

Apriori Algorithm for Surgical Consumable Material Standardization

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Abstract: Medical Surgical is an activity with zero mistake due to the slightest mistake in a surgery will not be tolerated in terms of medical, law and humanity. Surgical success would be determined by pre-surgical preparation, wherein each operating room personnel or the surgeon is required to accurately prepare everything to avoid delay in surgery. Therefore, the data mining system to determine the standardization of consumable material on surgery is required. In this study, Apriori algorithm is used to resolve the issue. The results obtained show that the Apriori algorithm can be applied in order to standardize the use of consumables material in the surgical unit.

Keywords: Apriori Algorithm, Hospital, Surgery, Association Rule, Data mining.

I. Introduction

A surgery is an activity with zero mistake, in which any little mistake in surgery action could not be tolerated in medical, law, and humanity sides. The successful of a surgery is highly determined by its pre-surgery preparation. Surgery room officer or the surgery doctor have to prepare everything from room, surgery instrument, consumable surgery material, including anesthesia until preparing the patient mental condition. Particularly in the matter of preparing the instrument and the consumable material, the experts (the surgery doctor and the surgery room officer) need a standardization system for predicting pre-surgery consumable material. Due to the experts rely on personal experience to determine the consumables to be used in an operation. Reza et al (2015) found an inconsistency in determining consumables for the same type of surgery by different surgeons.

For these problems, no study has specifically addressed the standardization of consumables material in the surgical unit, only focus on the availability of information systems alone. For example on the research that has been performed by Shusaku Tsumoto and Shoji Hirano (2009), the researchers only cover the availability of information systems for management stock of consumable materials. Whereas, incomplete consumables materials may cause delay in the surgery implementation which can lead to infection in the surgical process (Rudianto, 2012). Meanwhile, Patzakis and Wilkins in a review of 1025 open fractures reported that the infection rate was 4.7% (seventeen out of 364 samples) when it is started within three hours after injury and 7.4% (forty out of 661 samples) when has started four hours or more after five injury.

Pre-surgical preparations were not complete will have an impact on patients' health in general and the impact on hospital management in particular. Delay in surgery will lead to high levels of waiting time and overtime on the entire operating schedule. The high Waiting time will have an impact on the health of patients and the level of satisfaction of patients to hospital care. Otherwise it will affect the schedule for the next surgery. While overtime will have an impact on the quality of the services provided such officer. In addition, overtime costs to be incurred equal to 1.75 times higher than the cost to be incurred in the normal state (Dexter, 2002).

So with that problem, it is highly required a system which can optimally help to determine kind of tools and materials on the surgery action in terms of the increasing of hospital performance and reputation.

As for of the preliminary observation result is obtained information that the service in surgery room in XYZ hospital which is being a sample, as follows:

1. Those who prepare The Consumable Tool Material will be prepared by surgeon and surgery nurse.
2. In some cases, the senior surgeon assigned resident doctor for educational purpose.
3. Surgery classified into medium, large and specialized surgery.
4. The data is from surgery room transactional data and surgery room pharmacy unit. The data is from the transactional data surgical rooms and the pharmaceutical unit surgical room.

II. Apriori Algorithm

Priori algorithm is an algorithm with the rules associative data retrieval (Association rule) to determine the relationship associative a combination of items (Kusrini, 2007). Association Rule is done through a calculation mechanism support and confidence of a relationship item. An association rule will be successful if the value of the support is greater than the minimum support and confidence value is greater than the minimum confidence.

The basic idea of this algorithm is to develop frequent itemset. To develop frequent set with two items, can be used frequent item sets. Because if the item does not exceed the minimum support set then any item with larger size will not exceed the minimum support. In general, developing a set with fc-item used frequent sets with k-1 items developed in the previous step. Each step requires one check to the entire contents of the database.

Structure of Apriori Algorithm

The first phase will be analyzed patterns of frequency of occurrence of item A by finding the weight value using the formula in equation (1).

$$\text{Support } A = \frac{\text{the number of transactions containing ...}}{\text{Total transactions}} \quad (1)$$

As for the support value for two items uses formula in equation (2)

$$\text{Support } (A,B) = P(A \cap B) = \frac{\text{the number of transactions containing A and B}}{\text{Total transactions}} \quad (2)$$

If all the high frequency patterns have been found, then the rules of eligible associative for the minimum support confidence value $A \rightarrow B$ are determined by equation (3).

$$\text{confidence } P(A | B) = \frac{\text{the number of transactions containing A and B}}{\text{the number of transactions A}} \quad (3)$$

For example, a Transaction Item Data is shown in Table 1 below.

