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A strategic response to COVID-19 induced supply chain disruption in South Africa's pharmaceutical industry

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ABSTRACT

The COVID-19 pandemic had a significant impact on the pharmaceutical industry, leading to severe interruptions in global medicine supplies. Both large and small businesses implemented exceptional strategic efforts to mitigate the impact of the infection and minimize the resultant financial harm. A total of twenty-five semi-structured interviews were carried out with pharmaceutical supply chain experts in South Africa in order to gain insight into the strategic reactions and long-term impacts of these responses, as perceived by the participants. The occurrence of strategic reactions seems to resemble those observed in prior instances of disruptions in the pharmaceutical supply chain, but with some degree of variation. These solutions encompass methods for addressing the specific supply chain disruption, managing the reality of supply chain disruption to efficiently handle low switching costs, and implementing attempts to recover by increasing the customer experience. These strategic initiatives were expected to lead to the permanent closure of numerous pharmaceutical enterprises, increased consolidation in the global pharmaceutical supply chain, and long-term changes in responsiveness and efficiency improvements.

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Introduction

In the last forty years, numerous authors have elaborated and improved upon the notion of strategy (Louw & Venter, 2021) in order to address the requirement for organizations to adjust to changing market conditions in diverse circumstances. Hitt, Ireland, and Hoskisson (2019) provide a definition of strategy as a flexible and proactive course of action that outlines how businesses should respond to diverse external and internal environmental elements, considering both the short-term and long-term perspectives.In contrast, some scholars have defined strategy as the deliberate or existing synchronization of an organization's fundamental objectives and activities at a specific time and location, consistently aligning the firm with its surroundings (Johnson, Whittington, Regnér, Angwin, & Scholes, 2020).

The objective of this study is to investigate the strategic reaction to supply chain disruptions caused by COVID-19 in South Africa's pharmaceutical business. In this study, we used an exploratory qualitative research method to find out how much South Africa's pharmaceutical sector uses different competitive strategies in response to the PSC disruption, with the goal of making pharmaceuticals easier to get.

Moreover, it highlights the difficulties that pharmaceutical companies in South Africa encounter because to the COVID-19 pandemic in the pharmaceutical sector. Consequently, we aim to address these issues by providing answers to the following questions:

i. What obstacles do pharmaceutical companies encounter in the pharmaceutical sector due to the COVID-19 pandemic?
ii. What strategic measures are pharmaceutical companies implementing in response to the commercial climate created by the COVID-19 pandemic?

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The data were acquired through semi-structured expert interviews. The application of the thematic analysis technique is encompassed under research data analysis approaches.

The structure of this article is as follows: Section 2 presents a comprehensive analysis of the existing literature. Section 3 provides an in-depth analysis of the techniques and resources employed. The results are presented in Section 4. Section 5 introduces a novel pharmacological strategic response method to tackle the primary difficulties encountered in South Africa's PSCs during the COVID-19 outbreak.

Literature review

Strategic response to Covid-19 pandemic

Over recent years, many companies have fulfilled their objectives of responding to their supply-chains network and those for the economy (Fattahi, Govindan & Keyvanshokooh, 2017). According to Aruru, Truong and Clark (2021), the Covid-19 response faces a variety of challenges, including a shortage of appropriate PPE (e.g. masks and hand-sanitisers), monitoring kits, and ventilators, accessible hospital beds, licensed medication and a particular SARS-CoV-2 vaccine. Therefore, it is vital to incorporate strategic and operational decisions into the supply-chain design processes in today's competitive and unpredictable market climate to obtain a practical supply-chain framework (Fattahi & Govindan, 2020). One of the main tactics of an organisation is a supply-chain strategy. Supply chains should follow competitive and organisational processes (Ivanov, Tsipoulanidis & Schönberger, 2017). In addition, strategic considerations linked to long-term connections with suppliers, their output evaluation and the continuous review of spending trends are required for constant assessment and enhancement of the supplier's activities. Nasrollahi and Razmi (2019) focused on the PSC design to increase the system's reliability and simultaneously reduce the cost of the healthcare supply chain. Franco and Alfonso-Lizarazo (2017) provided a literature analysis of predictive models of PSCs. They defined three classification groups: strategic, tactical and operational decisions. Computational-model studies incorporate various types of methods; the study therefore suggested that the usage of hybrid technology is inadequate so that researchers should realistically estimate the activity of a PSC.

According to Schmalz (2020), strategic responses to the Covid-19 pandemic include creating regional chains, using technology more, and promoting overall productivity and resiliency. de Carvalho, Ribeiro and Barbosa-Povoa (2019) attempted to develop a vaccine supply chain that takes into account the three dimensions of the triple bottom line. The developed model helps the supply chain to make strategic and tactical decisions. There is imperative to recognise principles such as SCM, modelling, risk analysis and optimisation (Lozano Díez, Marmolejo-Saucedo & Rodriguez-Aguilar, 2020). Flexible and effective prototypes will help us adapt to contingencies. Paul and Venkateswaran (2020) analysed the inventory-management problem during an unpredictable epidemic. They also modelled the supply-shortage model and the integrated model. The supply-shortage model is employed to explain the phenomenon of the drug shortage.

