ADDRESS THE FACTORS RELATED TO INCREASES THE LEVEL OF EXPIRY IN PHARMACEUTICAL STOCK AT KING ABDULLAH MEDICAL CITY

Ahmed Alsuwayhiri[1*], Khadijah Maqbul[2], Yaqoob Abobakar[3], Abeer Alomiri[4], Khaled Alqethami[5], Hatoon Akram[6]

ABSTRACT

Introduction and Study Objective

According to budgetary data, the pharmaceutical inventory is a significant expense for healthcare institutions, ranking as the second-largest annual expense in their budgets. It is crucial to estimate the annual level of inventories accurately to avoid waste in resources and minimize costs. In this context, a recent study aimed to identify pharmaceutical items with high growth rates over an eight-year period and determine the percentage of wrong estimation.

Study Design and Methodology

The study uses a cohort retrospective study design and analyzed medical inventories data from an Enterprise Resource Planning (ERP) system. There are roughly 2077 medical items in total, some of which are unplanned requests and others have alternatives. Of these, 974 pharmaceutical products were examined in the study to generate the percentage of estimation.

Result and Findings

The results indicate that the departments of radiology and gastroenterology had the highest percentage of inaccurate demand estimates in their yearly inventories. Additionally, it demonstrates that the majority of the department miscalculated their yearly quantity utilized. Transferring patients to another facility is one of the many reasons why the amount of medication lent increases; in this case, KAMC is required to supply medication for the moved patient. Furthermore, inconsistent use forces KAMC to loan nearly expired medications to other healthcare organizations and re-distribute them when needed at different times. Drug items with a high percentage of borrowing are associated with poor medical services because healthcare services are interrupted and even when borrowing is done, it takes time to meet needs and affects the continuity of delivered the services.

Recommendation

The investigation discovered a significant difference over an eight-year period between the suggested and actual maximum levels. In order to reduce deviations in future quantities, the research team chooses to create a new amount by adding growth value to the average values of previously recorded years.

[1*]Pharmacy Technician at Laboratory and Medical Solutions Warehouse in KAMC,
[2]Research Centre at KAMC,
[3]Directoro of Medical and Non-Medical Warehouses at KAMC,
[4]Drug Controller at KAMC,
[5]Pharmacy Technician at KAMC,
[6]Quality controller at Primary Health Care Center.

***Corresponding Author:** Ahmed Alsuwayhiri
*Pharmacy Technician at Laboratory and Medical Solutions Warehouse in KAMC

DOI: 10.53555/ecb/2022.11.10.101

Background and Rational:

Since the services it offers are directly linked to improving the quality of life of patients, the health care industry is regarded as one of the biggest, accounting for around 10% of the country's GDP gross domestic product (Akbar *et al.*, 2022). After the salaries of healthcare workforce, the pharmaceutical inventory has been rank as the second-largest annual expense in the budgets of healthcare institutions. (Sari, 2017). Overstocking in pharmaceutical inventory is expensive, and it is critical to predict annual inventories in order to avoid waste and make the most use of resources. The mutual warehouse "multi hospital network" activated in Saudi Arabia between healthcare organizations in different cities aims to cover patients' needs by mobilizing medical items as needed and reducing the level of expired items, but the problem of expiration persists.

Pharmaceutical waste is the term used to describe medical products that have an expiration date or timeline for usage; if the right conditions are met, the product will be designated as waste after this time (Lyon *et al.*, 2006), (Tull, 2018), (Sarla, 2020). The problem of medical inventory management has spread throughout the world, regardless of when the expiration date is (Mohammed, Kahissay and Hailu, 2021) and a common solution is to calculate the amount of money that will be lost as a result of expiration in order to cover the costs of financial resources. This fascinating approach is meant to draw attention to the growing significance of the problems related to the cost of pharmaceutical products, while also motivating healthcare institutions to fulfill their future needs with the least amount of waste, prevent the shortage of pharmaceuticals, and preserve their financial stability.

The supply chain team must analyze the pattern of usage to save money on expired items since the periodic assessment of supply inventories is crucial because of changes in the pattern of pharmaceutical inventory utilization. In order to control and lower the amount of expiry over time, the study intends to address the amount of expired products and analyze the reasons behind them.

