COVID-19 AND EMERGING MARKETS: A STRATEGIC FRAMEWORK FOR PHARMACEUTICAL SUPPLY CHAINS

Blessing Takawira *, Emmanuel Mutambara **

* *Corresponding author*, College of Business & Economics, University of Johannesburg, Auckland Park Kingsway Campus, South Africa
Contact details: University of Johannesburg, P. O. Box 524, Auckland Park 2006, Johannesburg, South Africa
** Graduate School of Business & Leadership, University of KwaZulu-Natal, Durban, South Africa

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Abstract

The main aim of this study is to develop a strategic framework to address COVID-19-induced supply chain disruptions within the South African pharmaceutical industry. This study explores the perceptions of 25 pharmaceutical supply chain (PSC) professionals in South Africa. Using semi-structured interviews, the study elucidates strategies such as research and development (R&D), marketing strategies, collaborative supply chain disruption management, and local production that can be instrumental in overcoming PSC disruptions. Results underscore the importance of local R&D initiatives and the integration of digital technologies for enhanced resilience (Ivanov & Dolgui, 2020a; Paul & Chowdhury, 2021). Effective communication, local manufacturing, and strong relationships with suppliers and customers were highlighted as key marketing strategies. Collaborative approaches, including information sharing and joint planning, were deemed crucial, along with the potential of local production to reduce dependence on foreign suppliers (Ivanov, 2020; Socal et al., 2021). This strategic framework can significantly contribute to mitigating the impact of COVID-19 and future disruptions on PSCs in South Africa and other emerging markets. This research contributes a practical, industry-informed strategic framework that addresses a major gap in managing PSC disruptions during global crises. Further research is required to explore the specific interventions and policies that facilitate these strategies (Modisakeng et al., 2020).

Keywords: Supply Chain, Pharmaceutical Corporates, Emerging Markets, COVID-19, Pandemic, Strategic Framework

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1. INTRODUCTION

The COVID-19 pandemic has had an unprecedented global impact, causing a public health crisis and significant disruptions across various industries. The South African pharmaceutical industry, a key player in the healthcare sector, has been no exception. The pandemic has exposed vulnerabilities within the industry, such as supply chain disruptions, fluctuating demand, and a strained healthcare infrastructure (Tirivangani et al., 2021). In response to these challenges, a strategic and coordinated approach is essential to ensure the industry's resilience and sustainability and improve healthcare outcomes for the South African population.

A critical aspect of this strategic response is the adoption of appropriate frameworks that address the pandemic's immediate challenges and the long-term implications for the pharmaceutical sector. South Africa's pharmaceutical industry requires such frameworks since it has a high illness load and challenging socioeconomic conditions (Maphumulo & Bhengu, 2019). One such framework is the National Development Plan (NDP) 2030, which outlines the government's long-term vision for the country, including a strong emphasis on improving public healthcare and bolstering the local pharmaceutical industry (National Planning Commission, 2012). Implementing the NDP within the pharmaceutical sector necessitates a multi-stakeholder approach involving public and private entities, international organisations, and donors.

Moreover, the COVID-19 pandemic has highlighted the importance of adopting agile supply chain management strategies, which enable the industry to respond quickly to disruptions and mitigate their impact (Ivanov, 2020). In addition, strengthening local manufacturing capabilities and diversifying supply sources can contribute to the industry's resilience (Morris & Sweeney, 2019). However, the South African pharmaceutical industry must adopt a strategic response to the disruptions caused by the COVID-19 pandemic. This response should be based on appropriate frameworks that address both short-term and long-term challenges, promoting a resilient, sustainable, and efficient industry capable of meeting the healthcare needs of the South African population.

This study, therefore, aims to develop a strategic framework to deal with COVID-19-induced supply chain disruptions within the South African pharmaceutical industry. It intentionally focuses on supply chain disruptions because the South African pharmaceutical industry is vital in the country's healthcare development and poverty alleviation (Mattila et al., 2021). The pharmaceutical industry in South Africa is poised to play a significant role in the revival of the healthcare sectors both at home and abroad. This research is essential not just for the South African pharmaceutical business to adjust its tactics in light of the COVID-19 pandemic but also for the development of sustainable healthcare (Haripersad et al., 2022). Hence, the findings of this study have important implications for South African pharmaceutical industry policymakers and business managers, especially for those in emerging markets.

The COVID-19 pandemic has significantly impacted the South African pharmaceutical industry, leading to supply chain disruptions that have affected the availability of essential medicines and medical supplies. These disruptions have highlighted the need for a strategic framework to mitigate the impact of future supply chain disruptions and ensure the efficient flow of goods and services. Nonetheless, a more extraordinary investigation is underway into the development of such a framework within the South African pharmaceutical industry. According to Yu et al. (2021), the closure of borders and the reduction of transportation services have disrupted the supply chain in the South African pharmaceutical industry during the COVID-19 pandemic. COVID-19 has delayed the delivery of essential medicines and medical supplies to hospitals and clinics nationwide. Furthermore, there have been concerns about the availability of medical professionals' use of protective gear, highlighting the need for effective supply chain management (Martin-Delgado et al., 2020).

In addition, there needs to be more research on creating a strategic framework to deal with COVID-19-induced supply chain disruptions in the South African pharmaceutical industry, despite efforts to address these disruptions, such as collaboration between supply chain partners (Gereffi et al., 2022). Such a framework could include strategies for enhancing supply chain resilience, improving supply chain visibility, and managing inventory levels to ensure the availability of essential medicines and medical supplies.

