LAST MILE COLD CHAIN DISTRIBUTION CHALLENGES FOR PRIVATELY-OWNED AND RETAIL PHARMACIES IN AUCKLAND PARK AND SURROUNDING AREAS, JOHANNESBURG

ABSTRACT

Research objective: The primary research objective was to determine the challenges prevailing in the last mile distribution of cold chain medication to privately-owned and retail pharmacies in Auckland Park and surrounding areas.

Methodology: A positivist research philosophy guided a descriptive quantitative survey design. Structured questionnaires were hand-delivered to all 43 privately-owned and retail pharmacies in the Auckland Park and surrounding areas.

Findings: Some discrepancies were found in the cold chain distribution process that could compromise the quality of the cold chain medication. Although these pharmacies mostly used the correct storage systems for cold chain medication within the specified temperature range, the appropriate mode of transportation for delivery to the pharmacy is questionable.

Management implications: Thermometer-fitted vehicles for the transportation of cold chain medication to pharmacies is essential. If medication is not delivered to the pharmacies within the required temperature range, it could be compromised and should not be accepted. At the pharmacy, a secured storage system, such as a locked thermometer-fitted refrigerator is essential to prevent compromising the cold chain medication.

Originality/value: The research provides insight into the last mile of distribution of cold chain medication from distribution centres to retail and privately-owned pharmacies and the storage thereof in these pharmacies.

Keywords: last mile, cold chain medication, privately-owned pharmacies; retail pharmacies; compromised medication

INTRODUCTION

The last mile involves a set of activities necessary for the delivery process from point of origin to point of destination (Aized & Srai, 2014), and refers to the "last part of business-to-customer delivery, taking place in a certain area from the final transit to the customer" (Gopal & De Miguel, 2017). Last mile distribution from point of origin to point of distribution plays a vital role in today's competitive environment. Inefficient deliveries may impact negatively on customer relationships, and this may lead to numerous business failures (Devari, 2016). Last mile logistics

is critical as it is a link between the final delivery of products and customers (Aized & Srai, 2014). Thus, in the last mile organisations focus on the effective and reliable distribution and delivery of products to the end customer (Devari, 2016).

The distribution from wholesaler or distributor to retail outlets and then finally to the end consumer has become a critical focus area of distribution strategies (Olugbenga, 2014). In the design of delivery network structures, factors, such as delivery time and type of road transportation utilised are considered. Intracity and intercity delivery have become increasingly difficult. In the transportation of cold chain medication, in particular, temperature control is a key factor (Pronello, Camusso & Valentino, 2017). Apart from ensuring that cold chain medication does not become compromised during transportation, stakeholders and suppliers are required to distribute goods in a socially, environmentally and economic responsible manner (Browne, Allen, Nemoto, Patier & Visser, 2012).

Effective last mile logistics increases customer satisfaction through effective and efficient movement of goods from origin to end customer (Olugbenga, 2014). The increase in urban population has led to the rise in the demand for freight services, which, in turn contributes to increased traffic (Nsamzinshuti, Cardoso, Janjevic & Ndiaye 2017). To ensure timeous delivery fulfilment, distributors must embark on route planning to avoid traffic congested areas. To avoid delays, some distributors have elected to deliver at night, however, this increases exposure to criminal activities. Both the freight and the truck, in particular when transporting high pilferage goods such as cold chain medications, are at risk (Vieira & Fransoo, 2015).

Transportation and distribution play an integral role in preserving the quality of cold chain medication (Subzwari & Nasri, 2015). For such temperature-controlled goods, freight carriers have to select an appropriate mode of transport. The World Health Organisation (WHO) (2014) stipulates that the vehicle must have a compartment with insulated refrigeration that maintains a constant temperature throughout transit time. Transit time is the time from departure from the distribution centre to the customer, which in this case is the pharmacy.(International warehouse and logistics association (IWLA) 2010)

The health status of a country's citizens is considered a prerequisite for long-term economic growth and sustainability (Bidzha, Greying & Mahabir, 2017). In the national development plan 2030, the South African government, , prioritised health in chapter ten with the objective of

improving the health status of its citizens. Healthcare can be accessed through clinics, community health centers, hospitals and pharmacies (Gray, Riddin & Jugathpal, 2016).

The scope of Good Pharmacy Practice (GPP), approved by the South African Pharmacy Council (SAPC) defines a pharmacy as "a dynamic, information-driven, patient orientated practice, through its infrastructure, competence and skills, which is committed to the fulfilment of the healthcare needs of the country's citizens" (SAPC, 2013). The SAPC is a body of individuals governing and controlling the standards of pharmacy practice, and the various pharmacy practices that must be legally registered in fulfilment of the Pharmacy Act No. 53 of 1974 Amended, No. 1 Of 2000(SAPC, 2013).

