ANALYSIS OF THE OPTIMIZATION INDICES OF PRODUCT FLOW IN LOGISTICS INFORMATION SYSTEMS IN PHARMACY NETWORKS

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In this article we review the methodology for calculating key indices of activity effectiveness in pharmacy networks. We investigate the basic operation factors needed to calculate the indices. Such concepts as supplied goods, items out of stock, stock balance index, items out of stock percentage, items out of stock without warehouse, a pharmacy, office or general stock balance are revealed.

One of the most competitive advantages of a modern pharmaceutical company is a good range of products and the lack of items out of stock in the pharmacies of the network. It is very important that one can find everything he/she needs when coming to a pharmacy. Otherwise it is most probably that the person will never return to this pharmacy again. Companies with the branching pharmacy networks use a number of specific indices to control the effectiveness of the product flow distribution. One of the most common indices are stock balance index (SB index) and items out of stock in the pharmacy. Nowadays every company of the pharmaceutical market has its own methods of calculating these indices. And the methods depend on the company's specific regulation in terms of distribution logistics. Generally SB index is perceived as velocity of the warehouse stocks of a certain pharmacy or of the warehouse of the distribution centre. In other words it is the duration of the warehouse stocks turnover. But this understanding of the SB index does not show how many times the pharmacy stock balance exceeds the stocks required to satisfy customer demand. The method of SB index calculation which will be analyzed in this article will demonstrate the effectiveness of pharmacy stock balance management.

Another common index is items out of stock. Generally it is perceived as possible but not received pharmacy revenue. But this understanding does not show the amount by which the turnover decreases due to the shortage of a product. The method of items out of stock calculation which will be analyzed in this article will show the amount of a pharmacy revenue reduction which occurs due to ineffective pharmacy stock balance management.

Pharmacy networks have always paid adequate attention to the stock balance in terms of SBI (stock balance index) in order to provide that it did not exceed the amount of products needed to satisfy the customers' requirements. Another important question about items out of stock has also been considered. The question is: "Does a pharmacy always order enough goods to maximally satisfy the customers' requirements?"

Nowadays it is essential to work effectively with SBI indices and items out of stock which are the key indices of evaluating the effectiveness of flow optimization in pharmacy networks.

Items out of stock and SBI indices in pharmacy networks are calculated with S-products.

S-products (supplied products) are the goods with the same nomenclature, dosage and number but supplied by different producers. S-products combine the goods which can substitute one another when a company warehouse fills the order of the pharmacy.

When calculating items out of stock we consider S-products of all the product groups which have any sales-statistics in the pharmacy within the analyzed period. That means the products which have been sold at least once within the analyzed period and there have been days when the product was out of stock in the pharmacy.

Belonging of a product to a group according to sales indices is determined by ABC-XYZ analysis. We define the sales potential of the goods - groups X,Y,Z. The goods required by 80% of the customers make up group X, by

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16% make up group Y, and the rest 4% are considered to be group Z. Making up A,B,C groups according to the profitability of sales is based on the same principles. The goods whose sales revenue accounts for 80% of the pharmacy total revenues within the analyzed period make up group A, 16% - group B, and the rest 4% refer to group C. So the composed matrix has 9 product groups. When calculating items out of stock we consider only 4 groups of the S-products (AX, BX, AY, BY), which have any sales-statistics in the pharmacy within the analyzed period.

These are the 4 groups that comprise the majority of the buyers - more than 90%. It is not efficient to analyze items out of stock of the product groups which account for less than 2-3% of all buyers.

Items out of stock in pharmacy networks is the amount by which a pharmacy turnover reduces due to the fact that some product was not available in required quantity ceteris paribus.

Items out of stock without a warehouse is items out of stock minus the amount on which the warehouse did not fill the pharmacy orders, i.e. items out of stock which occurs "through no fault of the warehouse".