Therefore, the problem statement is that there is a need to develop a strategic framework to deal with COVID-19-induced supply chain disruptions within the South African pharmaceutical industry to ensure the efficient flow of goods and services and the availability of essential medicines and medical supplies. This framework should take into account the unique challenges facing the industry, such as the lack of digital infrastructure and resources in some parts of the country (Ahmad & Ribarsky, 2018) and the need to balance supply chain efficiency with the need for adequate inventory levels (Pettit et al., 2019).

There is a lack of in-depth studies that have focused on developing a strategic framework to address COVID-19-induced supply chain disruptions in the South African pharmaceutical industry. Despite efforts to address these disruptions, such as collaboration between supply chain partners, the need for more research on creating a strategic framework has been highlighted. The main aim of this study is to develop a strategic framework to address COVID-19-induced supply chain disruptions within the South African pharmaceutical industry. That is to answer the research question:

RQ: What strategies could enhance supply chain resilience in the South African pharmaceutical industry during the COVID-19 pandemic?

The research adopts the NDP 2030 as its framework, which emphasises improving public healthcare and strengthening the local pharmaceutical industry. The research is relevant and significant because it seeks to address the challenges faced by the South African pharmaceutical industry due to the COVID-19 pandemic. The strategic framework developed through this research could help the industry become more resilient, sustainable, and efficient. It would have important implications for policymakers and business managers within the South African pharmaceutical industry and potentially those in other emerging markets. The research uses a qualitative approach to develop a supply chain strategic framework for pharmaceutical corporations in the COVID-19-induced environment. However, the anticipated contribution is a strategic framework to address COVID-19-induced supply chain disruptions within the South African pharmaceutical industry.

This paper is organised as follows. Section 1 introduces the study giving the background of the research. Section 2 reviews the relevant literature. Section 3 presents the methodology used to collect and analyse data, study population, study

sample, and data collection tools. Section 4 provides the study results while Section 5 entails a discussion and interpretation of the study findings. Section 6 provides the conclusion and recommendations of the study, limitations of the study, as well as perspectives for future research.

2. LITERATURE REVIEW

The COVID-19 pandemic's impact on the global pharmaceutical industry, with a particular focus on South Africa, demonstrates the need for a strategic framework to minimize supply chain disruptions. Essential strategies include diversifying supply sources, potentially via local production facilities or multiple supplier relations; enhancing supply chain visibility and collaboration through digital technologies like blockchain and Internet of Things (IoT); developing contingency plans that cover potential risks, alternative suppliers, and flexible production processes; and building resilience via investments in infrastructure and technology. This framework addresses vital areas, such as risk management, supply chain resilience, collaboration, and digitalisation, aiming to ensure the continuous supply of essential medicines and medical supplies, even amid future disruptions.

2.1. Risk management

Risk management is crucial in pharmaceutical supply chains (PSCs), particularly in the context of COVID-19 disruptions, with numerous studies underscoring its importance in identifying potential supply chain vulnerabilities and developing mitigation plans (Sarkis et al., 2020). Specifically, for the South African pharmaceutical industry, a robust risk management framework addressing potential uncertainties in local and global supply chains is indispensable (Kumar & Kumar Singh, 2021). Supply chain risk management (SCRM) ensures the profitability and continuity of operations through coordination with various supply chain partners (Shekarian & Parast, 2021). With an uptick in supply chain disruptions, companies are placing renewed emphasis on risk management, recognising the significance of disruption risks arising from unforeseen events, which can span from natural disasters to technological shifts (Parast & Shekarian, 2019).

Conceptualised as the potential for harm, risk exposes supply chains to unintended, detrimental consequences (Qazi et al., 2016). Accordingly, supply chain risk encompasses any incident negatively impacting the flow of materials, information, or financial capital from suppliers to end-users (Silva et al., 2020). With increased scholarly interest in SCRM as a strategic business factor influencing company success and overall supply chain risk reduction (Chen et al., 2020), SCRM is seen as a systematic approach to analyzing and selecting suitable mitigation options, providing valuable input for decision-making (Daghfous et al., 2021).

2.2. Supply chain resilience

Supply chain resilience (SCR) is critical for managing pandemics, facilitating organizations' rapid response, recovery, and adaptation to disruptions (Tukamuhabwa et al., 2023). SCR strategy helps to maintain original functional states, absorb threats, and understand the impact and costs of disruptions (Shekarian & Parast, 2021). Despite increasing complexity and risk in supply chain networks, companies are encouraged to design resilient supply chains that can bounce back to prior performance levels after disruptions, with resilience defined as the capacity to endure and adapt to adversity (El Baz & Ruel, 2021). Such resilience not only controls and reduces the adverse effects of disruptions but also potentially provides a competitive advantage (Aslam et al., 2020).

The COVID-19 pandemic has emphasized the need for enhanced SCR, highlighting the intricate nature of supply chains and the necessity for their development and adaptation in response to disruptions (Golan et al., 2021). The application of complex adaptive system theory elucidates the dynamics of resilience in the PSC, presenting it as a complex adaptive system (Yaroson et al., 2021). Studies stress the importance of supply chain flexibility in the pharmaceutical industry, necessitating further exploration of resilience definitions, metrics, and disruption impacts across different supply chain models and industries (Wang & Jie, 2020). Resilience in this context encompasses the ability to deliver uninterrupted medical services during a disruption, highlighting the importance of readiness, response, recovery, and regeneration capabilities (Hosseini & Ivanov, 2021).

2.3. Pharmaceutical supply chain collaboration

The COVID-19 pandemic has emphasized the importance of supply chain collaboration, particularly in the South African pharmaceutical industry. Collaborative efforts among supply chain partners have been pivotal in maintaining the flow of goods and services, especially during crisis periods (Singh et al., 2021). This collaboration, encompassing elements such as information sharing, joint planning, and decision-making, has been crucial in ensuring the availability and distribution of essential medicines and medical supplies (Ivanov et al., 2021). For instance, the swift collaboration between pharmaceutical manufacturers, distributors, and retailers facilitated the nationwide distribution of medical necessities to hospitals and clinics (Kritchanchai et al., 2019).

