



The Effect of Inventory Control on Patients with Acute and Chronic Illness during Pre, Peri and Post COVID-19 Pandemic in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To determine the effect of inventory control protocols on patient's health management systems during the pre; peri and post COVID – 19 pandemic in India.

Study Design: An analytical observation type of study.

Place and Duration of Study: A tertiary care hospital, between June 2020 to November 2022.

Methodology: We collected the stock movement data of 10 brand drugs that include Acute disease medications and Chronic condition medication, from hospital pharmacy, at pre, peri & post-COVID times. These drugs were selected for their common usage. The study of inventory based on data collected, will show how the pharmacy managed its inventory during the pandemic era. The

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pharmacy practised the collaborative method of ABC – FSN inventory method to meet demands and the same has continued during COVID-19.

Results: Data collected on 5 drugs for acute diseases showed an average percentage increase of 62.33% in drug consumption between the pre and post-COVID period whereas the 5 drugs for chronic conditions show an increase of 86.39%. The hospital pharmacy managed the high range of demand with the successful model of inventory control. It is evidence of the successful use of ABC – FSN analysis in the hospital sector during the pandemic (COVID-19).

Conclusion: The study concluded that the ABC – FSN inventory approach was helpful during the pandemic and concentrates mainly on the effect of inventory control on patients with chronic and acute diseases.

Keywords: Inventory control; pandemic; COVID–19; acute disease; chronic disease; ABC analysis; FSN analysis.

ABBREVIATIONS

WHO: World Health Organization; PHC: Primary Health Centres; FIFO: First in First Out; NCD: Non-communicable Diseases; ABC: Always Better Control; FSN: Fast Slow & Non-moving; CDC: Centres for Disease Control and Prevention; ICD: International Classification of Diseases; HBV: Hepatitis B Virus; HCV: Hepatitis C Virus.

1. INTRODUCTION

1.1 Drug Inventory Control

“Inventory control of drugs plays a *pivotal* role in hospital management. Drug inventory control of hospital pharmacy is very essential in order to provide continuous supportive services. The inventory management of drugs is very essential, as it is adversely affected by the consumption rate and purchasing cost of drugs. Vital drugs are necessary to keep in stock to preserve precious human life” [1].

1.2 Pandemic – COVID – 19

A pandemic is defined as “an epidemic occurring worldwide or over a very wide area, crossing international boundaries and usually affecting a large number of people” [2].

“COVID-19 is a new coronavirus disease identified in December 2019. Patients have clinical symptoms such as dry cough, dyspnoea, fever, and bilateral lung infiltration imaging. On 7th January 2020, the causative agent was identified from throat swab samples conducted by the Chinese Centre for Disease Control and Prevention and was named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-

CoV-2). Furthermore, it was called as COVID–19 by the World Health Organization (WHO)” [3].

1.3 Acute Illness

“Any illness that develops quickly, is intense or severe and lasts a relatively short period. Any condition e.g., infection, trauma, fracture with a short (often less than 1 month) clinical course. Acute illnesses usually respond to therapy; a return to a state of complete pre-morbid health is the norm” [4].

1.4 Chronic illness

“A human health condition or disease that is persistent or otherwise long-lasting in its effects or a disease that comes with time. The term chronic is often applied when the course of the disease lasts for more than three months. Common chronic diseases include arthritis, asthma, cancer, COPD, diabetes, and viral diseases such as hepatitis C and HIV/AIDS” [5].

1.5 Drugs

The most used drugs for acute and chronic patients during the period of pre - COVID, COVID, post – COVID are being surveyed and analysed drugs are: -

1.5.1 Drugs for acute disease

1.5.1.1 Pan – 40

Generic name: - Pantoprazole

“It is a medicine that reduces the amount of acid produced in your stomach. It is used for treating acid-related stomach and intestine diseases such as heartburn, acidity, and peptic ulcer disease” [6].

1.5.1.2 Dolo 650

Generic name: - Paracetamol or Acetaminophen

Dolo 650 Tablet is a medicine used to relieve pain and reduce fever. It is used to treat many conditions such as headaches, body aches, toothaches, and the common cold [7].

1.5.1.3 Montek LC

Generic name: - Levocetirizine

"It belongs to a class of drugs called antihistamines or anti-allergics. It treats sneezing, runny nose, and allergic skin due to various allergies and hay fever (seasonal allergy). It is commonly used to diagnose or treat Allergic conditions, dust allergies, pet allergies, and nettle rash" [8].

1.5.1.4 Loparex

Generic name: - Loperamide

It is commonly used for the diagnosis or treatment of loose stools, mild traveller's diarrhoea, and idiopathic diarrhoea in AIDS patients [9].

1.5.1.5 Dulcoflex

Generic name: - Bisacodyl

It is commonly used for the diagnosis or treatment of labour or radiological investigation, bowel clearance before surgery, constipation, laxative and suppository [10].

1.5.2 Drugs for chronic disease

1.5.2.1 Glycomet 500

Generic name: - Metformin (Fortamet)

"Glycomet (500 mg) is an oral antidiabetic agent, prescribed for type 2 diabetes. It helps control blood sugar levels. Metformin is the active ingredient" [11].

1.5.2.2 Udiliv 300

Generic name: - Ursodeoxycholic Acid (Destolit)

"Udiliv (300mg) is a biliary agent, prescribed for gallstones. It helps to dissolve the stone by reducing the amount of cholesterol released by

the liver into bile. It is also used to treat a type of liver disease called primary biliary cirrhosis" [12].

