Correlation between Laboratory Turnaround Time in Pediatric Emergency Departement and Length of Stay

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ABSTRACT

A quick and precise diagnosis is essential in hospital services, especially in the emergency department. In condition with high volume patients, perfomance of laboratory usually decreases. Studies which identify directly the delay of laboratory examinations in emergency department in relation to length of stay in wards have not been conducted. We did correlative study using secondary data obtained from medical records. Inclusion criteria was child, age range from 29 days to 12 years old who needed supporting laboratory examinations, directly admitted to wards or PICU after getting treatments in emergency department. Exclusion criteria was child with growth and developmental problem, malnutrition, immuncompromised condition, incomplete medical records data, and child died in the emergency department. Average patient in 2016 was 3,6 yeras old and in 2017 was 2 yeras old, mostly boys. Mostly with chief complaints of infections Analysis in 2017 showed correlation coefficient of 0.466 which means there was strong association between laboratory turnaround time and length of stay and statistically significant (p 0.03). multivariate analysis shown there was strong correlation between laboratory turnaround time and length of stay and if the predictive value increased by one unit, the length of stay would increase 6,5%.

Keywords: *lab turnaround time; length of stay; emergency department.*

INTRODUCTION

Most of those studies were still focusing on associating factors related to delayed laboratory examinations with length of stay in emergency department, as well as length of stay in emergency department with length of stay in wards and economic burden. To date, studies which identify directly the delay of laboratory examinations in emergency department in relation to length of stay in wards have not been conducted. Moreover, there are lack of data in pediatric population as the studies only provided data for adult populations, the results could not be generalized in children population. Furthermore, similar studies in Indonesia, both in adult and pediatric populations are still few. Therefore, we conducted retrospective study to identify the association between laboratory turnaround time in pediatric emergency department and length of stay. Understanding of these factors would provide baseline data for consideration of better and effective services which eventually increase patient satisfaction and reduce the cost of hospital admissions and health insurance.

THEORETICAL REVIEW

A quick and precise diagnosis is essential in hospital services, especially in the emergency department (Thomas & Lanoue, 2016). As a one integrated unit, there are different porfessions which had to work in a coordinated way to provide effective and optimal services for the patients. The implication of the workflow is that there is dependency among professions (Quinn, Rudolph & Fairchild 2005).

In addition to anamnesis and physical examinations, physicians rely heavily on information obtained from supporting examinations to determine diagnosis and clinical decision. The most important information is mainly obtained from laboratory examinations (Quinn, Rudolph & Fairchild 2005). According to data of patients in emergency department, it was estimated that 71% of the patients had done one or more supporting

laboratory examinations (Nawar, Niska & Xu J 2005). Similar percentage of patients requiring laboratory examinations to determine diagnosis was stated by Blick, Holland, and Smith, which was about 60-70% patients (Holland, Smith & Blick 2005). Because of its vital role to determine diagnosis in emergency situation, request to speed up the laboratory examinations are often being done (Thomas & Lanoue, 2016).

In condition with high volume patients, as in emergency department, the perfomance of laboratory usually decreases, so that the time needed to complete specimens examinations would increase (Holland, Smith & Blick 2005). This would eventually make the clinical decision-makers difficult in making decision. Finally this condition would affect the condition of patients, which is undetermined, the length of stay in in emergency department would increase, the risk of medicall error would increase, and the patient satisfaction would decrease (Quinn, Rudolph & Fairchild 2005).

The longer length of stay of patients in emergency departmenet, the more space occupied by patients. This would increase the risk of delayed therapy, increased mortality and morbidity, and increased lenght of stay in wards (Storrow, et al 2008). Flabouris et al (2013) stated that length of stay in emergency department was significantly associated with length of stay in wards ($r = 0.07$, $p < 0.01$). Liew et al (2003) also stated that the longer lenght of stay in emergency department independently predicted the longer length of stay in wards, which is length of stay in emergency department < 4 hours, 4-8 hours, 8-12 hours, and > 12 hours (3.37 vs 5.65 vs 6.60 vs 7.2 days). Longer length of stay in wards would make higher economic burden. Huang et al (2010) stated that longer length of stay in emergency department would increase the total hospital cost for about 11.01% (6.0%-16.4%). Nonetheless, Chong et al (2013) stated length of stay in emergency department was known to not have association with mortality rate of patiens in ward (OR = 1.1, CI: 0.9-1.4). This results were contrary to other studies which stated that longer lenth of stay in emergency department would increase mortality rate of patients (Richardson, 2002).