Covid-19 pandemic disruptions

Covid-19 pandemic has undeniably affected populations, the public health system and economies worldwide (Trump & Linkov, 2020). The pandemic has been a disruption of an entirely unprecedented magnitude, and it is testing the resilience of GSCs (Brown, Kumar, Rajji, Pollock & Mulsant, 2020; Golan, Jernegan & Linkov, 2020). During the Covid- 19 pandemic, many companies failed to get their products to the market owing to supply chain constraints (Esper, 2021). This issue highlighted the various processes and people involved in getting goods to the consumers. This, in turn, highlighted the importance of ensuring the safety and welfare of the supply chain's workers. Initially, the coronavirus was viewed as a local issue in China. However, even at this stage, its impact on the GSC was felt widely. According to industry reports, 95% of *Fortune*-1000 companies have GSC operations in the country. The primary focus of SCM risk research is operational risks that threaten supply chain efficiency and inventory investments (Govindan, Fattahi & Keyvanshokooh, 2017). However, it is also necessary to consider the consumer welfare risks associated with GSCs.

Since there has been an overwhelming demand for medical equipment and protective healthcare products, new initiatives, such as three-dimensional (3D) printing, are being used to help healthcare providers (Larrañeta, Dominguez-Robles & Lamprou, 2020). The short-term implications of the Covid-19 pandemic for global trade tend to be manageable (Gruszczynski, 2020). Veselovská (2020) analysed the impact of the Covid-19 pandemic on supply chains in Central Europe. It focused on companies in various countries and included a detailed analysis of their supply chain characteristics and initial results. The findings indicated that some companies were able to modify their supply chains in such a way that they were able to increase their revenues. Other companies struggled. Craighead, Ketchen Jr and Darby (2020) explained to researchers several ideas that they believe are powerful instruments for understanding what has occurred, how organisations have been responding, and how mechanisms and procedures in the supply chains can be changed in the event of another pandemic.

Supply-chain disruptions

In 2019, almost 400 natural disasters occurred globally, which affected 95 million people and resulted in over 11,000 deaths. Asia had the highest number of disasters (Pujawan & Bah, 2021). Disruption is a phenomenon that occurs suddenly and with an enormous impact on society. It can cause economic losses and environmental damage (Albertzeth, Pujawan, Hilletofth & Tjahjono, 2020). Similarly, Reddy, Singh and Anbumozhi (2016) discussed the significance of disruption in describing cases of supply chains that significantly affect end-user activities. Araz, Choi, Olson and Salman (2020) asserted that disruption to a supply chain is considered

a significant breakdown in production processes. It occurs when the consumption activities of a supply chain are interrupted. The planet is becoming even more unsure and fragile. The last 10 years saw several unforeseen catastrophes, such as terrorist attacks, conflicts, earthquakes, economic crises, currency devaluation in Asia, SARS, tsunamis, strikes and computer-virus attacks (Mangan & Lalwani, 2016).

Geyman, Settanni and Srai (2020) worked in collaboration with other industry partners and explored the nature of supply-chain risk and how it can affect the efficiency and profitability of the pharmaceutical industry. They studied the factors that affect the stability of PSCs and their potential to disrupt them. These factors are a joint adaptation of beliefs, how sensitive views are about trustworthiness, and disruption characteristics. The journals investigated were designed to capture the present status of research on implications for and strategic response from PSCs during the Covid-19 pandemic. The review revealed that many writers in this field had written articles on various elements of the Covid-19 pandemic disruption, depending on the author's interests and study area. The authors provided some information about the background of the problem.

South Africa's pharmaceutical industry

The pharmaceutical industry involves drug discovery, development and manufacture by private and public organisations (Dailey, 2020). The modern pharmaceutical industry was founded in the 19th century after numerous threats to the well-being of plants, minerals and animals prompted research into their medicinal properties (Tannoury & Attieh, 2017). The global pharmaceutical industry recorded sales of more than $1 trillion in 2014 and was forecast to hit $1.2 trillion by 2020 (Horner, 2022). In 2019 the pharmaceutical industry invested $186 billion into research and development, an increase of more than $5 billion from the previous year (Statista, 2020). The GSC is an ecosystem supporting the core of the modern economy and society (Lehmacher, 2017). Global supply chain growth is an opportunity and strategic tool which can produce economic growth and jobs and solve other pressing challenges of our time (Caniato, 2020). At the same time, severe disruptions may ripple quickly through GSCs and cause losses in supply-chain performance that such key performance indicators can measure as revenues, sales, service level, and total profits (Ivanov *et al.*, 2017). Regardless of a country's current stage of economic development, the GSC allows for moving production away from less favourable locations (Lehmacher, 2017). Consequences can include job losses and social tensions. Thus, supply chains play a crucial role in a country such as South Africa, which incurs 14% of its GDP as logistics costs, a higher figure than the other BRICS nations (Brazil, Russia, India and China) (Alora & Barua, 2019).