Table 1: Transaction Item Data

Transaction ID	Item Set
1	Item A, Item C, Item D
2	Item B, Item C, Item E
3	Item A, Item B, Item C, Item E
4	Item B, Item E

If the minimum support is 50% (2 from 4 transactions), the algorithm is described as follows.

Step 1: Find the support value for each item set as shown in the Table 2.

L1= {large 1-itemset}.

Table 2: Support Value for one item set

Item set	Support
A	50%
B	75%
C	75%
D	25%
E	75%

Step 2: Find the item set candidate for L2:

1. Combine the item set on L1 (apriori-gene algorithm)

{ A B, A C, A D, A E, B C, B D, B E, C D, C E, D E}

2. Erase those which are not on the item set. Item set {B D, D E} is erased because it is not on the item set

Step 3: Calculate the support value for each item set. The result can be shown on Table 3.

Table 3: Support Value for two items set

Item set	Support
AB	25 %
AC	50 %
AD	25 %
AE	25%
BC	50%
BE	75%
CD	25%
CE	50%

Step 4: Determine the item set which fulfil the minimum support. The result can be shown on Table 4.
 L2 {large 2-itemset }

Table 4: The member of two Item Sets which fulfil the Minimum Support

Item set	Support
AC	50 %
BC	50%
BE	75%
CE	50%

Step 5: Repeat phase 2-4, until no more support candidate left.
 As for the pseudo code for a priori algorithm as on the figure 1 (Nurchafo, 2013).

```

L1 := { large 1-itemsets };
k := 2; // k represents the pass number
while (Lk-1 ≠ ∅) do
begin
    Ck := New candidates of size k generated from Lk-1; (apriori-gen)
    forall transactions t ∈ D do
        Increment the count of all candidates in Ck that are contained in t;
    Lk := All candidates in Ck with minimum support;
    k := k + 1;
end
Answer := ∪k Lk;
    
```

Figure 1: Pseudo code for Apriori Algorithm

Implementation of a priori algorithm on medical surgery

Generally, the process of apriori algorithm in this research is shown in figure 2 below.

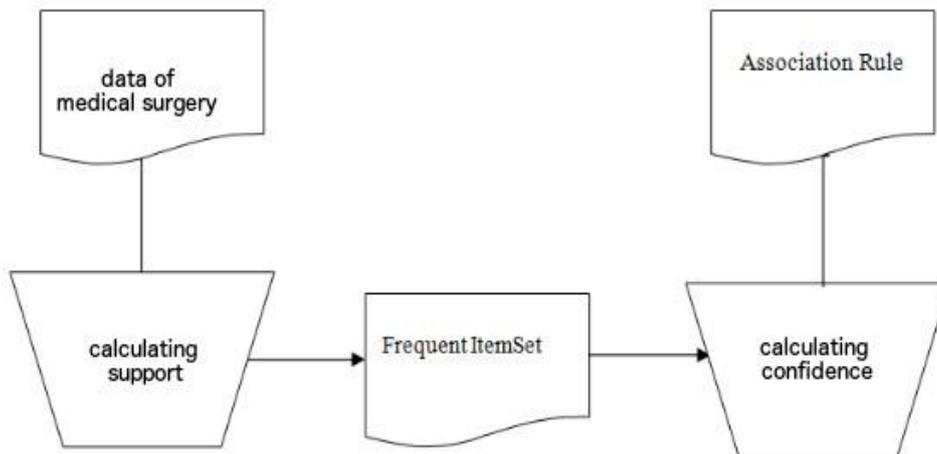


Figure 2: process of a priori algorithm

In the first step, data selection will be removed the noise. Then the results will be input into the system. The data attributes used are patient data, consumables material and the type of surgery. Furthermore, support the value of each item will be calculated which determines the frequency item set. These values will be compared to the minimum support to find the confidence value. The final step is to determine the strong rule based on the highest occurrence frequency value of consumables material.

III. Results And Discussion

The example of preliminary data from hospital XYZ is shown in Table 5 below.

Tabel 5: The example of transaction history data in surgery room

Patient	Consumable materials
A	[CTM] SPOIT SYRINGE 3 ML BD 1 Pcs
	[CTM] OPSITE 9,5 X 8,5 CM 2 PCS
	[MEDICINE] LIDOCAIN 2% INJ KF 7 Amp
	[MEDICINE] DEPO MEDROL INJ VIAL 2 VIA
B	[CTM] SPOIT 50 ML NIPRO 3 PCS
	[CTM] NEEDLE 18 G 1 PCS
	[MEDICINE] BUVANEST 0,5 % 20 ML EPIDURAL 2 V
	[CTM] SPOIT SYRINGE 10 ML BD 2 PCS
	[CTM] EPIDURAL SET DEWASA 1 set
[MEDICINE] LIDOCAIN 2% INJ ETHICA 10 Amp	
C	[CTM] SPOIT SYRINGE 3 ML BD 1 Pcs
	[CTM] SPOIT SYRINGE 10 ML BD 2 PCS
	[MEDICINE] GELOFUSIN 500 ML INFUS 1 Btl
	[CTM] SPOIT SYRINGE 5 ML BD 1 Pcs

Consumable and Tool Material (CTM) data in Table 5 is weighted for each item set using Apriori Algorithm. Weighting results in the form of frequency weighting for 2 items set as shown in figure 3.