Simultaneously, the collaboration was instrumental in meeting the demand for personal protective equipment for healthcare workers, with manufacturers, distributors, and retailers working closely to ensure efficient distribution (Omar et al., 2022). However, effective collaboration encounters challenges such as the need for heightened trust and the management of conflicts of interest among supply chain partners, potentially impeding the implementation of collaborative measures (Basso et al., 2019). The literature thus suggests the necessity for future research to focus on strategies to overcome these challenges, thereby enhancing supply chain collaboration within the South African pharmaceutical industry.

2.4. Pharmaceutical supply chain digitalisation

The COVID-19 pandemic has underscored the importance of digitalisation in the PSC, particularly in South Africa. Digital technologies,

including blockchain, artificial intelligence (AI), and the IoT, are being leveraged to optimize operations, enhance supply chain visibility, and improve communication between partners (Chen et al., 2023). During the pandemic, these technologies have played a key role in increasing supply chain resilience and responsiveness. For instance, real-time visibility offered by blockchain technology has not only facilitated tracking the movement of goods but has also aided in the identification of potential disruptions (Dolgui & Ivanov, 2022). Furthermore, access to real-time data and analytics has significantly improved decision-making (Min, 2019).

In South Africa, the government utilized digital systems for efficient procurement and distribution of COVID-19 vaccines, resulting in an effective allocation nationwide (Dzinamarira et al., 2021). Digitalisation has also ensured rapid distribution of medicines and medical supplies to hospitals and clinics across the country (Antwi et al., 2021). Nonetheless, there exist implementation challenges such as the need for more digital infrastructure and resources, especially in rural areas, and concerns over data security and privacy that may hinder the adoption of digital technologies (Fouche & Andrews, 2022). Future research, thus, should focus on strategies to overcome these barriers to enhance digitalisation in the pharmaceutical supply chain.

3. RESEARCH METHODOLOGY

The study adopts an exploratory research approach, owing to the nascent nature of research in the area of strategic pharmaceutical supply chain frameworks in the context of the COVID-19 pandemic (Babbie, 2020). This method, selected for its suitability in exploring new interests or fields of study in their infancy, aids in gaining new insights and expanding knowledge on the topic (Myers, 2019). A qualitative research methodology is employed to delve into the lived experiences of senior pharmacist managers, thus filling the void of existing theory in this area (Wiid & Diggines, 2020).

The research is conducted under the phenomenological philosophy, aiming to explore and understand the lived experiences and insights of pharmaceutical supply chain professionals (Flick, 2018). Epistemologically, this approach emphasizes personal knowledge and subjectivity, and it necessitates interaction with these professionals in order to comprehend how pharmaceutical corporates could endure in a COVID-19-influenced milieu (Gray, 2021). The sample population consists of pharmacists with considerable experience and expertise in pharmacy management and supply chain plan execution. A purposive sampling method is utilized, including only "information-rich" participants who possess significant insight and experience in pharmaceutical supply chain management (Creswell & Creswell, 2023).

This qualitative study employed a non-probability purposive sample technique to explore the nuanced viewpoints of professionals working within the pharmaceutical supply chain. The decision was motivated by a desire to obtain comprehensive and profound understandings, prioritising qualitative insights over statistical generalisations. Rahi (2017) and Gray (2021) underscore the significance of probability sampling in facilitating broader generalisation to the community. However, they also highlight the indispensable nature of non-probability samples, particularly purposeful sampling, in instances when specific insights or experiences are being sought. As a result, the selection of participants was conducted in a deliberate manner, taking into consideration their respective positions within the pharmaceutical business in South Africa. This encompassed a wide range of responsibilities, including suppliers, importers, drug makers, wholesalers, pharmacy chains, independent retail pharmacies, and governmental hospital pharmacies. The depth-first approach of this method is exemplified by the absence of a predetermined sample size, as recommended by Creswell and Creswell (2023). Instead, interviews were continued until the point of informational saturation was achieved. The study concluded with a final sample size of 25 participants, primarily consisting of individuals who held positions as supply chain or procurement managers. The distribution of these entities throughout various sectors within the pharmaceutical industry was as follows: there were four entities each from pharmaceutical suppliers, principal pharmaceutical importers, drug makers, drug distributors/wholesalers, and pharmacy chains/corporates. Furthermore, three participants were chosen from independent retail pharmacies, whereas two participants were picked from government hospital pharmacies. The employed sampling technique was designed to guarantee the inclusion of perspectives that are essential for comprehending the complexities of the pharmaceutical supply chain in South Africa, particularly within the framework of the COVID-19 crisis.

Thematic analysis is used to process the qualitative data collected from the interviews (Braun & Clarke, 2022). This method allows for the exploration of patterns and the development of themes, thus providing a comprehensive description of the data set (Castleberry & Nolen, 2018). Data analysis is performed in tandem with data collection, involving continuous iterations of note compilation, data reduction, and categorization (Babbie, 2020). Upon identification of themes, the data is displayed in a tabular format, reflecting the themes in a structured manner and assisting in discerning patterns and establishing connections (Braun & Clarke, 2022).