Objectives:

Primary Objective

The goal of the study is to identify the problems associated with pharmaceutical overstock and suggest new approaches for quantity estimation throughout time. Seldom done research focuses on estimating inventory levels after analyzing extensive historical usage records.

Secondary Objectives

Prepare a list of the eight-year high growth rate items together with the proportion of inaccurate estimations.

Generate the latest methods to improve the supply chain teamwork skills in long-term inventory estimation.

Literature Review:

According to literature, the quantity of pharmaceutical items that are no use worldwide is rising dramatically. In comparison to other types of pharmaceutical waste, such as vials, bottles, and so on, tablet sets are the most common, (Mohammed, Kahissay and Hailu, 2021) and the current study emphasized the need to look into the rate of inaccurate inventory estimation. Furthermore, a number of factors, including inappropriate storage standards, a deficient monitoring system, and excessive consumption, lead to a bad inventory management process. The lack of essential medical services, exposure to financial resources, and rise in costs are the root causes of the medical supply problem.

In addition, the researchers have shown that there are no strict regulations for medical inventory overflow, and the donation process, particularly between individuals, are not advised in order to reduce the possibility of improper storage or poor medical supplies, which could deteriorate human's health (Tull, 2018) moreover, in order to preserve the stability of healthcare services in their facilities, organizations may lend out practically expired medical supplies or provide a small quantity.

Staff accountability, on the other hand, will play an important role in evaluating the accurate level of inventories; however, they may incorrectly estimate the utilization quantity due to their limited experience and skills in forecasting the level of medical inventory; additionally, changes in the pattern of utilization have a undesirable impact on the annual quantity estimation. Opening or closing new services has both good and bad effects, causing healthcare organizations to estimate erroneous inventories due to changes in demand. There is also evidence that updates in evidence-based practice have changed the pattern of utilization on a yearly basis, as have environmental catastrophes such as the COVID-19 pandemic or any other natural disaster.

Methodology

Study design:

The Cohort Retrospective Study uses data from supply chain interface on the ERP system "Enterprise Resource Planning Software" around 8 years, and an excel sheet is used to retrieve data from the database.

Study Population:

a) All Medical stocks will be included.

All items whether in outpatients Department, admission services and Oncology Pharmacy at King Abdullah Medical City.

b) Inclusion /Exclusion Criteria

Study will address the medical stocks during last 8 years. The attributes will be (inventories Code, inventories Descriptions, Borrowing Quantities, loaning Amounts, Minimum Amounts, Maximum Amounts, Quantity Out or consumed).

Inclusion criteria:

- Medical items, between 2014 and July 2021.
- Stocks type (Ampoule, Tablet, Vial, and other)
- Loaning & Borrowing items in the study timeframe.

Exclusion criteria:

- Medical items used with no Min-Max assumption Amounts, that's mean not regular needed or unplanned stock because it's not in the scope of services for KAMC or dedicated for one patients.
- Non-Medical items.
- Some of the items with inaccurate assumption percentages that exceeded 100 were caused by a policy implemented among healthcare institutions, which refers to the availability of some medical materials in organizations versus others, so they are lent or borrowed the entire number of medical items, and high rates appear because the health institution rely on each other to provide sufficient inventory for their patients through other organizations without purchasing items.

Research Procedures:

- Inventories codes will use to summaries the group of items in one row because sometimes medical items have been requested from many Cost Centers \ (Departments).
- Include Maximum Quantity and compere them with Quantity dispensing.

i) Retrospective chart review collects the data based on the following variables:

- Inventories code.
- Inventory descriptions.
- Date of Dispensing.
- Type of stock (Ampoule, Tablet, Vial and so on..).
- Consumption/Quantity Out.
- Lending, Borrowing amount.
- Minimum/Maximum amount.

ii) Duration for data collection is 1-6 months.

iii) Crack object based on generic name.

- **Research Timeline:**

After receiving IRB permission, the study will begin collecting data, which will take between one to six months to clean and analyze before the results are evaluated.

Outcome Assessment:

The study's findings must define the causes for high levels of consumption and expiration during the study period, as well as provide clear instructions for how to avoid them in the future.