Items out of stock indices are calculated as follows:

$$Def_{ph} = \Sigma(D_d \cdot s_v \cdot p_b),$$

where D_d is the days of deficiency of the i-th S-product within the analyzed period; s_v is the sales velocity of the i-th S-product, calculated for the analyzed period and a certain group of products; p_b is the base price of the i-th S-product.

Days of deficiency is the number of days when a certain S-product was not in a pharmacy's stock balance. Days of deficiency vary from 0.5 (a product was available in the morning but finished by the evening time or vice versa, a product was not available in the morning but was bought in evening) to 27.5 or 41.5 days depending on the product group.

Sales velocity is the average velocity of the sales of a certain product in a certain pharmacy within the given period of analysis.

Price is the main base price.

Thus, if the sales velocity of a certain S-product within the analyzed period or the number of days of deficiency is zero, then, respectively, items out of stock of the product is zero. And this product will not affect the total items out of stock of the pharmacy.

Items out of stock percentage is the ratio of items out of stock to the period turnover multiplied by 100. In other words, it is the ratio of the possible revenue from a certain S-product which was not sold, to the revenue that could be received from the sales of this S-product if it was available within the whole period of analysis.

$$\%Def_{ph} = \frac{\Sigma(D_d \cdot s_v \cdot p_b)}{D_n \cdot \Sigma(s_v \cdot p_b)} \cdot 100\%,$$

where D_d is the days of deficiency of the i-th S-product within the analyzed period; s_v is the sales velocity of the i-th S-product, calculated for the analyzed period and a certain group of products; p_b is the base price of the i-th S-product; D_n is the number of days in the analyzed period.

$$D_n = D_d + D_P,$$

where D_d is the days of deficiency of the i-th S-product within the analyzed period; D_P is the days of presence of the i-th S-product within the analyzed period.

Items out of stock without a warehouse is the amount of items out of stock minus the possible revenue from a certain S-product which was not supplied by the warehouse within the analyzed period. In other words, it is items out of stock minus a certain S-product order amount made by the pharmacy but not supplied by the warehouse. Therefore it is items out of stock that occurred "through no fault" of the warehouse.

$$Def_w = Def_{ph} - (\sum T_{or} - \sum T_{del}),$$

where Def_{ph} is the items out of stock in the pharmacy within the analyzed period; T_{or} is the i-th S-product order amount within the period; is the amount of the i-th S-product delivered within the period.

The percentage of items out of stock without a warehouse is calculated similarly to items out of stock percentage:

$$= \frac{(\Sigma(D_d \cdot s_v \cdot p_b)) - (\sum T_{or} - \sum T_{del})}{D_P \cdot \Sigma(s_v \cdot p_b)} \cdot 100\%$$

This formula can be transformed:

$$\%Def_w = \frac{Def_{ph} - (\sum T_{or} - \sum T_{del})}{D_P \cdot \Sigma(s_v \cdot p_b)} \cdot 100\%$$

$$\%Def_w = \frac{Def_w}{D_P \cdot \Sigma(s_v \cdot p_b)} \cdot 100\% .$$

Thus, items out of stock of a certain S-product occur in a pharmacy under a number of obligatory conditions:

S-product must belong to one the 4 groups (AX, AY, BX, BY) of sales in the pharmacy;

S-product must be sold at least once in the pharmacy within the analyzed period, i.e. sales velocity must be greater than zero;

S-product in a pharmacy must come to an end at least once, i.e. the number of days of deficiency must greater than zero.

$$\%Def_w = \frac{(\Sigma(D_d \cdot s_v \cdot p_b)) - (\sum T_{or} - \sum T_{del})}{D_P \cdot \Sigma(s_v \cdot p_b)} \cdot 100\%$$

The stock balance index (SBI) is one of the basic indicators in pharmacy operating. Maintaining the stock balance indices in accordance with the standard value is the one of the indicators of correct pharmacy operating. SBI shows how many times the stock balance of a pharmacy exceeds the product balance required to meet the costumers' needs. Monitoring the SBI allows to build the "effective" stock balance, i.e. pharmacy stock balance should not hold goods more that it is required to meet the needs of the costumers.

