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STOCKPILE MANAGEMENT THROUGH THE EVERYDAY OPERATION OF A PHARMACEUTICAL COMPANY

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Abstract
In this article, the stock management activities and stock levels of a pharmaceutical wholesaler will be analysed. Stocks play a significant role in both material flow processes and the supply chain. If the quantity of stocks is not adequate, stockout or overstocking may occur. Companies can take various measures to ensure uninterrupted supply, and also prevent shortages and stockouts. Therefore, the objective is to reach an optimal level of stock. The aim of the present study is to find an answer to how stockouts may be reduced or minimized in the future, identify which aspects of stock management activity play a major role in minimizing shortages, as well as analyse strategically important decisions pertaining to stockpiling. Another issue is to find out why it is crucial for us to know our strategic product groups, why it is important to conduct a more pronounced measuring regarding stocks of these products, and reduce the shortages to zero. The competitive situation of the market allows for a company to retain its customers for the long term, and to this end, providing quick and flexible service and ensuring the availability of products are of key importance. Today, immediate availability is particularly important. Consequently, time is a crucial factor as people have high expectations and do not tolerate long waiting times, thus inventory and inventory management are especially important where deficiencies are not allowed. As the central topic of the current paper stock levels at various sites of a wholesaler have been examined focusing on the product scopes with low stockpiles on the basis of the calculated turnover rate. Generally, stock analysis methods that would result in the successful decrease of shortages were sought after. The analysis pertained to the context of turnovers and stock levels, seeking parallels between stock levels as well as the size and spatial distribution of the customer base . Corporate inventory management and demand forecasting are two interrelated areas of management that can directly and significantly affect the efficiency and economy of operations What is more, an adequate stock level can signal a competitive supply chain.
KEY WORDS: stock management; stock level; stock analysis; strategies; supply chain.

Introduction

Nowadays, the question of how to reduce and minimize company stockouts is a particularly critical issue that needs to be addressed. Every company is trying to meet consumer demands at the highest possible level. To this end, precision, flexibility and speed are vital. On the whole, customer demands are changing. This statement may seem generic but if we examine it, we must be aware that the level of consumer expectations is increasing, and the values are changing. The wide variety of products on the market and the wide range of goods on offer provide us with many choices what to lift off the shelves. Excessive amount of information is on offer day by day. Product life cycles are being shortened, and while the global economic and competitive forces continue to generate further uncertainties, volatility is becoming increasingly common for markets (Christopher 2000). In turn, companies are trying to meet and, in particular, anticipate demands, since this is how they are capable of providing a suitable range of products, and even more importantly, goods that are readily available. Our accelerated lifestyle brought about the immediate fulfilment of demands. This is why satisfying needs have instantly become more important, for which available stocks and support services are indispensable. The question of what kind of solutions we can find to reduce stockouts may arise, which would also reduce company stockout costs, the loss of customers trust, and the number of dissatisfied customers. The research was carried out between September 2021 and December 2021. One pillar of this research consists of the domestic and international academic elaborations closely linked to this topic, which support the areas being presented The results of the primary research are presented through the case study of a pharmaceutical wholesaler, for which the prioritized aspects include the place and role of the pharmaceutical wholesaler in the supply chain, its stock management activity, stockpiling strategies and decisions. In today's market competition, the analysis of inventories and good inventory management are particularly important for companies. By examining the current stockpiling policy of Pharma, the results are supported by analysing market criteria and stock levels. In the case study, inventory analysis methods are also presented.

Literature review

According to literature, wholesale trade includes any sales activities of goods or services that are conducted by resellers or professional users. This does not include producers and farmers engaged primarily in production, or retailers (Kotler-Keller 2012). Hence, wholesale trade is the commercial sale of procured goods to resellers. Its purpose is the purchase and storage of goods, the establishment of an assortment of goods to meet the demands of retail trade, as well as the organization of the relation of goods between production and retail trade (Gelei 2013). Its goal is to bridge the temporal and spatial difference between consumption and production

via stockpiling. The pharmaceutical supply chain consists of primary producers of raw materials (suppliers), secondary producers (pharmaceutical manufacturer), logistics providers/wholesalers, health care providers and retail stores (Savage et al. 2006; Zahiri et al 2017). Pharmaceutical wholesale trade is the sum of all pharmaceutical supply activities that result in the medicine going from the producer directly to the retail medicine supplier. This includes the acquisition, quality assurance, quality assessment, storage, stockpiling, and package disassembly of medicine, delivery to the client, performing product withdrawals, as well as providing data regarding the medicine and information to the distributor (SOTE 2020). Current pharmaceutical wholesale trade has multiple channels, which means that more and more wholesalers provide connections between pharmaceutical companies and pharmacies. The integration of suppliers, producers and traders, the spatial clustering of customers, and even the dominance of certain products, are all observable (Nagy 2005; Rácz-Kummer 2009).

The rapidly changing market environment and volatile customer demands require the effective operation of logistics processes (Kovács – Kot 2016). In recent years, globalization processes have accelerated, and with the development of the markets, it has become increasingly important for companies to have a good grasp of the supply chains and the connections between them (Kot 2012). With regard to the supply chain, we can say that various participants operate on an "everyone for everyone," or in other words, "all for each other" basis. Strategic cooperation can increase the quality of the products of companies, as well as the services provided to the customers (Bititci et.al 2004). The supply chain is, in fact, a series of value-creating production and logistics processes across co-operating organizations, which create products and services capable of responding to the needs of consumers (Chikán 2008). Participants are considered parts of the supply chain, if they cooperate in the process of the procurement, production and delivery of goods (products or services) to the customer (Harland 1996). As the timely accommodation of consumer demands has become increasingly prominent in the competition of products manufactured by companies, we can not only see products compete on the markets, but also a competition of supply chains, as well (Markovits-Somogyi – Ulechla 2016).