The pharmaceutical industry has been subject to a highly unstable economic climate. Challenges that have significantly impacted the development of the industry include political unease, competition from new entrants, social reforms, technical development, and global developments. In today's fast-paced pharmaceutical market, companies face a wide range of obstacles. To be competitive in today's rapidly evolving pharmaceutical market, organizations must be open to new ideas and methods of doing business. According to Seidman and Atun (2017), pharmaceutical supply-chain disruptions can hugely hamper drug availability. Considering the size of PSCs, Scheibe and Blackhurst (2018) cautioned that if the implications of the disruptions are not adequately understood, the disruption is likely to spread through the system and cause damage to more than one supply-chain network. A few studies have been conducted amid Covid-19 in the areas of logistics systems and disruptions in food supply chains (Singh & Kumar, 2020). The object of these studies has been to explore the impact of interruptions to HIV services (Jewell, Smith & Hallett, 2020), respond to disruptions in the PSC (Sweeney, 2020) and minimise disruption in the pharmaceutical industry (Cundell, Guilfoyle, Kreil & Sawant, 2020). However, the Covid-19 pandemic posed urgent and even novel challenges to the stability and integrity of medication supply. Therefore, this suggests a need to rethink and strengthen pharmaceutical management strategies (Kuo, Ou & Wang, 2021). Recent research has consisted of a comprehensive analysis of previous research on the epidemiology, infectivity and survival of coronaviruses and their susceptibility to disinfectants (Fitzpatrick, 2022).

The under-performance of supply chains presents a significant hindrance to disease control in South Africa. Stock-outs of essential medicines lead to treatment interruption, forcing changes in patient drug regimens, driving drug resistance and increasing mortality (Díaz-Reza, Morales-García, Rodríguez-Medina, Castellanos & García-Alcaraz, 2022). Therefore, empirical work is needed to explore the strategic response to Covid-19 induced supply chain disruptions in South Africa's pharmaceutical industry. This study hopes to contribute to increased knowledge of ways to minimise the impact of disruptive pandemics on PSCs since the adverse impact of disruptions on the operational performance of supply chains has been suggested to emanate from existing vulnerabilities. This study investigated strategic responses that could minimise the effects of the Covid-19 pandemic disruption on South African pharmaceutical industry supply chains, adding to the body of knowledge about mitigation plans and the factors that determine the pharmaceutical strategic response for a mitigation strategy in this industry. The disruption of PSCs in South Africa owing to the Covid-19 pandemic could be minimised using a competitive strategic response developed by the study.

Research & Methodology

Research design

This study aimed to better understand how the pharmaceutical business in South Africa can respond strategically to the supply-chain disruptions caused by Covid-19 pandemic and their potential long-term effects. An in-depth qualitative investigation was deemed to be the most appropriate to provide the new perspectives and justifications due to the exploratory nature of the study and the distinguishing features of the Covid-19 pandemics. It was deemed that semi-structured qualitative interviews were the best strategy

to use in order to gain such perspective and promote adequate clarification and contextualisation (Saunders, Lewis & Thornhill, 2023). A purposeful sample of twenty-five PSCs professionals in South Africa participated in this study after being identified as having expert knowledge of the pharmaceutical industry in the country. These individuals were sought out using professional networking sites like LinkedIn as well as through personal connections. After the twentieth interview, data saturation was observed, and interviews twenty-one through twenty-five served to confirm this. Following a constructivist methodology, it was determined that the sample size was sufficient to enable in-depth analysis (Flick, 2018; Sebele-Mpofu, 2020; Crick, 2021). Information about the participants is listed in Table 1.

Table 1: Demographic information on interviewees

ID	Gender	Position	Years of experience	Player/actor/ category	Province
P01	Male	Owner/Chief Executive Officer (CEO)	30	Drug manufacturer	KwaZulu-Natal
P02	Male	Chief Executive Officer (CEO)	19	Drug distributor / wholesaler	Gauteng
P03	Male	Chief Executive Officer (CEO)	20	Independent retail pharmacy	Western Cape
P04	Male	Chief Operating Officer (COO)	28	Drug distributor / wholesaler	KwaZulu-Natal
P05	Male	Procurement and Planning Manager	6	Pharmaceutical supplier	Gauteng
P06	Female	Regional Sales Manager	15	Primary pharmaceutical importer	Kwazulu-Natal
P07	Female	Sales Manager	25	Drug manufacturer	Gauteng
P08	Female	Professional Sales Representative	24	Primary pharmaceutical importer	KwaZulu-Natal
P09	Female	Sales Manager	19	Drug manufacturer	KwaZulu-Natal
P10	Female	Sales Representative	20	Pharmaceutical supplier	KwaZulu-Natal
P11	Female	Sales Representative	25	Drug manufacturer	KwaZulu-Natal
P12	Female	Sales Representative	30	Drug manufacturer	KwaZulu-Natal
P13	Female	Sales Representative	12	Primary pharmaceutical importer	KwaZulu-Natal
P14	Male	Business Analyst	10	Pharmaceutical supplier	Gauteng
P15	Female	Sales Representative	23	Drug distributor / wholesaler	KwaZulu-Natal
P16	Male	Supply Chain Team Lead	12	Drug manufacturer	Gauteng
P17	Male	Supply Chain Professional	21	Pharmaceutical supplier	Gauteng
P18	Female	Senior Supply and Demand Planner	7	Drug manufacturer	Gauteng
P19	Male	Responsible Pharmacist	10	Retail Pharmacy	Gauteng
P20	Female	Supply Chain Specialist	9	Drug manufacturer	Gauteng
P21	Male	Demand Planner	6	Drug manufacturer	Gauteng
P22	Female	Demand planning lead	16	Drug manufacturer	Gauteng
P23	Male	Supply Chain Planner	7	Drug distributor / wholesaler	Gauteng
P24	Male	Supply Chain professional	24	Drug manufacturer	Western Cape
P25	Female	Demand Manager	14	Drug manufacturer	Gauteng

