisions on sales volumes, inventory strategy, order processing mechanisms and market prices.

Table 4. Respondents 'perceptions on covid-19 screening and supply chain performance

Statement	**Number of received responses**					**N**	**Mean**	**Standard deviation**
	SD	**D**	**U**	**A**	**SA**			
The more people being screened of covid-19, the more inventory turnover rates of products in stock was affected	59	43	0	0	0	102	1.42	0.496
The more people being screened of covid-19, the more order lead times were affected	59	40	3	0	0	102	1.45	0.556
The more people being tested covid-19, the more sales prices on products were affected	37	64	1	0	0	102	1.65	0.5
The more people being screened of covid-19, the more order fill rates were affected	47	47	7	1	0	102	1.63	0.659
Legend: SD- Strongly disagree; D-Disagree; U-Undecided; A-Agree, SA-Strongly Agree								

Source: Primary Data (2021)

6.4. Supply chain performance and worn personal protective equipment.

The **table 5** describes at the highest mean of 1.68 and lowest mean of 1.58 correspond to Licket scale of scale of 1.00- 1.79; which indicate that respondents have a strong degree of disagreement that when more quantity of personal protective equipment (PPEs the inventory turnover rates of products in stock, the order lead times, the sales prices and the order fill rates were affected. There was a very weak or lack of evidence that the countrywide wearing of personal protective equipment is associated with the supply chain decisions on sales volumes, inventory strategy, order processing mechanisms and market prices of pharmaceutical products.

Table 5. Respondents 'perceptions on worn of PPEs and Supply chain performance

Statement	Number of received responses					N	Mean	Standard deviation
	SD	D	U	A	SA			
The more the number of PPE consumed, the more inventory turnover rates of products in stock decreased	36	63	3	0	0	102	1.68	0.53
The more the number of PPE consumed, the more order lead times were prolonged than usual	38	61	3	0	0	102	1.66	0.536
The more the number of PPE consumed, the more sales prices on products were increased than usual	42	52	8	0	0	102	1.67	0.619
The more number of PPE consumed, the more order fill rates were reduced than usual	51	44	6	1	0	102	1.58	0.652

Legend: PPE: Personal protective equipment, SD- Strongly disagree; D-Disagree; U-Undecided; A-Agree, SA-Strongly Agree

Source: Primary Data (2021)

4.5. Effect of social distancing, covid-19 screening and use of PPEs on Supply Chain Performance

The research has run Pearson correlation between the Covid-19 prevention measures variables and supply chain performance in selected pharmaceutical distribution firms in Kigali, Rwanda. The results of the analysis indicate the outputs, which are illustrated in tables **table 6**.

The **table 6** indicates the existence of a highly significant, strong and positive correlation between Social distancing practices and Supply chain performance ($r = 0.857$, $n = 102$, $p < .001$). However, there is no relationship between Covid-19 Screening practices and supply chain performance ($r = -0.033$, $n = 102$, $p > .0.05$); nor a relationship between the number of consumed personal protective equipment ($r = -0.158$, $n = 102$, $p > .0.05$).

4.7 Relationship between covid-19 prevention measures and supply chain performance.

The pattern described by **table 7**, indicates that the model has the coefficient of determination R-squared: $R^2 = 0.744$, which indicates a very strong relationship between research variables, Therefore, the independent variables contribute to74.4 % of change in dependent variable.

Table 6. Summary for the regression model.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.863	0.744	0.737	0.156

Source: Primary Data (2021)

To understand the relationship between the dependent variable with each one of independent variables, we evaluated the nature of regression coefficients and their corresponding p values, as shown in **table 8.**

Table 7. Correlation between dependent and independent variables

		Number of Social Distancing Practices implemented	Number of personal protective equipment consumed	Number of People screened and tested	Supply chain performance
Number of Social Distancing Practices implemented	Pearson Correlation	1	-.168	-.121	.857**
	Sig. (2-tailed)		.092	.227	.000
	N	102	102	102	102
Number of personal protective equipment consumed	Pearson Correlation	-.168	1	.617**	-.158
	Sig. (2-tailed)	.092		.000	.113
	N	102	102	102	102
Number of People screened and tested	Pearson Correlation	-.121	.617**	1	-.033
	Sig. (2-tailed)	.227	.000		.740
	N	102	102	102	102
Supply chain performance	Pearson Correlation	.857**	-.158	-.033	1
	Sig. (2-tailed)	.000	.113	.740	
	N	102	102	102	102