Pharmacies play a vital role in distributing and selling medication to the public. The majority of pharmacists in South Africa practise in community pharmacies, which either are pharmacist-owned (independent) or form part of pharmacy chains.(Gray et al.,2016) They service medical-aid scheme beneficiaries and cash customers for both prescribed and non-prescribed over-the-counter (OTC) medication (Gray *et al*., 2016). According to Reginoald-Prasad (2014), pharmacy operations comprise of qualified personnel, stock keeping, sales and purchasing of medication. The pharmacy must comply with SAPC standards for the storage and handling of different types of medications, particularly, temperature-sensitive medication, such as cold chain medication.

The GPP scope provides for safety conditions, the environmental state and infrastructure of pharmacies. It emphasises hygienic operations wherein cold chain medications are protected from adverse effects of temperature fluctuations, such as heat, freezing and humidity (SAPC, 2010). Therefore, the GPP scope recommends that cold chain medication be stored at temperatures ranging between 2° to 8° Celsius, to ensure that the quality of cold chain medication is not compromised.

Cold chain medication is the process of transporting and storing medication within safe temperatures which range between 2° and 8° Celsius (Chiodini, 2014). Cold chain medication plays an essential role in controlling diseases and illnesses, such as diabetes. There are various types of medication, for example, non-essential and essential medication such as insulin. Non-essential medications do not address the priority health care needs of the population (Zimbulu, 2013), while essential medications are those that the nation must always have in sufficient quantities for the greater number of its population (Manikandan, 2015). Challenges which impede the level of cold chain medication supplies, include auditing all medication refrigerators, reviewing the alarm setting and the number of incidents of stock loss owing to cold chain breaches

(Chiondini, 2014). In addition, the locking of refrigerators is critical for maintaining cold chain medication temperatures within the allowed range (Dorset Clinical Commissioning Group)

It is estimated that by 2030 the majority of the global population will live in urban areas (Browne *et al*., 2012:20), with Asia and Africa the leading urbanised continents in the world. Currently, South Africa has an urban population accounting for 66% of its total population. .(World Bank Open Data 2018) In Gauteng, the population amounts to 13.4 million people, with over 4 million residing in Johannesburg and surrounding areas (Statistics South Africa, 2016:23). The growing population in-turn demands goods and services to be delivered at the right time and location and of the right quality.

Auckland Park is situated on the north-western side of Johannesburg and is categorised as an urban area. In 2018, the World Population Review (2017) estimated the population in Auckland Park to be 1 001 600, with an expected growth rate of 2.14%. Auckland Park and surrounding areas accommodate various social groups such as several universities, their staff and students, families and businesses. The continued growth in the university student numbers would further contribute to the population in Auckland Park and surrounding areas, increasing the demand for basic products, including essential medication from pharmacies, such as cold chain medication.

The pharmaceutical last mile distribution of cold chain medication has been researched in Belgium, but not yet in Africa refs here please. Nsamzinshuti *et al*. (2017) first time – authors in full please focused on the last mile distribution challenges of cold chain medication in Brussels, specifically focusing on the distribution of medication to pharmacies and hospitals. The only South African related study addressed the key challenges of the outbound pharmaceutical cold chain focusing on the logistics costs and the quality regulatory requirements (Kosmas, 2016). This research intends to bridge this gap by evaluating the last mile challenges experienced by pharmacies in urban South Africa in terms of maintaining the prescribed temperature of cold chain medication during handling and storage.

RESEARCH PROBLEM STATEMENT

Cold chain medication may be compromised when not transported, stored and handled within the prescribed temperature range of 2° to 8° Celsius (The South African Pharmacy Council, 2013). Compromised medication is a life-threatening health risk to both the pharmacists and their customers. The risk entails inhalation, ingestion or absorption of medication unintendedly (Wong

& Lewis 2017), as well as cross contamination (Kevrekidis, Minarikova, Markos, Maluvecka, & Minarik, 2017).

RESEARCH OBJECTIVES

The primary research objective was to determine the challenges prevailing in the last mile distribution of cold chain medication to privately-owned and retail pharmacies in Auckland Park and surrounding areas.

Secondary objectives

1. To determine the systems used by privately-owned and retail pharmacies in Auckland Park and surrounding areas to maintain cold chain medication within the recommended temperature ranges.
2. To determine the effect that distribution has on the availability of cold chain medication in privately-owned and retail pharmacies in Auckland Park and surrounding areas.
3. To evaluate whether the mode of transport used is appropriate for the delivery of cold chain medication from the distribution centres to these pharmacies in Auckland Park and surrounding areas

LITERATURE REVIEW

Last mile challenges

Effective delivery to the end customer is an integral stage in last mile distribution increasing the level of customer satisfaction. However, last mile logistics account for approximately 13% to 75% of total cost in the supply chain (Aized & Srai, 2014). Typical challenges faced by distributors include factors such as: traffic congestion, appropriate storage and safety (Cardenas, Beckers & Vanelslander, 2017). A common problem of last mile distribution is the high rate of failed deliveries, as a result of traffic congestion (Gopal & De Miguel, 2017). These factors should be taken into consideration to avoid dealing with reverse logistics. Kulikova (2016) defines reverse logistics as the process of returning goods from their final destination to the manufacturer to reuse, dispose of or recover the residual value. In the case of cold chain medication, it may be returned because of inappropriate distribution or storage, resulting from incorrect temperature control. Tilahun, Thakuriah and Keita (2016) highlighted that the last segment of a trip that involves transit is often influenced by the last mile distribution problems.