Participants were given consent documents outlining their rights throughout the research process before any interviews commenced. These included the ability to decline participation in the study, revoke consent at any time, and prohibit tape recording at any stage. In order to protect the privacy of the participants, their signed consent forms were kept in a secure location, apart from the recordings. After gathering standard biographical data, we turned to qualitative exploratory questions to learn more about the actual experiences

of PSCs professionals in their role in the reaction to the Covid-19 pandemic. Questions were designed to probe interviewees' understanding of the South Africa's pharmaceutical industry's approach to strategic risk response and their thoughts on the aftermath of the Covid-19 pandemic response. The interview questions were developed in accordance with the study's aims and the literature's coverage of relevant topics, and they were structured so that participants could provide details about their personal experiences during the Covid-19 pandemic and their thoughts on the South Africa's pharmaceutical industry's potential future as a result of the response to the Covid-19 pandemic.

Researchers double-checked the questions to make sure they made sense, were relevant to the topic at hand, and did not miss anything out. One participant from the sample was then used in a pilot study. The pilot's findings led to the consolidation of two related questions that had yielded identical responses. As a result, data collecting continued without any additional changes. All 25 interviews had a duration ranging from 30 minutes to an hour and a half, with 35 minutes being the median.

With participants' agreement, interviews were videotaped using Zoom and Microsoft Teams and then manually transcribed right away so that we could keep better track of the data and get more reliable results.(Creswell & Creswell, 2023).

Thematic analysis was used to examine transcripts for recurring and new themes (Linneberg & Korsgaard, 2019; Saldaña, 2022). Researchers read transcripts numerous times in order to find relevant topics and citations. The recordings from the online interviews were transcribed and uploaded into ATLAS.ti. These documents were then coded using ATLAS.ti by assigning codes to each appropriate quotation in the documents. In their own time, the researchers looked for a range of both new and established topics. Social isolation, hand sanitizer use, staff cutbacks or salary cuts, and the fluctuating cost of drugs are just a few examples. Measures were analysed and categorised according to their outcomes, with the goal of countering the wellbeing-related effects of Covid-19 pandemic and bolstering the long-term viability of the companies. These were categorised as either particular responses or generic responses in the subsequent analysis.

Discussion

Analysis of the interviews revealed multiple emerging themes. Though some concepts were first explored in this study, others have been discussed in other works. In the first place, participants discussed their supply chain's responsiveness, which they extended to the *product design strategy*. The second theme that surfaced was the measures taken by PSCs to deal with the Covid-19 pandemic. This theme was split into two subthemes, *pricing and inventory responses*, to account for the unique effects that the Covid-19 pandemic had on efficient supply chains. A participant's view of how their response would affect strategic alignment was the theme of the final section. This was broken down into the following three subthemes: *supplier strategy response, manufacturing strategy response, and lead-time strategy response*.

Supply chain's responsiveness

Participants explained product design approach when asked what the pharmaceutical business did in response to the Covid-19 pandemic and why they made those choices.

Product design strategy

Participants described the most important and frequent factor which affected their decision-making process concerning their response was based upon product availability. When determining what course of action to take, pharmaceutical industry first needed to address relevant and constantly achieve strategic fit while serving many customer segments with a variety of products across multiple channels:

From the perspective of medication or medical products coming into the country or manufacturing or materials or producing, so in terms of product having enough supply of medication, I think from the pharmaceutical industry background, companies actually normally make reservations to have at least three to six months' worth of stock on hand at any given time. (P09)

Moreover, the pharmaceutical industry had to react to the product design; in addition to addressing the crisis to restore business, the sector had to deal with the lack of product availability, which led to a decline in revenue as markets dried up and many pharmaceutical companies went out of business:

So, in my experience, I believe, you know, that it has influenced you know accessibility mostly and availability of products. Especially of particular products. (P18)

Similar to how companies' access to a variety of pharmaceutical items was hampered by the closing of ports of entry:

In the height of Covid-19 the delayed imports, increasing cost of shipping were huge external factors affecting the market - The inconsistent supply and substantial increase in cost of goods put a lot of pressure on companies to maintain their supply as well as running a cost-effective business. Single price exit products' price increases is determined by legislation every year. (P21)

In addition, participants voiced concerns about the regulations' lack of adaptability and their instability:

The implications, Like I said, there's a shortage of supply and then they lead to high demand and supply. So, you know, for them, it's the basic economics. A pandemic will cause a negative shift in the supply and when demand is not checked. It leads to a high price,

low supply price. And we have seen that and we've applied to DOH get most of our products that contains paracetamol, to get increased regulation might be increased, which is above the normal annual increase. So, the implication it eats into surplus. (Difficulties in predicting stock level; Negative shift in supply leads to high price) (P07)

Therefore, government regulations had an impact on the pharmaceutical business in two key areas. The regulations mandated a particular reaction to the pharma industry, for example, more social distance and increased sanitization methods. Second, the regulations created a secondary crisis to which the pharmaceutical companies had to respond. Pharmaceutical companies, for instance, were compelled to adjust to falling demand and supply as a result of government rules capping production and restricting borders.

