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EVALUATION OF ANTIBIOTIC USE IN PEDIATRIC PATIENTS HOSPITALIZED WITH ACUTE DIARRHEA AS A RESULT OF CLINICAL PATHWAY IMPLEMENTATION IN A HOSPITAL

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ABSTRACT

This study aims to determine the effectiveness of clinical pathway implementation in pediatric patients with acute diarrhea with mild-moderate dehydration on clinical outcomes, length of stay, use of quality and quantity of antibiotics at North Jakarta Teaching Hospital. This study is a quantitative study using a retrospective cohort case study method. The samples in this study were pediatric patients with a diagnosis of acute diarrhea with mild-moderate dehydration who were hospitalized at the North Jakarta Teaching Hospital for the period January-December 2020 and January-December 2021 before and after the implementation of the clinical pathway, totaling 274 patients. The data used is secondary data in the form of medical records of pediatric patients with acute diarrhea with mild-moderate dehydration who were hospitalized at the North Jakarta Teaching Hospital. The data that has been collected is then processed and analyzed using the chi-square test. The results showed Qualitative use of antibiotics with the Gyssens method after the application of clinical pathway is better than before the application of clinical pathway. Quantitative antibiotic administration with the DDD method in pediatric patients with acute diarrhea with dehydration before and after the application of clinical pathway the highest was ceftriaxone antibiotics after the application of clinical pathway with DDD/100 patient-days value increased compared to before clinical pathway.

KEYWORDS *Clinical Pathway, Acute Diarrhea, Antibiotic Use, Clinical Outcome.*

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INTRODUCTION

Acute diarrheal disease is a significant health problem in Indonesia, especially in children. According to data from the Indonesian Ministry of Health, diarrhea is the leading cause of morbidity and mortality in children under the age of five in developing countries (Kementerian Kesehatan R.I., 2016). Acute diarrhea often causes dehydration that requires intensive care in the hospital. One of the approaches implemented to address this problem is the use of clinical pathways, which aims to improve the efficiency and quality of health services.

Clinical pathway is a series of coordinated steps structured based on medical standards to optimize patient clinical outcomes. According to Astuti, Dewi, and Arini's research in 2017, the implementation of clinical pathway in hospitals has been shown to improve coordination between departments and reduce variability in clinical practice. Thus, clinical pathway is expected to increase the use of more rational antibiotics in pediatric patients with acute diarrhea (Astuti et al., 2017).

The use of antibiotics in pediatric patients with acute diarrhea is often inappropriate. Research shows that more than 50% of pediatric diarrhea cases are caused by viral infections that do not require antibiotic therapy (Amin, 2015). This irrational use of antibiotics not only burdens the health system with unnecessary costs, but also contributes to the increase in antibiotic resistance. Therefore, a rigorous evaluation of the use of antibiotics in the management of acute diarrhea in children is needed.

Evaluation of antibiotic use can be done through various methods, including quantitative and qualitative analysis. Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) and Drug Utilization 90% (DU 90%) methods are some of the commonly used methods to measure and improve the quality of drug use (Aulia, 2017). These methods allow identification of dominant antibiotic use patterns and direct improvements in prescribing practices.

Implementation of clinical pathway is expected to improve adherence to clinical guidelines and reduce unnecessary antibiotic use. A retrospective study conducted at North Jakarta Teaching Hospital showed that the implementation of clinical pathway successfully improved the effectiveness of antibiotic use without significantly affecting clinical outcomes. This study also highlights the importance of continuous evaluation to ensure that the clinical pathway continues to adapt to the latest scientific evidence and patient needs.

As part of this evaluation, it is important to involve various healthcare professionals, including pharmacists, in the development and implementation of the clinical pathway. This aims to ensure that all aspects of patient care are taken into account and that the antibiotics selected are appropriate for the patient's specific clinical condition. Thus, it is expected that the use of antibiotics can be more targeted, reduce the risk of resistance, and improve the quality of care for pediatric patients with acute diarrhea.