Thus, the following SBI and stock balance values are calculated and used:

- general SBI and general Balance;
- office SBI and office Balance;
- pharmacy SBI and pharmacy Balance.

General balance is the average total balance of all goods, i.e. the goods ordered by the staff of the pharmacy as well as the goods that come to the pharmacy at the initiative of the office staff.

Pharmacy Balance is the average balance of the goods ordered by the staff of the pharmacy.

Office balance is the average balance of the goods ordered at the initiative of the office staff.

Pharmacy SBI is the index showing how many times the stock balance of a pharmacy exceeds the product balance required to meet the costumers' needs within the analyzed period.

Pharmacy SBI has two components: the pharmacy part (for the goods ordered at the initiative of the pharmacy supervisor) and the office part (for the goods ordered at the initiative of the office staff).

Pharmacy and office SBI is a share in the turnover of the whole pharmacy network as seen in the formulas below.

General SBI in the pharmacy networks is calculated as follows:

$$KTO_g = \frac{(\Sigma TO_g / D_n)}{(\Sigma TU_i / D_w)},$$

where TO_g is the total general balance of the i-th S-product for the period; is the number of days in the analyzed period; TU_i is the total turnover of the i-th S-product in the pharmacy within the period; is the number of days when the sales were done in a pharmacy within the analyzed period.

The general office SBI in "Implozia" company is calculated in the following formula:

$$KTO_{of} = \frac{(\Sigma TO_{of} / D_n)}{(\Sigma TU_i / D_w)},$$

where TO_{of} is the total office balance of the i-th S-product within the period; is the number of days in the analyzed period; TU_i is the total turnover of the i-th S-product in the pharmacy within the period; is the number of days when the sales were done in a pharmacy within the analyzed period.

Pharmacy SBI in "Implozia" company is calculated in the following formula:

$$KTO_{ph} = \frac{(\Sigma TO_{ph} / D_n)}{(\Sigma TU_i / D_w)},$$

where TO_{ph} is the total pharmacy balance of the i-th S-product within the period; is the number of days in the analyzed

Advisable normative figures of items out of stock and SB index

Pharmacy turnover within a month in rubles	Pharmacy items out of stock, %	SB index
up to 250 000	18%	up to 2
from 250 000 to 500 000	14%	up to 1,5
from 500 000 to 1 000 000	8%	up to 1,3
from 1 000 000 to 1 500 000	6%	up to 1,1
above 1 500 000	4%	up to 1

period; TU_i is the total turnover of the i-th S-product in the pharmacy within the period; is the number of days when the sales were done in a pharmacy within the analyzed period.

General SBI can also be calculated by the formula:

$$KTO_g = KTO_{of} + KTO_{ph}.$$

This equation can be approximate due to rounding-off of indices to two decimal places.

The total turnover of a pharmacy in a pharmacy network for the period is calculated by the formula:

$$TU_i = S_i + D_i ,$$

where S_i is the pharmacy sales revenue within the period; D_i is the discounts for the i-th S-product granted to the costumers within the period;

Turnover is the amount of the revenue without deduction of the discounts granted to the costumers.

Thus, the standard indicators of items out of stock and SBI in the pharmacy networks depend on the pharmacy turnover. Consequently, SBI and items out of stock can be brought to the standard values depending on the turnover of a certain pharmacy. Following the persuasive normative figures can be suggested as a method of effective pharmacy stock balance management. Depending on the turnover of a company or a certain pharmacy the given normative figures are applied nowadays by many pharmaceutical companies.

Thus, the given indices most accurately assess the effectiveness of optimization of the flows in the pharmacy networks because they consider the main parameters of pharmacy operating.

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