The last mile distribution problem refers to complex multidimensional problems that includes physical factors that affect distribution to the end customer (Tilahun *et al.* 2016). For extended trips, such as inter-city distribution, refrigerated vehicles should be used to prevent exposure to

extreme temperatures (Subzwari & Nasri, 2015). According to Winkenbach (2018), these factors can be improved upon by scheduling deliveries to customers in the most efficient and convenient manner. It is thus evident from the aforementioned discussion, that during the transportation and distribution of cold chain medication, good distribution practices must be followed. The WHO states that the use of vehicles and equipment for storage and handling of cold chain medication should appropriately protect the medication from exposure to conditions that affect their quality while in transit, such as heat and humidity (Kosmas, 2016). Kosmas (2016) emphasises the use of insulated containers, cooling packs, and refrigerated temperature-controlled vehicles, to protect the quality of cold chain medication in transit (Kosmas, 2016).

Distribution defined

Distribution can be defined as the elements in the marketing mix that guarantee the delivery of the product from the manufacturer to its customers (Wiid, 2016). For the purpose of this study, the customer refers to pharmacies receiving or collecting and storing the cold chain medication. The type of transport used for finished goods can be divided into two categories, namely primary and local transport. Primary transport refers to finished goods transported to the distribution center, while local transport refers to the distribution of pharmacy products to the cash-paying customers (Rushton, Croucher & Baker, 2014). It is further reiterated by Rushton *et al*. (2014) that transport is the highest cost of the distribution function and amounts to 40% of total logistics cost.

Distribution channels

The distribution channel refers to the structure that supplies customers with the product in demand (Wiid, 2016). For the purpose of this research, the focus will be on the retail channel, specifically, pharmacies. Pharmacies are resellers of pharmaceuticals which include amongst others cold chain medication. Wiid, (2016) identified the characteristics of a retailer as:

- Retailers are the link between the products and the customer, which suggests that they have a supply of the products that their customers require, for example, pharmacies stock cold chain medication such as insulin which is required by diabetic customers.
- Breakbulk which refers to the purchase of goods in larger volumes and sold in smaller quantities.

Last mile in cold chain medication distribution

The flow of cold chain medication within the last mile is illustrated in Figure 1. A research gap has been identified in the last mile delivery from distribution centres to privately-owned and retail pharmacies and from the latter to the customer.

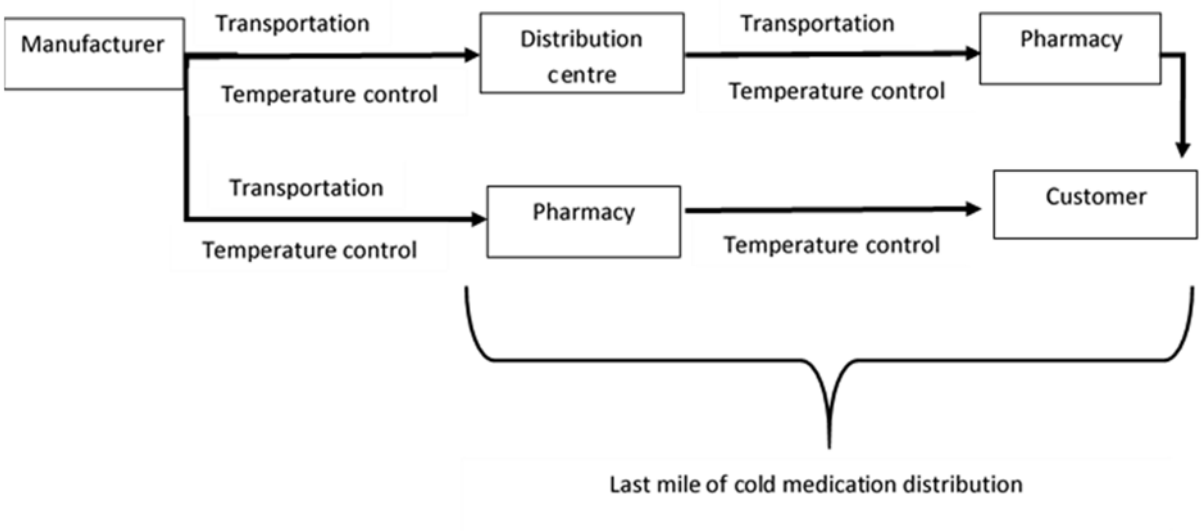

Figure 1: Last mile of cold chain medication distribution

Source: Authors' own compilation

The issue of temperature control is relevant from the moment the product is loaded at the manufacturer for transport and all the way on-route to the end customer (Figure 1). The pharmacy receives cold chain medication either directly from the manufacturer or from the distribution centre. The managing of distribution becomes a challenge and distribution companies need to apply innovative thinking to deliver their goods at the required time and in the preserved condition to pharmacies (Vieira & Fransoo, 2015). For the purpose of the study the emphasis will be on the temperature controlled transportation to the pharmacy as indicated in the bottom section of Figure 1.

