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Research Article

Role of Technology in the Performance Measure of Insulin Cold Chains

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Abstract

The pharmaceutical industry sees a great deal of demand for insulin, a vital medication. It is essential to optimize the supply chain for insulin to ensure patients have access to the medication they need and that provider or supplier costs are manageable. The insulin supply chain (ISC) can be made more efficient and effective so that patients can get timely access to this lifesaving medication. This study used semi-structured interviews of seven participants from the pharmaceutical field in Doha, Qatar, to examine the issue of making the ISC more effective and reducing the presence of counterfeit drugs. This study developed four themes. These were: Limitations related to the transportation of insulin affecting their use, 2) methods for ensuring the effectiveness of the supply chain, 3) the role of advanced traceability methods adoption in ensuring the effectiveness of transportation of insulin, and 4) RFID in ensuring the appropriate transportation of insulin in a supply chain. The participants said that Radio frequency identification (RFID) in the insulin cold chain increased its effectiveness.

Keywords: Supply chain management, cold supply chain, perishable drug, insulin, Qatar

Introduction

Cold Chain Management (CCM) is a complex action and activity impacting perishable goods. A “cold chain” is the steadiness of preserving perishable products at low temperatures from production to the final consumption stage. Major industries that use cold chains are pharmaceuticals and food [1]. Per [2], CCM is a crucial activity from economic, social, and environmental points of view.

Vecchi and Brennan noted that an efficient traceability system requires recording and monitoring temperatures throughout all production phases [3]. According to Ruiz-Garcia and Lunadei, cold chains are capital-demanding sectors primarily because of the need for crucial technological investments like transportation and storage equipment to sustain equal temperatures on all chain levels [4]. Techniques centred on technologies like Radio Frequency Identification (RFID) are now supplying new capacities to manage cold chains of drugs like insulin [5]. Hence, RFID facilitates visibility in a cold chain of sensitive products by enabling non-contact data collection in real-time and effectual contact with a control management system in supply chains. Vecchi and Brennan (2010) said that applications of RFID could also reduce risks linked with the safety of a product and lengthen the shelf life of the cold chain by establishing transparent accountability in the supply chain [3].

Problem Statement

According to Cefalu et al., the medical community requires the supply of insulin regularly to manage abnormalities of metabolism for people with diabetes [6]. Different studies have identified many insulin problems relating to supply chain management (SCM) and pharmaceutical supply chain (PSC). Hence, many researchers and studies have highlighted the SCM issues in pharmaceutical companies, but no studies provide coherent information and data about overcoming these issues and challenges in the PSCs concerned with insulin. Therefore, this study addresses the following objectives.

Review Objectives

This study addressed the following objectives. They were to:

- Identify the significance and issues of insulin in the PSC;
- Conceptualize the CCM of insulin to improve its efficiency and effectiveness in the pharmaceutical market;
- Determine the factors that increase the effectiveness of the insulin cold chain using RFID; and
- Provide recommendations to improve insulin's CCM and SCM to increase its efficiency and effectiveness.

Research Structure

The present study was divided into five sections as follows:

- Section 1 presents the articles, the background, the problem statement, and the aim and objectives of the current study.
- Section 2 comprises a review of the literature.
- Section 3 comprises the methodology through which the data is collected for the study. It includes the research approach, design, data collection method, research philosophy, and data analysis technique. In addition, ethical concerns are also depicted in this chapter.
- Section 4 consists of the findings and discussion of the gathered information and data. In addition, findings and results are also triangulated with the literature from the relevant studies.
- Section 5 is the last part of the study, which presents the research's conclusion, implications, and recommendations.

Literature Review

CCM of Insulin to Improve its Efficiency and Effectiveness in the Pharmaceutical Market

It is crucial to optimize the supply chain for insulin to ensure that patients have access to the medication they need and that the costs are manageable for healthcare providers. Some ways to improve the supply chain include increasing transparency in the distribution process, developing contingency plans for supply disruptions, and encouraging competition among manufacturers and distributors. By improving the efficiency and effectiveness of the insulin supply chain (ISC), timely access of patients to this lifesaving medication can be ensured.