1.5.2.3 Capetero 500

Generic name: - Capecitabine

Capetero 500mg Tablets is an anticancer medication. Inside the body, this medicine gets converted into 5-fluorouracil (chemical). These chemicals hamper the synthesis of genetic materials (RNA and DNA) in the cancer cells, thereby interfering with their growth [13].

1.5.2.4 Clopitab - A

Generic name: - Clopidogrel (Plavix)

"Clopitab (75mg) is an anti-platelet agent, that is, a drug that inhibits the ability of platelets to clump together as part of a blood clot. Clopitab Tablet is an antiplatelet medicine or a blood thinner that helps to prevent the formation of harmful blood clots in your blood vessels" [14].

1.5.2.5 Orcibest 10mg

Generic name: - Orciprenaline

"This medication is a Metaproterenol which is used to relieve symptoms associated with chronic bronchitis, asthma, emphysema, and other related lung conditions. It is a moderately selective adrenergic receptor agonist. Thus, the tablet stimulates receptors found on the smooth muscle in the uterus, lungs, and vasculature supplying the skeletal muscle" [15].

1.6 Difficulties Faced by Acute & Chronic Patients

"Most chronic diseases are silent killers. According to the WHO report of 2018, a mortality of 63% was recorded related to chronic diseases like heart disease, diabetes, cancer, and respiratory disease. COVID-19 patients having cardiovascular diseases (CVDs) are associated with a higher risk of mortality. Routine care for chronic diseases during the pandemic is the most challenging" [16].

1.6.1 Mentally

"Corona phobia," which is the fear of COVID-19 has become an emerging issue among different communities and healthcare workers. Stress is one of the mental health disorders that occurred as a result of the COVID-19 outbreak.

Society has developed fears for themselves and their families, manifesting feelings of helplessness, boredom, loneliness, and depression [16].

1.6.2 Economically

“The healthcare costs from NCDs are high and projected to increase. Significant costs to individuals, families, businesses, governments, and health systems add up to major economic impacts. Cardiovascular disease, stroke, and diabetes cause billions of dollars per year. Healthcare systems in LMICs are mainly affected by COVID-19 due to the unorganized healthcare system” [16].

1.7 Rural Versus Urban Patients

“Rural participants were disproportionately affected by the COVID-19 lockdowns compared with urban participants. A greater proportion of rural participants experienced acute medical illness (rural 14.2%; urban 6.4%), difficulties in accessing health facilities (rural 95.0%; urban 75.0%) and medicines (rural 36.9%; urban 10.9%), worsened diabetes or hypertension symptoms (rural 16.0%; urban 11.0%), a lower treatment satisfaction rate (rural 3.5%; urban 23.8%), reduced fruit or vegetable consumption (rural 68.8%, urban 28.7%), and loss of household income (rural 67.3%, urban 56.9%)” [17].

Thus, we can have a clear understanding that during the pandemic compared to the urban population the rural population had suffered the most. The major reason for this worst condition during a crisis is the improper management of medicines without proper inventory control and outdated knowledge. This condition can be overcome through the right awareness by the respective authorities. By providing the new type of combination inventory model we can manage for longer term periods.

1.8 Objectives of the Research

- i. To assess the effects of COVID-19 on inventory.
- ii. To exhibit how inventory would affect acute and chronic patients.
- iii. To emphasize the proper way to overcome pharmacy demands with the best inventory method.
- iv. To compare between the sole and combined inventory methods.

1.9 Data Collection

The data is secondary which are collected from the database of pharmacy in a tertiary care hospital, located in an urban area of Chennai, Tamil Nadu. The software used for inventory data collection is “Kranium Health”. Data were collected in the hospital pharmacy with permission from the authority.

The drugs which are being used are: - Pan – 40; Dolo 650; Montek LC; Loparet; Dulcoflex; Glycomet 500; Udiliv 300; Capetero 500; Clopitab – A; Orcibest 10mg.

2. METHODOLOGY

2.1 Materials

The data was collected from the pharmacy of a tertiary hospital using “Kranium Health” software. The software aided as our main tool to collect data accordingly with respect to specific months of pre, peri & post-COVID – 19. The data from 10 drugs have been collected for analysis.

2.2 Methods

2.2.1 The current use of inventory control

Various methods of inventory control are practised to procure the medicines to the pharmacy to meet the day-to-day demands within the assigned budget without stock out or overstock situations. Following are the methods of inventory control [18].

2.2.1.1 ABC analysis (Always Better Control method)

ABC method of inventory control is also called the always better control method. This method is based on the cost of the medicines. Medicines can be classified based on cost as high-cost medicines, moderate-cost medicines, and low-cost medicines. As per the ABC analysis, 'A' category items are costly items, B category items are moderate cost items and C category items are economical items.

As per the investment, 75% of the total allocated budget will be spent on category A items, 20% of the budgeted amount should be spent on 'B' category items, and 5% of the budget should be spent on purchasing category 'C' items. For efficient management of category 'A' items, strict control should be exercised to avoid pilferage and other losses.

2.2.1.2 VED analysis (Vital, Essential, and Desirable)

Vital (V): These are essential materials whose non-availability while putting a halt to business operations. These materials need to be always in stock else, production will be affected. Essential (E): This refers to materials that you require a certain amount of. You just require a minimum amount of them to keep production active. Desirable (D): This refers to materials that do not affect production. Production can run with or without these materials.