Basic operational structure of pharmacies in South Africa

Pharmacies can be categorised into 7 fields, namely; academic institutions, community pharmacies, consultant pharmacies, private institution, public institution, manufacturing pharmacy and wholesale pharmacies. (Gray *et al*., 2016). For the purpose of this study, the focal point is retail pharmacies which are part of retail chains, and privately-owned pharmacies both which are predominant found in communities. Retail pharmacies includes but are not restricted to; pharmacies that forms a part of a supermarket pharmacy such as the pharmacies found in Checkers and Pick and Pay or chain pharmacies such as Dischem. The activities in these pharmacies include dispensing medication to customers, stock control for inventory management and ordering. The purpose of these activities is to obtain, store and provide medication to the customer in a timely and cost-effective manner (Department of Health, 2015).

Pharmacy supply chain

Figure 1 indicates the medicinal supply chain from point of distribution to customer when medicine is dispensed. The efficiency of the service provided by pharmacies is determined by the availability of medication based on the customer's needs. In most instances, privately-owned pharmacies do not have a distribution centre of their own as is the case with pharmacies that belong to retail chains. The latter manage the supply of medication through their distribution centres or warehouses. In contrast, privately-owned pharmacies rely mostly on distribution companies to ensure safe, adequate supply of medication to their pharmacies (Khayyal, 2015).

Infrastructure and equipment used in retail and privately-owned pharmacies

The SAPC (2013) emphasises the availability of adequate and suitable dispensing equipment in pharmacies, such as refrigerators and cold rooms. Koegelenberg (2017) highlighted that cold chain medication must be stored in its purest form without any cross contamination as certain medications, such as vaccines become ineffective when stored at wrong temperatures for prolonged periods, or accidentally frozen owing to lack of maintenance of the refrigerating equipment.

The Department of Health (2015) stated that most refrigerators used in South African pharmacies especially privately-owned pharmacies are domestic refrigerators which are not suitable for the storage of cold chain medication. It is argued by Todd (2008), that domestic refrigerators normally operate between 0° and 10° Celsius, which results in uneven temperature distributions. This makes it difficult to monitor the temperature of cold chain medication inside the refrigerator. Domestic refrigerators can possibly freeze the medication if it is exposed to the chiller plate or the coil at the back of the refrigerator. Therefore, it is the responsibility of pharmacies to avoid using such equipment as they may pose an increased risk in compromising the quality of cold chain medication.

Cold chain

Lu, Gu and Predko (2015) classified cold chains as a network of refrigerators and cold stores that are organised to maintain the right temperature throughout. According to Chiodini (2014), cold chain medication is the process of transporting and storing medication within a safe temperatures range, between 2° and 8° Celsius. According to Lu, Gu and Predko (2015), cold chain maintenance is the process of planning, implementing and controlling flow and storage of perishable goods, related to services and information from one or more points, for instance, from the distributor to the pharmacy. Various aspects should be considered before and while transporting cold chain

medication, such as auditing all medication refrigerators, reviewing the alarm settings, and monitoring the temperature levels. It further includes performance testing associated with activated alarms and the number of incidents of stock loss owing to cold chain breaches. Todd (2008) highlighted the importance of the locking of refrigerators for maintaining cold chain medication temperatures.

Auditing of medication fridges is essential to ensure that no discrepancies, leakages or damages occur (Osborne & Scott, 2013) which will avoid delays in delivering medication from the distributor to the pharmacy. Secondly, the performance of the temperature alarm should be tested. The at a regular basis and temperature alarm must always be on (Chiodini, 2014). To prevent refrigerators from switching off, it is the responsibility of pharmacies to complete a basic check of doors, power supplies, and thermostat settings, thus ensuring that the medication maintains a high-quality standard. A designated person should design a schedule to indicate the date and times these checks are made thereby enforcing quality control. (Centers for Disease Control and Prevention 2017)

The third aspect is stock loss due to breaches. A cold chain breach is defined as medication being out of the temperature range of 2° to 8° Celsius; this excludes the fluctuations of up to 12° Celsius, lasting up to 15 minutes owing to the re-evaluation of stock or restocking refrigerators (Victoria State Government: Department of Health and Human Services, n.d.). Breaches should be avoided to prevent medication from becoming toxic, which can be defined as a poisonous process that could influence an individual's body through inhalation, ingestion, or absorption of a chemical (Wong & Lewis, 2017). The breach of cold chain medication will not only affect the flow from the distributor to the pharmacy, but it will affect the health of the cash-paying customer who purchases the medication for their respective health care issues, for instance diabetes. The last aspect is the locking of the refrigerators. The South African Pharmacy Council clearly stipulates the duties ad responsibilities of the pharmacist as preventing any unauthorised person to have access to medicines or scheduled substances. This includes recordkeeping, storage and safekeeping of said substances. (My membership 2016)

According to Todd (2008), locking of refrigerators is essential wherein only the licensed individual on duty is responsible for the opening and closing of the refrigerator. This is necessary to avoid multiple access which could cause fluctuations of the internal temperature of cold chain medication, therefore making it difficult to monitor.