Efficient supply chains

The availability of information about the company's streamlined supply chains was a second element that influenced their reactions and choices. Participants described how they would respond using their existing efficient supply chains management plans as the efficiency took shape. Although all participants had effective supply chain management plans in place, not all addressed pandemic conditions, and those that did tended to focus on regional considerations based on historical pricing and inventory tactics:

I believe they tried to respond, but it wasn't it wasn't easy, you know, not to mention, you know, that they were flying stuff and they got to find an airplane that was flying, you know, because a lot of the aircraft were grounded, you know, so they tried to get stop. And the problem being was that, you know, if it was a pharmaceutical, they had to sell it at the same price. But when they were flying masks and the masks, that only cost 50 cents, you know, people were selling at twenty-five rand, you know, so the prices went up, you know, they imported to stock, you know, finished product and created shifts so they could work with longer manufacturing hours. (P06)

Participants also voiced worry that the strategies rarely addressed the possibility of persistent or ongoing disruptions. Emerging disruption mitigation strategies are inadequate to direct the pharmaceutical industry's response to the Covid-19 pandemic, which is still having a significant impact on firms a year after it first emerged.

So, the strategic response and maybe we just need to first define what is the strategy, so the strategy is a way of doing things that is aligned to achieve your goals as an organization, given the scarcity of resources. And when I say scarcity of resources, it covers a lot wider that it can be human resources, it can be issues like raw materials. When I get the strategic response, it means what are you in putting in your strategy to ensure that you are well prepared for the unforeseeable challenges. (P07)

Following government rules, the pharmaceutical industry planned its response to the supply chain disruptions with the use of strategic response methods. Many of the participants, however, realised that their solutions did not adequately address pandemics or did not account for the long-term nature of disruptions like the one caused by the Covid-19 pandemic.

Pharmaceutical supply chain strategic response

The pharmaceutical industry's responses to the Covid-19 pandemic can be broken down into two broad categories: pricing response and inventory response.

Pricing response

As the initial impact of the COVID-19 pandemic was on the pharmaceutical supply chain, the initial response focused on those industries' needs. This was necessary for the company to ease customers' minds, but it was also required by law in some places. Some participants stated how they had to modify education and training and customer services, in addition to regulating the usage of PPE, and reminders to keep social distance between employees and customers:

I think that the disruption comes from a couple of elements. Number one, the logistical issues. Let's start with the logistical issues. So, we have to send a delivery person now that has to be fleet, so there is Personal protective equipment (PPE) restraints, he has got to have his mask, he has got to be in his van, he has got to be sanitized. (P01)

Staff members required further training in order to become familiar with the new processes. The methods by which these trainings were provided have to vary in order to meet regulatory requirements, with examples including Microsoft Teams and television commercials:

I think it will help with customers then knowing what they want when they walk into a pharmacy, so to cut down the time of just walking around and looking around, you know, with which is which is not an ideal situation, I think with this response of the TV advertising, with the pharmacy assistance, giving them advice and setting in the basket of products, maybe, you know, the training is always asking questions and increasing the basket of products for the customer instead of the customer walking in and grabbing something and walking out. So that's where the training comes in. (P03)

While some tried to use their unique reaction to the Covid-19 pandemic as a selling point, others tried to play it safe:

So, it has been quite disruptive for them. And they've also found that there's a lot of stock that's expiring because different things are selling now as to previous, you know, before the covid. So, we've had a lot of expired stock as well. For instance, the front shop items people were not coming in to buy the front shop items anymore. So, yes, it's being quiet, disruptive. (P03)

The specifics of this supply chain disruption, a nationwide lack of pharmaceuticals, were homed in on by the responses. In additional remarks, the need for better inventory management was raised:

Inventory response

Like any other form of disruption, this one also has secondary effects on businesses, mostly in the form of decreased demand and the need to cut expenses. As demand dwindled, participants repeatedly recounted measures they had to take to reduce expenses:

I think that the demand planning is critical now and the time spent in understanding statistics, understanding the and what is happening around the world, maybe looking at other trends. I can't say what went wrong because everybody was caught off guard with regards to the pandemic. We were not prepared for it because obviously we were we were working on history with regards to supply chain and what, you know, supply and demand. And all of a sudden you have a huge demand. And then within 11 months of this time, the time is progressing. You see the marketing starting to become stable again. And then all of a sudden now it's becoming more erratic again. You're getting pockets of demand and pockets of upholds, of all the stocks. So, it really has affected the supply chain services in the pharmaceutical industry negatively in the beginning. (P05)

Four of the interviewees also mentioned reviewing contracts with vendors, freelancers, and temporary workers as a cost-cutting measure at their pharmaceutical companies.