4. RESULTS

Table 1 below outlines four key themes identified by the researcher for mitigating the impacts of disruptions in the pharmaceutical industry due to COVID-19. Each theme is numbered sequentially, from one to four, for easy referencing throughout the study. The first theme, labelled as "Research and development (R&D)", suggests the importance of investing in and prioritizing research and development activities to discover new methods, drugs, or procedures that could aid in managing the pandemic's challenges. The second theme, "Local production", underscores the significance of enhancing and prioritizing the domestic production of pharmaceuticals, potentially minimizing the reliance on imports and mitigating supply chain disruptions. The third theme, "Marketing strategies", indicates the potential role of specific marketing

approaches in dealing with the industry's current challenges, perhaps by effectively communicating product availability and promoting locally produced medicines. Finally, the fourth theme, "Adequate vaccination", emphasizes the necessity of effective and widespread vaccination efforts to control the spread of the virus, therefore reducing the stress on the pharmaceutical industry.

Table 1. Study themes

No.	*Mitigation plans themes*
1	Research and development (R&D)
2	Local production
3	Marketing strategies
4	Adequate vaccination

Source: Researchers' compilation.

4.1. Mitigation plans

The participants devised four methods of developing a strategic framework to minimise COVID-19 pandemic disruption. Effective COVID-19 pandemic disruption reduction in supply-chain design has made the difference between successful and unsuccessful PSCs. Underestimating effective COVID-19 pandemic disruption in the PSCs and failing to implement appropriate mitigation techniques can lead to disastrous consequences, as demonstrated by the participants' statements. The importance of understanding and incorporating pandemic disruption-mitigation methods into PSCs cannot be overstated. These examples show how incorporating disruption-mitigation measures into a PSC enhances its ability to cope with disruptions. As a result, PSC professionals must develop customised disruption-mitigation solutions that compromise reducing COVID-19 pandemic disruption and increasing costs. However, every method of risk reduction has a price and may inadvertently lead to a rise in other dangers. Increasing inventory, for example, reduces delays but also increases the risk of obsolescence. Suppliers can reduce the risk of disruption, but this can also raise prices because they may no longer be able to benefit from cost reductions. A few different approaches to COVID-19 pandemic disruption reduction are outlined below.

4.2. Research and development (R&D)

Eight participants mentioned that R&D decisions affect innovation and new product entry. Therefore, the study shows that R&D is an excellent strategy for mitigating problems. Participant 9 said it is also impossible because many companies they dealt with were multinationals. They had products developed overseas because that is where the R&D happens; unfortunately, that does not occur in South Africa. Participant 9 suggested that we must examine whether there is room for R&D and manufacturing in South Africa. She indicated the need for a structure to protect medicines:

"We need locally based manufacturing plants; need for research and development. That is also not a possibility because many of the companies we deal with are multinationals and we have products that are applied from overseas because that is where the research and development happen. We have to look at that; there may be room for research, development, and manufacturing within this country rather than outsourcing it" (Participant 9, personal communication, July 22, 2021).

She further said that they need to ensure that the fleet of trucks is serviced and changed regularly and adequately managed. Participant 6 indicated that they had to pull the resources and create a COVID-19 supply chain or hotline. She gave an example: if one needs a mask, there would be a website to log on to and make orders. Participant 6 further said that other brands should be sourcing, and the framework should minimise distractions. Participant 7 believed they should collaborate and strategically partner with suppliers, especially in this competition. Finally, Participant 1 believed that the supply rate would be short. These PSC professionals echoed this experience of R&D, the unproductive outflow of COVID-19 pandemic disruption:

"Plants for production, research, and development must be established in the area. R&D is also not an option since most businesses we deal with are global conglomerates, and many of our products are sourced internationally. Because of this, we need to consider whether or not it makes sense to do R&D and manufacture goods here rather than send them outside" (Participant 9, personal communication, July 22, 2021).

4.3. Local production

Local production can help boost industrial policies and facilitate access to medicines in emerging countries. A developing country's ability to finish off bulk active ingredients purchased from developed or other countries at exorbitant costs may not affect patient access to required medications, provided the country has manufacturing facilities. There has yet to be much foreign backing for African local pharmaceutical development, but that may change soon. There is a belief that Africa could be better for developing cost-effective, quality-assured, and safe pharmaceuticals. Some argue that buying cheap drugs from China and India is a more productive use of capital than investing in domestic manufacturing.

Nevertheless, African countries are sending a transparent message that they are on the up-and-up, have long-term visions, aim for integrated and sustainable development, and expect regional and transnational addressing of social innovation through the efforts of PSC professionals. In this framework, intergovernmental contributors should also identify innovative means of assisting the African continent's efforts to alleviate poverty, sickness, and shortage of medicines. In addition, R&D operations in this sector are hindered by challenges such as unsupportive regulatory frameworks and human resource capacity restrictions, which are a hurdle to expanding the investment strategy for locally produced pharmaceuticals.

Participant 8 said local manufacturing without reliance on big parties is ideal but doubtful. Local manufacturing was echoed by Participant 9, who said that if there is a strategic framework in every industry, all parties can come together and sort this out. She indicated that they would not have an issue in the future or could minimise the problems they experienced during this time. In contrast, Participant 8 believed the framework would only work if they depended on other countries. She said

there is talk of possibly building some facilities, but the question is how long that will take. In words persistently echoed by some of the PSC professionals, more local production was cardinal to the distinctive position of the PSC in the global market:

"We still kept production going. More local production is needed. I think if we have a lot more goods produced locally definitely, it will help more local production" (Participant 2, personal communication, July 30, 2021).

"Because of the hard lockdown and slow production due to COVID-19 social distancing and working below capacity, paracetamol's supply was interrupted, leading to a price increase" (Participant 7, personal communication, June 15, 2021).