The proper distribution of resources and cooperation across company boundaries provides the essence of successful supply chain management (Fawcett at al., 2014). Every company belongs to a supply chain, often to a supply network as well, with multiple suppliers and partners (Morley, 2017). Within the supply chain, the procurement, storage, stockpiling, quality control and delivery of medicine to pharmacies, as well as providing quick and flexible service to pharmacies, are important and high-priority tasks of the wholesaler. As such, the market factors that affect every participant within the supply chain impact the operation and stock management activity of the pharmaceutical wholesaler. Companies within the supply chain must pay attention both upstream and downstream, as well as be agile and react to the changes they observe (Pulcini et al 2018). The pharmaceutical industry has grown recently, and this growth has necessitated to expedite transport and logistical challenges. Pharmaceutical industry is a global industry. The importance of a coordinated and flexible supply chain cannot be overstated (Venkateswaran 2018).

As a result of the deteriorating profitability of retail trade, a decrease in pharmacy stock levels can be observed. Pharmacies do not keep stock of medical products that have a lower and less predictable turnover and/or are expensive. With regard to the wholesaler, the decrease in customer (pharmacies) stock levels result in pharmacies ordering small quantities multiple times and wishing to receive those within the shortest deadline possible. As referenced above, the decreasing profitability of retail trade, the increasing expenses of pharmacies, the rapid expansion of the range of products, and especially the exponential increase in the number of generic products with the same active agent, the stockpile reductions of pharmacies have caused the task of stockpiling to largely be transferred from pharmacies to pharmaceutical wholesalers due to regular changes to prices and subsidies. Pharmacies do not possess proper, adequately designed and equipped spaces for storing large quantities of goods, and it is also important to observe that the pharmacist does not have the time and economic expertise to address stockpiling and its optimization thereof. The interdependency of supply chain participants is especially relevant in this industry. Providing patient care and stock availability in the pharmacy is more of a task for the wholesaler, who is an important connecting link between the manufacturer and the pharmacy. The consistent servicing of customers without the issue or shortages is dependent on the stock management of the wholesaler. One of the most important tasks is to ensure a safe supply of medicine, without any shortages. Future supply chains will have to improve upon affordability and availability to patients and health care providers alike (Srai et al 2014). Knowledge of the number of pharmacies is a decisive factor in maintaining a high level of service. According to a survey from 2020, there are a little over 3,000 pharmacies operating in Hungary, of which we can presumably consider 2,500-2,600 actively operating pharmacies.

A wholesaler has around 2,400 purchasing partners, while the daily incoming orders exceed 9,000. The number of boxes sold per year is around 150-180 million. Based on this data, we can infer how much stock and storage capacity a pharmaceutical wholesaler needs to have. We can say that the number of products marketed is around 14,000-17,000 pieces for a single wholesaler,. As a result of the market demand for an increasing supply level, the quality of service standards has become a crucial factor in the competition between wholesalers. The requirements pertaining to time, and the greater amount of flexibility from the logistics provider with regards to that, is becoming more and more important within customer expectations (Anderson et al 2011). In the competition for final consumers, service standards have a key role as the supply chains compete for the same customers, and the decisions of

these customers depend primarily on these two factors, i.e., stock size and quality of service (Balogh et al 2020). Immediate availability, available products and quick delivery are all important. It is especially important for a wholesaler to be capable of immediately satisfying daily needs, without any shortages, or at the very least minimize them. Purchase orders, stock status, coordination of deliveries and timeliness form the basis of successful sales activities (Dubey-Jain 2014). The past 10 years have seen constant developments for trading houses and warehouses, which consisted of increased storage capacity, improvement to storage technologies, the use of automated pickers and powered track picking systems, as well as radio frequency picking. All of this comprises an enormous support structure for managing incoming goods. This is because the logistics system, including the warehouse, can contribute to improving the performance of logistics, the company or the supply chain, by supporting an increase in sales volume and revenue. (Gelei 2017) The methods for submitting orders have changed, the use of various electronic channels has become widespread within the field of order submissions, and transport capacity has also been expanded and revamped. The vehicle fleet performing deliveries has around 210 cars available, which have the temperatures required for the storage of pharmaceutical products. This is not a competition of prices, but a competition of services. One of the reasons for this is a government decree that specifies the margins wholesalers may operate under when selling prescription-only medicinal products. The applicable margin rate is digressive, meaning that the higher the price of a product, the lower the margin rate will be. This rate is 8% for products with producer prices of under HUF 500 (of which there are very few), but if the price of the medicinal product is HUF 2000, the margin is 4.4%. When selecting products and services, the availability of the product and/or service, as well as the time between the order and its delivery (lead time) have become increasingly prominent, in addition to product price and quality. (DeTreville 2004; Leng-Parlar 2009) The basis for achieving customer satisfaction is good logistics service, the timely arrival of the goods ordered at the customer's premises, following strict quality control without any shortages or bad deliveries, and without any interruption in medicine supply. A pharmacy with an average turnover operates with 3-5 thousand products and 10-14 days of stocks; therefore, a wholesaler background and fast service are important for it, which require for the issue of stockouts to have strategic importance. A supplier that is capable of guaranteeing delivery times (within a specified tolerance) has a clear advantage over its competitors. (Oláh et al 2017) Meeting promised delivery deadlines, up to 3 times within 24 hours when delivering for a pharmacy can only be possible if there are stocks available.

Material and method

Stock management activity of the pharmaceutical wholesaler

Stock management is the process of planning, organizing and controlling stocks, with the aim of "minimizing stock investments, while balancing supply and demand" (West 2009). Effective stock management increases both gross and net profits by reducing the cost of sourced pharmaceuticals and all related operating expenses (Hidayat-Saleh 2020). In this industry, safe sourcing and the prevention of counterfeits take priority. Only registered medicines can be placed on the market, as the wholesaler will serve as the guarantee for the pharmacy that a safe product will be placed on the shelves. The stockpiling activity itself is complex, and involves the procurement, quality control and storage of stock, and the assessment of optimal stock levels. The presence of stocks is validated by physical and economic constraints (Benkő 2018). Bad stock management may result in harmful consequences to the safety of the patients. Such results can be attributed to the availability of expired, counterfeit, substandard or spoiled products, the unavailability of basic products, and the existence of unclaimed prescriptions (Hidayat-Saleh 2020). Stock levels are controlled at all times, and stockpiling policies come into effect when determining minimum and maximum stock levels. After all, it is very important for stocks (a passive resource) to be at the optimum level for the operation of the company. Overstocking is economically disadvantageous, while low stock levels can jeopardize the safe operation of the business (Hajós et al. 2007; Nagy 2002).