- List the top 20 stocks with the highest loan and borrowing percentages over the last 8 years. Display the percentage of inaccurate estimations across the many departments utilizing medicinal products.

Research Data management:

A data sheet will be prepared to serve the study's objectives; the source of data is an ERP system, and the data owner is the medical supply chain administration. Data gathering forms do not show any nominative information. Datasheets will be kept in a secure location, and two to three members will extract and clean the data before one of them transfers it to an SPSS database for analysis.

Sample size

Eight years of data will be retrieved from the system. Multiple departments will be included since they have medical inventories during the study period. The total number of medical items is approximately 2077, some of them are unanticipated requests and others have replacements. The study investigated 974 medical items to determine the proportion of estimation for each one.

Research Data Analysis Plan:

The current study will employ SPSS version 21 to examine the study hypothesis using various statistical analysis approaches.

- First, current study aims to identify departments with the biggest rate of misconception in estimating the medical

inventory levels, with the goal of increasing awareness and reducing expenses.

- The odds ratio will be used to compare suggested and present maximum quantities, identifying the most affected items over 8 years and determining under/overutilization of all medicinal items in the study.
- Examine the relationship between consumption and loans to prevent overestimation and improve supply chain staff's capability to forecast annual inventory levels.
- Assess and Evaluate the discrepancies between consumption and borrowing to increase accuracy in estimating annual quantities for the future.

Statistical Result

Item Group per Cost Center	%Wrong Estimation
Radiology	26.94%
Gastroenterology	26.10%
Narcotics & Controlled Medications	24.70%
Biological product	23.27%
Anesthesia	22.93%
Neurology	19.91%
Oncology	19.81%
Chemicals	19.80%
Vaccines	19.58%
Obstetrics & Gynecology	18.42%
Antimicrobial	17.12%
Emergency medications	17.11%
Other Group	16.99%
Pulmonology	16.94%
Dermatology	15.77%
Endocrinology	15.30%
Antidote	14.59%
Ophthalmology	14.55%
Electrolytes & Fluids	14.39%
Non-Formulary	13.82%
General	13.81%
Cardiology	13.73%
Pediatrics	12.80%
Urology	10.49%

In this section, the data will be displayed in various ways to demonstrate the study results, which will be assessed using odds ratios to examine the inaccurate prediction over an eight-year period.

Current analysis demonstrates that the Radiology and Gastroenterology departments have the highest portion of wrong anticipating percentage when calculating their annual demand, as shown in table one. Unlike Urology and Pediatrics, the percentage of incorrect demand determinations was lower compared to other departments. Wrong demand determination resulted in overstocking or understocking, both of them had a severe impact on the quality and budgets of healthcare services.

Table-1 Exhibit the list of departments according to the biggest improper estimation rate

Table-2 show the remaining quantity in top twenty items during the study duration with big growth rate and inaccurate rate of forecasting produced from proposed maximum amount deducted from real highest quantity trendy during the eight years utilized by beneficiaries. If the result between them in minus the value means that the concerned departments (beneficiaries) underestimated their yearly consumption. A smaller amount urge the medical inventories team to borrow stock from other health organizations or the healthcare practitioners will not be capable of providing the medical services. By the same talk, results show high residual or what called big

amount due to the beneficiaries miscalculate their inventory needs and company supplies will spoil due to overstock. Even when borrowing medical items, the demand is insufficient because some items have a high utilization rate in other health organizations, so no one will lend them, or they will send a few amounts, such as a limited quantity, like if an organization requests 100 BEVACIZUMAB VIAL (AVASTIN), they will provide 20 out of 100 to avoid refusing the request and keep activating the multi hospital network. In terms of cooperation in multi hospital networks, the healthcare institutions must accept the request even if they supply less amount than the necessitated amount to remain the healthcare services render in their organization and peer organization. The small improper estimation with great growth proportion proves the level of severity in medical supply availability and the shortage due to poor anticipating for the quantity on annual bases.