RESEARCH METHODOLOGY AND DESIGN

Research approach: A positivist research approach guided this descriptive quantitative survey using a structured questionnaire (Saunders, Lewis & Thornhill, 2016).

Respondents: The unit of analysis was all privately-owned and retail pharmacies in Auckland Park and surrounding areas, in a proximity of 10 km to 20 km of Auckland Park in each map direction. The surrounding areas include Florida, Cresta, Melville, Northcliff, Braamfontein, Johannesburg Central, Greenside, Parktown, Linden, Newtown and Weltevreden. The population of pharmacies complying with the inclusive criteria in the defined area comprised 43 pharmacies. All 43 pharmacies were targeted, which implies that a census of the 43 pharmacies was taken. No sampling occurred. At each of the targeted pharmacies, a respondent, who was directly involved with matters regarding ordering, receiving and storage of cold chain medication, completed the questionnaire. The respondents were predominantly pharmacy managers (38%), pharmacists (25%) and pharmacy assistants (25%), as well as stock controllers (5%) and others (7%). Southern Health NHS Foundation Trust (2018:6) argued that only licenced personnel should have access to cold chain medication.

Measuring instrument: Guided by the research results of Kosmas (2016) and Nsamzinshuti *et al*. (2017,) and the research gaps that they had identified, a questionnaire, aligned with the objectives of the study, was developed. The questionnaire was submitted for expert review and ethical clearance. Subsequently, it was distributed by hand to the 43 privately-owned and retail pharmacies in Auckland Park and surrounding areas. A total of 43 completed questionnaires were received – 100% response rate. The 21 questions in the questionnaire were coded and captured in a MS Excel spreadsheet for analyses using descriptive statistics.

RESULTS

Type of refrigeration used for cold chain medication storage

To determine if respondents are knowledgeable about the storage recommended for cold chain medication, they had to indicate the type of refrigeration utilized. Most (77%) of the respondents use thermometer-fitted refrigerators. Although 14% of the respondents indicated the use of domestic refrigerators in their pharmacies, they specified that a wireless thermometer system is connected to the refrigerator to display the temperatures inside the refrigerator to aid monitoring and control of the temperature. However, a further 9% used domestic refrigerators with no thermometer system attached. Cold chain medication is temperature controlled and must be protected from adverse temperatures. Temperature variations may be detrimental to the quality of cold chain medication causing, for example, contamination.

Awareness of temperatures specified for the storage of cold chain medication

According to Lu, Gu and Predko (2015), it is critical that cold chain medication be stored in the temperature range between 2° and 8° Celsius. When asked at what temperature cold chain medication should be stored, all 43 respondents selected temperatures between 2° and 8° Celsius. This indicates their awareness of the maintenance requirements of cold chain medication.

Security of cold chain medication

Cold chain medication should be kept secured (locked in refrigerators) to prevent compromised medication, When asked whether the cold chain medication was kept in a locked refrigerator, the majority (83%) of the respondents stated that the refrigerator is 'never' locked, with a further 7% of respondents stating 'seldom'. Some these respondents argued that refrigerators are never locked as only licenced pharmacists have permission to access the medication in the refrigerator. However, the South African Pharmacy Council argued that locking of refrigerators is paramount as it avoids the cold chain medication from being compromised. (My membership 2016) Only one (2%) respondent answered 'always', while a second respondent answered, 'Most of the time' and a further 3 (5%) responded 'about half the time'. According to the Southern Health NHS Foundation Trust (2018), the correct method of storing the cold chain medication is in a locked refrigerator.

Following this lack of security, respondents were asked: 'How often is cold chain medication compromised (not usable)?' Only 42% of the respondents stated 'never', while 58% respondents indicated rarely. From this answer, it follows that it does occur that cold chain medication is compromised sometimes.

Effect of distribution on availability of cold chain medication at respondents' pharmacies

Frequency of delivery to pharmacies

The regularity of delivering medication is essential to ensure stock on hand for customers. Nearly half (49%) of the pharmacies receive cold chain medication daily, while 40% received weekly deliveries (Figure 2). The remaining 11% receive either once, or twice or three times and more monthly.