Insulin supply chain management (ISCM) is among the most critical factors in controlling diabetes. Keeping insulin at room temperature can be detrimental to its effectiveness and efficiency, while cold supply chain management (CSCM) of insulin can improve both. CSCM is the storage or transportation of items that must be preserved at temperatures below 5 degrees Celsius (41 degrees Fahrenheit) [7]. This definition may be applied to pharmaceuticals, vaccines, biological products, blood products, cultures, tissues, organs for transplantation, and foods and dairy products.

The supply chain has three phases: the first is the manufacturing phase, the second is the distribution phase, and the third is the consumption phase. These phases require proper SCM to ensure that desired results are achieved with minimal costs. ISCs have high risks of failure due to their effective temperature range, and ISCs are most vulnerable when insulin is in the manufacturing, distribution, or consumption stages. The supply chain must be carefully planned to maintain the CSCM of insulin at all stages [8]. The supply chain can be compromised by various factors such as poor planning, costs that do not align with desired results, incorrect assessment of effectiveness and efficiency, human error in supply chain processes, supply shortages, and supply transporters being taken hostage for ransom.

Failure to maintain CSCM will degrade insulin's efficiency and effectiveness at every phase of the PSC. There are several ways to maintain CSCM, but the most important way is through proper planning. The supply chain must be planned to keep insulin at a consistent temperature to maintain CSCM, which requires the cooperation of all supply chain members, from manufacturers to consumers [9].

Factors Increasing the Effectiveness of the Insulin Cold Chain Using RFID

The effectiveness of the insulin cold chain can be improved by using RFID technology. Certain factors can lead to a more efficient and effective system. These factors include supply chain visibility, real-time inventory management, and automated data collection. When it comes to the supply chain for medications such as insulin, ensuring that the cold chain is maintained is critical to preserving the efficacy of the medication. While technologies such as RFID have been around for some time, their use within the PSC has been limited [10]. However, with recent advancements in RFID reader technology and a growing understanding of how this technology can improve supply chains, there is a renewed interest in using RFID to improve insulin's CCM.

It is essential to have supply chain visibility into where pharmaceuticals are at all times to ensure a more effective supply chain of insulin. When a supply chain lacks sufficient visibility through its supply network, processes slow down and become less efficient due to communication problems between multiple trading partners involved in getting medications from producers to consumers or patients. In addition, when individuals have poor insight into available inventory at any given time, they do not have enough stock on hand, forcing them to search for alternatives. RFID can play an essential role in improving supply chains by tracking and tracing products as they move through the different phases of the supply chain [11]. This is especially important for

products that need to be kept cold, such as insulin. By providing a means of tracking inventory in near-real-time, RFID can help to ensure that the right products are being delivered to the right places at the right time. This delivery not only helps to improve efficiency within the supply chain but also helps to ensure that products are not wasted or lost.

In addition to improved visibility and efficiency, RFID can also help to improve data collection among supply chain stakeholders. Automated data can help to reduce human error and improve the accuracy of collected data. This is important for supply chains that need to track the movement of products through the different chains and show the condition of these products. RFID can help improve the accuracy of data collection by automatically collecting data as products move through the supply chain [12]. This automatic collection helps to reduce the time and effort needed to collect data manually, which can often be error-prone. In this way, the effectiveness of the insulin CCM can be improved by using RFID technology.

Improving the CCM of Insulin to Increase its Efficiency and Effectiveness

The efficiency and effectiveness of CCM are critical for the safe and effective transport of temperature-sensitive insulin. Poor CCM can lead to product degradation and loss of effectiveness, resulting in medical complications for patients. There are several ways to improve the CCM of insulin. One fundamental way is to ensure that the right equipment is used for each process stage. This includes thermally insulated packaging, appropriate storage containers, and reliable refrigeration units. It is also important to have well-trained staff aware of the importance of maintaining a consistent cold chain throughout the distribution process (Taylor, 2015). Staff must be able to properly pack, handle, and transport products according to the necessary temperature standards, keeping similar standards in mind when unloading or transferring insulin to other vehicles.

The cold chain must be monitored throughout its handling process until it reaches the patient to ensure efficiency and effectiveness. These can be achieved by recording the product's temperature every step of the way at controlled checkpoints along the SCM process. Temperature monitors should also be used when transporting insulin by hand to detect any possible problems that could degrade effectiveness quickly. Another way to improve efficiency and effectiveness is to create partnerships with pharmaceutical companies, healthcare providers, regulatory agencies, and public health departments [13]. These types of partnerships give a better understanding of how CCM can best work for various situations while allowing the discussion of new ideas about managing insulin effectively and efficiently.