I think it's out of their control. I don't think it is. I mean, you can plan for a pandemic, but who knows when you're ever going to get one? I mean, did we even know we were going to be like this? You know, and we are basically the world shut down. And especially because we have so many different suppliers overseas and manufacturing and things like that. (P04)

The pharmaceutical industry was forced to revise its demand forecasts for the following the economic trends:

I think, like I say, you can increase your forecast in your supply chain to help, but as I say, you know what? Companies are wary to increase that drastically because you don't know if you're going to sit with that stock. And it's actually money that's sitting there and raw materials. And if it doesn't get used or it expires before time, then again, it's money lost. (P02)

There were also three respondents whose companies had moved resources like dividend payments to bolster operations:

Obviously, it can also be financial in the sense that you know sales are not recorded as it was supposed to be in terms of delayed revenue. Right. So, if items don't get to point of consumption on time, then what it means is there will be a delay in sales as well. And also, we have seen some of the restrictions brought about by most of the participants in the sector, in the sense that maybe sales reps were not allowed in hospitals. And then, hence, also affecting the number of interruptions. Due to the delayed sales and reduced sales. (P16)

Strategic alignment

Supplier strategy response.

Supplier strategy response was the focus of the pharmaceutical industry's final strategy implementation. This usually meant focusing on the domestic market and encouraging getaways when this disruption occurred:

I think what you're going to find is my belief that it's going to be market forces that rescue the day, not necessarily an industry response. Yeah, I think it's going to really boil down to supply and demand where the demand comes from and who can meet the supply. (P01)

Five of the PSC professionals indicated they had shifted their focus to prioritize long-term suppliers:

It is all about political willingness and government intervention in this regard. I have a framework that can actually work, which is building the strategic partnership with our suppliers which is basically supply chain relationship management. You must move all our strategic suppliers, this how-to save this strategic supplier if they cannot supply us then we are done. We must also improve them in terms of these are the only supplier within this space so if we do not have a good relationship with them just because there is only two of them or it is only one of a certain component then we are done. (P17)

According to three interviewees, the lengthened supplier market included clientele who were stranded internationally due to the closure of global markets:

Okay, so, with the COVID-19 pandemic I would like to think that there was an impact in terms of items or products coming into the country and also cross border movement in the pharmaceutical industries. This is not only in the pharmaceutical industry, it is all over all commodities. There were disruptions in terms of movement during the first lockdown when they first announced that there would be lockdown all over the globe. (P25)

Two important long-term repercussions, including production shutdown and lead-time delays, were predicted as a result of Covid-19 and the pharmaceutical industry's countermeasures to the pandemic.

Manufacturing strategy response

Many drug manufacturers were forced to temporarily shut down as a result of weak demand. The majority of respondents were of the opinion that currently closing businesses might remain closed for longer than expected, if they remained open at all:

The disruption, you know, and then without mentioning names, certain pharmaceutical companies closed because they started to sanitize the whole warehouse, all that. And then it opened for three days and then that closed again. So it was it was a nightmare from that side of things. OK, so the other nightmare was everyone was wearing masks, so it was not normal cold and flu virus. So we bought in stock for cold and flu season and there wasn't one. So then you had this situation where the stock was expiring and that we didn't sell through a cold and flu season. It was in stock. So there wasn't a cold and flu season because everyone was isolated home wearing masks. (P06)

Since larger PSCs would be able to continue operating thanks to higher profits, it was predicted that only smaller pharmaceutical enterprises would be seriously impacted by the indefinite shutdown. As a result, as the recovery from the Covid-19 pandemic sped up, participants believed that a number of pharma and related businesses would close permanently, lowering the overall level of competition in the sector. As a result of these closures, other businesses may seek to combine, amplifying the impact.

Lead-time strategy response

The ultimate effect dealt with the lead-time approach to boost productivity or modify the customer's experience. A consensus emerged amongst the study participants that the pharmaceutical industry might stand to improve its efficiency by studying the lessons of the Covid-19 pandemic's disruption:

Obviously, I think the delivery side of things was affected severely in terms of delivery standard times was affected in the sense that capacity from transport service providers made it impossible for our goods to go through from point of origin to point of consumption. Due to the limitation brought about by the COVID-19 in terms of allowing a certain number of people at a point in time, in maybe say office space or warehouse space, you know. Such was reduced. Capacity was reduced. Hence, then also are affecting the lead times that delivery standard lead times that we are used to prior COVID-19. (P22)

Similarly, participant 05 anticipated a higher level of involvement from top management in day-to-day operations, which would decrease stock delays and, hopefully, out-of-stocks.

Because things will be quicker. OK? You're not are you cutting out the delay process where we can go from the stocks coming in to actually getting out to the customers. So, I can give you an accurate assessment. We have a infill rate of 90 percent. OK. In other words, that we're able to replenish 92 percent of our stock. About seven percent of it has been supply out of stock and one percent is of our own.

As a whole, these three participant-provided themes point to a more dynamic industry in the near future to foreseeable future and the possibility of additional innovative technologies in the years to come. There will be more commercial interest and conflict between well-established drug chains vying for the same consumer and investor market in the coming future, leading to fewer buyers, venture capitalists, new entrants, and local producers overall. Because of this, and the other strategic shifts brought on by the Covid-19 pandemic, there will be lasting advances in technology that propel effectiveness in strategic response.