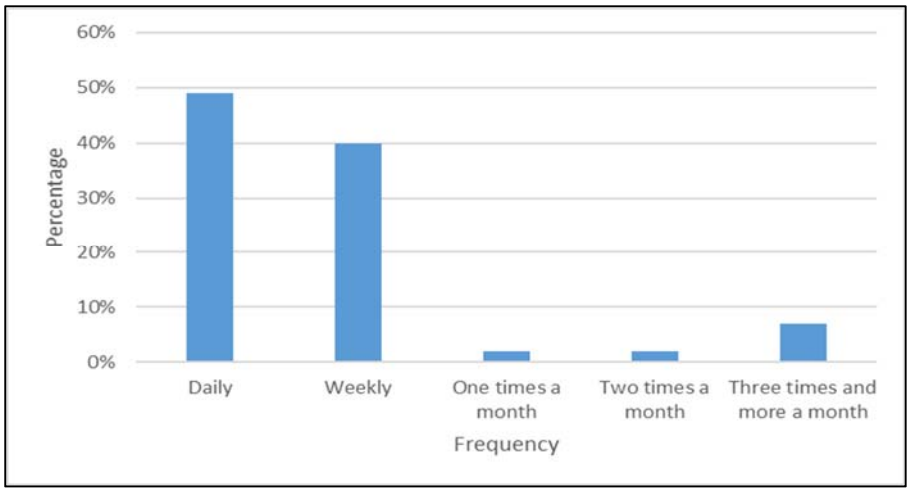

Figure 2: Frequency of delivery of cold chain medication to pharmacies (n=43)

Delivery irregularities experienced by targeted pharmacies

It seems that respondents rarely (47%) or never (33%) do not receive stock owing to distribution issues (Table 1). About two-thirds (66%) of the respondents indicated that late deliveries occur rarely or never, while a third (34%) find it happens sometimes (Table 1). However, with regard to cold chain medication stock-outs, a cumulative54% of the respondents indicated that this occurs sometimes or often. A further third (33%) of respondents reveal that it occurs rarely, while 13% has never experienced such stock-outs (Table 1).

Table 1: Delivery challenges experienced by respondents

Challenge	Frequency of occurrence			
	Often	Sometimes	Rarely	Never
How many times in a month do you not receive stock due to distribution issues?	7%	13%	47%	33%
Do cold chain medication stock-outs occur?	4%	50%	33%	13%
Does late delivery occur?	0%	34%	46%	20%

Factors affecting distribution of cold chain medication to the pharmacy

As cold chain medication is distributed from the wholesaler or distributor to retail outlets, several factors may impact on timeous delivery of the medication. It seems that the availability of the cold chain medication at the distribution centre is the main factor affecting distribution to retailers as highlighted by 78% of the respondents (Figure 3). Tayob, (2012) stipulated that it is imperative for distribution centres to follow a stringent process to enhance the availability of medication, which will alleviate delay and improve on customer satisfaction. A second concern is late delivery time, identified by more than half (54%) of the respondents, followed by traffic congestion mentioned by nearly half (48%) of the respondents. Weather conditions were blamed by 24% of the respondents.

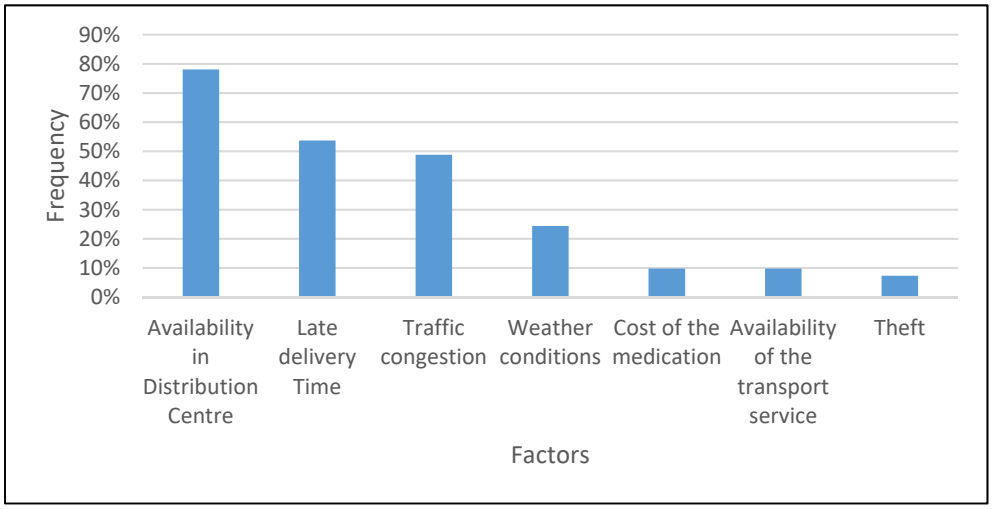

Figure 3: Factors affecting cold chain medication distribution to the pharmacy (n=43)

Additional challenges in receiving, storing and delivery of cold chain medication

An open-ended question was asked to elicit additional challenges that respondents have experienced in the receiving, storing or delivery of cold chain medication in their pharmacy. More than half (56%) of the respondents had not experienced any additional challenges (Figure 4). It seems that load shedding (electricity utility's discontinuation of electricity supply for a number of hours) is an additional challenge for 19% of the respondents as it directly impacts on the temperature control of the refrigerator. Possibly linked to this, is the challenge of maintaining the temperature at the specified level, stated by 9% of the respondents. Stock-outs/stock delays were mentioned by 11% of respondents.