Improving the SCM of Insulin to Increase its Efficiency and Effectiveness

Insulin supply has become a global challenge for healthcare professionals and patients because ISCs are constantly disrupted, limiting the supply of this lifesaving drug to low-income countries. This situation causes supply shortages and price hikes, impeding the effectiveness of supply chains. Evans et al. (2014) report that more than half of all countries struggle to meet their national demand for insulin, while some populations within these countries do not have access to any at all. Speculation and profiteering from pharmaceutical companies that artificially raise prices and reduce production worsen the situation, creating supply shortages and price hikes. That is why improving the supply chain management of insulin to increase its efficiency and effectiveness has become highly significant.

Relationship between the Lack of Availability of Insulin and Counterfeiting

Due to the inefficient supply chain of drugs and external factors like the Covid-19 pandemic, the lack of availability of insulin or other drugs has increased. As Haji et al. (2022) noted, the lack of availability of medicines and drugs is an alarming situation that might lead to alternatives or counterfeit drugs [10]. Counterfeit medicinal drugs include those with no or few active ingredients with substituted, adulterated, and hazardous ingredients, entirely misrepresented or sold with a fake brand name. Besides the issue of fake brand names, legitimate drugs that have passed their expiry dates are also considered false drugs. In this manner, the issue of counterfeit insulin in legitimate PSCs has increased over the years. The demand for insulin and other drugs is increasing rapidly because many people are being diagnosed with diabetes. Indeed, Haji et al. (2021) argued that the number of people diagnosed with type 1 and type 2 diabetes had increased exponentially. This increase generates the need to ensure a proper supply of insulin while mitigating the lack of availability of this lifesaving drug [12].

When insulin is unavailable, people may turn to counterfeit products or drugs that severely harm their health. Unfortunately, as Haji et al. (2022) found, people who use fake or counterfeit products or drugs for cures face severe health issues [13]. Fake and counterfeit chemicals and drugs can damage other parts of the body or make the health issue more severe. In this case, it generates the need for companies to ensure an efficient supply chain of insulin to prevent them from using fake products or drugs.

Literature Gap

The emergence of RFID technology in the pharmaceutical sector has been a new area of development where researchers are still figuring out the various applications that can be used to

improve efficiency and effectiveness. That is why a considerable literature gap in RFID applications in the supply chain of insulin can be explored. Although RFID technology has been identified as a potential solution for improving the efficiency and effectiveness of the pharmaceutical sector, there is still a lack of l evidence to support this claim and a lack of research on RFID's ability to manage stock levels and detect counterfeit products.

The absence of evidence means there is still uncertainty about how effective and efficient RFID technology can be implemented to manage the ISC. For example, studies have not examined the costs and benefits of RFID to examine the effectiveness and efficiency of this technology for managing supply chains in the pharmaceutical sector. Moreover, no research has evaluated whether organizations are using RFID systems, so determining what opportunities exist or whether more organizations have plans or are already using RFID technologies would be challenging. Thus, these are the potential areas for future researchers to fill out the gaps in the existing literature.

Methodology

A phenomenological qualitative design was chosen to understand the lived experiences and perceptions of the experts and stakeholders of the PSC. Moustakas (1994) explained that phenomenological research describes what the participants experienced and how they have experienced it [14]. Patton (2002) underlined that phenomenological research develops a deep rich understanding of phenomena by examining participants' lives and experiences [15]. In addition, Locke et al. (2010) further contributed that phenomenological research utilizes interpretive and descriptive methods to examine the participants' lived experiences [16].

The current study used a micro-level design, i.e., a small-scale, in-depth investigation, to ensure a rich, thick, and intensive description of the participant's lived experiences. The research was conducted in a natural setting in Qatar. The study was holistic, and information about the phenomenon of interest was retrieved and analyzed inductively from interviews. The strength of each interview was contingent upon insights gleaned in a compendium of statements that together described the essence of the experiences of supply chains management, professionals in the healthcare industry (i.e., hospitals, clinics, or other medical service providers), or professionals in PSC management (sourcing, procurement, warehousing, distribution, retailing).

The researcher investigated how a safe insulin cold chain could be developed and utilized and if that supply chain could protect insulin users.