RESEARCH METHODOLOGY

Research design of this study was correlative study using secondary data obtained from medical records. Data was collected from July 2017 to June 2018. Data was classified into two groups, which was data from year 2016 and data from 2017. This classification was done because in 2017 there were policies in Sanglah hospital related to laboratory turnaround time, in which the completion had to be done within 2 hours. The application of these policies encouraged the researchers to analyze the association between laboratory turnaround time and length of stay before and after the policies was applied. Length of stay was presented in days. Accessible population was every children admitted to emergency department of Sanglah Hospital. Inclusion criteria was child, age range from 29 days to 12 years old who needed supporting laboratory examinations, patient who was directly admitted to wards or PICU after getting treatments in emergency department. Exclusion criteria was child with growth and developmental problem, malnutrition, immuncompromised condition, incomplete medical records data, got secondary infection during hospitalized and child died in the emergency department. Sample was selected by random sampling method. Time of specimen examination, time of completing the laboratory result, time of patient admission in the wards, and length of stay in wards were obtained from medical records.

Sample size needed for this study was determined by using corelation analytic numeric-numeric formula as shown below:

$$n = \left[\frac{Z\alpha + Z\beta}{0{,}5 \ln \frac{1+r}{1-r}} \right]^2 + 3$$

Information :

n = sample size
Za = confidence level with standard value 1.96
Zb = standard Beta value = 1,28
R = Korelation koefficient minimal, stated 0,5

The proportion of length of stay < 7 days in < 3 hours laboratory turnaround time was set in 0.5 (Flabouris 2013). According to the formula above, the sample size needed for this study was 45 children.

Age was defined as chronological age of children by the time the children admitted to emergency department. Age was counted in days, months, and years from the date of birth and presented in days, months, and years. Subjects were selected from children age between 29 days to 12 years old. The reason of 12 years being set as cut off was because in Sanglah

Hospital, children age ≤ 12 years old were the children allowed to be admitted to pediatric wards during research period.

According to Thomas and Lanoue (2016) as cited by Strrow et al (2008) laboratory turnaround time was duration of the first time, the blood specimen withdrawed until the time the result of laboratory examination was reported and verified. We then divided laboratory turnaround time into three groups, which were < 1 hours, 1-3 hours, and > 3 hours. We assumed that all laboratory examinations were affected by laboratory condition.

Length of stay in emergency department was the duration of patients spent in emergency department from the first time patient admitted to the emergency department until the time the decision of admitting the patient to pediatric ward was made. Length of stay in emergency department was recorded in minutes and hours (Huang et al, 2010).

Length of stay in pediatric ward or PICU was the duration from the decision making of admitting patients to the ward to the time when patient was released from the ward or PICU. Length of stay in pediatric ward or PICU was recorded in hours and days. Length of stay in pediatric ward was divided into two groups, < 7 days group and > 7 days group.

Triage in emergency department was adapted from 5 level of emergency severity index (ESI) which could be applied both in children and adult. Patient was divided into 5 categories; ESI-1, patient who needed resuscitation (live-safing); ESI-2, patient with high risk emergency signs, which are lethargy, disorientation, or severe distress/pain; ESI-3 (urgent), patient with more stable condition but needed more than one supporting examinations (laboratory, ECG, IV line, nebulizer, spesialistic consultation, and radiology); ESI-4, patient who needed one supporting examination (less urgent); and ESI-5, patient who do not need supporting examination (non-urgent). When deterioration in vital signs happened in patient with ESI-3, the status would be upgraded to ESI-2 (Gilboy et al, 2012).

Nutritional status was determined based on antopometric status, which is body weight (BW) in relation to height (H). Subjec ≤ 5 years old was assessed by Z-score of W/H according to WHO Anthro Chart and interpreted as: (1) W/H z-score > 3 SD: obese, (2) W/H z-score > 2 SD: overweight, (3) W/H z-score > 1 SD: potential risk of overweight, (4) W/H z-score -2 – (+) 2 SD: normal (5) W/H z-score < -2 SD: wasted, (6) W/H z-score < -3 SD: severely wasted. Subjects ≤ 5 years old was assessed by W/H according to The Center for Disease Conrol and Prevention (CDC) in 2000 and classified according to Waterlow criteria (W/Ideal Weight) as: (1) obesity: > 120%, (2) overweight: 111-120%, (3) Normal: 90-110%, (4) Moderate Malnutrition: 70-89%, (5) Severe Malnutrition: <70%. Patients with severe malnutrition were not included in this study.

Immunity status was classified into two groups, immunocompetent and immunocompromised. Immuncompromised status was defined as a state in which there was suspicion of impaired immune system both in primary immunity or secondary immune deficiency from underlying factors (post-splenectomy, AIDS, severe malnutrition, malignancies/leukemia, and the use of immunosuppresive drugs). Patients with immuncompromised status were not included in this study.