2.2.1.3 EOQ method (Economic Order Quantity)

Economic Order Quantity is one of the best-known inventory models that are commonly utilized in purchasing medicines for pharmacies. Economic Order Quantity (EOQ) is defined as the optimum quantity to be ordered at once. In order to minimize such costs without affecting the demand and supply, possible minimum numbers of orders are required to be placed. The minimum number of units placed in each order is called Economic Order Quantity. This can be calculated by using the following formula.

$$EOQ = \frac{\sqrt{2} \times PC \times Q}{CC}$$

PC = Procuring cost.

CC = Carrying Cost.

Q = Quantity of the product ordered in the number of units.

Procuring Cost includes communication expenditure, media cost, cost made on purchasing, receiving, and checking goods, and marking and stocking of goods.

Carrying Cost includes expenditures incurred due to the storage, insurance, interest on the loan, deterioration of products or damage during the storage, etc.

2.2.1.4 Open to buy budget system

Open to buy budget system is another method of inventory control commonly practised in hospitals. In the preparation of the hospital budget, based on the previous year's sales record a stipulated amount is allocated as pharmacy budget for pharmacy requirements. Based on the sales requirement, the pharmacy manager will order the stock and the amount will be debited to the account. In this method, the pharmacy manager will know the unwanted stock

purchases and minimize the overstock and stock-out situation.

2.2.1.5 Bin card system

The Bin Card system is a most simple and reliable method of inventory control. In this method, a separate card sheet is prepared for every product. The card contains the details such as the manufacturer's name, date of supply, price, stock quantity, daily sales, etc. In the bin card system, the details should be updated daily to get the accurate stock position and also helps the pharmacist to follow the First in First Out (FIFO) system to liquidate the old stock.

2.2.2 Major Difficulties for Chronic (or) Acute Towards Inventory?

Patients, majorly chronically ill patients, dealt with a major problem during the pandemic. According to the studies, there was a little increment in the price of drugs during COVID - 19 era. In India, the prices were 8.1% increased in antibiotics; 23.4% increased in analgesics and 16.2% increased in antimalarials. Whereas, the price of face masks increased by over 98.2% [19].

Alongside the cost hike, the other major problem that led down the country was an economic crisis. It made the situation even worse. So, financial stability became a big deal for the patients [20].

On the other hand, patients with stable financial status could have dealt with a shortage of medications, in case of poor inventory management.

2.2.3 The Inventory Control in the rural places of India

Stock management at all visited primary health centres is on equal terms. Only the drugs enlisted in the essential drug list are available. Settlement of drug receipts with the exchange of supplies and issues with the other health facilities are practised. Bin cards and stock ledgers book are used to document the stock movement in the health facility [21].

The major drawbacks of inventory in a rural area:

- i. Computers are not utilized for stock management.
- ii. Instances of stock out remain common in most of the PHCs. Due to the availability of required drugs, patients are forced to

purchase drugs from local pharmacies, increasing out-of-pocket expenditure.

- iii. Blacklisted and expired drugs are accumulated over the years and there is no recent event of disposing of such drugs by the authority [21].

2.2.4 The major limitations of current inventory methods

In India, the inventories majorly followed by pharmacies are the ABC model of analysis. But this model of analysis did not keep up during the time of a pandemic like COVID-19. The major limitations are as follows:

The ABC analysis only considers volume. But what about the frequency, regularity, variability, and urgency of demand? [22].

2.2.4.1 Complex and Time Consuming

It is a very complicated task to categorize materials into different groups. It consumes more resources such as time, labour and cost to group materials in case of a large group of inventories [23].

2.2.4.2 Possibility of Loss

It gives less attention to B and C grouped materials. Therefore, there is a chance of loss because of overstock, damage, and wastage of these items [23].

2.2.4.3 Requires Substantial Resources

The ABC method requires more resources to maintain than traditional costing systems. When cycle counts are performed, class A inventory must be routinely analysed to determine if the inventory still consists of high-priority items. If an inventory piece is no longer used or demanded as frequently, it is moved to another inventory classification. This constant process requires much more data measurement and collection [24].

2.2.4.4 Loss Risk

Just because B and C items do not have as high a value as Class A products does not mean they have no value. One of the limitations of ABC analysis is that excess stocks are always in jeopardy of obsolescence or damage. Therefore, the inventory that habitually goes uncounted or unmonitored may be subject to misappropriation [25].

2.2.4.5 Value Blindness

The ABC classification captures only a small part of the total value of each item [26]. And the analysis is based on the monetary value of the items in use. Other important factors one ignored [27].

2.2.5 The transition of consumption for acute & chronic drugs during pre, peri & post COVID – 19 era

The data has been collected from a respective tertiary hospital for 10 different brand drugs and the rate of consumption for specific months has been observed and noted. With the data, we made a comparative study over each month of the specific drug. And the consumption has been presented graphically.

The drugs used, Acute disease: Pan – 40; Dolo 650; Montek LC; Loparet; Dulcoflex. Chronic disease: Glycomet 500; Udiliv 300; Capetero 500; Clopitab – A; Orcibest 10mg.

The ABC – FSN method of inventory is been followed by the hospital during the pandemic.

The rates of consumption of the medicines are accelerated from the pre – COVID conditions to post – COVID conditions for both Acute and Chronic diseases, as shown below in graphical Figures (Fig. 1 & Fig. 2).