In conclusion, the implementation of clinical pathways in hospitals is not only beneficial in improving the quality of care and antibiotic use, but can also serve as a model for the development of other health policies. Further research and continuous evaluation are needed to optimize the benefits of this approach and ensure its sustainability and effectiveness in the long term.

RESEARCH METHOD

In this study, a quantitative approach was used with a retrospective cohort case study method in pediatric patients with acute diarrhea with mild-moderate dehydration before and after the clinical pathway was applied, the results were presented descriptively and analytically. The type of research that will be used is a retrospective method with a pre and post clinical pathway implementation approach using secondary data, namely medical records of patients with acute diarrhea with mild-moderate dehydration who are hospitalized at the North Jakarta Teaching Hospital.

This research was conducted at the North Jakarta Teaching Hospital. Data were collected in January-December 2020 before the establishment of the clinical pathway and data collection continued after the establishment of the clinical pathway in January-December 2021. The study was conducted during the period October 2023-May 2024 Study Population: All pediatric patients with a diagnosis of acute diarrhea with mild-moderate dehydration who were admitted to the inpatient department of the North Jakarta Teaching Hospital.

Study Sample: Pediatric patients with a diagnosis of acute diarrhea with mild-moderate dehydration who were hospitalized at the North Jakarta Teaching Hospital for the period January-December 2020 and January-December 2021 before and after the implementation of the clinical pathway. Secondary data obtained from the medical records of pediatric patients hospitalized at the North Jakarta Teaching Hospital. The data taken include demographics, diagnosis, drug therapy given, especially antibiotics, symptomatic therapy during treatment and clinical outcomes.

a) Descriptive statistical analysis
   Data on demographics, comorbidities, previous history of disease, antibiotic administration in acute diarrhea therapy with mild-moderate dehydration, dehydration *score*, antibiotic administration according to *clinical pathway*, number of antibiotics, clinical *outcome* and therapy administration according to *clinical pathway* descriptively.
b) Antibiotic quality analysis
   Analysis of the suitability of antibiotics before and after the establishment of *clinical pathways* was carried out with the *Gyssens* algorithm.
c) Quantitative analysis of antibiotics by DDD method
   Antibiotic analysis before and after the establishment of *clinical pathway* is done by quantitative DDD method, the results obtained are based on the results of DDD and determine DU 90%.
d) Inferential statistical analysis
   The chi-square and *fisher exact* tests using SPSS 27.0 were used when the variables were categorical. *The chi-square* statistic was used to determine the association between two variables which included the comparison of length of hospitalization, number of antibiotic uses, antibiotic administration, clinical *outcomes* and antibiotic rationality test.

RESULT AND DISCUSSION

Demographic Profile of Acute Diarrhea Child Patients with Dehydration

Table 1. Clinical pathway recommended length of stay (3 days) and antibiotic recommendations according to clinical pathway

Length of stay 3 days and AB according to clinical pathway	Before clinical pathway	After the clinical pathway	*P-Value
Length of stay 3 days no antibiotics given	44 (32.1%)	24 (17.5%)	0.000
Length of stay >3 days not given antibiotics	31 (22.6%)	16 (11.7%)	
Length of stay 3 days given antibiotics according to *clinical pathway*	18 (13.1%)	31 (22.6%)	
Length of stay >3 days given antibiotics according to *clinical pathway*	25 (18.2%)	49 (35.8%)	
Length of stay 3 days given antibiotics outside of *clinical pathway*	3 (2.2%)	2 (1.5%)	
Length of stay >3 days given antibiotics outside of *clinical pathway*	16 (11.8%)	15 (10.9%)	
Total	137 (100%)	137 (100%)	

**Fisher exact test*

In Table 1, the length of treatment recommended by the clinical pathway for pediatric patients with acute diarrhea with dehydration at the North Jakarta Teaching Hospital is 3 days and the recommended antibiotics used are ceftriaxone, cefotaxime and metronidazole.

The length of stay of 3 days for children with acute diarrhea with dehydration who were not given antibiotics after clinical pathway 24 patients (17.5%) decreased compared to before clinical pathway 44 patients (32.1%) and the length of stay more than 3 days after clinical pathway 16 patients (11.7%) decreased compared to before clinical pathway 31 patients (22.6%).