Data obtained from sample then were collected and processed by Microsoft Excel 2007 softawere then were analyzed by SPSS 20.0 software. The results were presented in absolute number (percentage) in mean and absolut number. Normality test was done using Shapiro-Wilk test. To determine correlation between laboratory turnaround time and length of stay, Spearman correlation study was conducted. P-value < 0.05 was set as a significant marker. Levels of correlation were classified according to the correlation coefficient. 0.00-0.199 = very weak correlation, 0.20-0.399 = weak correlation, 0.40-0.599 = moderate correlation, 0.60-0.799 = strong correlation. 0.80-1.000 = very strong correlation. Statistically significant was declared if the p-value ≤ 0.05.

Ethical clearance of this study was given by Bidang Penelitian dan Pengembangan (Litbang) Komisi Etika Penelitian Fakultas Kedokteran Universitas Udayana RSUP Sanglah Denpasar**.**

RESULT AND DISCUSSION

During the course of the study, the number of pediatric triage visit in 2016 was 2,348 and in 2017 was 2,868. From table 1, it can be seen that most subjects were male

age 3.6 years old in 2016 and 2 years old in 2017. Most of the patient came with chief complaints of infections. Average laboratory turnaround time in 2016 was 1.9 hours and in 2017 was 2 hours. The most frequent triage criteria of patients in 2016 was ESI-4 and in 2017 was ESI-3. The most common admission ward after completing treatment in emergency department was ordinary ward with length of stay ≥ 7 days in 2016 and 2017. Average length of stay in PICU in 2016 was longer than that in 2017. In table two, it was shown that the most common order for supporting laboratory examination was complete blood count with average completion time of 2 hours. Chemical blood test required longer period of completion which was 2.8 hours (show in table 1 and table 2).

Bivariate analysis conducted to determine association between variables was Spearman test. It was used because both variables were independent from each other. Correlation between laboratory turnaround time and length of stay during period from 2016-2017 was presented in table 3. In 2016, the correlation coefficient was 0.243 which means there was acceptable association between laboratory turnaround time and length of stay but statistically not significant (p 0.242). Results obtained from different analysis in 2017 showed correlation coefficient of 0.466 which means there was strong association between laboratory turnaround time and length of stay and it was statistically significant (p 0.03). Multivariate analysis using predictive linear regression among variables such as laboratory turnaround time, age, triage criteria, and sex towards length of stay was shown in table 5. Analysis in 2016 showed coefficient correlation of 0.215. This showed that there was weak association among predictors (laboratory turnaround time, triage criteria, sex, and age) towards length of stay, in other words predictors (laboratory turnaround time, triage criteria, sex, and age) affected length of stay for 21.5%, other 78.5% was contributed by other variables outside this regression model. Analysis from data in 2017 showed correlation coefficient of 0.651, this showed that there was strong association among predictors (laboratory turnaround time, triage criteria, sex, and age) towards length of stay, with determination coefficient 0.424, in other words laboratory turnaround time, age, sex, and triage criteria affected length of stay for 42,4%, other 57,6% was contributed by other variables not included in this regression model. Table 5 showed simultaneously regression coeffiecient test with significant value of 0,651.It was concluded that laboratory turnaround time, age, sex, and triage criteria simultaneously affected length of stay. Table 5 showed interpretion of coefficient table, in which the increase of predictive value of laboratory turnaround time in one unit would increase 6,5 % length of stay (positive correlation).

In 2016, the correlation coefficient was 0.243 which means there was acceptable association between laboratory turnaround time and length of stay but statistically not significant (p 0.242). In 2017 showed correlation coefficient of 0.466 which means there was strong association between laboratory turnaround time and length of stay and it was statistically significant (p 0.03) (show in table 4).

Laboratorium requests were mostly from the resirology and infection diseasses. Regarding the high number of patients and the nedd for crucial laboratory examinations. The duration of laboratory work is 1-3 hours on average.

Analysis using predictive linear regression among variables such as laboratory turnaround time, age, triage criteria, and sex towards length of stay. Simultaneously regression coeffiecient test with significant value of 0,651. It was concluded that laboratory turnaround time, age, sex, and triage criteria simultaneously affected length of stay.

In this study, it was found that there were more children under three years old and male children. Complaints during first admission varied and most of them were from infection category. Similar result was found in previous study either in Sanglah Hospital or other studies in developed countries (Chandra 2016 and Wardani 2017). This showed that the occurence of infection was still high both in developed and developing countries.

Services in emergency department are united as one unit. In emergency department, there are many different professions who have to be able to work in a coordinated way to provide effective and optimal services for patiens. Most of them required laboratory examinations, and the most common order was complete blood count. This finding was similar to that of Storow et al (2008). According to bivariate analysis conducted in 2017, there was strong correlation between laboratory turnaround time and length of stay.