When creating a stockpiling policy, the following factors should be evaluated:

- the nature of the output process (demand, ordering, service)
- the nature of the input process (source, ordering)
- the costs
- the operating policy principles, decisions (Benkő 2018)

Company stock management and demand forecasting are two interrelated management areas, which may have direct and significant impacts on the efficiency and profitability of operations (Dobos-Gelei 2015). The driving force behind stockpiling is essentially demand, as demand is what causes changes in the stock (Benkő 2018). Demand is difficult to forecast, although prior sales data and expected market movements may provide a good reference point. The wholesaler, hereinafter referred to as Pharma, relies on prior sales data to help determine the quantity it should order. Demand forecasting forms the basis of good supply chain management. The tactics for demand planning rely on two principal areas of business practices: forecasting and data sharing, in order to match supply and demand. As soon as a reliable demand forecast is available, companies can take a number of measures to ensure uninterrupted supply, as well as prevent shortages and stockouts (Cogan et al 2018). The goal is to reach an optimal level of stock. As a wholesaler, Pharma has interest in ensuring that the procured goods are delivered as quickly as possible.

With a faster turnover, it is possible to achieve higher revenue and higher profits, with less stock. The factors that determine the optimal level of stocks include the volume of sales and its fluctuation over time, the frequency and quantity of procurement, transport distances, the nature and variety of goods placed on the market, as well as the range of goods that substitute each other, storage capacity, costs associated with stockpiling, and the financial situation of the business (Herbáth-Stágel 2009; Föli-Török 2018).

Procurement also needs to address forecasting, planning and assessing demands. Since stocks are in a constant rotation, demands are usually fulfilled from stock, rather than directly. The primary purpose of stocks is to ensure that the received demands can be fulfilled in the time, quantity and quality requested by the entity that places the order (Hirkó et al 2008). The stock management of a company is considered effective if the capital invested in stocks is quickly recovered through the sale of goods (Vincze-Földi 2015). Modern companies may keep stock of many different goods. With regard to stock management, the questions of how much and when are both important (Ravinder-Misra 2014). In order to determine the order date (t) and the ordered quantity (q), it is necessary to know the stock level, which can be achieved via control measures. There are two basic methods of controlling stock levels: continuous and periodic stock monitoring. With continuous stock monitoring, reordering is immediate as soon as the stock falls to a predetermined level. Periodic stock monitoring means that stocks are only monitored at the end of discrete intervals, such as at the end of each month, and the decision to order is only made at this time (Benkő 2018). Stock size should be considered in conjunction with sales. An increase of stocks can be considered unfavourable if the turnout has either not increased or increased at a lower rate. Successful stock management is achieved by attaining a specific revenue, while keeping stocks as low as possible (Vincze-Földi 2015). It is indeed important to define demand and sales with regard to stockpiling, since the first step is customer demand emerging on the market, which Pharma must be able to meet. This customer demand generates the continuous monitoring of stock, the replenishment of stock and procurement from the manufacturer. Procurement is a typically complex and multistage process. This is because procurement is an integral part of the logistics process (Mankovits et al 2015). The procurement activities of Pharma comprise an integral part of the material flow process, as it is responsible for the supply of nearly 2,500 pharmacies and the patients using them. Procurement demands can be managed in the following ways (Szegedi-Prezenszki 2003):

- centralized procurement
- decentralized procurement

Pharma practices both centralized and decentralized stock management. Depending on product turnover, deliveries may be split per site, or centralized, in which case part of the incoming goods are dispatched to rural logistics centres, but there are also certain products that are only stockpiled in the central warehouse. The reason behind this also relates back to demand, and to invoke the writings of János Benkő (Benkő 2018) again, “the driving force behind stockpiling is demand”. Delivery times are within 24 hours, which means that if a rural pharmacy in the western part of the country places an order for a product that is stocked only in the central warehouse, they will be able to receive it within 24 hours. A common dilemma for companies with multiple sites or a divisional structure, is the question of which tasks should be handled centrally and which by the departments, i.e., to what extent procurement should be centralized or decentralized. It is rare to encounter a fully centralized or fully decentralized organizational solution as companies usually utilize a mixture of the two (Vörösmarty 2006).

The fundamental question of stock management strategies is when (time) and how much (quantity) should be ordered. The order interval depends on whether orders must be placed every fixed “t” intervals, or whether stock replenishment is decided when the stock level falls to a specific “S” minimum stock level (reorder point). The order item size may be a fixed “Q,” or the order item may refer to quantity that will result in the stock reaching a predetermined maximum “S” level after receipt (Benkő 2018). Its stockpiling strategy has a profound effect on operating efficiency. Stock is the physical stock held in order to fulfil a forecast demand or production, which requires a financial sacrifice on the part of the company. According to lean, stockpiling equals wastage, which is also an incentive for stockpile reduction and optimization. This approach is definitely true, as stockouts can cause just as much damage as when the stock levels are high (Balogh et al 2020; Szász – Demeter 2017). The four types of stockpiling strategies known from the academic literature are not completely clear-cut in practice, but they overlap. A steady stockpiling strategy, otherwise known as the "sawtooth" model, works well for products with a balanced turnover, such as medicines for cardiovascular diseases. The procurement of OTC products shows some fluctuations, particularly with regard to seasonal products, for which a cyclical stocking model is commonly utilized, wherein the quantity of items that need to be ordered varies from season to season, and there can be significant differences in the quantities purchased and stockpiled over the course of a year. The stock levels of certain vitamins, nutritional supplements and immune boosters need to be topped up well before the season. During and at the end of the season, it is of paramount importance to adjust the level of the indicator and safety stocks to the appropriate level, otherwise shortages and/or unreasonably high stock levels may be expected. The establishment of safety stocks may serve to improve the level of consumer service (Hauck 2015).