Interview Questions

The interview sessions used a semi-structured open-ended structured questionnaire. Each participant was asked the same question in the same order.

1. What mechanisms do organizations use to meet temperature requirements for drugs?
2. Do those temperature regulation mechanisms influence the effectiveness of drugs?
3. What are the major problems that organizations face in transporting insulin?
4. Are you aware of cold supply chain management?
5. Is a cold supply chain method a better transportation mechanism for transporting insulin?
6. What kind of traceability technologies do organizations usually adopt for their products?
7. Do you think radio frequency identification could effectively manage an insulin supply chain?
8. Is radio frequency identification the most suitable option for product identification? Why? Or why not?
9. What are the different challenges organizations face when adopting radio frequency identification technology?
10. Will radio frequency identification be more expensive for organizations in the near future? Why? Or why not?
11. Do radio frequency identification labels help distributors, retailers, and consumers identify and track a product?
12. In your opinion, is your current transportation of supply chain model effective, or would a cold supply chain be more effective?

Research Design

Hennink, Hutter, and Bailey (2020) noted that a research design is a general plan focusing on achieving the objectives [17]. It is a framework used to choose specific data collection and analysis methods. There are three types of research designs: qualitative, quantitative, and mixed methods. The current study utilized a qualitative approach, using semi-structured interviews to gain in-depth findings, human views, and opinions.

Sample Size and Technique

The study's sample included seven participants for the interview sessions to get the primary qualitative data. These participants were professionals in the healthcare industry (i.e., hospitals, clinics, or other medical service providers) located in Doha, Qatar. Some belong to the medical profession, whose knowledge about the role of technology in the performance measure of insulin cold chains varies and depends upon their age and experience. Some were experienced in supply chain management or pharmaceutical supply chain management

(sourcing, procurement, warehousing, distribution, retailing).

Participants were recruited through a purposive sampling strategy, a common qualitative sampling technique designed to secure information-rich cases that can provide profound details on the phenomena of interest [14, 18, 19]. In phenomenological research, purposive and criterion sampling is used to identify participants who have experienced a specific phenomenon and can provide descriptions of this phenomenon [14]. A purposeful sampling procedure was followed to provide insights into the lived experiences and perceptions of the participants to provide rich, thick descriptions of the participants' experiences and attitudes. Consistent with Patton (1990), purposeful sampling implies selecting information for an in-depth study [15]. Although the sample size was only 7 participants, it was appropriate for the research design because interviews require a smaller sample size than surveys [19].

Interview Procedure

Participants were recruited via emails, phone calls, and virtual and physical interviews, and all individual interviews were conducted from November 2021 to January 2022. Because of the social distancing mandates due to the coronavirus pandemic, the researchers could only conduct all individual interviews virtually, either on Zoom or Google meet.

This study utilized intensive semi-structured open-ended interviews for data collection. Based on Patton's (1995) recommendations, initial interview sessions were structured to get to know the participants and establish trust. The researchers explained the purpose of the study to the participants [15]. Participants were informed that participation was voluntary and that they could discontinue their participation if, during the process, they found that they were no longer interested in completing the process. Participants were promised anonymity. They were assured that all interview recordings and transcripts would remain secure, and only the research team would have access to the records. Verbal consent was obtained from the participants.

The data were collected via 45-60-minute digital-recorded interviews with all participants. Before data analysis, the digitally recorded interviews were transcribed verbatim. Then, five researchers independently analyzed and categorized the data into emerging themes using codes to compare all narratives and transcripts of the participants. Inductive coding was used to reveal themes and potential patterns across interviews. The transcripts were read and reviewed several times independently. Then the researchers discussed the statements, codes, and themes together several times to check for accuracy [20]. The data were constantly compared through and across interview transcripts and field notes data. The validity and reliability of the data analysis were ensured through detailed journaling of the entire data collection process, member checks, and clarification of researcher bias, along with rich, thick descriptions [21].

Once the transcripts were deemed accurate, the data analysis discovered the major themes. After developing an initial set of themes, the codes were refined to reflect their connections (or lack thereof) to the current literature related to CCM. The analysis of phenomenological data resulted in identifying four central themes. To maintain the quality, validity, and rigour of analysis, interviews and transcripts were listened to and read repeatedly; field notes and interpretations were recorded and shared alongside transcript excerpts by the research team.