Length of stay of 3 days in children with acute diarrhea with dehydration given antibiotics in accordance with clinical pathway, after clinical pathway 31 patients (22.6%) increased compared to before clinical pathway 18 patients (13.1%) and after clinical pathway length of stay more than 3 days given antibiotics according to clinical pathway 49 patients (35.8%) increased compared to before clinical pathway 25 patients (18.2%). The length of stay of 3 days of acute diarrhea children with dehydration who were given antibiotics outside the clinical pathway, after clinical pathway 2 patients (1.5%) decreased compared to before clinical pathway 3 patients (2.2%) and after clinical pathway the length of stay of more than 3 days with antibiotics outside the clinical pathway 15 patients (10.9%) decreased compared to before clinical pathway 16 patients (11.8%). In addition, the p-value of 0.000 was obtained, the value was <0.05 so that it could be decided that there was a difference in the length of stay of clinical pathway recommendations between before the application of clinical pathway and after the application of clinical pathway.

Antibiotic Administration in Acute Diarrhea Pediatric Patients with Dehydration

Table 2. Administration of the number of antibiotics during treatment pediatric patients with acute diarrhea with dehydration

Number of Antibiotics	Before Clinical Pathway	After Clinical Pathway	*P-value
1 Antibiotics	41 (29.9%)	81 (59.1%)	1.000
2 Antibiotics	20 (14.6%)	14 (10.2%)	
> 2 Antibiotics	1 (1.7%)	2 (1.5%)	
Total	137 (100%)	137 (100%)	
**Chi-square, fisher exact test*			

In table 2. the administration of 1 antibiotic in patients with acute diarrhea with dehydration at the North Jakarta Teaching Hospital during the patient's hospitalization after clinical pathway 81 patients (59.1%) increased compared to before clinical pathway 41 patients (29.9%) the number of antibiotics in accordance with clinical pathway recommendations for pediatric patients with acute diarrhea with dehydration can be given one antibiotic during the patient's hospitalization.

No antibiotics were given in the therapy of acute diarrhea patients with dehydration after clinical pathway decreased compared to before clinical pathway with 75 patients (54.8%) to 40 patients (29.2%). In addition, the Sig. value of 0.000 <0.05 was obtained, thus it can be decided that there is a difference in the number of antibiotics between before and after the clinical pathway (Table 2).

Table 3. Types of antibiotic therapy for pediatric acute diarrhea with dehydration

Types of Antibiotics	Before Clinical Pathway	After Clinical Pathway
No Antibiotics Given	75 (54.8%)	40 (29.3%)
Ceftriaxone	18 (13.3%)	50 (36.6%)
Metronidazole	7 (5.2%)	9 (6.7%)
Cefotaxime	8 (5.9%)	2 (1.5%)
Cefixime	5 (3.6%)	
Cefotaxime+Cefixime	4 (2.9%)	
Ceftriaxone+Metronidazole	4 (2.9%)	5 (3.6%)
Ceftriaxone+Cefixime	3 (2.2%)	
Cefotaxime+Ceftriaxone	2 (1.5%)	
Ampicillin	1 (0.7%)	10 (7.3%)
Metronidazole+Cefotaxime	1 (0.7%)	
Gentamycin+Ceftriaxone	1 (0.7%)	1 (0.7%)
Metronidazole+Cotrimoxazole	1 (0.7%)	
Coamoxiclav	1 (0.7%)	
Metronidazole+Cefixime	1 (0.7%)	
Azithromycin+Cefixime	1 (0.7%)	
Cefotaxime+Amoxycillin	1 (0.7%)	

