



**ORIGINAL RESEARCH PAPER**

**Management**

**MARKET BASKET ANALYSIS OF MEDICAL STORES DURING COVID19 TO DISCOVER NEW REVENUE PRODUCTS**

**KEY WORDS:** Market Basket Analysis, Apriori algorithm, Lift and Confidence, COVID19

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**ABSTRACT**

COVID 19 pandemic has negatively affected almost all sectors of Indian economy, but few sectors like pharmaceuticals, have seen growth during this period. This has spurred sales of specific medicines and equipment in pharmacies. However, for better profit margin, pharmacies have to look beyond traditional medicines and equipment. This research helps in identifying uncommon items which can be sold along with medicines by pharmacies in Tiruvallur district for better profit margin. This is achieved through market basket analysis of transactions carried out in pharmacies.

**I. INTRODUCTION**

Indian pharmaceutical sector ranks 3<sup>rd</sup> in the world as far as sales volume is concerned. With an annual turnover of Rs. 2.89 Lakh Crore for the year 2019-2020, it is a major force in India's economic development. The pharmaceutical sector is also major source of employment. As per Statistica, 8,00,000 retail pharmacies (Medical Stores) are spread across India and are dominant channel of medicine distribution. This ensures that pharmacies are major source of employment. During the peak of COVID19 pandemic, pharmacies continued to operate and contributed in controlling COVID19 pandemic. Such an important distribution channel is under constant pressure to maintain profit margins and improve turnover to remain in business. Government's effort to control prices of medicines and medical equipment has brought down the profit margins of pharmacies further down. The pharmacies have to discover new non-traditional product to distribute and improve their profit margin and maintain business. Market Basket Analysis is one of the techniques which can come to rescue and help in discovering new products through sales association. This research outlines the methodology to ferret out new products through Market Basket Analysis.

**II. LITERATURE REVIEW**

Hruschka, H (2021) in his article "Comparing unsupervised probabilistic machine learning methods for market basket analysis" compared Dirichlet allocation and the correlated topic model, the restricted Boltzmann machine and the deep belief net. It was found that among these models of Market Basket Analysis, deep belief net with 45 variables in the first and 15 variables in the second hidden layers was the best model.

Ünvan, YA (2021) in his article "Market basket analysis with association rules" conducted market basket analysis on sales data of supermarket received from the Vancouver Island University. The result showed that the top rule was "a customer who buys Milk, Sweet Relish and Pepperoni Pizza (Frozen) also gets eggs" with 21.06 Conviction and 1 (100%) confidence values.

Rao, AB, & Kiran, JS (2021) in their research paper presented the application of Market Basket Analysis in healthcare. The research paper presented method to find frequent diseases that occur together in an area by using the Apriori algorithm.

**III. OBJECTIVES OF THE STUDY**

- Find the maximum number of useful product associations in pharmacies using Market Basket Analysis based on Lift value.
- Find the top 5 product associations in pharmacies using Market Basket Analysis Rules
- Discover new revenue product using Market Basket Analysis Rules.

**IV. METHODOLOGY**

**Sample and Sampling Method**

In Tiruvallur suburban area of Tamilnadu, five medical shops from two different pharmacy chains were selected using convenient sampling method. 230 transactions from each of the five medical shops were selected using simple random sampling. Out of the total 1150 transactions, 51 transactions were ignored due to data corruption when extracting and converting from the database. Thus 1099 transactions were used for the analysis. The items included for analysis are: Paracetamol tablets, Zinc Supplement, Multivitamin tablets, Diahorria tablet, Thermometer, Sanitizer, Blood Pressure Meter, Oximeter, Mask and Acupressure Slipper.

**Procedure**

Transaction data during COVID period from March 1, 2021 to April 1, 2021 was collated from selected medical shops. Ten top selling items during the period were recorded for analysis. Items which were bought were assigned nominal value of '1' and items not bought were assigned '0'. A sample transaction is shown in Table 1

**Table 1: Items Analyzed in Transaction**

ID	Paracetamol	Zn Supplement	Multivitamin	Diahorria	Thermometer	Sanitizer	BP Meter	Oximeter	Mask	Acupressure Slipper
t1	1	0	0	0	0	1	0	1	1	0
t2	1	1	1	1	1	0	1	0	0	1
t3	1	0	0	1	0	0	0	1	0	0
t4	1	1	0	0	1	1	1	0	1	0
t5	0	1	0	1	1	0	0	0	0	1

The above table 1 indicates the nominal value assigned to the items bought. For e.g. in Transaction 1 (t1), the items bought by customer include Paracetamol, Sanitizer, Oximeter and Mask. These were assigned the nominal value of '1'. Zn Supplement, Multivitamin, Diahorria, Thermometer, BP Meter and Acupressure Slipper were not bought so they are assigned the value of '0'.

The Market Basket Association rule is commonly measured by Coverage, Support, Confidence, Lift, Conviction and Leverage.