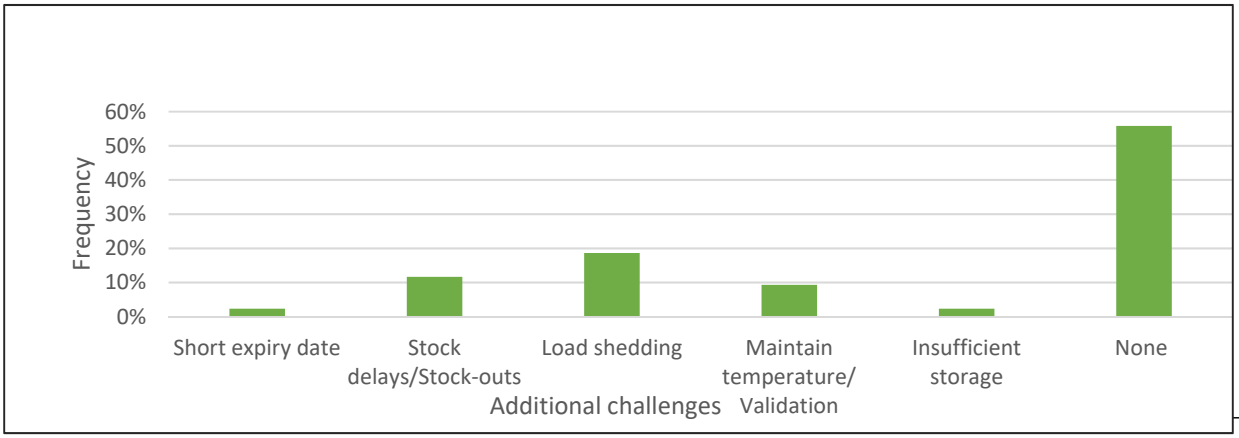

Figure 4: Additional challenges in cold chain medication distribution (n=43)

Analysis of the mode of transportation utilised

Incidences of compromised medication caused by transportation choice

Incidences such as handling, or the mode of transportation utilised have a direct impact on the quality of cold chain medication. The research identified that 43% of the respondents have never dealt with compromised medication. This result is achieved by allocating vehicles fitted with thermometers to control the required temperature range. According to Southern Health NHS foundation trust (2018), thermometers are an essential control mechanism to minimise the risk of compromising efficiency and safety of cold chain medication. Of the respondents, 58% stipulated that cold chain medication is rarely compromised. Some respondents explained that it transpires when utilising cooler boxes to transport the medication as the exact temperature range of the cold chain medication cannot be controlled, resulting in compromised medication.

Mode of transport used to deliver to pharmacy

Only about a third (37%) of the respondents specified that a thermometer-fitted motor vehicle is used to deliver the medicine to the pharmacy. About half (51%) of the respondents indicated that a normal motor vehicle is used for delivery. This is of concern as the temperature in the latter vehicles cannot be maintained at 2^{o} to 8^{o} Celsius as required. It was explained that the cold chain medication is packed into cooler boxes containers with a thermometer inside the cooler box to monitor the temperature. Such a system could be compromised should there be traffic congestion or other traffic delays. A further 11% of the respondents indicated that other forms of transport are used. These were not specified and could include motorbikes.

Type of service provider used for the transportation for cold chain medication delivery

In relation to the different vehicles that are used, the survey examined whether pharmacies use their own transport or an alternative transport service provider. Most (41%) of the respondents use an outsourced service provider to transport the cold chain medication to the pharmacy. About a quarter (26%) depend on the distributor to deliver, while 15% depend on the wholesaler for delivery. Only 18% of the respondents would use their own transport.

DISCUSSION

Systems utilised by privately-owned and retail pharmacies to maintain cold chain medication within the recommended temperatures

The study revealed that refrigerators are utilised by surveyed retail and privately-owned pharmacies as the storage facility for cold chain medication, adhering to the prerequisites specified by the GPP scope in terms of: Refrigerators being used as the main storage equipment maintaining the quality of cold chain medication. Most (91%) of these pharmacies utilise a temperature-controlled refrigeration system. However, 9% of the pharmacies utilise domestic refrigerators.

Domestic refrigerators do not provide visible, consistent, reliable and durable temperature control and are not specifically designed for the storage of cold chain medication. For these pharmacies it would be a challenge to monitor and control the temperature of the cold chain medication at all times (WHO, 2015).

Although, all the surveyed pharmacies were fully aware of the temperature range at which cold chain medication should be kept, it transpired that the majority of pharmacies do not lock the refrigerators which could result in the cold chain medication being breached. According to Wong and Lewis (2017), this could cause the cold chain medication to become toxic.

