

PHARMACEUTICAL INDUSTRY RESILIENCE UNDER HORMUZ STRAIT DISRUPTIONS: SUPPLY CHAIN RISKS AND DRUG SECURITY IN IRAQ – A NARRATIVE REVIEW

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ABSTRACT

Background: The stability of pharmaceutical supply chains is essential for healthcare system resilience, particularly in import-dependent countries. Iraq relies heavily on imported medicines and raw materials, making it vulnerable to disruptions in global trade routes such as the Strait of Hormuz. **Objective:** This review aims to examine the potential impact of disruptions in the Strait of Hormuz—within the context of recent geopolitical tensions—on pharmaceutical supply chains and drug security in Iraq. **Methods:** A narrative review approach was adopted. Relevant literature was identified through databases including PubMed, Scopus, Google Scholar, and ScienceDirect using predefined keywords related to pharmaceutical supply chains, geopolitical risk, and Iraq. Selected studies were analyzed thematically. **Results:** Disruptions in the Strait of Hormuz can lead to significant consequences for Iraq's pharmaceutical sector, including supply chain interruptions, increased transportation and insurance costs, drug shortages, and reduced access to essential medicines. Indirect effects include market instability, higher drug prices, and increased risk of counterfeit medicines. Local pharmaceutical production remains insufficient to mitigate these risks due to continued dependence on imported inputs. **Conclusion:** Iraq's pharmaceutical supply chain is highly vulnerable to geopolitical disruptions affecting critical maritime routes. Strengthening drug security requires a multi-dimensional strategy, including diversification of supply sources, enhancement of domestic production, establishment of strategic stockpiles, and regulatory reforms.

KEYWORDS: Strait of Hormuz, Pharmaceutical Supply Chain, Drug Security. Iraq, Geopolitical Risk, Drug Shortages, Maritime Chokepoints, Healthcare Systems, Supply Chain Disruption and Active Pharmaceutical Ingredients (APIs).

INTRODUCTION

The stability of global pharmaceutical supply chains is a fundamental support of healthcare system pliability, particularly in countries that rely heavily on imported medicines and medical products.^[1] These supply chains are inherently complex, involving multiple interconnected stages, including the production of active pharmaceutical ingredients (APIs), manufacturing, international transportation, and distribution. Due to this complexity, pharmaceutical supply systems are highly sensitive to external disruptions such as geopolitical tensions, trade restrictions, and regional conflicts.^[2,3]

In recent years, escalating geopolitical tensions in the Middle East—including U.S. and Israeli military activities and broader regional confrontations—have intensified concerns regarding the security of global trade routes. One of the most strategically critical maritime chokepoints in this context is the Strait of Hormuz. This narrow waterway facilitates the transit of a substantial proportion of global energy supplies and international trade flows, making it a vital artery for global logistics.^[4] Any disruption to navigation in this region—whether due to military escalation, security incidents, or political instability—can generate cascading effects across global supply chains, including those related to pharmaceuticals and essential medical supplies.^[5,6]

While the importance of the Strait of Hormuz is frequently discussed in relation to energy security, its indirect role in sustaining healthcare systems through uninterrupted pharmaceutical supply chains remains underexplored. This issue is particularly critical for import-dependent countries such as Iraq. The Iraqi pharmaceutical sector is characterized by a high reliance on imported medicines and raw materials, with domestic production covering only a limited proportion of national demand.^[7,8] Although efforts have been made to strengthen local manufacturing capacity, the sector continues to face structural challenges, including limited technological capabilities and dependence on external supply chains.

Recent geopolitical developments in the Gulf region have further amplified these vulnerabilities by increasing shipping costs, raising insurance premiums, and introducing uncertainty into international logistics networks.^[9] Such disruptions may lead to delays in pharmaceutical imports, reduced availability of essential medicines, and increased financial pressure on healthcare systems. In prolonged scenarios, these challenges could contribute to drug shortages and the expansion of informal or unregulated pharmaceutical markets, thereby posing additional risks to public health.

Despite the growing relevance of these issues, there remains a notable gap in the literature addressing the intersection between geopolitical instability in the Strait of Hormuz and pharmaceutical supply security in Iraq. Existing research tends to examine global trade disruptions or healthcare system challenges independently, without adequately integrating both dimensions in the context of import-dependent countries.