The analysis shows that government restrictions and strategic reactions had a major impact on South Africa's pharmaceutical industry actions during the Covid-19 pandemic. While both influenced pharma's responses to the induced supply chain disruption, government laws appeared to have had a more direct impact on pharma's industry-specific responses, such as social distance and mask use. The pricing strategy response and the inventory strategy response seemed to be more influenced by the strategic response strategies. The pricing and inventory answers were additionally impacted by the particular responses. Although respondents agreed that product design, supplier strategy response, and lead-time strategy response were all likely to have long-term effects, they were unable to say whether or not any given approach was more likely to have a particular effect.

Discussion of results

Preparedness for Covid-19 pandemic, the South Africa's pharmaceutical industry

Both the interviews and the literature agree that contingency planning is a strategy that can aid in the recovery of firms and help to discover strategic opportunities (Bø, Hovi & Pinchasik, 2023). Even though the participants knew about these strategies and agreed with the policy process, they said that the strategies depended on actual fact although they did not take into account how long the turmoil would last (Olutuase, Iwu-Jaja, Akuoko, Adewuyi & Khanal, 2022). This sentiment was also voiced by pharmaceutical staff in China during the Covid-19 epidemic, which concluded that contingency planning protocols for pandemics were in place, but ultimately proved to be ineffective (Almurisi, Al Khalidi, AL-Japairai, Mahmood, Chilakamarry, Kadiyala & Mohananaidu, 2020). Those who have researched the impact of a Covid-19 pandemic on the pharmaceutical business have long been worried about this

very issue (Zwanka, 2022). A failure to undertake a thorough investigation was perceived by those who lived through the Covid-19 pandemic in 2020 as a lack of implementing the strategy to solve complex problems from the pandemic(Afrin, Chowdhury & Rahman, 2021). Given the persistence of the turmoil, it is probable that even more well-being-concentrated strategies would not have been sufficient for pharmaceutical industry. When thinking about the future, it is important to not just account for well-being issues, but also for the possibility that they shall last longer than expected.

The strategic response to Covid-19 induced supply chain disruption.

Like the SARS epidemic, the COVID-19 pandemic was a shocking and unexpected development that took most companies off unprepared. Because of this, firms have to make most of their choices on the run, as opposed to the careful planning advocated for by Ivanov (2020). Due to the fluid nature of the Covid-19 pandemic, updates on the evolving situation were constantly relayed to corporate offices, necessitating reevaluation and revision of response measures (Lee, Chen, McDonald & O'Neill, 2020).

Pharmaceutical supply chain's responsiveness

The strategic response to the Covid-19 pandemic can be broken down into six segments, each of which can be compared to the responsiveness, efficiency, flexibility, or long-term availability of the response at that stage. These segments are product design strategic response, pricing strategic response, supplier strategic response, manufacturing strategic response, and lead-time strategic response (Alzoubi, Elrehail, Hanaysha, Al-Gasaymeh & Al-Adaileh, 2022). However, these sections cannot be grouped into a single stage because of the variety of responses received and the continuous complexity of the Covid-19 pandemic.

The first section, product design strategic response, discussed the measures taken by the pharmaceutical industry in response to the medicine shortages caused by the disruption in the drug supply chain (Tirivangani, Alpo, Kibuule, Gaeseb & Adenuga, 2021). Among these were facilitating access to medical care, insurance, and certifications of good health, as well as the distribution of personal protective equipment. During past instances of infectious illnesses including HIV/AIDS, tuberculosis (TB), and malaria, similar measures were taken (Tessema, Kinfu, Dachew, Tesema, Assefa, Alene, Aregay, Ayalew, Bezabhe & Bali, 2021). The removal of potentially contaminated things from guest rooms and public places is a sanitary practice that is rarely highlighted during epidemics. The pharmaceutical supply chain is the primary target of these measures (Nguyen, Lamouri, Pellerin, Tamayo & Lekens, 2022).

A second of pharmaceutical supply chain's responsiveness set of replies addressed the issue of strategic pricing. These aimed to reduce higher margins because pricing is not a primary consumer motivator, help efficient and responsive supply chains, and perhaps compensate for lost income as a result of the secondary Covid-19-induced disruption (Forman & Kohler, 2020; Phuong, 2021). According to participant reports and prior research, these measures included requests for employees to take time off (both paid and unpaid), salary reductions, contract terminations, and the elimination of superfluous expenditures as supply and other costs are quite high the rising cost of operations is a direct result of the logistics industry's constant evolution (Almurisi *et al.*, 2020). The study indicated that online pharmaceuticals sectors are anticipating a fall in worldwide pharmaceutical demand until the year 2023, thus a longer-term correction was necessary than after the Covid-19 pandemic, which caused a decline in the Indian market for only one economic downturn (Konar & Pitroda, 2022). Many of these widespread interruptions have bought companies some time to get used to the Covid-19 pandemic's long-term effects on their operations, their customers' behavior, and their ability to generate revenue. In order to buy companies some time to come up with more substantial answers, these measures are increasingly centered on attaining strategic fit in the face of supply chain disruption (Po-Lynn, 2019; Kaur & Kaushik, 2022).