Distribution effects on availability of cold chain medication

A high frequency of medication delivery to the pharmacies seems evident as nearly half (49%) of the pharmacies receive cold chain medication daily, while 40% received weekly deliveries (Figure 1). Although respondents rarely (47%) or never (33%) do not receive stock owing to distribution issues, cold chain medication stock-outs do occur sometimes or often, according to 54% of the respondents (Table 1). The pharmacies receive cold chain medication either directly from the manufacturer or from the distribution centre. The research found that the availability of cold chain medication at the distribution centres has an impact on their availability at 78% of the pharmacies and is the primary cause of stock-outs, according to respondents (Figure 2). It follows that the availability of cold chain medication at the distribution centres requires a seamless distribution system (Vieira & Fransoo, 2015).

A second concern is late delivery time, identified by more than half (54%) of the respondents, followed by traffic congestion mentioned by nearly half (48%) of the respondents. Devari (2016) explained that inefficient deliveries may impact negatively on customer relationships, and this may lead to numerous business failures.

Analysis of the mode of transportation utilised

The survey suggests that most (82%) of the pharmacies make use of either the wholesalers' or distributors' transport or outsource the transport service for cold chain medication delivery. Thus, pharmacies seem to rely on service providers that specialise in cold chain medication distribution. The transportation of cold chain medication has been standardised. According to the WHO (2014), the type of vehicle utilised must comprise of a compartment with insulated refrigeration. The motor vehicles have either a separate compartment with a thermometer inside or a vehicle with a fitted thermometer attached to the vehicle's insulated compartment, such as a reefer truck. It is evident

from this survey, that a thermometer-fitted motor vehicle accounts for cold chain medication transportation for only 37% of the respondents. For the rest (63%) this is not the case, which implies that the transportation of their cold chain medication can be compromised. Combine this fact with storage in an unlocked ordinary domestic refrigerator, and the probability of compromised cold chain medication increases substantially for these pharmacies.

CONCLUSIONS

Systems utilised by privately-owned and retail pharmacies to maintain cold chain medication within the recommended temperatures

From the research, 91% of the pharmacies utilise refrigerators fitted with a thermometer system for the storage of cold chain medication. This satisfies the recommendations of the GPP scope for reliable control and maintenance of cold chain medication temperatures. Although they mostly comply with the refrigeration specification, most of them do not lock the refrigerator. A counter argument is that only licensed pharmacists have access to these refrigerators. It is evident from research that most of these pharmacies utilise the correct systems to maintain cold chain medication. All the respondents indicated that their medication is never or rarely compromised as it is kept in its recommended temperature range. Although electricity 'load shedding' has become an emerging problem in cold chain medication storage, as identified by some of the respondents, it was not determined how they counteract it.

Distribution effects on availability of cold chain medication

From the research, it was discovered that delivery of cold chain medication is affected by various challenges. The respondents highlighted two main challenges that delay the delivery of cold chain medication, namely, availability of cold chain medication at distribution centres and late delivery. To counteract the possibility of stock-outs of cold chain medication, most of these pharmacies have frequent deliveries, either daily or weekly.

Analysis of the mode of transportation utilised

The survey found that retail and privately-owned pharmacies experience few challenges with the transportation component in the distribution process. These pharmacies have firm transportation structures in place to avoid compromising the cold chain medication. They either use the transportation that is provided by the wholesaler and distributor or make use of an outsourced service provider that specialises in cold chain medication transportation. Only a small percentage use their own transport. However, only 37% of the deliveries to the pharmacies take place by means of a thermometer-fitted motor vehicle.

MANAGEMENT IMPLICATIONS

When cold chain medication is delivered to a pharmacy, in any type of vehicle other than a thermometer-fitted vehicle, the recipient should check whether the temperature at which the medication was transported is within the range of 2º to 8º Celsius. If not, such medication can be compromised and should not be accepted. Manufactures and distribution centres should acquire thermometer-fitted vehicles for the safe transportation of cold chain medication. At the pharmacy, a secured storage system, such as a locked thermometer-fitted refrigerator is essential to ensure that the cold chain medication is not compromised at all.

Contribution of the study

The study contributed to the literature available regarding the last mile of distribution of cold chain medication for retail and privately-owned pharmacies in Auckland Park and surrounding areas. Some discrepancies were found in the distribution process that could compromise the quality of the cold chain medication. Although these pharmacies mostly used the correct storage systems for cold chain medication within the specified temperature range, the appropriate form of transport for delivery to the pharmacy is questionable. The safety of using cooler boxes as an alternative to temperature-controlled vehicles, needs further investigation.

Limitation

The demarcated area produced a small sample size which may have affected the reliability of the statistics. Increasing the demarcated area would have generated a larger sample size which would have made the statistics more reliable. The researchers could not prove the reliability of the information provided by the respondents regarding the use of domestic refrigerators as there was no visual view of the thermometer fitted in the refrigerator.

Future research

Future studies should focus on evaluating the last mile distribution challenges of cold chain medication from the manufacturer or distribution centre to the pharmacies. The use of domestic refrigerators in pharmacies and the locking of refrigerators necessitates further research. Pharmacies situated in rural areas, situated a distance from distributors, might experience similar or completely unique problems and can be compared to rural pharmacies.

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