2.2.5.1 Drugs for Acute disease

2.2.5.1.1 Pan – 40; Dolo 650; Montek LC; Loparet; Dulcoflex.

2.2.5.2 Drugs for chronic disease

2.2.5.2.1 Glycomet 500; Udiliv 300; Capetero500; Clopitab – A; Orcibest 10mg.

2.2.6 Reasons for the increased consumption for acute and chronic disease medications

The data collected for the acute and chronic disease medications from tertiary hospital shows that there is a drastic increase in the consumption of the medications. Each and every drug has a graph of exponential rate. The reasons for the increase in consumption are as follows:

2.2.6.1 Acute diseases

After the outbreak, many health problems followed along the way of COVID–19. Some of the common acute diseases like fever, common cold, constipation, diarrhoea and especially allergies and lung problems.

2.2.6.1.1 Fever

The reason for the persistence of fever remains unclear, but it may be due to the proportion of lymphocytes. Interestingly, fever recurred, except when the ratio of lymphocyte count to white blood cell counts improved [28].

2.2.6.1.2 Allergy

“Anaphylaxis is potentially life-threatening and requires immediate treatment. The allergy

conditions increased after vaccination. In nine of 10 cases of anaphylaxis after receipt of Moderna COVID–19 vaccines, patients had symptom onset within 30 minutes of vaccination, and nine anaphylaxis patients also had a history of allergies or allergic reactions, including some with previous anaphylaxis events; up to 30% of persons in the general population might have some type of allergy or history of allergic reactions” [29].

2.2.6.1.3 Constipation

Research shows “COVID–19 may also change the gut microbiota, and once inside the GI tract, they can also travel through the portal vein that drains blood from the digestive tract. Thus, leading to intestinal disorders” [30].

Table 1. The number of COVID–19 cases during selective months of pre-COVID, COVID, and post-COVID times

Time period	Month	Cases
Pre - COVID	June 2020	70977
COVID	June 2021	2455332
Post – COVID	November 2022	3594035

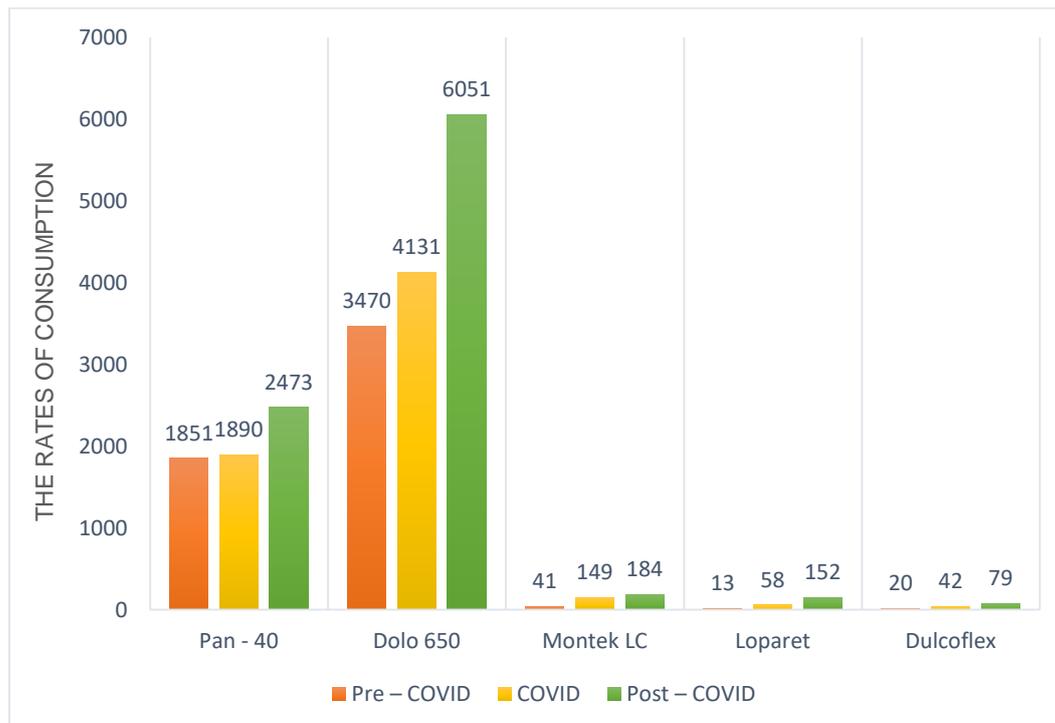


Fig. 1. The rates of consumption of Pan – 40; dolo 650; montek LC; Loparet; dulcoflex during Pre – COVID, COVID & Post – COVID time periods

2.2.6.1.4 Diarrhoea

“There has been a rise in the number of people showcasing gastrointestinal symptoms, including diarrhoea, acid reflux, cramps, and nausea during the second wave of the coronavirus. Scientists also believe that one of the primary reasons the gastrointestinal system is so acutely affected is because of the high presence of ACE2 receptors near the gut, which makes it easier for the spike protein of the coronavirus to latch itself onto, spreading and causing symptoms. Since the gut could be so acutely affected signs of lasting gut infection can be a common long COVID – 19 manifestation and concern a patient, weeks after recovering from the virus” [31].

2.2.6.1.5 Common colds

After the COVID – 19, the affected patients had a weakened condition of the respiratory system thus it led to a high chance of infection to easily communicable and seasonal diseases like the common cold, flu, etc.