Therefore, this narrative review aims to examine the potential impact of disruptions in the Strait of Hormuz—within the context of recent geopolitical tensions—on pharmaceutical supply chains and drug security in Iraq. The review synthesizes existing literature to analyze supply chain vulnerabilities, assess potential public health implications, and explore strategic responses, including supply diversification, strengthening domestic pharmaceutical production, and policy interventions aimed at enhancing resilience and ensuring sustainable drug security.

METHODOLOGY

This study adopts a narrative review methodology to examine the potential impact of geopolitical tensions in the Strait of Hormuz on pharmaceutical supply chains and drug security in Iraq. A narrative approach was selected due to the interdisciplinary nature of the topic, which integrates elements of geopolitics, global trade, and healthcare systems, as well as the limited availability of directly focused empirical studies. Narrative reviews are particularly useful for synthesizing diverse bodies of literature and providing a comprehensive understanding of complex issues.^[10]

A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Scopus, Google Scholar, and ScienceDirect. The search covered publications from 2000 to 2025, with particular emphasis on recent studies (2015–2025) to ensure the relevance and timeliness of the findings.

The search strategy utilized a combination of keywords and Boolean operators (AND, OR). The primary keywords included: “Strait of Hormuz,” “pharmaceutical supply chain,” “drug security,” “Iraq,” “geopolitical risk,” “drug shortage,” and “Middle East.” These terms were used in various combinations to identify relevant literature addressing both global supply chain disruptions and regional healthcare implications.

Inclusion criteria encompassed peer-reviewed journal articles, reports from international organizations (such as the World Health Organization and World Bank), and relevant policy papers focusing on pharmaceutical supply chains, access to medicines, and the impact of geopolitical instability. Grey literature, including governmental and institutional reports, was also considered where it contributed meaningful insights.

Exclusion criteria included studies that were not directly related to the research objectives, articles lacking academic rigor, non-English publications, and sources with insufficient methodological transparency.

The selected literature was analyzed using a thematic approach, allowing the identification and categorization of key themes, including supply chain vulnerability, economic impact, drug shortages, and mitigation strategies. This analytical framework enabled the integration of findings from diverse sources into a coherent narrative relevant to the Iraqi context.

It is important to note that, as a narrative review, this study does not aim to provide an exhaustive or systematic synthesis of all available evidence. Instead, it seeks to offer a critical and integrative overview of the most relevant literature to highlight key risks and policy implications associated with disruptions in the Strait of Hormuz.

The Strategic Importance of the Strait of Hormuz

The Strait of Hormuz is a critical maritime chokepoint that plays a central role in global trade and energy security.

Geographically, it connects the Persian Gulf to international waters, making it an essential corridor for the movement of oil, gas, and commercial goods. The International Energy Agency (IEA) highlights that disruptions in this region can have immediate and widespread implications for global markets due to the high concentration of energy flows through the strait.^[11] Beyond energy, the strategic importance of the Strait of Hormuz extends to global supply chains, which rely heavily on maritime transportation. According to the United Nations Conference on Trade and Development, maritime routes form the backbone of international trade, and disruptions at key chokepoints can lead to systemic

supply chain instability.^[12] This is particularly relevant in highly globalized industries such as pharmaceuticals, where production and distribution processes are geographically fragmented.

Recent geopolitical tensions and military activities in the Gulf region have significantly increased the vulnerability of maritime transport through the Strait of Hormuz. Security analyses indicate that even limited regional conflicts or targeted military operations can elevate risks to shipping, leading to precautionary measures such as route diversification, increased transit times, and higher operational costs.^[13] These developments highlight the sensitivity of the strait to geopolitical instability and its potential to disrupt global logistics networks.

From a supply chain perspective, chokepoints like the Strait of Hormuz represent critical nodes where localized disruptions can generate global ripple effects. Research in supply chain risk management demonstrates that disruptions in strategic transit routes can lead to delays, cost escalation, and reduced reliability, particularly for industries dependent on time-sensitive logistics.^[14] The pharmaceutical sector is especially vulnerable due to its reliance on continuous supply, strict storage conditions, and limited tolerance for delays.