Different results were obtained from different analysis, one conducted in 2016, the other conducted in 2017. This was caused by different regulation and total number of visits. The total number of visits in 2017 was higher than the total number of visits in 2016.

Table 5 showed assocation between predictors (laboratory turnaround time, subdivision, triage criteria, age, and sex) towards length of stay, which the five variables simultaneously affected length of stay for 42%, while 58% was affected by other variables not included in this study. According to study conducted in Sanglah Hospital by Chandra et al (2016), factors affecting length of stay especially in intensive patients were the use of mechanical ventilator, central vein access, urinary catheterization, and PELOD score. PELOD score and the use of ventilator were related to laboratory examinations. In this study, the predictive linear analysis of laboratory turnaround time towards length of stay showed that if there was an increase in laboratory turnaround time in one unit, the length of stay would increase for 6,5%. Factor that associated laboratory turnaround time such as high volume patients, analytical technology, transport systems and computerisation (Hakins, 2007). According to study by Wardani et al (2017), the longer the length of stay, the higher the total cost spent by hospital, so efficient laboratory turnaround time have health impact and economic impact.

CONCLUSIONS AND RECOMENDATIONS

This study was the first study in Sanglah Hospital analyzing the association between laboratory turnaround time and length of stay. The average laboratory turnaround time in Sanglah Hospital was 2 hours. There was strong correlation between laboratory turnaround time and length of stay and if the predictive value increased by one unit, the length of stay would increase 6,5%.

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Table 1. Clinical Characteristics of Subjects

Characteristics	Year	
	2016 n	2017 n
1. Sex		
Male	11 (44%)	17 (68%)
Female	14 (56%)	8 (32%)
2. Age (mean)	1316.8 days	760.84 days
3. Nutritional Status		
Poor	9 (36%)	6 (24%)
Good	16 (64%)	19 (76%)
4. Dissease group		
Hematology and Oncology	2 (8%)	1 (4%)
Infection	8 (32%)	7 (28%)
Cardiology	1 (4%)	1 (4%)
Metabolic	2 (8%)	1 (4%)
Nephrology	2 (8%)	1 (4%)
Neurology	2 (8%)	4 (16%)
Respirology	7 (28%)	6 (24%)
Gastrohepatology	1 (4%)	1 (4%)
5. Laboratory Turnaround Time (mean)	116.93 minutes	124.87 minutes
6. Laboratory Turnaround Time		
< 1 hour	5 (20%)	3 (12%)
1-3 hours	11 (44%)	12 (48%)
> 3 hours	9 (36%)	10 (40%)
7. Triage of Patients Criteria		
ESI-1	3 (12%)	1 (4%)
ESI-2	9 (36%)	10 (40%)
ESI-3	5 (20%)	14 (56%)
ESI-4	8 (32%)	0 (0%)
ESI-5	0 (0%)	0 (0%)
8. Ward Admission		
PediatricWard	20 (80%)	19 (76%)
PICU	5 (20%)	6 (24%)
9. Length of stay in ordinary ward (Mean)	24.8 days	21.3 days
10. Lenth of stay in PICU (Mean)	23.8 days	15.67 days

Differences in characteristic between 2016 and 2017.

Table 2. Type of Laboratory Examinations

No.	Type of Laboratory Examinations	Total	Average Completion Time (minutes)
1.	Complete Blood count	25	117.4
2.	Chemical Blood Test	17	167.35
3.	Electrolytes	13	123.46
4.	Blood Gas Analysis	5	91.25

Table 3. Correlation between Laboratory Completon Time and Length of Stay

Korelasi	Year	
	2016	2017
Completion time (hours)		
Coefficient correlation	0,243	0,566
Sig	0,242	0,003

Table 4. Duration Laboratory Turnaround Time Each Division

	Laboratory Turnaround Time			Total
	< 1 hour	1-3 hour	>3 Hours	
Gastrohepatology	0	0	1	1
Hemato-onkology	0	2	1	3
Infection	3	7	5	15
Cardiology	0	0	2	2
Consultation	1	0	0	1
Metabolic	0	3	0	3
Nefrology	0	0	2	3
Neurology	3	4	2	6
Respirology	8	7	6	16

Table 5. Multivariate Analysis between Each Variable and Length of Stay

	B	p value	Confident Interval
Sex	-0,062	0,764	0,055 – 15,353
Age	2,301	0,775	0,999 – 1,002
Division	0,244	0,236	0,386 – 73,370
Lab Turnaround Time	0,065	0,042	1,050 – 10,06
Triage Criteria	-0,418	0,031	0,003 – 0,986
Correlation		R = 0,651	R Square = 0,424