Table-2 Exhibit the Medical items with biggest growth rate during eight years

Item Code	Item Description	Total	Growth Rate	Suggested Min value	Suggested Max value	Min Value of 8 Years	Max Value of 8 Years	%Wrong Estimation	Residual QTY
400100	ATORVASTATIN 20 MG TABLET	6503560	93.13%	200000	400000	10200	1974500	-79.74%	-1574500
400973	OMEPRAZOLE 20 MG CAPSULE	3093314	85.91%	100000	200000	10080	1438528	-86.10%	-1238528
400634	HYDRALAZINE 25 MG TABLET	2750980	85.52%	200000	400000	4800	673500	-40.61%	-273500
401030	PERTUZUMAB 420 MG / 14 ML VIAL (PERJETA)	3444	81.74%	360	720	4	1071	-32.77%	-351
400135	BEVACIZUMAB 100 MG/4 ML IN 4ML VIAL (AVASTIN)	3063	81.62%	50	100	8	947	-89.44%	-847
401267	TACROLIMUS 0.5 MG CAPSULE	150400	78.32%	20000	40000	400	40900	-2.20%	-900
401165	ROSUVASTATIN 20 MG TABLET	851408	72.48%	18300	36600	5000	391600	-90.65%	-355000
401164	ROSUVASTATIN 10 MG TABLET	1333309	69.97%	83000	166000	5000	400410	-58.54%	-234410
401219	SODIUM CHLORIDE 9 MG/ML (0.9%) IN 1000 ML BAG	27758	68.57%	1500	3000	80	5338	-43.80%	-2338
400290	CLINDAMYCIN TOPICAL SOLUTION 10 MG/ML SOLUTION	5231	65.28%	300	600	20	1114	-46.14%	-514
400627	HUMAN IMMUNOGLOBULIN (5%) 2.5 G \ 50 ML VIAL	10215	65.03%	1000	2000	50	2751	-27.30%	-751

Item Code	Item Description	Total	Growth Rate	Suggested Min value	Suggested Max value	Min Value of 8 Years	Max Value of 8 Years	%Wrong Estimation	Residual QTY
401401	VORICONAZOLE 200 MG TABLET	50370	63.63%	5000	10000	150	10890	-8.17%	-890
400716	ISOSORBIDE DINITRATE, ISDN 5 MG TABLET SubLingual	973760	63.10%	70000	140000	4300	225200	-37.83%	-85200
400764	LEVETIRACETAM 500 MG TABLET	1366640	60.12%	80000	160000	6900	298090	-46.32%	-138090
400746	LAMOTRIGINE 25 MG TABLET	87052	59.82%	5500	11000	300	17884	-38.49%	-6884
400128	BETAHISTINE DIHYDROCHLORIDE 16 MG TABLET	266150	59.33%	15000	30000	1200	59680	-49.73%	-29680
400217	CARVEDILOL 25 MG TABLET	598510	59.26%	40000	80000	2880	119200	-32.89%	-39200
400264	CHOLECALCIFEROL; VITAMIN D{3} 50,000 IU CAPSULES	514276	56.72%	35000	70000	3000	109200	-35.90%	-39200

Table-3 shows the items with high level of lending amount throughout the eight years to summaries the medical items with overstock such as left-over in the items since the loaning practises help the healthcare institution to avoid items disposable, but the inventory planning team must take this point into consideration since this will affect the predicting process in the future. Without providing the remaining amount the incorrect assessing percentage will become horrible.

In the recent situation loaning process between the healthcare organizations depend on many conditions, which is a scarcity of medical items in other healthcare institutions such as when result illustrate those substances as MESALAZINE 4 G ENEMA found that was exceedingly demand from gastroenterology clinics among the other healthcare organizations in multi hospitals network, healthcare practitioners require this suppository as its importance for continuity of medical services in many health organizations if they offers this type of service under gastro. Even though, the result indicates that the ALTEPLASE, TPA 50 MG TREATMENT SET is very vital medical products for cardiac disease as well as Acute Ischemic Stroke, Myocardial Infarction, and Pulmonary Embolism (PE), those classify as high-risk cases, so there is an extraordinary demand with severe stock scarcity, as governmental cooperation try to avoid service suspend. Moreover, this drug was affecting the patient safety, present result supports to utilize and lend left quantity to other institution in condition to face the risk of stock deficiency. As the King Abdullah Medical City has the main oncology centre at Makkah FLUOROURACIL, 5-FU 1000 MG VIAL: is important medication for the treat the cancer patient and shortage not acceptable as it correlated to most critical services. Antidote medication as ACTIVATED CHARCOAL 100 G POWDER: is a lifesaving medical product for many cases of toxicity. Moreover, VERAPAMIL HCL 5 MG (2.5 MG/ML) AMPOULE: shortage of diltiazem and this medical item very crucial in emergency department as calcium channel blocker used for hypertension and angina.