2.2.6.2 Chronic disease

2.2.6.2.1 Diabetes

“The risk of diabetes increased after COVID–19 infections compared to patients with general upper respiratory tract infections. Patients with severe COVID–19 were at higher risk of diabetes after COVID-19. There is also new evidence regarding the effect of the SARS-CoV-2 virus on pancreatic β -cell function. It has been suggested that SARS-CoV-2 may affect the pancreas by acting on the mRNA of angiotensin-converting enzyme 2 (ACE2) in the endocrine and exocrine glands of the pancreas” [32].

2.2.6.2.2 Liver diseases

“Corticosteroids, such as dexamethasone, significantly increase survival and reduce morbidity among hospitalized patients with COVID–19 and in patients with moderate or severe COVID–19. Because corticosteroids are derived from cholesterol metabolism,

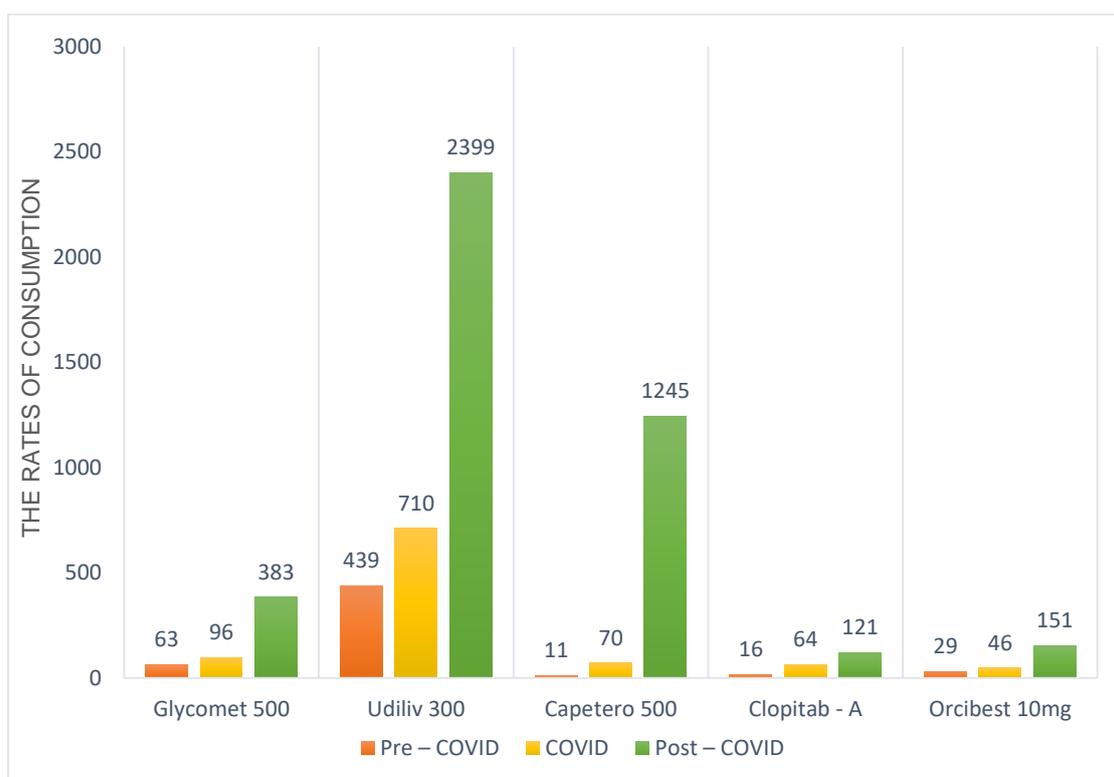


Fig. 2. The rates of consumption of Glycomet 500; Udiliv 300; Capetero 500; Clopitab – A; Orcibest 10mg during Pre – COVID, COVID & Post – COVID time period

which can interfere with multiple aspects of glucose homeostasis, attention should be paid to the possible effects of these compounds on liver metabolism and hepatic steatosis. Indeed, corticosteroid treatment in severe COVID-19 has been associated with significant liver injury” [33].

2.2.6.2.3 Cancer

“Immune responses in COVID-19 patients are orchestrated by proinflammatory cytokines (IL-1, IL-6, IL-8, and TNF- α), which are also known to drive tumorigenesis. Additionally, COVID-19 has been associated with T-cell depletion and activation of oncogenic pathways, including JAK-STAT, MAPK, and NF- κ B, potentially increasing the risk of cancer development. Hypoxia due to inflammation or virus-induced angiotensin-converting enzyme 2 depletion can induce oxidative stress and malignant transformation. Over time, both chronic inflammation and oxidative stress can lead to DNA damage and subsequent carcinogenesis. Moreover, COVID-19 is known to cause multiorgan damage, and extensive tissue damage is an oncogenic driver” [34].

2.2.6.2.4 Cardiovascular disease

“Coronavirus infection also affects the inner surfaces of veins and arteries, which can cause blood vessel inflammation, damage to very small vessels, and blood clots and leads to Myocarditis. Viral infections can cause cardiomyopathy, a heart muscle disorder that affects the heart’s ability to pump blood effectively. When attacked by a virus, the body undergoes stress and releases a surge of chemicals called catecholamines, which can stun the heart” [35].