"I think it is not very easy to say because they tend to plan when it comes to production but cannot plan for something like Covid. After all, it is difficult to predict the outcome. However, if we look at anticoagulants, the demand has skyrocketed, so it also means the production, but it is a global issue" (Participant 8, personal communication, July 24, 2021).

"It upscales its production in upscale, its human capital, upscale its turnaround time, and upscale its pricing policy where applicable" (Participant 13, personal communication, June 15, 2021).

"We are talking operations, so there must be a flow of information regarding what is in the warehouse and how it can empower our production" (Participant 17, personal communication, July 22, 2021).

"Therefore, this has affected those products' production, manufacturing, and lead times. So, prices of inputs shot up, which then had implications for the production and our final product" (Participant 18, personal communication, July 22, 2021).

"Even from a planned perspective, change belts, change production plans and move them to the needed" (Participant 22, personal communication, August 4, 2021).

"Some pharmaceutical companies had to lay people off as production lines were not fully utilised. Therefore, this resulted in out of stocks for end users and overstock at the factories as production continued, but dispatch/shipping was halted" (Participant 24, personal communication, July 18, 2021).

"Production disruptions due to reduced labour at production sites" (Participant 25, Participant 22, personal communication, August 2, 2021).

4.4. Marketing strategies

Marketing techniques have a direct impact on a company's growth and success. Various variables influence the pharmaceutical industry's marketing plans and strategies. Pharmaceutical marketing strategies influence consumers' purchase decisions to a large extent. In addition, pharmaceutical firms rely on consumer perceptions swayed by their advertising campaigns. According to this study, pharmaceutical businesses' marketing methods are connected to their customers' purchasing decisions. For example, three participants indicated that promotional tools were the primary or secondary factor influencing customers to acquire the marketed drugs. Visits from medical representatives and packing stock high to increase shelf space were the first two tools that the three PSC professionals agreed were the most motivating. Other tools included extensive training for pharmacy assistants to know what to recommend to patients and many TV commercials to raise consumer awareness of the brand.

As the number of people infected with COVID-19 climbed and the prospect of a cure was elusive, the public became more frightened. The marketing strategies of pharmaceutical corporations had to be altered. Most organisations were increasingly looking for alternatives to in-person marketing that necessitated less face-to-face engagement. Pharmaceutical corporations have staples for telemarketing, internet marketing, and other special offers. Fear of contracting the virus and the desire to protect oneself were driving forces behind this shift. Participant 3 says they never used to have much TV advertising, but they have increased this, as well as handing out masks and sanitisers. He also said they needed to ensure enough stock levels because if they did not, other competitive companies would naturally come in with similar products. Companies could lose sales to competitors, training, and anything else that helps move inventory out of pharmacies. Participant 5 also mentioned the training of staff. He emphasised that there needs to be more efficient training. He believed staff needed the proper plans to ensure they were safe. In his opinion, the South African government had not come on board in this respect; they needed to focus on the supply chain, which could result in a quicker virus spread. Participant 5 also said that they should consider practical strategies about high-risk areas when having deliveries, especially goods of high value, such as COVID-19 vaccines.

"So with the marketing team, we have many TV ads going on at the moment to create customer awareness. Thus, marketing is the most important thing at the moment. So think strategically for the company going forward. We do have a powerful marketing team. We have no choice but to create customer awareness with our marketing" (Participant 3, personal communication, June 16, 2021).

"The marketing is starting to become stable again" (Participant 5, personal communication, June 17, 2021).

"And then, from the marketing side of things, from the marketers, all hospitals are not accessible" (Participant 8, personal communication, July 24, 2021).

"So, it goes over and above the sales and marketing teams" (Participant 16, personal communication, June 28, 2021).

4.5. Adequate vaccination

A vaccination would elicit an immunological response that activates both parts of the body's immune system. Vaccination's primary goal is to lower the number of community members who are vulnerable to infection. Relaunching and deploying vaccines is a complex, delicate balance. However, an appropriate and efficient vaccine could avoid significant morbidity and death related to COVID-19 and minimise the subsequent effects of non-pharmaceutical therapies. Investment in communication, behavioural change, community involvement skills, and aptitude is essential to delivering such confidence and policy. Participant 2 said they just needed to ensure they received enough vaccines, and he emphasised that they

needed to vaccinate many people to be safe. He said it would help because it would not strain our healthcare system. Participant 2 further said the strategic framework must be tailored specifically for each company. Eight of the PSC professionals portrayed how a lucid and focused sense of vaccination is a strategic intervention that will be helpful in the management of the PSCs industry to address COVID-19 pandemic disruptions in a pharmaceutical business context:

"The way to go is because vaccination can help bring us back to normal and make our companies work close to their capacity, unlike right now, companies are looking at 50% capacity" (Participant 7, personal communication, June 15, 2021).

"Since the first quarter, emerging markets like Africa have been behind major markets with 40 to 60% vaccination in most African countries" (Participant 15, personal communication, June 27, 2021).

"However, at the same time, the lack of vaccination in Africa was due to other markets" (Participant 22, personal communication, August 4, 2021).

5. DISCUSSION OF THE RESULTS

The participants indicated that the industry could develop a strategic framework to minimise COVID-19 pandemic disruption in PSCs in South Africa. The strategies to stop the disruptions mentioned were R&D, marketing strategies, collaborative supply chain disruption management, and local production.