Metronidazole+Ceftriaxone+Cefixime	1 (0.7%)	
Cotrimoxazole	1 (0.7%)	5 (3.6%)
Cefotaxime+Gentamycin+Cefixime	1 (0.7%)	
Ampicillin+Gentamycin		4 (2.9%)
Ampicillin+Gentamycin+Ceftriaxone		3 (2.2%)
Ampicillin+Ceftriaxone		1 (0.7%)
Ampicillin+Gentamycin+Amoxycillin		1 (0.7%)
Amoxycillin		1 (0.7%)
Azithromycin		1 (0.7%)
Ampicillin Sulbactam		1 (0.7%)
Ampicillin Sulbactam		1 (0.7%)
Ampicillin Sulbactam+Gentamycin		1 (0.7%)
Ceftriaxone+Azithromycin		1 (0.7%)
Total	137 (100%)	137 (100%)

In antibiotic therapy in patients with acute diarrhea with dehydration recommended by the North Jakarta Teaching Hospital *clinical pathway*, namely *ceftriaxone*, *metronidazole* and *cefotaxime* antibiotics before and after *clinical pathways* that were not given antibiotics decreased after *clinical pathway* 40 patients (29.3%) compared to before *clinical pathway* 75 patients (54.8%). This study was given ceftriaxone antibiotic therapy after *clinical pathway* 50 patients (36.6%) increased compared to before *clinical pathway* 18 patients (13.3%) (Table 3).

Table 4. Antibiotic administration for children with acute diarrhea with dehydration according to *clinical pathway* recommendations

Antibiotic Administration in accordance with Clinical Pathway	**Before Clinical Pathway**	**After Clinical Pathway**	***P-value**
No Antibiotics Given	75 (54.7%)	40 (29.2%)	0.000
Antibiotics are given according to *clinical* pathway	41 (29.9%)	80 (58.4%)	
Clinical Appropriate Antibiotics Given *Pathway* with Non *Clinical* Pathway Antibiotic Combination	14 (10.2%)	12 (8.8%)	
Given Antibiotics Outside the *Clinical* Pathway	7 (5.2%)	5 (3.6%)	
Total	137 (100%)	137 (100%)	
**Chi-square*			

Antibiotic administration in acute diarrhea patients with dehydration in accordance with *clinical pathway* showed after *clinical pathway* 80 (58.4%) increased compared to before *clinical pathway* 41 patients (29.9%). In addition, the *pvalue* of 0.000 was obtained so that it can be decided that there is a difference in antibiotic administration between before *clinical pathway* and after *clinical pathway* (Table 4).

Gyssens Method Analysis

Table 5. *Gyssens* method according to *clinical* pathway pediatric patients with acute diarrhea with dehydration

***Gyssens* Method Results**	**Before *Clinical Pathway***	**After *Clinical Pathway***
No antibiotics given	75 (54.8%)	40 (29.2%)
0 Appropriate/wise use of antibiotics	33 (24.1%)	72 (52.6%)
IIIB Antibiotic use too short	16 (11.7%)	14 (10.2%)
IVA There are other antibiotics that are more effective	12 (8.7%)	11 (8%)
V No indication of antibiotic use	1 (0.7%)	0 (0%)
Total	137 (100%)	137 (100%)

In Table 5, the results of the analysis of antibiotic quality according to the Gyssens method using clinical pathway for children with acute diarrhea with dehydration at the North Jakarta Teaching Hospital category 0, the use of antibiotics is appropriate / wise after clinical pathway 72 patients (52.6%) increased compared to before clinical pathway 33 patients (24.1%).

Table 6. Empirical antibiotic recommendations

Organisms	**First Choice Antibiotics**	**Second Choice Antibiotics**
Campylobacter, Shigella or *Salmonella spp*.	Ciprofloxacin 500 mg orally 2 times a day for 3-5 days	Shigella/Salmonella *spp*
		Ceftriaxone 1 gram IM/IV a day
		TMP-SMX DS oral 2 times one day, 3 days
		Campilobacter spp
		Azithromycin 500 mg orally 2 times a day
		Erythromycin 500 mg orally 2 times a day, 5 days
Vibrio cholera	*Tetracycline* 500 mg orally 4 times a day for 3 days	*Tetracycline* resistant
	Doxycycline 300 mg oral, single dose	*Ciprofloxacin* 1 gram orally 1
		Erythromycin 250 mg orally 4 times a day, 3 days
Traveler's diarrhea	*Ciprofloxacin* 500 mg twice daily	TMP-SMX DS orally 2 times a day, 3 days.
Clostridium difficile	*Metronidazole* 250-500 mg 4x daily, 7-14 days, oral or IV	*Vancomycin* 125 mg 4 times a day, 7-14 days

In a study on drug prescribing patterns in acute diarrhea in an inpatient setting in a private hospital conducted in India antibiotics were empirically administered

third generation cephalosporins namely *ceftriaxone* the most preferred choice to initiate treatment for diarrhea followed by *fluoroquinolones* antibiotics.