Many reasons led to lending this medical products in the table three such as relocating the patients to another health organizations due to indication that the general specialties not available at KAMC, that force KAMC to provide medication for transferred patient. Additionally, unstable utilization urges KAMC to redistribute the nearly expired Medication by lending them to other healthcare organization to dispense and consumed before the expiration date and get new stock upon the request in another time.

Table-3 Exhibit the top twenty lending medical items for eight years.

Item Code	Item Description	Min Quantity	Max Quantity	Dispensed QTY (2014-2021)	%Lending out of Consumption >> Overestimation
400842	MESALAZINE 4 G ENEMA	500	1000	5509	99.84%
400037	ALTEPLASE, TPA 50 MG TREATMENT SET	40	80	659	95.90%
401428	RADIOLOGY BARIUM SULFATE 100 ML SUSP (ORAL)	20	40	100	95.00%
401050	PHYTOMENADIONE, VITAMIN K{1} 10 MG/ML AMPOULE	200	400	3590	92.06%
400552	FLUOROURACIL, 5-FU 1000 MG VIAL	40	80	8618	89.92%
401099	PROCHLORPERAZINE 5 MG TABLET	700	1400	1700	88.24%
400137	BICALUTAMIDE 50 MG TABLET	1200	2400	11936	87.97%
400712	ISOPRENALINE 0.2 MG / ML AMPOULE	50	100	2390	85.98%
401387	VERAPAMIL HCL 5 MG (2.5 MG/ML) AMPOULE	150	300	3594	83.72%
401111	PROPYLTHIOURACIL 50 MG TABLET	170	340	8290	80.94%
401077	POTASSIUM PHOSPHATE 4.4 MMOL potassium /ML 3 Mmol phosphate	500	1000	5803	80.30%
400007	ACTIVATED CHARCOAL 100 G POWDER	3	7	84	79.76%
401124	VACCINE, RABIES Immune Globulin EQUINE 200 - 400 I.U	9	18	98	78.57%
400178	CALCIPOTRIOL CREAM 0.05 mg/g TUBE 30 G	40	80	130	76.92%
401439	RADIOLOGY, ORAL IONIC IODINE CONTRAST MEDIUM Gastrografin 370 mg iodio/ml VIAL (100 ML)	400	800	1999	75.04%
400721	ITRACONAZOLE 100 MG CAPSULE	800	1600	22460	74.89%
401071	POTASSIUM ACETATE 40 MEQ (2 MEQ / ML) VIAL	500	1000	4070	73.59%
400069	AMOXICILLIN; CLAVULANIC ACID 1.2 G VIAL	300	700	6500	72.46%

Table-4 shows that the medical stock with big proportion of borrowing is indicates poor quality of medical services due to discontinuity of delivering the services. The borrowing process does not easily it also time-consuming while waiting for health organizations to receive the application and correspondingly and the long distance between healthcare organizations will increases the time of the process to items availability particularly if the health organization in other city. For instance; the 5 items in the table below for different type of VACCINEs, the consumption of this serum increases at particular time of the year or seasonally specifically in (winter & Hajj season), over and above vaccine campaigns lead by the Preventive Medicine or public health physicians, all are manage by the Ministry of Health and lent as it's the main center for supply medical stock and provided to the polyclinic also many hospitals more than 70% of borrowing proportion was due to periodic needs so the scheduling of this stocks will be changed up on timing and quantity with respects to the patients number because they fixed based on the previous annual statistic. One more example for DEXAMETHASONE 0.5 MG TABLET the purpose of big borrowing amount is the deficiency of other attentiveness concentration such as 2mg &4mg, replaced by 0.5 mg and will distribute to patient extra pills to match large dosages, this encourages to raise in utilization and necessity of borrowing from other health organization to cover the yearly utilization. Further example as CETIRIZINE HCL 10 MG TABLET unavailability was result of other antihistamine for example: Loratadine, switch the utilization by CETIRIZINE, this led to replace in consumption of CETIRIZINE, the demand to borrow stock from other health institutions to cover unanticipated utilization in yearly demand. Several factors force health care organizations to borrow and make the predication technique more difficult and complex.