5.1. Research and development

The findings from the semi-structured interviews conducted with 25 pharmaceutical supply chain professionals highlight the significance of R&D in mitigating the COVID-19 pandemic disruption within the South African pharmaceutical supply chain. This study's findings align with previous literature that emphasizes the role of R&D as a critical component in strengthening the pharmaceutical supply chain resilience (Paul & Chowdhury, 2020; Ivanov & Dolgui, 2021b). One major concern raised by the interviewed professionals was the dependency on international suppliers for active pharmaceutical ingredients and other raw materials, which has been a significant bottleneck in the supply chain during the pandemic (Evenett, 2020; de Vet et al., 2021). The professionals suggested that investing in local R&D initiatives could help decrease the dependency on international suppliers and enhance self-sufficiency. This result agrees with the findings of Singh et al. (2021), who emphasised the importance of developing local manufacturing capabilities to ensure the uninterrupted supply of pharmaceutical products during global crises. The interviewees also highlighted the role of R&D in facilitating the development of novel therapeutics and vaccines, which can substantially reduce the pandemic's impact on public health and the pharmaceutical supply chain (Bloom & Cadarette, 2019; Lurie et al., 2021). Collaboration between public and private sectors, including academic institutions and the pharmaceutical industry, was identified as a crucial aspect of accelerating R&D efforts (Saha et al., 2022; Thakur-Wernz & Wernz, 2022).

Furthermore, the integration of digital technologies into the pharmaceutical supply chain, as a result of R&D, was identified as a key strategy to improve supply chain resilience during the pandemic. The implementation of cutting-edge innovations like the convergence of the IoT, blockchain technology, and AI can contribute to enhanced visibility, traceability, and responsiveness within the supply chain (Sarkis et al., 2020; Chowdhury et al., 2021). The interviewees acknowledged that the South African government should invest more in digital infrastructure and promote the digital transformation of the pharmaceutical industry to mitigate the negative impacts of future disruptions. Additionally, the professionals emphasized the need for regulatory support and policy changes to facilitate R&D initiatives in South Africa. They suggested that a conducive regulatory environment could encourage innovation and collaboration between different stakeholders in the pharmaceutical industry (Iizuka & Ikeda, 2021; Lepasepp & Hurst, 2021). This would require the South African government to adopt a proactive approach to promoting R&D, supporting local manufacturing, and attracting foreign investments in the pharmaceutical industry (Modisakeng et al., 2020). Therefore, the findings of this study underscore the importance of R&D as a key strategy to mitigate the COVID-19 pandemic disruption in the pharmaceutical supply chain in South Africa. Fostering local R&D initiatives, promoting public-private partnerships, adopting digital technologies, and creating a supportive regulatory environment are essential steps to build a resilient and self-sufficient pharmaceutical supply chain. Further research is needed to explore the specific interventions and policies that can facilitate the realization of these objectives in the South African context.

5.2. Marketing strategies

The COVID-19 pandemic has significantly disrupted the pharmaceutical supply chain in South Africa, leading to potential shortages and challenges in meeting the healthcare needs of the population. This study aimed to develop a pharmaceutical supply chain strategic framework from perception of 25 pharmaceutical supply chain professionals as a means to mitigate the disruption caused by the COVID-19 pandemic. The semi-structured interviews revealed several key insights, supported by relevant literature. One major theme that emerged from the interviews was the importance of effective communication and information sharing between stakeholders in the pharmaceutical supply chain. The professionals highlighted that timely and accurate information about supply and demand patterns could help the industry adapt more quickly to changes caused by the pandemic (Dan-Nwafor et al., 2020). This result agrees with those of prior research emphasized the role of information sharing in enhancing supply chain resilience (Sturm et al., 2023).

Another critical marketing strategy identified by the participants was the need to enhance local manufacturing capabilities to reduce dependency on international suppliers. This would help mitigate

the risk of shortages caused by global disruptions, such as the COVID-19 pandemic (Moosavi et al., 2022). In this context, government support and incentives to promote local pharmaceutical production, as well as collaborations between pharmaceutical companies, were seen as essential drivers (Kumar & Sharma, 2021). This finding aligns with studies that suggest that investing in local manufacturing can enhance supply chain resilience and support economic growth (Ivanov & Dolgui, 2020b). Furthermore, the professionals emphasized the importance of fostering strong relationships with suppliers and customers to enhance supply chain resilience. They highlighted the need for flexibility in pricing, delivery, and inventory management to accommodate the changing needs of customers during the pandemic (El Baz & Ruel, 2021). Additionally, close collaboration with suppliers was seen as crucial to ensuring a stable supply of raw materials and finished products (Butt et al., 2022).

This is in line with the literature that highlights the importance of supplier relationship management and customer orientation in mitigating supply chain disruptions (Scala & Lindsay, 2021). Lastly, the study participants pointed out the significance of digital marketing and e-commerce as tools to adapt to the changing market dynamics during the pandemic. The shift to online platforms allowed pharmaceutical companies to maintain customer engagement and reach new markets despite lockdown restrictions and social distancing measures (Sheth, 2020). This finding is supported by research that shows how digital transformation can enhance supply chain resilience in the face of disruptions (Queiroz et al., 2020). Yet, this research provides evidence that marketing strategies can help lessen the impact of the disruption caused by the COVID-19 pandemic in the pharmaceutical supply chain in South Africa. The interviewed professionals highlighted the importance of effective communication, enhancing local manufacturing capabilities, fostering strong relationships with suppliers and customers, and adopting digital marketing and e-commerce as key strategies. To further understand the long-term effects, more study is required on the impact of these strategies on the resilience and performance of the pharmaceutical supply chain in South Africa.

5.3. Collaborative supply chain disruption management

The present study aimed to understand the perceptions of 25 pharmaceutical supply chain professionals on the effectiveness of collaborative supply chain disruption management as a strategy to mitigate COVID-19 pandemic disruption in the pharmaceutical supply chain in South Africa. The findings from the semi-structured interviews revealed that collaborative approaches significantly contribute to the resilience of the pharmaceutical supply chain amidst the pandemic. The participants emphasized the importance of information sharing among supply chain partners, which is consistent with previous literature highlighting that effective communication and information sharing are key aspects of collaborative supply chain disruption management (Ivanov, 2022). By sharing accurate and timely information, the stakeholders can better anticipate potential disruptions and collectively develop contingency plans, thereby reducing the impact of the pandemic on the supply chain (Ivanov & Dolgui, 2021a).