**These terms are defined below:**

**Coverage:** Coverage measures the frequency of any item set in the transaction data set.

**Support:** It measures how frequently collections of items were bought together as a percentage of all transactions. Higher support indicates stronger buying correlation between two items.

**Confidence:** It is basically conditional probability. If there are items: X and Y, confidence measures the percentage of times item Y was purchased, given that item X was purchased. Confidence values ranges from 0 to 1. Higher confidence value indicates that the item Y will be purchased in more number of cases given that X was purchased.

**Lift :** It is the ratio of Confidence / Support of item sets. It is the main measure which is used to determine the usefulness of Market Basket Analysis rule. If Lift of item set is above 1, then the items will be bought together more often.

**Conviction:** It is similar to lift but unlike lift it is a directed measure. It compares the probability that X appears without Y with the actual frequency of the appearance of X without Y in the transaction data.

**Leverage :** Leverage measures the difference of X and Y appearing together in the data set and what would be expected if X and Y were statistically dependent. It helps in finding how many more units of items X and Y together are sold than expected from the independent sales of X and Y item.

**Algorithm:** In order to calculate Support, Confidence and Lift, Open source Weka 3.8.5 software's Apriori algorithm was used for Market Basket association analysis. The Metric type was set to Lift with Minimum Metric value of 1 and Number of Rules was changed to 30. The rest of the values were set as default.

**V. DATA ANALYSIS**

The Market Basket Analysis of the transactions led to generation of 26 rules with Lift above 1. The results of the analysis are tabulated below:

**Table 2: Market Basket Analysis Rules**

Sl No.	Antecedent	Consequent
1	Diahorria=1 Thermometer=1 270	Mask=1 154 conf:(0.57) < lift:(1.15)> lev:(0.02) [20] conv:(1.17)
2	Mask=1 543	Diahorria=1 Thermometer=1 154 conf:(0.28) < lift:(1.15)> lev:(0.02) [20] conv:(1.05)
3	Thermometer=1 558	Zn Supplement=1 Mask=1 157 conf:(0.28) < lift:(1.15)> lev:(0.02) [20] conv:(1.05)
4	Zn Supplement=1 Mask=1 268	Thermometer=1 157 conf:(0.59) < lift:(1.15)> lev:(0.02) [20] conv:(1.18)
5	Thermometer=1 BP Meter=1 290	Mask=1 163 conf:(0.56) < lift:(1.14)> lev:(0.02) [19] conv:(1.15)
6	Mask=1 543	Thermometer=1 BP Meter=1 163 conf:(0.3) < lift:(1.14)> lev:(0.02) [19] conv:(1.05)
7	Paracetamol=1 Thermometer=1 274	Sanitiser=1 154 conf:(0.56) < lift:(1.14)> lev:(0.02) [18] conv:(1.15)
8	Sanitiser=1 543	Paracetamol=1 Thermometer=1 154 conf:(0.28) < lift:(1.14)> lev:(0.02) [18] conv:(1.05)
9	Thermometer=1 558	Diahorria=1 Mask=1 154 conf:(0.28) < lift:(1.14)> lev:(0.02) [18] conv:(1.04)
10	Diahorria=1 Mask=1 267	Thermometer=1 154 conf:(0.58) < lift:(1.14)> lev:(0.02) [18] conv:(1.15)
11	Thermometer=1 558	Multivitamin=1 Mask=1 152 conf:(0.27) < lift:(1.13)> lev:(0.02) [17] conv:(1.04)

12	Multivitamin=1 Mask=1 264	Thermometer=1 152 conf:(0.58) < lift:(1.13)> lev:(0.02) [17] conv:(1.15)
13	Multivitamin=1 Thermometer=1 284	Sanitiser=1 159 conf:(0.56) < lift:(1.13)> lev:(0.02) [18] conv:(1.14)
14	Sanitiser=1 543	Multivitamin=1 Thermometer=1 159 conf:(0.29) < lift:(1.13)> lev:(0.02) [18] conv:(1.05)
15	Thermometer=1 558	Zn Supplement=1 Sanitiser=1 153 conf:(0.27) < lift:(1.13)> lev:(0.02) [17] conv:(1.04)
16	Zn Supplement=1 Sanitiser=1 267	Thermometer=1 153 conf:(0.57) < lift:(1.13)> lev:(0.02) [17] conv:(1.14)
17	BP Meter=1 Accupressure Slipper=1 274	Paracetamol=1 153 conf:(0.56) < lift:(1.12)> lev:(0.02) [16] conv:(1.13)
18	Paracetamol=1 547	BP Meter=1 Accupressure Slipper=1 153 conf:(0.28) < lift:(1.12)> lev:(0.02) [16] conv:(1.04)
19	BP Meter=1 Mask=1 288	Thermometer=1 163 conf:(0.57) < lift:(1.11)> lev:(0.02) [16] conv:(1.13)
20	Thermometer=1 558	BP Meter=1 Mask=1 163 conf:(0.29) < lift:(1.11)> lev:(0.02) [16] conv:(1.04)
21	Thermometer=1 558	Sanitiser=1 Mask=1 154 conf:(0.28) < lift:(1.11)> lev:(0.01) [15] conv:(1.04)
22	Sanitiser=1 Mask=1 273	Thermometer=1 154 conf:(0.56) < lift:(1.11)> lev:(0.01) [15] conv:(1.12)
23	Sanitiser=1 543	Multivitamin=1 Mask=1 144 conf:(0.27) < lift:(1.1)> lev:(0.01) [13] conv:(1.03)
24	Multivitamin=1 Mask=1 264	Sanitiser=1 144 conf:(0.55) < lift:(1.1)> lev:(0.01) [13] conv:(1.1)
25	Sanitiser=1 543	Multivitamin=1 Accupressure Slipper=1 149 conf:(0.27) < lift:(1.1)> lev:(0.01) [13] conv:(1.03)
26	Multivitamin=1 Accupressure Slipper=1 274	Sanitiser=1 149 conf:(0.54) < lift:(1.1)> lev:(0.01) [13] conv:(1.1)