We can encounter a minimum stock level in the two-warehouse strategy, and it is particularly important for Pharma's stock management to set the indicator and minimum stock levels, as well as to monitor and if necessary, adjust them. These provide reference points for reviewing the order cycle time. With a consignment contract, rented storage procurement is conducted and a different stockpiling policy is followed where usually identical quantities are received at unspecified intervals and stock levels are not dependent on minimum stock levels. Pharma, as the recipient, does not bear the direct

costs of managing and maintaining the stock, and may use it according to its needs, only ever buying the amount it needs at any given moment. Due to seasonal demand, stocks for smart bandages (wound coverage + healing aids) do not always need to be replenished to the same level, as their consumption fluctuates constantly and are difficult to predict. This also needs to follow a new strategy in terms of stockpiling. Stocking risks increase significantly in the case of excessive amounts of stockpiling, the extent of which depends on the value of the stock, the obsolescence period, and the uncertainty of supply and demand. The quality factor is more in favour of low stock levels which stockpiling can typically only worsen rather than improve. This is because the more time a finished product spends in the warehouse, the bigger the chance that it begins to lose its value. However, the risk that the low stock levels as a result may prove insufficient in the event of a sudden surge in demand, should also be considered (Hauck 2015).

Stock analysis of the Pharma company

For effective stock management, it is essential for a company to continuously analyse and evaluate the size and composition of its stocks, as well as the relationship between changes in stock and turnover (Vincze-Földi 2015; Váradi 2008). Efficient use of resources can be achieved with proper stock levels, but it is necessary to regularly analyse each element of the stock by revenue, margin and volume. Choosing the right stockpiling mechanism aims to establish a shortage-free state of stocks, as well as for the quantity of stocks not to be too large (Balogh et al 2020). The company provides the stock of goods for sale as part of the procurement activity. In order to effectively manage trade without interruptions, it is important to have as large of a range of stocks as possible, as a sufficiently large quantity and selection can surely meet the demands of customers (Pap 2009). Pharma is a commercial entity, which means cost-effective management is important for it. Because of this, the goal is to allocate a smaller stock, since stockpiling incurs significant costs, such as storage costs, administrative costs, storage losses and the reject rate. The stock levels are determined by the volume and composition of the turnover, the resupply time of the stock, and the order item sizes. Adequate stock levels determine the availability of the company, its market position and the perception customers in the supply chain have of it. The stock also determines the flexibility of the company, which is one of the most important expectations of the customer, i.e., it is a tool for providing satisfaction. Efficient use of resources can be achieved with proper stock levels, but it is necessary to regularly analyse each element of the stock by revenue, margin and volume. Choosing the right stockpiling mechanism aims to establish a shortage-free state of stocks, as well as for the quantity of stocks not to be too large. An adequate stock level can signal a competitive supply chain (Balogh et al 2020).

Efficient stock management ensures that customer and patient demands are met (Carroll 1998). The goal in every case is to keep the level of stock-related expenditures as low as possible. (Csipkés 2018) The aim is to reduce shortages, and as the academic literature puts it, “achieve a stock status that is without shortages” and, more importantly, to maintain this status in the long term. A lack of finished product stocks can result in a loss of market share for the company, which will also lead to revenue loss (Szász – Demeter 2017). It is important that we determine and clarify what the participants within this industry understand as a product shortage. The concept of a shortage has different interpretations for the manufacturer, the wholesaler and the pharmacy, albeit with overlaps. In Europe, shortage in the pharmaceutical industry is interpreted in one of two ways. The pharmacy cannot acquire the product within 72 hours from any wholesaler. Only 65% of the next month's estimated quantity of a specific product is available in the warehouse of the wholesaler. In the event of a product shortage or supply issue, the manufacturer is primarily obliged to report this shortage to the National Institute of Pharmacy and Nutrition (Országos Gyógyszerészeti és Élelmezés-egészségügyi Intézet - OGYEI). This is the case if the reason for the product shortage is a manufacturing problem. The issue of safety product supply can be found with the manufacturer. Today, OGYEI can register a product as in short supply within its own competence and can announce this to pharmacies and wholesalers.

For manufacturers, this shortage means that the patient cannot acquire the product in the pharmacy. The close link in the supply chain between manufacturer and wholesaler is also evident here, as the flow of information allows the manufacturer to immediately see which products from its portfolio have become unavailable at the wholesaler at a given moment, which it could not deliver to the pharmacy and which the patient did not receive, as a result. Pharma, as a wholesaler, defines a shortage as something that occurs when none of its customers (pharmacies, hospitals) have received the product they would have needed at a specific time. It is possible that the wholesaler was unable to deliver the specified product to the pharmacy or hospital from any of its warehouses. The customer of the pharmacy is the patient, and for them, a shortage means that the needs of the customer/patient will not be met, as the pharmacy is presently out of stock, while no other wholesaler in Hungary has any stock available. This shortage is a symptom of fragile supply chains, since there are few competitors at various stages of the chain, the failure or departure of a single factory, manufacturer or intermediary can result in the collapse of the entire supply chain (Cogan et al 2018). This also highlights the key role the pharmaceutical wholesaler plays in this issue, and in the prevention of shortages. Its available stocks will be available to the pharmacy, as well as the end user, and this provides reassurance for the manufacturer, in that their product can be ordered from the wholesaler and the patient will receive the product they need. Using this thought as a baseline, it is important to talk about addressing shortages, and to propose solutions to them. Shortages are particularly important metrics for evaluating the procurement activity and performance. The wholesaler is responsible

for informing the pharmacies about the shortage, the reason for it, and the expected time of delivery. What causes these shortages?