The interviewees also highlighted the value of joint planning and decision-making among the pharmaceutical supply chain partners. This result agrees with the findings of prior studies that demonstrate the role of collaborative planning in enhancing supply chain resilience (Dubey et al., 2021). When partners collaborate on strategic, tactical, and operational planning, they can identify vulnerabilities and devise strategies to overcome them together (Manavalan & Jayakrishna, 2019). The collaborative approach thus enables pharmaceutical supply chain stakeholders to manage disruptions more effectively. Moreover, the interviewees suggested that adopting a risk-sharing mechanism can help manage the uncertainty and risk associated with the pandemic. This finding supports the idea that SCRM strategies, such as risk pooling and risk-sharing agreements, can enhance supply chain resilience and mitigate the effects of disruptions (Hosseini et al., 2019). By sharing risks and developing joint risk management plans, the pharmaceutical supply chain stakeholders in South Africa can better respond to the challenges posed by the COVID-19 pandemic.

Hence, the present study provides valuable insights into the potential of collaborative supply chain disruption management as a strategy to mitigate the impact of the COVID-19 pandemic on the pharmaceutical supply chain in South Africa. The findings suggest that information-sharing, joint planning, and risk-sharing mechanisms are crucial elements of successful collaboration. By adopting these strategies, pharmaceutical supply chain stakeholders can enhance their resilience and ensure the continued availability of essential medicines during such unprecedented times.

5.4. South African pharmaceutical local production

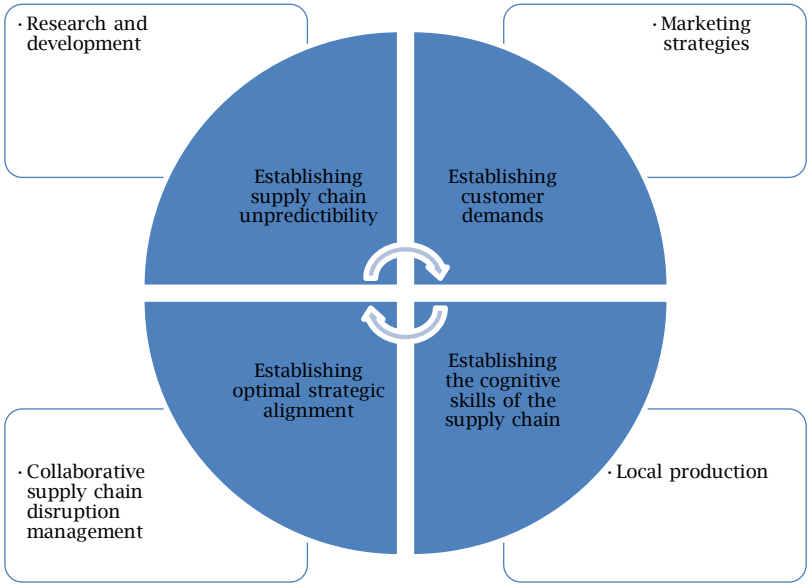
In order to lessen the effects of the COVID-19 pandemic on the South African pharmaceutical supply chain, 25 industry professionals were interviewed on their thoughts on the topic of pharmaceutical supply chain strategic framework development. The semi-structured interviews revealed several key themes, including the benefits of local production, challenges faced, and recommendations for future implementation. One of the key benefits of local pharmaceutical production identified by the participants was reduced dependence on foreign suppliers, which could enhance the resilience of the South African pharmaceutical supply chain during crises like the COVID-19 pandemic (Socal et al., 2021; Terblanche & Niemann, 2021). Local production could also help reduce the lead time for drug procurement, ensuring the timely delivery of essential medicines to healthcare facilities and patients (Gautam & Pan, 2016; Sharma & Modgil, 2020). Moreover, it could foster job creation and economic growth, contributing to the overall development of the South African economy (Ndomondo-Sigonda et al., 2017; Ekeigwe, 2019). However, participants also highlighted several challenges to implementing local pharmaceutical production in South Africa. These included limited

infrastructure and production capabilities, a lack of skilled workforce, and inadequate investment in R&D (Perumal-Pillay & Suleman, 2017; Modisakeng et al., 2020). Furthermore, the high cost of production and the inability to achieve economies of scale were cited as potential barriers to the competitiveness of locally produced pharmaceuticals in the global market (Suleman, 2016; Mayounga, 2021).

In light of these challenges, participants suggested several recommendations to enhance the feasibility and success of local pharmaceutical production. These included government support in the form of subsidies and incentives, investments in R&D and workforce development, and the establishment of strategic partnerships with international players in the pharmaceutical industry (Karnouskos, 2021). Collaboration between the public and private sectors, as well as academia, could foster innovation and ensure the sustainability of the local pharmaceutical industry (Mäder & Kattner, 2020).

Figure 1 in the study presents the pharmaceutical supply chain strategic framework during disruption, which consists of eight matrices. The inner four matrices (PSC strategic fit) provide strategies to minimize pharmaceutical supply-chain disruptions, while the outer four matrices (PSC strategic response) link with the PSC strategic fit and must be diligently established and monitored.

Figure 1. Pharmaceutical supply chain strategic framework during disruption



Source: Researchers' compilation.