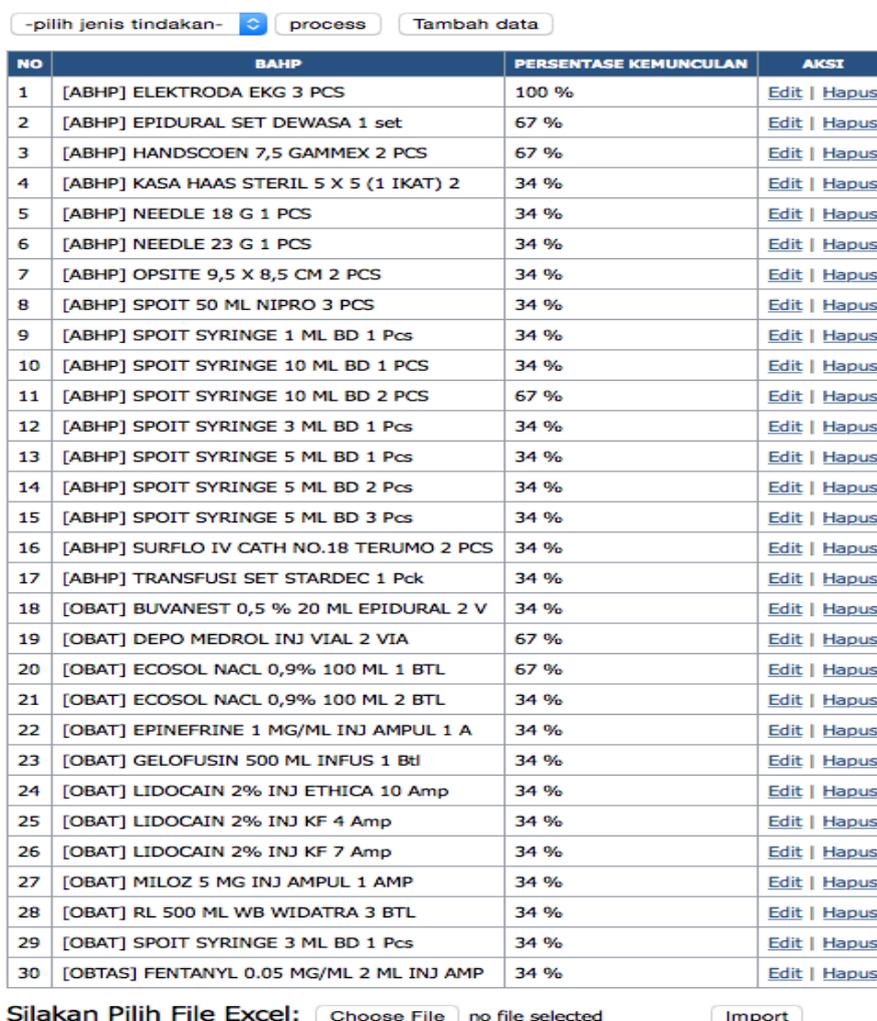


Figure 3: result of weighting itemser frequency

The next step is to perform a second iteration to be compared with the minimum support of 60% for value strong rule of each item set as illustrated in figure 4. The data will be used to determine Consumables by certain surgical operations.

Figure 4: The result of strong rule
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NO	BAHP	PERSENTASE KEMUNCULAN	AKST
1	[ABHP] ELEKTRODA EKG 3 PCS	100 %	Edit Hapus
2	[ABHP] EPIDURAL SET DEWASA 1 set	67 %	Edit Hapus
3	[ABHP] HANDSCOEN 7,5 GAMMEX 2 PCS	67 %	Edit Hapus
4	[ABHP] SPOIT SYRINGE 10 ML BD 2 PCS	67 %	Edit Hapus
5	[OBAT] DEPO MEDROL INJ VIAL 2 VIA	67 %	Edit Hapus
6	[OBAT] ECOSOL NAACL 0,9% 100 ML 1 BTL	67 %	Edit Hapus

IV. Conclusion

The results show that the Apriori algorithm can be applied well for the standardization of consumables surgical material using hospital data transaction, especially in surgery room.

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