- supply difficulties, problems during manufacturing, the manufacturer being unable to transport
- sudden increase in turnover, for which neither the manufacturer nor Pharma is prepared for
- issues with storage capacities, problems with "parking" products, i.e., products that cannot be placed in storage or provided
- quality assurance issue, products that cannot be released or are quarantined
- unpredictable transport delay (medicines created biologically in reactors for treating rare diseases, wherein the transport time provided cannot be upheld)
- lack of stock management strategy

However, stockout costs comprise a significant amount of costs incurred. Moreover, additional transport costs can also accumulate. If a rural warehouse has a shortage of a requested product and the pharmacy has to be provided for from the central warehouse, the order generates a so-called stock transfer, meaning that if the central warehouse has available stock, it will transfer the quantity. The product will be transported from the central warehouse to the pharmacy, increasing labour capacity, transport costs and serves to decrease time efficiency. The most often used metric for stock analysis is the turnover rate of stocks. Stock turnover rate is the average time (number of days) in a specific period that the average stock lasts for, i.e., the number of days it takes to replace the stock (Balogh et al 2020). The turnover rate metric depends on the type of product, as well as its marketability and the demand for it. The changes in the turnover rate of each commodity group helps procurers decide on the frequency of procurement. The turnover rate in days shows the average number of days the stock is replaced in a given period. Effective stock management is characterized by the lower metric. Fsn = (Average stock x days in a specific period) / Sales (days) (Vincze– Földi 2015). In the case of Pharma, the calculation of the turnover rate involves comparing 3 months of stock values and sales numbers. Based on the turnover rate calculated during the analyses, existing stocks may be classified into the following categories. (Table1 own creation based on Pharma wholesale trader database).

Table 1. Turnover rate categories

A - Low	0-14 calendar day
B - Normal	15-45 calendar day
C - High	46-179 calendar day
D - Very high	180+ calendar day

In order to answer questions regarding the reduction of shortages, it is important to examine products that have too low stock levels. Stocks that are kept too low are at risk of shortages. Here we would once again refer back to literature stating that stocks are moved as a response to demand, (Benkő, 2018) as such, it is necessary to examine how much turnover has changed/increased compared to the past, the reasons behind this change, and whether this change in turnover, if any such can be observed, will be permanent and long lasting. Or if demand remained constant, procurement and supply from the manufacturer was deficient and problematic.

Research results

It is important to monitor stocks regularly the level they are at in relation to turnover, and monitor stocks in each warehouse separately as well. It could be possible that a particular product may be classified as normal in terms of stock category based on its turnover rate, but outliers could become visible once the per site breakdowns are analysed. For this case study, the available stocks in a given period were analysed while observing the average stock over a year. Let us see how the periodic stocks of the products are classified based on their calculated turnover rate. (Table2, Table3 own creation based on Pharma database)

Table 2. Stock ratio (pcs)

stock categories	Site1	Site2	Site3	Site4	Site5	amount in pieces
A -Low	130 235	150 341	92 630	265 125	130 952	769 283
B - Normal	614 118	567 129	434 657	2 742 051	657 319	5 015 274
C - High	389 958	387 581	328 959	2 605 022	413 927	4 125 447
D - Very high	11 500	16 990	10 375	730 525	12 704	782 094
amount in pieces	**1 145 811**	**1 122 041**	**866 621**	**6 342 723**	**1 214 902**	**10 692 098**

A - Low	11,37%	13,40%	10,69%	4,18%	10,78%	7,19%
B - Normal	53,60%	50,54%	50,16%	43,23%	54,10%	46,91%
C - High	34,03%	34,54%	37,96%	41,07%	34,07%	38,58%
D - Very high	1,00%	1,51%	1,20%	11,52%	1,05%	7,31%
total	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**

Table 3 Stock ratio (value)

stock categories	Site1	Site2	Site3	Site4	Site5	total (Hungarian forint)
A - Low	284 242 787	359 593 436	226 923 151	1 196 518 848	369 203 313	2 436 481 535
B - Normal	699 986 640	625 819 199	449 323 558	5 933 014 522	710 197 207	8 418 341 126
C - High	373 884 535	388 133 331	313 193 635	5 071 250 384	412 944 083	6 559 405 968
D - Very high	24 558 675	30 489 910	37 126 649	1 776 031 762	17 948 346	1 886 155 342
total (Hungarian forint)	**1 382 672 637**	**1 404 035 876**	**1 026 566 993**	**13 976 815 516**	**1 510 292 949**	**19 300 383 971**
A - Low	20,56%	25,61%	22,11%	8,56%	24,45%	12,62%
B - Normal	50,63%	44,57%	43,77%	42,45%	47,02%	43,62%
C - High	27,04%	27,64%	30,51%	36,28%	27,34%	33,99%
D - Very high	1,78%	2,17%	3,62%	12,71%	1,19%	9,77%
total (Hungarian forint)	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**

ABC analysis test

The ABC analysis (Pareto analysis) is a common method of analysis in practice, which can also be used to successfully determine procurement priorities. ABC analysis was published in 1951, in which Ford developed the effects of pareto principles on stockpiling systems and processes (Ford 1951). This method is useful in identifying materials of greater or lesser importance with regard to the material management system. (Földesi 2006) Above all, efforts should be focused on the selected few items that constitute the bulk of the turnover. (Hirkó et al 2008) This method of analysis allows us to identify strategically important products that need their stockpiling to be of special importance, and prioritize the availability of such products from permanent stock, as well as reducing shortages to 0. ABC classification categories in the case of Pharma:

- **Category "A": goods that account for the first 80% of the total daily turnover**
- Category "B": goods that account for the following 10% of the total daily turnover
- Category "C": goods that account for the subsequent 10% of the total daily turnover

The number of products being traded, regardless of how many are available of each product at each site, is close to 10,000 pieces. Based on the turnover numbers the results were the following (Table4 own creation).

Table 4. ABC categorization distribution in % terms

Category	Products (pcs)	% of the total daily turnover amount
A	1254	13%
B	936	10%
C	7604	78%

Products classified as Category "A," which account for 80% of the total daily turnover only amount to 13% of the total range of products. Utilizing additional stock analysis methods, these products can be classified into more categories. According to the FMRW category classification:

- Category "F": sales happen at least every 2 days or more often
- Category "M": sales happen at least every 2 weeks or more often, but less than every 2 days
- Category "R": sales happen at least every 2 months or more often, but less than every 2 weeks
- Category "W": sales happen less often than every 2 months

We have identified 304 products in Category A, Class F. Further analysis was conducted to see how the stocks of the 304 Category A, Class F products change over time is, as these are considered the most important products, which are sold daily and represent a major part of the total daily turnover.