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary Data (2021)

The results from regression analysis of social distancing practices and supply chain performance indicate that the number of social distancing practices implemented produce a highly significant effect on supply chain performance (t=16.8, β= 857 p=0.000). Morever,the results from regression analysis of number of personal protective consumed and supply chain performance indicate that the number of consumed PPE has no significant effect on supply chain performance (t=-1.423, β = -.093 p=0.158). Thus, the use of PPE has negligible effect on supply chain significance. The results from regression analysis of screening and testing practices and supply chain performance indicate that the number of screened and tested people has no significant effect on supply chain performance (t=1.965, β=0.128, p=0.078). Thus, Covid-19 screening practices have had negligible effect on supply chain performance.

The results in table 7 exhibited R square of 0.744, an indication that 74.4% of the deviations supply chain performance by affecting inventory turnover, order fill rates, order lead-times and sales prices in pharmaceutical 74.4% changes were caused by variation in social distancing, screening and use of personal protective practices. Distribution firms in Kigali. Other elements not involved in the model represented 25.6%.

Table 8. Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.524	.270		1.941	.055
	Number of Social Distancing practices implemented	.888	.054	**.857**	16.530	.000
	Number of personal protective equipment consumed	-.090	.064	**-093**	-1.423	.158
	Number of People screened and tested	.138	.070	**.128**	1.965	.078
a. Dependent Variable: Supply chain performance						

Source: Primary Data (2021)

7. Conclusions

The study generally revealed a strong association between supply chain performance and social distancing practices (r =0.857, n=102, p= 0.000.) and lack of association between Covid-19 screening and practices (r = -0.033, n=102, p =0.078) and the use of PPEs (r = -0.158, n=102, p =0.113)

It is in this vain that we tested the research hypotheses initially assumed for this research. Based on our analysis, we came to affirm that the social distancing practices affected the supply chain performance in pharmaceutical distribution firms in Rwanda. In addition, the alternative hypothesis stated that Covid-19 screening practices affected the supply chain performance in pharmaceutical distribution firms in Rwanda. The model analysis led to the rejection the alternative hypothesis, and thus accepted opposite hypothesis. Therefore, there is no statistical effect of covid-19 screening on supply chain performance. Furthermore, the negative hypothesis that the number of used personal protective equipment does not affect supply chain performance in pharmaceutical distribution firms in Rwanda was also verified and accepted. Hence, there is no significant relationship between the used PPEs and supply chain performance.

The findings of this research are supported and or criticized by the most relevant literatures. First, Ekpenyong (2021) asserted that Covid-19 pandemic lockdowns significantly caused supply disruption (t-values = 9.084, at p = 0.005). Secondly, IFC Annual Report of 2020 indicated that during the initial rise of coronavirus cases, the consumption of PPE has gone high than usual resulting in quick adaptation of manufacturers to quickly meet market requirements. This report asserted that the leading manufacturers have reached 40 times of usual productions within first three months of covid-19 pandemic (IFC, 2020). There was initial rise in market prices of PPEs but, with increased production, the price has been quickly stabilized. As the distributions phase was initially affected due to disruptions in transport and logistics, new PPEs domestic manufacturers were licensed (OECD, 2020). The case of Rwanda, about 89 manufacturers of facemasks and hand sanitizers were licensed to operate before end of year 2021. (Rwanda-FDA, 2021). Furthermore, Mutesa (2020) indicated that Rwanda in support with several stakeholders received donation of covid-019 tests and other PPEs and hence the supply chain maintained (Mutesa, 2020).

Based on findings of this research, it is worth to recommend the enforcement of screening practices and the use of PPEs in covid-19 prevention efforts in Rwanda. The execution of social distancing practices should be accompanied with other interventions to attenuate their effects on supply chain. Further studies should deepen in resilience of pharmaceutical supply chains in different in context of disasters.

Acknowledgments

This study was possible with great contribution from Dr. Rusibana Claude who supervised this research from the beginning up to the end. Additionally, the recognition is extended to all academicians, affiliated with University of Kigali, who reviewed the original research and provided their technical inputs. Special appreciation is extended to wholesale pharmaceutical companies in Kigali who provided primary data, trough filling our questionnaire.

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