Finally, we looked at inventory strategic response and discussed pharmaceutical's attempts to recover business as part of our examination of the responsiveness of the pharmaceutical supply chain. Both minimising inventories to cut costs and keeping a buffer inventory to deal with demand/supply unpredictability were mentioned by participants as being important strategies. It has been stated that, in times of crisis, people often take the action of reducing their stock levels in order to save money (Goodarzian, Taleizadeh, Ghasemi & Abraham, 2021). However, research did not previously highlight the need of buffer inventories in coping with demand/supply unpredictability. Some respondents identified the need for managers to make decisions and balance competing impacts in the areas of forecasting, planning, procurement, financing, stock levels, and marketing strategies in order to help their organizations reach their objectives (Moosivand, Ghatari & Rasekh, 2019). Both tactics for reviving the economy involved expanding into different markets, which shows the resilience and adaptability of this tactic (Munyaka & Yadavalli, 2022). Given its prevalence, this strategy probably needs further formalization inside companies in order to facilitate quicker adoption and promote more strategic uses. Despite the fact that the inventory holding cost works to minimize the total cost of supplying demand and, so, must make the right cost tradeoffs when making the lot-sizing choice, it is noteworthy to observe that participants rarely spoke about cycle inventory levels in practice for business (Alfares & Ghaithan, 2019).

Pharmaceutical industry: efficient and strategic alignment

Participants worried that some pharmaceutical enterprises that closed due to lack of financial flow, insolvency, or low demand would never reopen, making the disruption to the pharmaceutical supply chain a chronic issue. Due to the worldwide and extended character of the Covid-19 epidemic, this phenomenon was not detected in the existing research on supply chain disruptions (Ivanov, 2019). Put together, this information points to a market dominated by a handful of huge pharmaceutical firms that not only weathered the Covid-19 epidemic, but also acquired their smaller, struggling competitors. Since the effects of such a prediction would be felt for

such a long period of time, manufacturing, lead-time, and supplier strategy response to such a disruption would be difficult to align in an efficient and strategic manner, and thus the topic has received relatively little attention in the literature.

Many of the remarks made by participants have literary backing, suggesting that there are lessons to be learned from past disruptions that might promote reintegration (Roscoe, Skipworth, Aktas & Habib, 2020). The mixed outlook on disruption's future and the influence on the industry's sustainability are only two examples of the statements that seem to go counter to the literature or have not been considered before. Differences between the research and the remarks of participants can be explained in one of two ways. To begin, the Covid-19 pandemic has a wider geographical and longer-lasting temporal impact than previously mentioned supply chain disruptions, covering more of the world and for a longer time than past pharmaceutical disruptions. Because of this, businesses have felt a stronger effect, which may result in more profound, long-term transformation (Sharma, Talan, Srivastava, Yadav & Chopra, 2020). The second observation is the emergence of new technologies, such as 4IR technologies, that may be used as a practical substitute for conventional business methods used before the year Covid-19. It is possible that the Covid-19 outbreak will serve as the impetus for businesses to put their doubts about these technologies to rest and instead take use of the new possibilities they present (Ahmad, Alshurideh, Al Kurdi & Salloum, 2021).

Conclusions

Ultimately, our research has made a substantial contribution to our comprehension of the appropriate strategic response that the pharmaceutical industry in South Africa should adopt in light of the supply disruption resulting from the COVID-19 epidemic. According to the findings of this study, it is imperative to take prompt measures to guarantee the uninterrupted availability of essential medications and healthcare services in the nation, given the ongoing spread of the pandemic.

The study has identified and recommended many crucial steps that can help in establishing a more resilient and robust pharmaceutical supply chain to address these challenges. The initial and paramount strategic response is to diversify the supply base, as this reduces dependence on a limited number of worldwide suppliers. To mitigate the dangers linked to concentrated supply chains, the pharmaceutical industry might establish collaborations with several suppliers and actively pursue local sourcing.

South Africa has the potential to gain advantages from resource, manufacturing capacity, and infrastructure synergies by establishing regional alliances with its neighboring countries. The second strategy entails leveraging digital transformation and state-of-the-art technologies like as big data analytics, artificial intelligence, and blockchain to improve supply chain performance.

Two further advantages include enhanced data-driven decision-making and expedited response times to unforeseen fluctuations in demand or supply. One possible approach is to allocate resources towards research and development (R&D) and foster a culture of innovation. South Africa has the potential to reduce its dependence on imports by allocating resources to research and development and fostering the expansion of domestic manufacturing capacities.

Encouraging innovation and establishing public-private collaborations can foster the development of novel solutions to current healthcare challenges.

Lastly, robust policy and regulatory frameworks are essential. The integrity and resilience of the pharmaceutical supply chain rely on heightened regulatory oversight, the adoption of rigorous quality control protocols, and the promotion of cooperation among stakeholders. Enhancing the proficiency of regulatory authorities and promoting collaboration with international organizations will assist in protecting public health and effectively addressing future pandemics or health emergencies. Hence, it is imperative to develop a comprehensive approach to address the disruptions in South Africa's pharmaceutical supply chain caused by the COVID-19 pandemic.

If the recommended procedures are executed, the country will build a pharmaceutical supply chain that is more resilient, self-sustaining, and capable of lasting for a long time. Consequently, this will enhance public safety, increase the accessibility of life-saving drugs, and stimulate South Africa's economy.

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