When analysing the types of material in the context of the sale of pharmaceutical products, those which are sold daily and account for a considerable proportion of total daily turnover are blood products, cardiovascular medicine, as well as respiratory products and those used in diabetes treatments. This reflects the fact that a significant percentage of the Hungarian population suffers from some form of cardiovascular disease, and the rate of people with diabetes is also quite high. After stock and turnover rate calculations, 136 products were identified as strategic but with low stock levels, i.e., with a supply lasting for no more than 14 days. These products are sorted by turnover, first by number of items sold, followed by value in descending order.

name of the product	group of substances	sale (pcs)	sale (hungarian forint)	turnover rate
MEFORAL 1000MG FILMTABLETTA 60X	SPE-ATAP	780	536 655	6,4
MILURIT 100MG TABLETTA 50X	SPE-MVÁZ	724	362 852	12,6
MILURIT 300MG TABLETTA 30X	SPE-MVÁZ	718	431 732	11,6
COVEREX AS 5MG FILMTABLETTA 30X	SPE-CSZIV	704	475 095	11,9
NEBILET 5 MG TABLETTA 28X	SPE-CSZIV	629	629 222	9,6
COVEREX AS KOMB 5MG/1,25MG FILMTABL 30X	SPE-CSZIV	571	800 360	11,9
TENAXUM 1MG TABLETTA 30X	SPE-CSZIV	560	766 789	12,9
MALTOFER FOL RÁGÓTABLETTA 30X	SPE-BVÉR	527	762 505	0,4
FRONTIN 0,25MG TABLETTA 100X	SPE-NKIDP	499	300 964	11,4
NOOTROPIL 1200MG FILMTABLETTA 60X	SPE-NKID	470	544 936	13,1
CANESTEN 10MG/G KRÉM 1X 20G	SPE-DBŐR	423	365 366	12,3
VENTOLIN EVOHALER SUSP TÚLNYOMÁSOS 200AD	SPE-RLÉGZ	416	262 566	13,8
COVERCARD 5 MG/5 MG TABLETTA 30X	SPE-CSZIV	415	532 130	14,4
SALVUS GYÓGYVÍZ 1X 1,5L	VTA-GYHAT	414	150 193	13,4
COVEREX-AS KOMB FORTE FILMTABLETTA 30X	SPE-CSZIV	406	694 666	11,3
MILURIT 300MG TABLETTA 30X	SPE-MVÁZ	368	221 208	14,9
ASPIRIN PROTECT 100MG GY-ELL BEV TBL 56X	SPE-BVÉR	326	301 134	14,0
COVEREX AS KOMB 5MG/1,25MG FILMTABL 30X	SPE-CSZIV	298	416 798	12,8
CLEXANE 4ENE/0,4ML 40MG INJ 10X ET FECSK	SPE-BVÉR	93	544 093	0,4
CLEXANE 4ENE/0,4ML 40MG INJ 10X ET FECSK	SPE-BVÉR	294	1 715 468	5,6
		SUM	10 814 732	

Fig. 1. Low stock products ranked according to number of items sold, source: own creation" based on Pharma database

name of the product	group of substances	sale (pcs)	sale (hungarian forint)	turnover rate
CLEXANE 4ENE/0,4ML 40MG INJ 10X ET FECSK	SPE-BVÉR	294	1 715 468	5,6
NOVORAPID PENF 100E/ML INJ 10X3ML PATRON	SPE-ATAP	74	1 123 382	2,3
SYMBICORT TURBUH 4,5/160MCG INH POR 120X	SPE-RLÉGZ	149	1 100 807	5,1
ACTRAPID PENF 100NE/ML INJ 5X 3ML PATRON	SPE-ATAP	168	878 398	2,1
SPIRIVA RESPIMAT 2,5MCG INHAL OLD 30 AD	SPE-RLÉGZ	89	816 823	13,7
COVEREX AS KOMB 5MG/1,25MG FILMTABL 30X	SPE-CSZIV	571	800 360	11,9
ULTIBRO BREEZHALER 85/43MCG POR KAPS 30X	SPE-RLÉGZ	56	790 650	11,1
TENAXUM 1MG TABLETTA 30X	SPE-CSZIV	560	766 789	12,9
MALTOFER FOL RÁGÓTABLETTA 30X	SPE-BVÉR	527	762 505	0,4
SPIRIVA INH POR 30X KKAP HANDIHALER KÉSZ	SPE-RLÉGZ	82	755 420	12,1
APIDRA 100NE/ML INJ 5X 3ML TOLL SOLOSTAR	SPE-ATAP	100	699 810	2,1
COVEREX-AS KOMB FORTE FILMTABLETTA 30X	SPE-CSZIV	406	694 666	11,3
VELMETIA 50 MG/1000 MG FILMTABLETTA 56X	SPE-ATAP	72	668 377	12,4
NEBILET 5 MG TABLETTA 28X	SPE-CSZIV	629	629 222	9,6
IDEÁL TESZTCSÍK 50X	GYS-DIAB	270	620 284	14,0
MÉRY TESZTCSÍK VÉRCUKORMÉRŐHÖZ 50X	GYS-DIAB	271	598 813	0,5
CARDURA XL 4MG MÓD HA LEAD FILMTABL 30X	SPE-CSZIV	238	551 742	11,4
NOOTROPIL 1200MG FILMTABLETTA 60X	SPE-NKID	470	544 936	13,1
CLEXANE 4ENE/0,4ML 40MG INJ 10X ET FECSK	SPE-BVÉR	93	544 093	0,4
MEFORAL 1000MG FILMTABLETTA 60X	SPE-ATAP	780	536 655	6,4
		SUM	15 599 200	

Fig. 2. Low stock products ranked according to turnover value

Sorting by sales value produces a higher total value. It is important to look at the goods not only in terms of the number of items sold but also consider the average price and the closing stock value key factors. Based on this, the range of products may also change. The analysis has identified the products wherein stock levels are low compared to turnover, thus there is a possibility and risk of stock shortages. Henceforth, the stock and turnover of these products per site is also worth analysing, looking at the distribution of stocks at each site, and possibly revealing whether an uneven distribution of stocks results in one site having more stock of a specific product, while the other has less. The question is also whether this low stock level persists at all sites, and if so, whether the cause is an indicator stock adjustment or a manufacturer supply issue. Stocks are always a status at a given moment, as the next order or expected receipt, or moving the amount being received to storage, will change the current stock level. The results of the analysis have shown which products need to have their stocks put into focus and maintained at an optimal level, as these are the strategic goods of the company.