2.2.6.2.5 Lung disease

“In COVID – 19 if pneumonia progresses, more of the air sacs can become filled with fluid leaking from the tiny blood vessels in the lungs. Eventually, shortness of breath sets in, and can lead to acute respiratory distress syndrome (ARDS), a form of lung failure” [36].

3. RESULTS

Data collected on 5 drugs for acute diseases show an average percentage increase of 62.33% (Table 2) in drug consumption between the pre and post COVID – 19 period whereas the 5

drugs for chronic conditions show an increase of 86.39% (Table 3). The graphical representation (Fig. 1 & Fig. 2) of every drug is exponential. Here it states that the demand for the drug accelerated from 2020 to 2022, and so did its sale, showing that the pharmacy followed a good inventory control method to match with the hike in demand.

3.1 Advantages of ABC – FSN Model of Inventory

The ABC analysis is the widely used model of inventory control in most of the healthcare fields, but as we have seen the ABC analysis has many limitations which are reducing the efficiency and profit outcome. Thus, this type of limitation can be overcome by following a new type of criteria. The FSN model of inventory control has many pros which follows [37].

- i. FSN is a simple method to identify deadstock, preventing you from stacking products that barely have any demand in the market.
- ii. FSN analysis also enables you to decide on the budget of a particular product and the quantity that should be bought. As a result, it helps to avoid blocking money in slow-moving or non-moving goods.
- iii. Based on FSN analysis, you can keep the fast-moving goods closer to you in a warehouse that is easily accessible and it reduces time.

Thus, FSN analysis has the potential to overcome the limitation of ABC. Therefore, the ABC – FSN model of inventory method is a successful method in practice.

4. DISCUSSION

“As compared to ABC analysis, FSN works with usage rate and ABC works with annual consumption value. As per the importance of materials in production ABC and FSN are used. FSN techniques significantly reduce unnecessary motions while issuing materials if they are arranged accordingly. From the classification F items based on consumption rate F items are those which move Fastly and constitute 60% of total components. S items are those which move Slowly and constitute 20% of total components and N items are those which do not move (Non-moving items) constitute 20%” [38].

Table 2. The average percentage increase for acute disease drugs

Drugs for Acute disease conditions				
Percentage increase in consumption during pre and post COVID – 19				
S. No	Drug name	Pre - COVID	Post - COVID	Percentage change
1	PAN - 40	1851	2473	25.15%
2	DOLO - 650	3470	6051	42.65%
3	MONTEK LC	41	184	77.72%
4	LOPARET	13	152	91.45%
5	DULCOFLEX	20	79	74.68%
The average percentage increase for Acute disease drugs				62.33%

S. No – Serial number

Table 3. The average percentage increase for Chronic disease drugs

Drugs for Chronic disease conditions				
Percentage increase in consumption during pre and post COVID – 19				
S. No	Drug name	Pre - COVID	Post - COVID	Percentage change
1	GLYCOMET - 500	63	383	83.55%
2	UDILIV - 300	439	2399	81.70%
3	CAPETERO - 500	11	1245	99.12%
4	CLOPITAB - A	16	121	86.78%
5	ORCIBEST - 10	29	151	80.79%
The average percentage increase for Chronic disease drugs				86.39%

S. No – Serial number

“The ABC- FSN matrix shows that there are 3x3=9 elements indicating nine different classes as AF, AS, AN, BF, BS, BN, CF, CS, and CN. All nine class has their priorities. So, based on the priorities all nine classes are categorised in only three categories say category I, category II, and category III” [39].

Based on the priority matrix, elements of ABC-FSN matrix AF, AS, AN, BF, and CF, being the most important inventory are grouped into sub-category I, BS, BN, and CS having medium importance are grouped into sub-categories II, and only CN being least important or have no important at all are grouped into subcategory III.

“This categorization of drugs based on ABC – FSN matrix analysis helps identify the group of drugs that need strict monitoring and control. The drugs are narrowed down by the priority-based analysis and it is simplifying monitoring and control strategies of pharmaceutical drugs and leads the pharmacy to provide customer requirements in an efficient manner” [40].

5. CONCLUSION

From this study, we can understand that during the pandemic (COVID-19) the ABC – FSN method holds hands with the pharma sector to meet the essential needs of the patients.

Thus, the constraints and problems faced during COVID–19 by the hospital inventory management can be overcome by implementing a new inventory model and attaining serviceability effectively and efficiently. The initial step to a successful inventory model is to choose based on the current situation. The ABC – FSN inventory matrix was established based on priority and refocused on the drugs for monitoring and control strategies of pharmacy drugs. In the future, if all these are done, high-quality service to the customer can be provided and there will be an adequate supply of the items in the pharmacies [41].