Data Analysis

In scientific research studies, data analysis comprises the entire process of data evaluation upon which the results are constructed and discussed further to cultivate the research conclusions. This research study evaluated qualitative data sets using content analysis to obtain subjective and detailed analysis and evaluation of the collected data. The content analysis finds the themes in the subjectively written content or response to identifying different ideas [22].

Results and Discussion

Table 1 presents the demographics of the participants.

Table 1: Demographics of Participants

Pseudonym	Age	Gender	Work Experience	Domain
Participant 1	25	Male	4-6 Years	Hospitals/Clinics/Pharmacy
Participant 2	29	Male	7-9 Years	Distributor/Wholesaler of drugs
Participant 3	33	Male	7-9 Years	Distributor/Wholesaler of drugs
Participant 4	44	Female	>10 Years	Packager of drugs
Participant 5	46	Female	>10 Years	Manufacturer of drugs
Participant 6	49	Male	>10 Years	Supply chain professional
Participant 7	50	Female	>10 Years	Manufacturer of drugs

Thematic Analysis

This part of the research study gives a detailed focus on the interpretations from the interviews of the respondents. The primary reason for conducting the interviews was to understand their opinions of performance measures for a safe insulin cold chain using RFID. The interview questions were designed so that the respondents could provide detailed and comprehensive views of the respondents regarding the study's variables. The researchers developed themes and then discussed them in terms of the results of prior studies. The themes formed for this research study are discussed below.

Theme 1: Limitations related to the transportation of insulin affecting their use

The initial question focused on attaining input from the participants regarding the limitations related to the transportation of insulin affecting their use. Participant 5 said,

Insulin is known as an anabolic hormone that elicits metabolic impacts throughout an individual's body, and it is vital that when it is being transported from one place to another, it needs to have a certain temperature. It has to remain cold, and for medical providers, it is important that they have a cold temperature in their transportation.

Similarly, Participant 2 said,

One main limitation when it comes to the transportation of insulin is that the higher prices can make its cost increase, which can lead to delays in the transportation of the insulin. Given this, insulin needs to have a particular temperature for its transportation, and the increase in costs can lead to delays in the supply chain of insulin.

In alignment with these observations, Warnke (2021) said that an increase in expenses and hurdles in the supply chain procedures is the primary reason for insufficient insulin availability, leading to patients' early deaths [5].

Theme 2: Methods for ensuring the effectiveness of the supply chain

The second question asked about what methods could be used to ensure the effectiveness of the ISC. Participant 3 said,

Insulin is an essential medication used to treat diabetes, and its handling and transport require special procedures so it can remain effective. The procedure varies from manufacturer to manufacturer, some of them requiring the use of sensors attached via UBS (data logger) to the insulin pallets or in the refrigerators that track the insulin throughout transport until the appropriate retailer, such as a hospital or pharmacy, receives the insulin. During the trip, the temperature is monitored in real-time. The only way to ensure that diabetes receives effective and safe insulin is through CCM.

Participant 1 said,

As pharmacists, we take great care not to accept any insulin without checking the temperature sensor attached to it in real-time. Manufacturers mandate that we do so. We even go beyond this by packaging the insulin in special ice-filled packages and educating the patient about how to handle the insulin until they reach home.

Feyisa et al. (2021) noted that various methods could help ensure the availability of insulin through appropriate CCM, and this method ensures appropriate drug storage by setting a proper temperature of fewer than 41 degrees Fahrenheit [7]. Similarly, Bastani et al. (2021) said that a cold supply chain was an effective technique that allows the long-term storage and management of insulin at different levels of its availability, leading to a decline in its shortage [8]. Cold storage reduces the overall issue of the limited availability of insulin.

Theme 3: Role of advanced traceability methods adoption in ensuring the effectiveness of transportation of insulin

The lack of insulin available in the market and other related issues, such as counterfeiting, can be circumvented by using

different techniques, including different methods enhancing the overall traceability of the drug. Participant 6 said,

In my opinion, using RFID is the most effective method of ensuring the traceability of the product. It is easier to understand and implement, and it has a very simplistic design that counters the mass counterfeiting of this drug which is a major problem currently.