Table 7. Rationality of Gyssens method antibiotics pediatric patients with acute diarrhea with dehydration.

Antibiotic Rationality	Before clinical pathway	After the clinical pathway	*P-Value
Rational	108 (78.8%)	111 (81%)	0.651
Not Rational	29 (21.2%)	26 (19%)	
Total	137 (100%)	137 (100%)	

**Chi-square test*

The results of the study on the rationality of giving antibiotics qualitative analysis of the Gyssens method to patients with acute diarrhea with dehydration at the North Jakarta Teaching Hospital, the rationality of antibiotics after clinical pathway increased compared to before clinical pathway 108 patients (78.8%) to 111 patients (81%) while irrational data after clinical pathway decreased in the administration of antibiotics with the results of qualitative analysis of the Gyssens method with categories 3b, 4a, and 5 (Table 7).

Based on the paired sample test statistics, the qualitative test of the Gyssens method has a p-value of 0.651 greater than 0.05 so that it can be interpreted that the qualitative test of the Gyssens method before and after the implementation of the clinical pathway is not much different.

Antibiotic Analysis by ATC/DDD

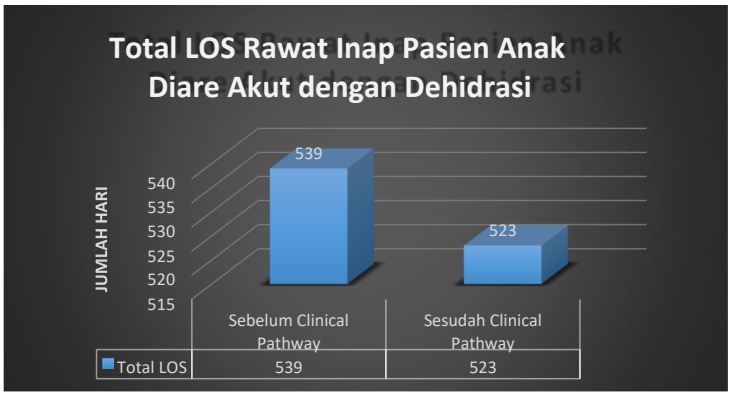

Figure 1: Total *length of stay* (LOS) of pediatric patients acute diarrhea with dehydration

Figure 1 illustrates the total hospitalization of pediatric patients with acute diarrhea with dehydration before 539 days and after the *clinical pathway* 523 days from where after the *clinical pathway* the total number of hospitalizations decreased before the *clinical pathway*. Total hospitalization is used to calculate the number of DDD-100 *patient days.*

Table 8. Appropriateness of antibiotics with hospital formulary

Types of Antibiotics	Conformity with hospital formulary
Ceftriaxone	√
Cefixime	√
Coamoxiclav	√
Cefotaxime	√
Ampicillin Sulbactam	√
Ampicillin	√
Azithromycin	√
Amoxycillin	√
Cotrimoxazole	√
Gantamycin	√
Metronidazole	√

Antibiotic prescribing and antibiotic use before and after *clinical pathway* in pediatric patients with acute diarrhea with dehydration showed that prescribing was in accordance with the North Jakarta Teaching Hospital formulary. The use of formulary is a standard of prescribing and *cost-effective* in order to realize the use of drugs in accordance with established standards.