Better ways of inventory methods to manage stressful conditions like the pandemic (COVID–19) can be developed in the upcoming days of future. The ABC – FSN inventory method provides us with a positive side. But in the future, better ways can bring new changes and development in pharmacies.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

1. Singh Vishavdeep, Singh Harwinder, Singh Sukhjeet. Drug Inventory Management of a Pharmacy Store by Combined Abc- Ved Analysis. International Journal on Mechanical Engineering and Robotics (IJMER). 2015;3:19-22. Available: https://www.researchgate.net/publication/309488145_Drug_Inventory_Management_of_A_Pharmacy_Store_by_Combined_Abc_Ved_Analysis
2. Kelly H. The classical definition of a pandemic is not elusive. Bull World Health Organ. 2011; 89(7):540-1. DOI: 10.2471/BLT.11.088815. PMID: 21734771; PMCID: PMC3127276
3. Arif Kivrak, Berdan Ulaş, Hilal Kivrak, A comparative analysis for anti-viral drugs: Their efficiency against SARS-CoV-2, International Immunopharmacology. 2021;90:107232. ISSN 1567-5769. DOI.org/10.1016/j.intimp.2020.107232 Available: <https://www.sciencedirect.com/science/article/pii/S1567576920336997>
4. "Acute Illness." Segen's Medical Dictionary. 2011. Farlex, Inc; 2022. Available: <https://medical-dictionary.thefreedictionary.com/Acute+Illness>
5. Bernell, Stephanie, and Steven W Howard. "Use Your Words Carefully: What Is a Chronic Disease?" Frontiers in public health. 2016;4:159. DOI:10.3389/fpubh.2016.00159

Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4969287/>

6. Anonymous, Pantoprazole, Medline Plus, National Library of Medicine, Last Revised; 2022. Available: <https://medlineplus.gov/druginfo/meds/a601246.html>
7. Anonymous, Acetaminophen, U.S. Food and Drug Administration; 2022. Available: <https://www.fda.gov/drugs/information-drug-class/acetaminophen>
8. Anonymous, Levocetirizine, Drug Bank online, Drug created at. 2008;16:21 / Accessed on. 2021;21:43. Available: <https://go.drugbank.com/drugs/D06282>
9. Anonymous, Loparet Tablet, Medi Buddy. Available: <https://www.medibuddy.in/medicines/loparet-tablet#:~:text=Loparet%20Tablet%20is%20a%20Tab>
10. Anonymous, Dulcoflex Tablet 10's, Apollo pharmacy. Available: <https://www.apollopharmacy.in/otc/dulcoflex-tablet>.
11. Anonymous, Glycomet 500 MG Tablet, Practo, Last updated on; 2023. Available: <https://www.practo.com/medicine-info/glycomet-500-mg-tablet-4909>
12. National Centre for Biotechnology Information. "Pub Chem Compound Summary for CID 31401, Ursodeoxycholic acid" PubChem. Available: <https://pubchem.ncbi.nlm.nih.gov/compound/Ursodeoxycholic-acid> Accessed on 9 July 2023.
13. Anonymous, Capetero 500 mg Tablet, TATA 1mg. Available: <https://www.1mg.com/drugs/cape-tero-500mg-tablet-311467>
14. Information Checked by Dr M. Sree Mohana Preetha, Pharm D Further Checked by Dr. M. Janani Priya, Pharm D, Clopitab (75mg) (Clopidogrel) Drug Price and Information. Available: [https://www.medindia.net/drug-price/clopidogrel/clopitab-75mg.htm#:~:text=Clopidogrel\(Plavix](https://www.medindia.net/drug-price/clopidogrel/clopitab-75mg.htm#:~:text=Clopidogrel(Plavix)
15. Anonymous, Orcibest 10Mg Tablet, Lybrate. Available: <https://www.lybrate.com/medicine/orcibest-10mg-tablet>
16. Fekadu, Ginenus et al. Impact of COVID-19 pandemic on chronic diseases care follow-up and current perspectives in low resource settings: A narrative review. International Journal of Physiology,

