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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 pharmachy 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).

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

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

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

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).

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

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 alghorithm)
{ 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 (Nurcahyo, 2013).

L_1 := { large 1-itemsets };
k := 2; // k represents the pass number
while ($L_{k-1} \neq \emptyset$) **do**
begin
  C_k := New candidates of size k generated from L_{k-1}; (*apriori_gen*)
  forall transactions $t \in \mathcal{D}$ **do**
    Increment the count of all candidates in C_k that are contained in t;
  L_k := All candidates in C_k with minimum support;
  k := k + 1;
end
Answer := $\bigcup_k L_k$;

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.

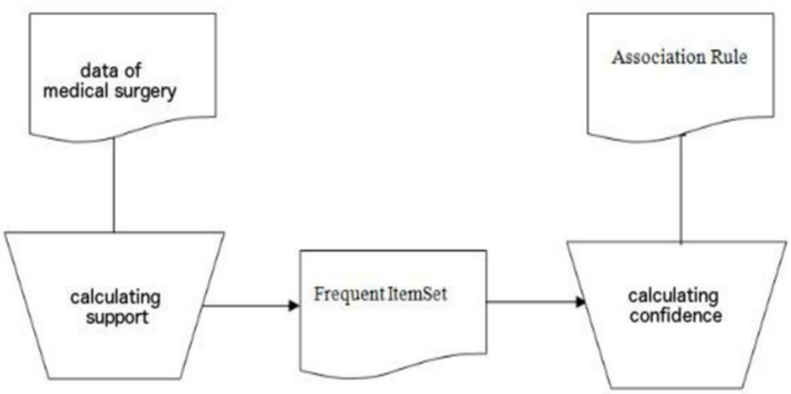

Figure 2: process of a priori algorithm

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.

-pilih jenis tindakan- process Tambah data

NO	BAHP	PERSENTASE KEMUNCULAN	AKSI
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] KASA HAAS STERIL 5 X 5 (1 IKAT) 2	34 %	Edit | Hapus
5	[ABHP] NEEDLE 18 G 1 PCS	34 %	Edit | Hapus
6	[ABHP] NEEDLE 23 G 1 PCS	34 %	Edit | Hapus
7	[ABHP] OPSITE 9,5 X 8,5 CM 2 PCS	34 %	Edit | Hapus
8	[ABHP] SPOIT 50 ML NIPRO 3 PCS	34 %	Edit | Hapus
9	[ABHP] SPOIT SYRINGE 1 ML BD 1 Pcs	34 %	Edit | Hapus
10	[ABHP] SPOIT SYRINGE 10 ML BD 1 PCS	34 %	Edit | Hapus
11	[ABHP] SPOIT SYRINGE 10 ML BD 2 PCS	67 %	Edit | Hapus
12	[ABHP] SPOIT SYRINGE 3 ML BD 1 Pcs	34 %	Edit | Hapus
13	[ABHP] SPOIT SYRINGE 5 ML BD 1 Pcs	34 %	Edit | Hapus
14	[ABHP] SPOIT SYRINGE 5 ML BD 2 Pcs	34 %	Edit | Hapus
15	[ABHP] SPOIT SYRINGE 5 ML BD 3 Pcs	34 %	Edit | Hapus
16	[ABHP] SURFLO IV CATH NO.18 TERUMO 2 PCS	34 %	Edit | Hapus
17	[ABHP] TRANSFUSI SET STARDEC 1 Pck	34 %	Edit | Hapus
18	[OBAT] BUVANEST 0,5 % 20 ML EPIDURAL 2 V	34 %	Edit | Hapus
19	[OBAT] DEPO MEDROL INJ VIAL 2 VIA	67 %	Edit | Hapus
20	[OBAT] ECOSOL NACL 0,9% 100 ML 1 BTL	67 %	Edit | Hapus
21	[OBAT] ECOSOL NACL 0,9% 100 ML 2 BTL	34 %	Edit | Hapus
22	[OBAT] EPINEFRINE 1 MG/ML INJ AMPUL 1 A	34 %	Edit | Hapus
23	[OBAT] GELOFUSIN 500 ML INFUS 1 Btl	34 %	Edit | Hapus
24	[OBAT] LIDOCAIN 2% INJ ETHICA 10 Amp	34 %	Edit | Hapus
25	[OBAT] LIDOCAIN 2% INJ KF 4 Amp	34 %	Edit | Hapus
26	[OBAT] LIDOCAIN 2% INJ KF 7 Amp	34 %	Edit | Hapus
27	[OBAT] MILOZ 5 MG INJ AMPUL 1 AMP	34 %	Edit | Hapus
28	[OBAT] RL 500 ML WB WIDATRA 3 BTL	34 %	Edit | Hapus
29	[OBAT] SPOIT SYRINGE 3 ML BD 1 Pcs	34 %	Edit | Hapus
30	[OBTAS] FENTANYL 0.05 MG/ML 2 ML INJ AMP	34 %	Edit | Hapus

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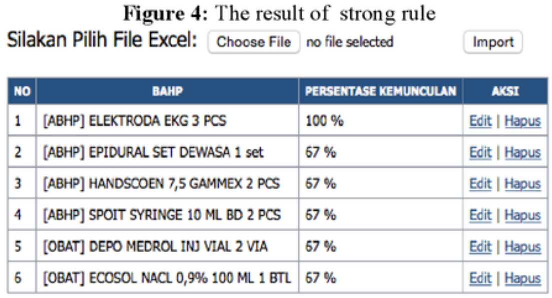
Figure 3: result of weighting itemser frequency

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


Silakan Pilih File Excel: Choose File no file selected Import

NO	BAHP	PERSENTASE KEMUNCULAN	AKSI
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 NACL 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 surgerical material using hospital data transaction, especially in surgery room.

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