Moreover, the economic impact of disruptions in maritime chokepoints is not limited to physical interruptions of transport. Increased geopolitical risk can drive up freight rates, insurance premiums, and uncertainty in global markets, thereby indirectly affecting the availability and affordability of essential goods.^[15] For countries that depend heavily on imports, such as Iraq, these indirect effects may translate into significant challenges for healthcare systems and access to medicines.

In this context, the Strait of Hormuz represents a key vulnerability within the global supply chain infrastructure. Its stability is essential not only for energy markets but also for ensuring the uninterrupted flow of critical goods, including pharmaceuticals, which are vital for maintaining public health and healthcare system functionality.

Pharmaceutical Supply Chains in Iraq

The pharmaceutical supply chain in Iraq is characterized by a high level of dependency on imports, limited domestic production capacity, and a mixed public–private distribution system. Over the past decades, the sector has been significantly affected by political instability, economic challenges, and infrastructural limitations, all of which have contributed to its current structure and vulnerabilities.

A defining feature of Iraq's pharmaceutical sector is its heavy reliance on imported medicines and raw materials. Recent estimates indicate that more than 90% of medicines consumed in Iraq are sourced from international markets, including countries such as India, Turkey, Iran, and Jordan.^[16] This dependency extends not only to finished pharmaceutical products but also to active pharmaceutical ingredients (APIs), which are essential for local manufacturing.^[16] As a result, the entire supply chain—from procurement to distribution—is highly sensitive to external disruptions.

The structure of pharmaceutical distribution in Iraq involves both public and private sector actors. The public sector is primarily managed through the State Company for Marketing Drugs and Medical Appliances (KIMADIA), which is responsible for procuring and distributing essential medicines to public healthcare facilities.^[17] In parallel, the private sector plays a dominant role in retail distribution, with a growing number of pharmacies and private hospitals contributing to the availability of medicines across the country.^[18]

Despite these structural challenges, the Iraqi pharmaceutical industry has shown signs of gradual development in recent years. Government initiatives aimed at localizing pharmaceutical production have led to an increase in the number of manufacturing facilities and the expansion of domestic output. Reports indicate that dozens of pharmaceutical factories are currently operational, producing hundreds of therapeutic products and contributing to a growing share of national demand.^[19] In some cases, local production has reached significant levels, with estimates suggesting that it may cover up to 40% of domestic demand under recent policy frameworks.^[19]

Furthermore, investments in the pharmaceutical sector and increased collaboration between public and private stakeholders have supported efforts toward self-sufficiency. These initiatives have already generated measurable economic benefits, including reductions in import costs and increased availability of certain essential medicines.^[20]

However, the sector still faces major constraints, including limited technological capacity, regulatory inefficiencies, and delays in accessing raw materials, which can take several months to procure.^[21]

Another critical challenge lies in the regulatory and quality control environment. The presence of substandard and falsified medicines in the market, along with gaps in monitoring and enforcement, poses a significant risk to public health.^[17] Additionally, fluctuations in economic conditions, such as inflation and exchange rate instability, further affect drug pricing and supply chain stability.^[22]

Overall, the pharmaceutical supply chain in Iraq remains in a transitional phase, moving from a predominantly import-dependent model toward gradual localization and system strengthening. However, its continued reliance on external sources makes it particularly vulnerable to global supply chain disruptions, especially those linked to geopolitical instability and critical maritime routes such as the Strait of Hormuz.

Impact of Hormuz Strait Disruptions on Pharmaceutical Supply Chains in Iraq

The Iraqi pharmaceutical supply chain is highly vulnerable to external disruptions due to its significant dependence on imports and limited domestic production capacity. Consequently, any instability affecting critical global trade routes—particularly the Strait of Hormuz—can have direct and indirect implications for drug availability, affordability, and overall healthcare system performance.