- Pathophysiology and Pharmacology. 2021;13(3):86-93.
Available:<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8310882/>
17. Singh K, Kondal D, Mohan S. et al. Health, psychosocial, and economic impacts of the COVID-19 pandemic on people with chronic conditions in India: A mixed methods study. *BMC Public Health*. 2021;21:685
Available:<https://doi.org/10.1186/s12889-021-10708-w>
 18. Community pharmacy practice, By Ramesh Adepu, PharmaMed Press. 2015;83,84,86.
 19. Haque M, Kumar S, Charan J, Bhatt R, Islam S, Dutta S, Abhayanand JP, Sharma Y, Sefah I, Kurdi A, Wale J, Godman B. Utilisation, Availability and Price Changes of Medicines and Protection Equipment for COVID-19 Among Selected Regions in India: Findings and Implications. *Front Pharmacol*. 2021 Jan 14;11:582154.
DOI: 10.3389/fphar.2020.582154
PMID: 33628172; PMCID: PMC 7898674.
Available:<https://pubmed.ncbi.nlm.nih.gov/33628172/>
 20. Piette, John D et al. Medication cost problems among chronically ill adults in the US: did the financial crisis make a bad situation even worse? Patient preference and adherence. 2011;5:187-94.
DOI: 10.2147/PPA.S17363
Available:<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3090380/>
 21. Assessment of Pharmaceutical Store and Inventory Management in Rural Public Health Facilities—A study with reference to Udupi District, Karnataka. Monica Balakrishnan Kokilam1, Harish Ganesh Joshi, Veena Ganesh Kamath (pdf). Available:<https://www.phmethods.net/articles/assessment-of-pharmaceutical-store-and-inventory-management-in-rural-public-health-facilities-a-study-with-reference-to-u.pdf>
 22. Dr. IR. Rob van Stekelenborg, Why ABC-analysis is inadequate for your supply chain, CPIMJul 1, 2020THE JIT COMPANY Products and Services, Just-in-Time Manufacturing.
Available:<https://thejitcompany.com/abc-analysis-inadequate-supply-chain/>
 23. Keshav poudel, advantages and disadvantages of abc analysis, benefits-drawbacks.available: Advantages And Disadvantages Of ABC Analysis | Benefits-Drawbacks
 24. Alia Nikolakopulos, Advantages and Disadvantages of ABC Analysis Inventory. *Chron. Newsletters*; 2019. Advantages and Disadvantages of ABC Analysis Inventory (chron.com)
 25. Abby Jenkins, Product Marketing Manager, ABC Analysis in Inventory Management: Benefits & Best Practices; 2020.
Available:<https://www.netsuite.com/portal/resource/articles/inventory-management/abc-inventory-analysis.shtml>
 26. Stefan de Kok, Supply Chain Innovator, Stop Driving Inventory by ABC! Published; 2016.
Available:<https://www.linkedin.com/pulse/stop-driving-inventory-abc-stefan-de-kok>
 27. Smriti Chand. The A.B.C. Method of Inventory Control System: Advantages and Disadvantages.
Available:<https://www.yourarticlelibrary.com/inventory-control-the-a-b-c-method-of-inventory-control-system-advantages-and-disadvantages/26150>
 28. Yoh Arita, Shohei Yamamoto, Manabu Nagata, Nobuyuki Ogasawara, Shinji Hasegawa, Long COVID presenting with intermittent fever after COVID-19 pneumonia, *Radiology Case Reports*. 2021;16(9):2478-2481.ISSN1930-0433.
DOI: 10.1016/j.radcr.2021.05.081.
Available:<https://www.sciencedirect.com/science/article/pii/S1930043321003769>
 29. Allergic Reactions Including Anaphylaxis After Receipt of the First Dose of Moderna COVID-19 Vaccine — United States; 2020–2021. *MMWR Morb Mortal Wkly Rep*. 2021;70:125–129.
DOI:<http://dx.doi.org/10.15585/mmwr.mm7004e1externalicon>
Available:<https://www.cdc.gov/mmwr/volumes/70/wr/mm7004e1.htm>
 30. Anonymous, Digestive issues after COVID-19: Watch out for these symptoms, *The Indian Express*. Epaper, Today's Paper; 2023.
Available:Digestive issues after COVID-19: Watch out for these symptoms | Lifestyle News, *The Indian Express*
 31. Anonymous, Coronavirus: Digestive Post-COVID Symptoms To not ignore after recovery, As Per Doctors, *TIMESOFINDIA.COM*, Last updated on. 2021;14:22 IST.
Available:<https://m.timesofindia.com/lifestyle/health-fitness/health->

- news/coronavirus-digestive-post-covid-symptoms-to-not-ignore-after-recovery-as-per-doctors/amp_etphotostory/84137295.cms
32. Zhang T, Mei Q, Zhang Z, et al. Risk for newly diagnosed diabetes after COVID-19: A systematic review and meta-analysis. BMC Med. 2022;20:444. Available: <https://doi.org/10.1186/s12916-022-02656-y>
33. Martinez MA, Franco S. Impact of COVID-19 in liver disease progression. Hepatol Commun. 2021;5:1138-1150. Available: <https://doi.org/10.1002/hep4.1745>
34. Saini G, Aneja R. Cancer as a prospective sequela of long COVID-19. Bioessays. 2021;43(6):e2000331. DOI: 10.1002/bies.202000331 Epub 2021 Apr 29. PMID: 33914346; PMCID: PMC8206711.
35. Wendy Susan Post, MD, MS. Nisha Aggarwal Gilotra, MD. Heart Problems after COVID-19. Available: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/heart-problems-after-covid19#:~:text=Yes%3A%20Although%20COVID%2D19%20is,oxygen%20can%20reach%20the%20bloodstream> Accessed on April 28, 2022.
36. Panagis Galiatsatos MD, MHS. COVID-19 Lung Damage. Available: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/what-coronavirus-does-to-the-lungs#:~:text=What%20does%20COVID%20do%20to,the%20lungs%20and%20other%20organs> Accessed on February 28, 2022.
37. Rhema Hans, Understanding FSN (Fast, Slow, Non-Moving) Inventory Analysis. Understanding FSN (Fast, Slow, Non-Moving) Inventory Analysis (deskera.com).
38. Ghewari, Asita. (2020). An Inventory Control using ABC Analysis and FSN Analysis. (PDF) An Inventory Control using ABC Analysis and FSN Analysis (researchgate.net)
39. Selective inventory control using ABC and FSN analysis in retail sector: A Case Study, 2022. International Journal for Research in Applied Science & Engineering Technology (IJRASET) Available: <https://doi.org/10.22214/ijraset.2022.43648> <https://www.ijraset.com/best-journal/selective-inventory-control-using-abc-and-fsn-analysis-in-retail-sector>
40. Palanisamy, Manivel, Ranganathan, Rajesh. Prioritized FSN analysis of inventory management in private and hospital pharmacy followed by questionnaire. International Research Journal of Pharmacy. 2017;7:104-113. DOI: 10.7897/2230-8407.0712155 Available: https://www.researchgate.net/publication/312186132_Prioritized_Fsn_Analysis_Of_Inventory_Management_In_Private_And_Hospital_Pharmacy_Followed_By_Questionnaire
41. Manivel P, Rajesh Ranganathan. Prioritized ABC – FSN analysis of inventory management in private and hospital pharmacy followed by questionnaire. Int. Res. J. Pharm. 2016; 7(12):104-113. Available: <http://dx.doi.org/10.7897/2230-8407.0712155>

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