6. CONCLUSION

This study engaged 25 pharmaceutical supply chain professionals to provide insights into a strategic framework for mitigating the COVID-19 pandemic's disruptions in South African PSCs. The strategies identified prominently feature R&D, marketing strategies, collaborative supply chain disruption management, and local production.

R&D was found to be a vital strategy for alleviating the COVID-19 disruption in the PSCs, emphasizing the need for local R&D initiatives to diminish dependence on international suppliers and promote self-sufficiency. The findings highlight the necessity for public-private partnerships and the incorporation of digital technologies to expedite R&D efforts and boost PSC resilience. Furthermore, a supportive regulatory environment was identified as a requirement for facilitating these initiatives.

Marketing strategies were also underscored as a crucial element in navigating through pandemic-induced disruptions. The significance of clear communication, enhanced local manufacturing, fostering strong relationships with suppliers and customers, and the implementation of digital marketing and e-commerce were mentioned as pivotal marketing strategies to bolster the resilience and performance of the pharmaceutical supply chain.

The study also highlighted the importance of collaborative supply chain disruption management. Enhanced information sharing, joint planning, and the adoption of risk-sharing mechanisms among PSC partners can create robust contingency plans and foster supply chain resilience, ensuring a steady supply of essential pharmaceutical products during global crises.

Local pharmaceutical production, despite identified challenges, such as limited infrastructure, inadequate skilled workforce, and insufficient investment in R&D, was seen as a strategic approach to reducing dependence on foreign suppliers and promoting job creation and economic growth. Strategic partnerships, government support, and investments in workforce development and R&D are crucial to overcoming these obstacles and encouraging local pharmaceutical production.

This study's findings offer valuable insights into strategies for mitigating COVID-19-induced disruption in South African PSCs. The key roles of R&D, effective marketing strategies, collaborative supply chain disruption management, and local production in enhancing pharmaceutical supply chain resilience and performance were emphasized. However, the South African government must take a proactive role in facilitating these strategies, such as providing regulatory support, fostering

public-private partnerships, investing in digital infrastructure, and promoting local pharmaceutical production.

The study recommends adopting the developed strategic framework to navigate COVID-19-induced supply chain disruptions within the South African pharmaceutical industry. This framework is adaptable, comprehensive, and well-structured, and it places significant emphasis on collaboration among key stakeholders such as government agencies, industry players, and healthcare providers. It also recognises the importance of contingency planning and risk management, providing in-depth guidance on developing and implementing these strategies.

In light of the unpredictable nature of the pandemic and the potential for ongoing disruptions to the supply chain, the strategic framework presented in this study can be a valuable resource for the South African pharmaceutical industry. Industry players are encouraged to consider its recommendations and strategies when developing their responses to managing COVID-19-induced supply chain disruptions. By working together and implementing these strategies, the industry can help ensure the continued availability of essential medicines and healthcare products amid unprecedented challenges.

This study highlights the potential of local drug manufacturing as a means to mitigate the disruption caused by the COVID-19 pandemic in the South African pharmaceutical supply chain. While several challenges need to be addressed, the recommendations provided by the interviewed professionals could serve as a roadmap for policymakers and industry stakeholders to promote local pharmaceutical production and enhance the resilience of the South African pharmaceutical supply chain.

The implications of developing and implementing the strategic framework proposed by the study are significant for the South African pharmaceutical industry and beyond. Firstly, by adopting the recommended strategies, the industry can enhance its resilience to future supply chain disruptions caused by the COVID-19 pandemic or other global health crises. The framework highlights the importance of contingency planning and risk management, which can help mitigate future disruptions' impact and ensure the continued availability of essential medicines and healthcare products. Secondly, the collaborative approach advocated in the framework has broader implications for the healthcare industry. By working with key stakeholders, including government agencies, healthcare providers, and industry players, the industry can build stronger relationships and develop more effective solutions to the challenges posed by the pandemic. This approach can help strengthen healthcare systems and improve patient outcomes, not just in South Africa but worldwide. Finally, the strategic framework proposed in this study has important implications for the global pharmaceutical supply chain. The COVID-19 pandemic has shown how fragile global supply chains are and how much work has to be done to make them more resistant to disruption. The strategies outlined in the framework can serve as a model for other countries and industries, guiding how to manage disruptions and ensure the continued supply of critical medicines and healthcare products.

Despite the comprehensive approach taken in developing the strategic framework to deal with COVID-19-induced supply chain disruptions in the South African pharmaceutical industry, however, there are some caveats to this study that are acknowledged. It is important to keep these constraints in mind when highlighting the results of the study and should be addressed in future research. One limitation is that the framework was developed specifically for the South African pharmaceutical industry, and its effectiveness in other countries or industries is still being determined. Further investigations should be conducted to analyse the generalizability of this framework to other settings and industries. Another limitation is that the framework was developed based on current data and knowledge of the COVID-19 pandemic. As the pandemic evolves and new challenges arise, the framework's effectiveness may need to be re-evaluated and updated. Therefore, ongoing research and evaluation of the framework are necessary to ensure its continued effectiveness.

One notable limitation of this study is the relatively small sample size, which may limit the generalizability of the findings. Future research could expand the sample to include a larger number of participants and explore additional collaborative strategies to further validate the findings and impart a deeper comprehension of the efficacy of collaborative supply chain disruption management in mitigating the impact of the COVID-19 pandemic. Furthermore, the framework assumes a stable political and economic environment, which may only sometimes be accurate. Future research should investigate how the framework can be adapted and implemented in unstable political and economic contexts. Finally, the framework is focused on managing the impact of COVID-19 on the pharmaceutical industry's supply chain. However, other disruptions that are not directly related to the pandemic may require additional strategies or approaches. Future research should explore the framework's applicability to other supply chain disruptions.

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