One of the most immediate impacts of disruptions in the Strait of Hormuz is the interruption of pharmaceutical supply chains. Given that a large proportion of medicines and raw materials used in Iraq are transported via maritime routes, any delay or restriction in shipping can lead to shortages of essential medicines. Studies on global supply chain disruptions indicate that maritime chokepoints play a crucial role in maintaining the continuity of international trade, and disruptions can result in significant delays in the delivery of time-sensitive goods such as pharmaceuticals.^[23]

In addition to physical disruptions, geopolitical instability in the region contributes to increased transportation costs. Elevated security risks in the Gulf lead to higher maritime insurance premiums and shipping costs, which are often passed on to import-dependent countries. According to maritime economics research, geopolitical risk is strongly associated with fluctuations in freight rates and shipping costs, particularly in conflict-prone regions.^[24] For Iraq, this translates into higher drug prices and increased financial burden on both the government and patients.

Another critical consequence is the potential shortage of essential medicines. Pharmaceutical supply chains operate on tightly coordinated logistics systems, often relying on just-in-time delivery models. Disruptions in transit routes can therefore quickly lead to stock depletion, especially for life-saving medications such as insulin, oncology drugs, and antibiotics. Evidence from previous global disruptions—including the COVID-19 pandemic—demonstrates that supply interruptions can severely affect access to essential medicines in import-dependent countries.^[25]

Furthermore, disruptions in the Strait of Hormuz can negatively affect domestic pharmaceutical production in Iraq. Although local manufacturing has expanded in recent years, it remains dependent on imported active pharmaceutical ingredients (APIs) and raw materials. Delays in importing these inputs can halt or reduce production capacity, further exacerbating supply shortages. This highlights the interconnected nature of global supply chains, where even local production is indirectly dependent on international logistics systems.^[26]

In addition to supply and cost-related impacts, prolonged disruptions may lead to the expansion of informal and unregulated pharmaceutical markets. In situations of drug shortages, patients and healthcare providers may turn to alternative sources, including unauthorized suppliers.^[27] Moreover, the cumulative effect of these disruptions places additional pressure on Iraq's healthcare system. Increased drug prices, limited availability, and supply uncertainty can strain public healthcare institutions, particularly those dependent on centralized procurement systems. Over time, this may reduce the system's ability to respond effectively to public health needs, especially during crises.

Overall, disruptions in the Strait of Hormuz—whether actual or anticipated—can generate cascading effects across Iraq's pharmaceutical supply chain. These impacts extend beyond logistics to include economic, industrial, and public health dimensions, reinforcing the need for strategic interventions aimed at enhancing supply chain resilience and ensuring sustainable drug security.

Mitigation Strategies

Given the high vulnerability of Iraq's pharmaceutical supply chain to external disruptions—particularly those associated with geopolitical instability in critical maritime routes such as the Strait of Hormuz—it is essential to adopt comprehensive mitigation strategies aimed at enhancing resilience and ensuring sustainable drug security.

One of the most important strategies is the diversification of supply sources and transport routes. Relying on a limited number of countries or shipping pathways increases exposure to geopolitical risks. Expanding procurement networks to include multiple regions, as well as utilizing alternative transport modes such as land and air freight when necessary, can help reduce the impact of maritime disruptions.^[28]

Another key approach is the strengthening of domestic pharmaceutical production. Increasing local manufacturing capacity can significantly reduce dependence on imports and improve supply chain stability. This includes not only the production of finished pharmaceutical products but also the development of local capabilities in producing active pharmaceutical ingredients (APIs). Studies have shown that enhancing domestic production is a critical factor in improving medicine accessibility and national health security.^[29]

The establishment of strategic pharmaceutical stockpiles is also essential in mitigating the effects of short-term supply disruptions. Maintaining adequate reserves of essential medicines, particularly for chronic and life-threatening

conditions, can provide a buffer during periods of crisis. The World Health Organization emphasizes the importance of national stockpiling strategies as part of broader health emergency preparedness frameworks.^[30]

In addition, improving supply chain management and digital infrastructure can enhance visibility and responsiveness within the pharmaceutical system. The use of digital tracking systems, real-time inventory monitoring, and predictive analytics can support more efficient planning and reduce the risk of shortages.^[2] Such systems enable policymakers and healthcare providers to anticipate disruptions and respond proactively.