Similarly, Participant 7 said,

For products such as insulin, traceability plays a critical role in ensuring the safety and authenticity of the drug. Many technologies are being used today to assist in the full visibility of critical points of products, and RFID is one of them. To increase RFID's efficiency and effectiveness, RFID is being integrated with other trendy technologies such as blockchain and IoT. This integration opens the door to the further development of these technologies.

Haji et al. (2022) agreed with this assessment and suggested a need existed to develop a strong partnership with the different actors involved, including pharmaceutical companies, healthcare providers, regulatory agencies, and public health departments [13].

Theme 4: RFID in ensuring the appropriate transportation of insulin in a supply chain

The research focused on the use of RFID in the cold supply chain to enhance the availability of insulin and suggested that the technology has been discovered to have an undeniably effective role in developing a secured transportation system [11]. Implementing RFID increases overall traceability, which tends to detect counterfeit products at the suppliers' end before their delivery. Participant 4 said,

In my opinion, RFID is the best method to ensure that the product does not fall out of the supply chain at any level. The constant connectivity that it assures is the major method that ensures supply chain consistency.

Similarly, Participant 7 said,

The RFID device has both simplicity and complexity, and this is a well-established and well-matured technology that is used for much more than tracking items and checking inventories. RFID proved to be a powerful tool for ensuring full visibility along the entire supply chain and transmitting information on the previous history of a product, such as insulin, with a high degree of accuracy and speed and is highly scalable.

This response led to the conclusion that the technique can significantly enhance the overall supply chain and ensure its effectiveness. Haji et al.'s (2021) study also aligned with the conclusion that RFID enhances the accuracy of data collection through an automated approach. This evidence led to the idea that RFID can enhance a product's transferability across different levels [12].

Conclusion and Recommendations

Summary of Findings

Different kinds of supply chains can impact business operations in the pharmaceutical industry. One type of supply chain, the CCM, had complex actions and activities influencing the shelf life of perishable goods. CCM is a crucial activity from economic, social, and environmental points of view.

This research investigated perceptions of the effectiveness, efficiency, and applicability of the Insulin cold chain through the participants' perceptions. The study's insights suggest that RFID technology can enhance the effectiveness of the insulin cold chain. While technologies such as RFID have been around for some time, their use within the PSC has been limited.

Recommendations

The researcher sought suggestions from respondents regarding the significant role of technology in the performance measure of the insulin cold chains. The participants made several suggestions, which involved understanding the nature of safety measures to establish performance metrics, reduce waste, and create efficient and effective policies.

Participant 3 said, "I think there is much need to understand the practical implications and safety measures before examining the performance measures when the need arises to maintain the temperature."

Participant 2 said, "It is a pre-requisite for the department to ensure the inclination towards making efforts to reduce the waste to improve the quality of the performance and avoid any mishaps during the insulin cold chains."

Participant 5 added, "Efficient policy regarding the insulin cold chains must be implemented by the government policymakers as well the department itself take strict action against to remove the waste around the products."

Last, participant 6 said,

In my view, adopting RFID is one of the effective methods that can play an integral part in tracing the product and efficiently ensuring safety. The main advantage of this method lies in its simplistic design that can easily be understood and implemented for better results and ultimately results in the improvement of cold chain problems.

Limitations

Like all studies, this research has limitations, including sample size and methodology. The following are among the most

significant. First, the sample size was quite limited; thus, the results are not generalizable. A larger sample size would provide more knowledge and in-depth insights.

Second, the study only focused on seven interviews with participants in Doha, Qatar. An excellent extension of this research would involve participants from other nations. and backgrounds. Third, this was a qualitative study, and a quantitative study using surveys using more participants would provide additional information. Fourth, research on the role of technology in developing performance metrics for insulin cold chains is quite limited, and it was challenging to find data on the pharmaceutical industry and technology for them.

Future Research

Future research might expand upon this study by looking at different nations and participants, examining the attitudes and opinions of managers, or using quantitative research. Using a quantitative methodology like a survey can help measure attitudes and behaviours related to insulin cold chains and provide more generalizable results. It might address other methods of securing that supply chain and focus on solutions, best practices that best help insulin cold chain supply management, and barriers to implementation. Such a methodology would provide insights via inferential statistics and advanced modelling via techniques like PLS-SEM. The development of secured transportation is another aspect that needs to be examined, and different methods can help supply chain management effectively transport insulin, which should be examined.

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