Conf: Confidence, lev: Leverage, conv: Conviction

The table shows rules which have Lift value above 1. It can be noted from the table that

**The top 5 rules based on Lift value are:**

**Table 3: Top 5 Market Basket Analysis Rules**

Antecedent	Consequent
Diahorria=1 Thermometer=1 270	Mask=1 154 conf:(0.57) < lift:(1.15)> lev:(0.02) [20] conv:(1.17)
Mask=1 543	Diahorria=1 Thermometer=1 154 conf:(0.28) < lift:(1.15)> lev:(0.02) [20] conv:(1.05)
Thermometer=1 558	Zn Supplement=1 Mask=1 157 conf:(0.28) < lift:(1.15)> lev:(0.02) [20] conv:(1.05)
Zn Supplement=1 Mask=1 268	Thermometer=1 157 conf:(0.59) < lift:(1.15)> lev:(0.02) [20] conv:(1.18)
Thermometer=1 BP Meter=1 290	Mask=1 163 conf:(0.56) < lift:(1.14)> lev:(0.02) [19] conv:(1.15)

- In 1<sup>st</sup> rule , Lift is 1.15 ,Confidence if 0.57 ,Leverage is 0.02 and Conviction is 1.17

- 2<sup>nd</sup> rule shows Lift is 1.15 ,Confidence if 0.28 ,Leverage is 0.02 and Conviction is 1.05
- 3<sup>rd</sup> rule indicates Lift is 1.15 ,Confidence if 0.28 ,Leverage is 0.02 and Conviction is 1.05
- 4<sup>th</sup> rule shows Lift is 1.15 ,Confidence if 0.59 ,Leverage is 0.02 and Conviction is 1.18
- In 5<sup>th</sup> rule , Lift is 1.14 ,Confidence if 0.56 ,Leverage is 0.02 and Conviction is 1.15
- The interesting rule which will help pharmacies sell unusual items in pharmacies and get better margin is indicated in rule 25.

25	Sanitis	Multivitamin=1	Accupressure Slipper=1	149
	er=1	conf:(0.27)	< lift:(1.1)>	lev:(0.01) [13] conv:(1.03)
	543			

- It can be noted that people who bought Sanitiser also bought Multivitamin and Accupressure Slipper. Here the interesting and unusual item is Accupressure Slipper which can be sold by pharmacies to get better margin. This would not have been discovered without Market Basket Analysis. For this rule, Lift is 1.1 ,Confidence is 0.27 ,Leverage is 0.01 and Conviction is 1.03. The lift of greater than 1 indicates that the association between the Antecedent and Consequent is good. The confidence of 0.27 shows that 27% of people who bought sanitizer also bought Multivitamin and Accupressure.

## VI. FINDINGS AND DISCUSSION

The Market Basket Analysis brought forth 26 rules with Lift of above 1, indicating that the customers of Tiruvallur pharmacies buy wide range of associated Over the Counter (OTC) products. This bodes well for pharmacies and pharmaceutical companies which can examine the rules and they can promote related OTC products based on customers initial sale. The analysis also helped in discovering non-traditional products sales through pharmacies. The discovery of Accupressure slipper as a new additional stock keeping unit (SKU) will help widen the product range and improve profit margin for pharmacies. Market Basket Analysis can thus help discover new avenues of revenue for pharmacies.

## VII. CONCLUSION

The research highlights an innovative approach to discover new products association through Market Basket Analysis rules and exploit the rules to improve profit margins of pharmacies. This approach is generalized approach and can be implemented across various industries and across geographical region where the transaction data can be collated. This research is also a reference point for further study to optimize sales and product placement in pharma and consumer retail.

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