XYZ analysis

XYZ analysis is also useful for predicting turnover, and thus facilitating the planning of stocks. Categorization according to the fluctuation of demand and the accuracy of the prediction is called an XYZ analysis. Instead of demand, the quantities used can also be examined. In terms of the temporal utilization of materials, three groups can once again be identified. There are materials which are used in near-constant quantities, while the use of other products shows some fluctuation. There are also certain materials wherein their use is completely irregular. The aspects comprise the categorization of materials into categories „X," „Y" and „Z" (Földesi 2006., Hirkó et al 2008) As Pharma can manage its medicinal products with a constant turnover rather well, a balanced turnover can be assumed, and these will form Group X. These include prescription medicine for blood pressure and other vascular diseases, diabetes medication, thyroid medication and cholesterol-lowering medicines. Referring back to the results gained from the ABC analysis, it is clear that these medicinal products are considered strategic goods, and their stockpiling is easy to plan for, but requires special attention. Group Y is the group of products where use showed a greater amount of fluctuation. Its turnover can be decently planned, as well as predicted by examining previous turnovers. This product group mainly consists of nutritional supplements, "winter, fall" vitamins, immune boosters, and various items on sale. Considering the changes during the COVID period, it is particularly important to monitor the turnover of vitamins C and D, as well as immune boosters, as higher stock levels should be considered at the moment, yet it is necessary to check whether this is sustained or not, to avoid the risk of permanent overstocked levels. Certain products that are procured only on demand (very expensive products, products with irregular use), or only have a few items in stock, are considered Category Z, as per the literature classification. Category Z, and especially the very expensive products, make up for a significant percentage of the daily average gross profits. The question may arise on how the stockpiling of these products could me optimized and what exactly counts as low stocks. Stockpiling depends on multiple factors. Stockpiling is worthwhile when there is a weekly, or at the very least monthly demand for a specific medicinal products, and its use is for the long term. As the original cost is high, only a minimum stock is required to be stored. If the order is placed at the same interval and the quantity is constant, the product can be ordered from the manufacturer, and if so, stocking is not necessarily due to the price of the product and the turnover figures. It should also be taken into account whether the product in question is a vital product or not, since this range of these products is mostly life-saving, particularly important and urgent. The figures support the above statement when looking at Pharma's stocks of products for which the moving average is above HUF 1 million, the average stock is 8 items. Stocks are only found in the central warehouse.

The effects of COVID on stockpiling

The global coronavirus pandemic has also made a significant impact on the lives of pharmaceutical wholesalers, not only in terms of new demands and increased sales of certain products but also because customer habits on the market had also changed considerably. This also had an effect on the lives of wholesalers. A rearrangement of the market and turnovers is observable. The number of purchase transactions has decreased, people went the pharmacies less often, but bought in larger quantities. The growth of original medicinal products and the stagnation of generic medicines became typical. During the height of COVID, the prescription market grew by 1.5x, while the non-prescription market doubled. The average customer cart value increased from the previous HUF 6000 to HUF 9000 nationwide. The turnover of immune boosters (4x), vitamins (2.5x) and pain medication (2x) had increased. Demand for larger retail packs of products increased, and prevention became even more important. Above all else, vitamins C and D, as well as immune boosters saw an increased turnover. It was also observed that due to the use of masks, antiseptics and a higher vitamin intake, there was a decrease in products

for the flu season (colds, cough suppressants). Overall, the statistics have shown that the non-prescription market increased my 14% across the nation, while this increased on the prescription market amounted to 6%. (Purmann-Németh 2020) The growth of the medicine market can be seen as average, but the turnover for nutritional supplements within the medicine supply chain increased by 30.4%. The figures highlight these changes should be identified in stockpiling as well, and the current stock levels should be reviewed. The increased turnover over the last 2 years justifies higher stock levels of these products, but it is important to monitor whether this trend will continue in the long term, and whether some items will be added to the strategic goods category, such as ABC analysis.

County level pharmacy distribution versus stock value at specific sites

The following figure provides a good illustration of the distribution of pharmacies per region. We can see that the number of municipalities without a pharmacy is much higher in the western part of the country than in the eastern.

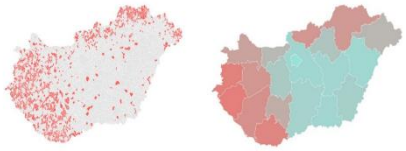

Fig 3. Municipalities in Hungary without pharmacies Source: KSH, 2018

This analysis is aimed at observing the ratio of pharmacies per county. Then we looked at which pharmacies in each county are served by which trading house. Part of the calculation looks at the proportion of pharmacies provided for by a specific site, relative to the total number of pharmacies while the other part examines at the stock percentage of a specific site, relative to the total Pharma inventory. We wanted to find out whether comparing these two ratios shows a near equal distribution, because if so, this could support the idea that the stock distribution between sites is proportional to the number of pharmacies served.