Regulatory and policy reforms also play a crucial role. Strengthening regulatory oversight and quality control mechanisms can help prevent the entry of counterfeit and substandard medicines into the market, particularly during periods of shortage. Furthermore, streamlining procurement processes and reducing bureaucratic delays can improve the efficiency of medicine distribution.^[31] Finally, fostering international cooperation and regional partnerships can support supply chain resilience. Collaboration with neighboring countries and international organizations can facilitate access to emergency supplies, technical expertise, and coordinated responses during crises. Global health frameworks increasingly emphasize the importance of cooperative strategies in addressing cross-border supply chain challenges.^[32] Overall, a multi-dimensional strategy that integrates supply diversification, local production, strategic stockpiling, technological advancement, and policy reform is essential for strengthening Iraq's pharmaceutical supply chain. These measures can significantly reduce vulnerability to disruptions in critical trade routes such as the Strait of Hormuz and enhance the country's long-term drug security.

DISCUSSION

This review highlights the significant vulnerability of Iraq's pharmaceutical supply chain to geopolitical disruptions, particularly those associated with instability in the Strait of Hormuz. The findings demonstrate that Iraq's heavy reliance on imported medicines and raw materials creates a structurally fragile system that is highly sensitive to external shocks.

One of the key insights emerging from this analysis is the interconnected nature of global supply chains. Disruptions in critical maritime chokepoints can generate cascading effects that extend far beyond their geographic location, affecting national healthcare systems and access to essential medicines. Research on global supply chain disruptions has shown that highly interconnected systems are particularly susceptible to ripple effects, where localized disruptions propagate across multiple sectors and regions.^[33]

Another important finding is that the impact of geopolitical instability extends beyond direct physical disruptions. Risk perception alone can significantly influence supply chain performance by altering market behavior, increasing uncertainty, and driving cost escalation. Empirical studies indicate that geopolitical risk is closely linked to increased volatility in global trade and logistics systems, even in the absence of actual conflict.^[34]

The review also underscores the limitations of current mitigation efforts. While initiatives aimed at strengthening domestic pharmaceutical production represent a positive step, they remain insufficient to fully offset external dependency. Local manufacturing in Iraq continues to rely on imported inputs, particularly active pharmaceutical ingredients, which means that vulnerability still persists indirectly. Similar challenges have been observed in other

developing and import-dependent countries, where efforts toward pharmaceutical self-sufficiency are constrained by global supply dependencies.^[35]

Comparatively, evidence suggests that countries adopting diversified sourcing strategies, combined with strategic reserves and stronger regulatory systems, are more resilient to supply chain disruptions. Integrated approaches that combine multiple layers of risk mitigation have been shown to significantly reduce exposure to global shocks.^[36]

From a policy perspective, the findings highlight the urgent need for a comprehensive national drug security framework in Iraq. Such a framework should incorporate risk management, supply chain diversification, and regulatory strengthening to enhance system resilience. Without these measures, the pharmaceutical sector will remain vulnerable to recurring disruptions driven by geopolitical instability.

Finally, this study contributes to the growing body of literature examining the intersection between geopolitics and public health. It demonstrates that disruptions in global trade infrastructure—particularly in strategically sensitive regions—can have profound implications for healthcare access and equity, especially in countries with limited domestic production capacity.

CONCLUSION

In conclusion, this review demonstrates that disruptions in the Strait of Hormuz—whether actual or anticipated—pose a significant risk to pharmaceutical supply chains and drug security in Iraq. The country's heavy dependence on imported medicines, combined with structural limitations in domestic production, makes it particularly vulnerable to geopolitical instability in critical maritime routes.

The analysis shows that such disruptions can lead to multiple challenges, including supply delays, increased costs, drug shortages, and heightened risks of counterfeit medicines. These impacts extend beyond logistics, affecting economic stability and public health outcomes.

To address these challenges, Iraq must adopt a comprehensive and multi-dimensional strategy that includes diversifying supply sources, strengthening domestic pharmaceutical production, establishing strategic drug reserves, and improving regulatory and supply chain management systems. In addition, greater regional and international cooperation will be essential in enhancing resilience against future disruptions.

Ultimately, ensuring drug security in Iraq requires a long-term commitment to structural reform and strategic planning. As geopolitical uncertainties in the region persist, proactive measures will be crucial to safeguarding the continuous availability of essential medicines and protecting public health.

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