Table-4 Exhibit the top twenty biggest proportion of borrowing for eight years.

Item Code	Item Description	Min Quantity	Max Quantity	Dispensed QTY (2014-2021)	%Borrowing out of >> Consmption Underestimation
401567	PARAFFIN WHITE SOFT emollient 45 G TUBE	4000	8000	35142	95.90%
401482	VACCINE, TETANUS IMMUNE GLOBULIN, HUMAN 250 IU/1M PRE	12	24	112	91.07%
401459	VACCINE, HAEMOPHILUS INFLUENZA CONJUGATE VACCINE	30	60	147	88.44%
400678	VACCINE, INFLUENZA VIRUS VACCINE 0.5ML P.SYRINGE	2500	5000	22631	81.19%
400815	VACCINE, MEASLES VIRUS VACCINE	35	70	915	76.50%
400925	MUPIROCIN 2MG/G (2%) IN 15G OINTMENT	100	200	1450	75.31%
400623	VACCINE, HEPATITIS B VACCINE, RECOMBINANT 20 MCG/ ML (ADULT VACCINE) VIAL	180	360	2541	70.84%
400376	DEXAMETHASONE 0.5 MG TABLET	1400	2800	50990	67.05%
400334	CYCLOSPORINE (ciclosporine) MODIFIED 25 MG CAPSULE	700	1400	28800	65.98%
401922	VACCINE, TETANUS TOXOID-TETAVAX 40 UNIT AMPOULE	14	28	380	65.79%
400584	GENTAMICIN 3 MG/ML (0.3%) EYE/EAR DROPS (8 ML) BOTTLE	30	60	989	64.71%
400317	CROTAMITON 10% CREAM IN 20 G TUBE	50	100	618	64.40%
400972	OMALIZUMAB 150 MG VIAL (XOLAIR)	80	160	760	64.08%
401079	POVIDONE-IODINE 10% SOLUTION	1200	2400	23889	63.80%
401084	PRAZIQUANTEL 600 MG TABLET	50	100	1380	62.32%
400656	HYOSCINE-N-BUTYLBROMIDE 20 MG/ML AMPOULE	1000	2000	14080	61.72%
401106	PROPARACAINE (0.5%) EYE DROPS 15 ML BOTTLE	120	240	1926	61.37%
400242	CETIRIZINE HCL 10 MG TABLET	11700	23400	154912	60.73%
400831	VACCINE, MENINGOCOCCAL POLYSACCHARIDE DIPHTHERIA TOXOID CONJUGATED VACCINE SINGLE DOSE 0.5 ML VIAL	100	200	3858	60.39%
401547	GONADOTROPHINUM CHORIONICUM 1500 international unit AMP	30	60	82	58.54%

Discussion

Current study underlines medical inventories controlling and addressing the matters connected to them. Some of the concerns led to business resources wastage and others link to the services steadiness. With respect to the considerations all the proposed implemented solutions of the problem keep it up due to correlated attributes as well as the consumption mode changes and shortage of replacement as state in the result. Also, employee performance will raise the level of miscalculation for the quantity and lack of

standard too. Unlike the liability with enhancing the storing process, addition to good observing system surly will enrich the pharmaceutical supplies management. Besides, the higher knowledge level of in-charge unit absolutely will reduce the proportion of error in anticipating the future demand.

This research study prevent to calculate the pharmaceutical items offered for particular patient as (non-formulary) medication, and there is no require to use them for several reasons; as if the person allocate to other health institution, or if they moving their place of dwelling, on top of that in case of decease as the patient pass away the drugs will dispose as no one will used it. From the other point of view, replacement scarcity directed to large consumption due to international deficiency of some pharmaceutical items that's usually increase in utilization of other items. Renewing the formulary list of drugs led to update the condition of planned and unplanned pharmaceutical suppliers as inventory quantity or non-stock items.