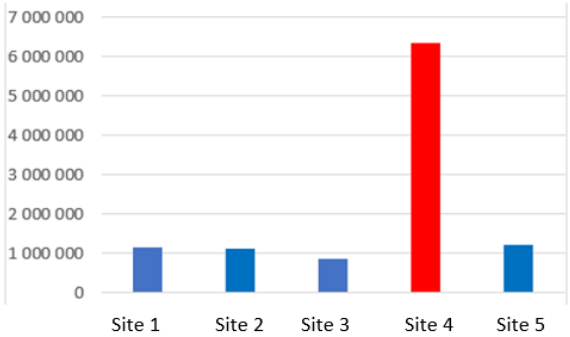

Fig 4. Stock distribution between sites in pcs, *"Source: authors' own editing based on Pharma database*

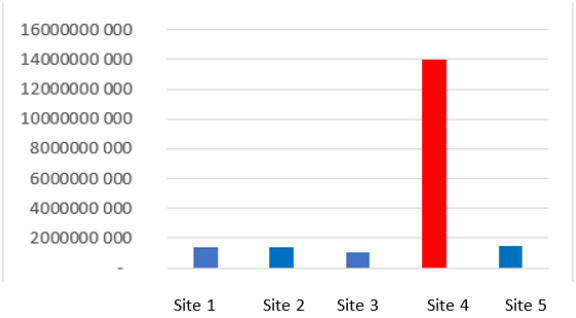

Fig 5. Stock distribution between sites, in value (Hungarian forint) *Source: authors' own editing based on Pharma database*

Table 7. Comparative table regarding the ratio of served pharmacies and stocks on site

Sites	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**total**
number of pharmacies by sites	651	581	383	1002	752	3369
ratio of pharmacies served by the site to total pharmacies	19%	17%	11%	30%	22%	100%
Sites	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	
stock ratio between sites	7%	7%	5%	72%	8%	100%

The results indicate (Table7 own creation) that the stock percentages show a similar distribution (%) at each site. We can observe that the central site (Site 4) possesses the largest stock in both quantity and value, which amounts for 72% of the total Pharma stock while at the same time, it is observable that the central warehouse provides service for the highest number of pharmacies meaning that 30% of pharmacies are provided for via the central warehouse of Pharma. The stock of Site 3 is the lowest , which is also reflected in the number of pharmacies it serves. In all the other sites, the ratio of stock and the ratio of the pharmacies they serve is nearly equal.

Stock efficiency analysis

Stock efficiency refers to the turnover achieved with a specific unit of stock as well as how much stock was necessary for a specific unit of turnover. Stock efficiency increases if the stock decreases while turnover remains constant, or if turnover increases while the stock level remains the same, or if turnover increases by a greater degree when both of them increase. The size of the stock per site, as well as the turnover per site were compared. The following table shows the results. (Table 8 own creation based on Pharma database)

Table 8. Stock value and monetary turnover

	closing stock value (Hungarian forint)	average daily turnover (Hungarian forint)	rotate	stock rate
site1	1 382 672 637	66 290 429	20,9	7%
site2	1 404 035 876	72 032 254	19,5	7%
site3	1 026 566 993	48 084 285	21,3	5%
site4	13 976 815 516	462 226 199	30,2	72%
site5	1 510 292 949	72 245 479	20,9	8%
Total	**19 300 383 971**	**720 878 646**	**26,8**	**100%**

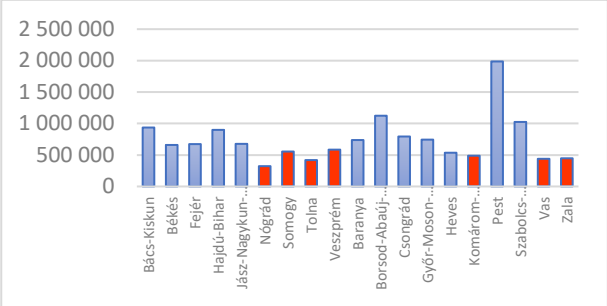

Fig 4 Medicine trade in Hungary per month (box), *Source, "authors' own creation" based on NEAK, 2020*

This means that the available stock lasts for 27 days; this is considered a normal condition, not too high and not too low. We checked how many boxes of medicine were sold in total per county and on a national level. The following table and chart show the monthly turnover. This data was compiled on the basis of December 2020 statistics, and the lowest number of boxes were highlighted with red. In 2020, pharmaceutical sales in Hungary were 14,050,726 boxes per year, which means 168,608,716 boxes per year.

In the previous analyses we have seen that Pharma's total stock is just over 10 million boxes/month, and once compared to the monthly turnover of boxes, we can certainly say that stock availability falls below statistical sales (the sales data includes "on-demand only" products).

The current sales figures recorded by Pharma during this period are as follows and based on this calculation we can also calculated with a 30-day supply, where the figures are similar to those of the statistical sales. If we project the daily turnover onto the monthly turnover, the resulting number is nearly equal with regard to the statistical monthly turnovers of boxes. (Table9 own creation based on Pharma database).

Table 9. Stock and turnover comparison based on boxes sold

	closure set (pcs)	average daily turnover (pcs)	rotate
site1	1 145 811	46 943	24,4
site2	1 122 041	49 194	24,3
site3	866 621	33 001	263
site4	6 342 723	181 217	35
site5	1 214 902	48 591	25
Total	**10 692 095**	**355 946**	**30**

Conclusions and recommendations

Time has become an increasingly important requirement on the market in terms of customer demands, and the decisions made by consumers nowadays are mostly based on the availability of stocks and the quality of service. If competing companies in the industry recognize this, they can gain a competitive advantage by using the right stockpiling mechanisms. Timeliness will be a decisive factor along with immediate availability, available stocks, flexible and fast service, and the operation of efficient logistics processes. Product availability and delivery times determine the market position of the company, its customer perception and its flexibility. Stock shortages cause a loss in market positions and may result in diminishing turnovers as well. The problems arising from constant stock shortages will decrease the sense of security and the trust of customers. Shortages are a symptom of a fragile supply chain, which must be remedied. Particular emphasis should be given to stock analysis, and in connection with that, any changes in turnovers. In the long term, a proper stockpiling mechanism should be established with the purpose of achieving a no-shortage state of stocks.

In terms of reducing shortages, prioritizing and reviewing strategic goods more frequently are recommended, as it is important to observe how the range of these products changes, or if any of the changes proves to be significant. It is essential to keep track of stocks of these goods and to constantly monitor their turnover in order to explain the reasons for any changes. Stock management can only be effective if stock analysis and the monitoring of turnovers are performed continuously. In addition, communication is important so preparations may be made in observance of the expected manufacturer forecasts for the planned period using the necessary stocks. Consignment storage is preferred as the delivery times shorten while quick restocking may also become possible if needed. Preventing and reducing shortages is only possible if we pay attention to market changes, predict the expected demands and continuously analyse our stocks. In addition to the automatic ordering processes, a control process should be added to prevent shortages.

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