General modifications in annual amount are sometimes restructured by new specifications elaborated and guidelines develop in cure care plans, such as cancer medications and antibiotic drugs plans, which are referred to as evidence-based practices. One of the reasons for the inaccurate pharmaceutical quantity was the presence of medical inventories required by medical doctors, which would not be used if they were not offered.

Sometimes, incorrect medical item collected in particular from multi hospital network at the time of borrowing request raised to get some drugs. Moreover, additional service activated or extra clinics opening in other hospital surely will adjust the annual consumption level.

Other type of medication for instance: vaccines, the consumption level grow based on the seasons demand mainly in (winter & Hajj), Also if any ambulatory activities done by the public health / Preventive health department.

All mentioned points will work together to alter the level of consumption annually and make the stock management process very demanding so supply chain team has to take them into consideration to enhance the outcome of the annual forecasting process.

Research lesson learned.

The current study reviews the result and advises new techniques to estimate the inventories annual quantity in the future. After interpreting the result, the researchers found great inconsistency between the suggested largest quantity and actual values during eight years. The research team agrees to generate a new quantity from the arithmetic mean values of earlier years data and add quantity of growth value to them. New techniques will help the planning team to control the resources and reduce the consequence of underestimation for inventory. Additionally, the team will restrict the wastage in the stage of the supplies prediction process at planning.

Limitation

New methods will work for items with a high growth rate and result might be not accurate for items with minus growth quantity. Along with stock totally granted by King Abdullah Medical City and circulated to other healthcare organizations can't anticipated because the data of consumption not documented at KAMC and no influence on the amendments occur to the stocks. As well as stock totally owned by other healthcare bodies and KAMC collected from them occasionally.

Ethical part & confidentiality:

All investigation teams will keep the privacy of data. No consent will be requested because records dose not related to patients. Data collection will start after obtaining the final approval from KAMC IRB body. The ethical agreement granted on 16 of October 2022 and No. (22-1001)

Publication:

The primary acknowledgement in publication will go to the primary investigator and co-investigators. Those who participate less substantially will have an acknowledgement in the manuscript.

Acknowledgment:

Investigation teamwork would like to acknowledge supply chain administration at King Abdullah Medical City as they are collecting the data annually and justified. Thanks once more, for the information technology department to recall the data from ERP system. Thanks, limitless for unlimited support and counseling from the research center staff in study duration.

References:

1. Akbar, M. A. et al. (2022) 'Towards roadmap to implement blockchain in healthcare systems based on a maturity model', Journal of Software: Evolution and Process, (August). doi: 10.1002/smr.2500.

2. Lyon, R. C. et al. (2006) 'Stability profiles of drug products extended beyond labeled expiration dates', Journal of Pharmaceutical Sciences, 95(7), pp. 1549–1560. doi: 10.1002/jps.20636.
3. Mohammed, S. A., Kahissay, M. H. and Hailu, A. D. (2021) 'Pharmaceuticals wastage and pharmaceuticals waste management in public health facilities of Dessie town, North East Ethiopia', PLoS ONE, 16(10 October), pp. 1–15. doi: 10.1371/journal.pone.0259160.
4. Sari, A. N. (2017) 'ANALYSIS OF INVENTORY MANAGEMENT FOR PHARMACEUTICAL PRODUCTS PHARMACEUTICAL PRODUCTS AND CONSUMABLE FINAL PROJECT By Alivia Nurlita Sari Undergraduate Program School of Business and Management Institut Teknologi Bandung', (August). doi: 10.13140/RG.2.2.12089.06244.
5. Sarla, G. S. (2020) 'Efficacy and disposal of drugs after the expiry date', The Egyptian Jouranl of Internal Medicine, 31(4), pp. 431–434. doi: 10.4103/ejim.ejim.
6. Tull, K. (2018) 'Drug expiry standards in developing countries Question • What is the global evidence/experience on expiry of drugs?' Available at: http://www.accessdata.fda.