Table 9. ATC/DDD calculation before and after *clinical pathway*

Antibiotics	**ATC Code**	**DDD WHO(g)**	**Before *clinical pathway* (g)**	**after *clinical pathway* (g)**	**DDD Usage before *clinical pathway***	**DDD Use after *clinical pathway***	**DDD/100 *patientdays* before *clinical pathway***	**DDD/100 *patientdays* after *clinical pathway***	***DDD/patientdays* before *clinical pathway***	***DDD/patientdays* after *clinical pathway***
Ceftriaxone	J01DD04	2	52.31	140.80	26.16	70.4	4.85	13.46	0.049	0.135
Cefixime	J01DD08	0.4	6.5		16.25		3.01		0.030	
Cefotaxime	J01DD01	4	17.55	2.1	4.39	0.53	0.81	0.10	0.008	0.001
Amoxycillin	J01CA04	1.5	0.94	4.13	0.63	2.75	0.12	0.53	0.001	0.005
Ampicilin Sulbactam	J01CR01	6		12.84		2.14		0.41		0.004
Ampicillin	J01CA01	2	1	90.8	0.5	45.4	0.09	8.68	0.001	0.087
Coamoxiclav	J01CA02	1.5	1.35		0.9		0.17		0.002	
Metronidazole	J01XD01	1.5	9.04	17.76	6.03	11.84	1.12	2.26	0.011	0.023
Cotrimoxazole	J01EA01	0.4	2.98	13.92	7.45	34.8	1.38	6.65	0.014	0.066
Azithromycin	J01FA10	0.3		0.6		2		0.38		0.004
Gentamycin	J01GB03	0.24	0.13	2.31	0.54	9.63	0.10	1.84	0.001	0.018
DDD/100 *patient-days*							11.65	34.31	0.117	0.343

The quantitative results of antibiotic use were analyzed using the ATC/DDD system according to WHO. The results of this study showed the use of antibiotics in units of DDD/100 *patient-days* before and after *clinical pathway* showed the highest use of *ceftriaxone* antibiotics, after *clinical pathway ceftriaxone* antibiotics experienced an increase in *DDD/patient-days* 0.049g DDD daily to *ceftriaxone* 0.135g DDD/day with DDD values according to WHO for *ceftriaxone* antibiotics 2 DDD in quantity at the North Jakarta Teaching Hospital is lower than the WHO DDD standard (Table 9).

Table 10 DU 90% segment before and after *clinical pathway*

Antibiotics	DDD/100 patientdays before clinical pathway	% Before clinical pathway	DU Segment	Antibiotics	DDD/100 patientdays after clinical pathway	% After clinical pathway	DU Segment
Ceftriaxone	4.85	41.63		*Ceftriaxone*	13.46	39.23	
Cefixime	3.01	25.83		Ampicilin	8.68	25.29	
Cotrimoxazole	1.38	11.84	90%	Cotrimoxazole	6.65	19.38	90%
Metronidazole	1.12	9.61		Metronidazole	2.26	6.58	
Cefotaxime	0.81	6.95		Gentamycin	1.84	5.36	
Coamoxiclav	0.17	1.45		Amoxcillin	0.53	1.54	
Amoxcillin	0.12	1.03	10%	Ampicillin Sulbactam	0.41	1.19	10%
Gentamycin	0.10	0.85		Azithromycin	0.38	1.10	
Ampicilin	0.09	0.77		Cefotaxime	0.10	0.29	
Ampicillin Sulbactam				Cefixime			
Azithromycin				Coamoxiclav			
Total	11.65				34.31		

This study met the DU segment 90% before clinical pathway ceftriaxone, cefixime, cotrimoxazole and metronidazole while after clinical pathway ceftriaxone, ampicillin, cotrimoxazole and metronidazole.

Clinical Pathway Recommended Length of Stay (3 Days) and Clinical Pathway Recommended Antibiotics

The length of stay recommended by the clinical pathway for pediatric acute diarrhea with dehydration at the North Jakarta Teaching Hospital is three days (maximum) and the recommended antibiotics used are ceftriaxone, cefotaxime and metronidazole.

The length of stay of 3 days for children with acute diarrhea with dehydration who were not given antibiotics after clinical pathway decreased compared to before clinical pathway as well as the length of stay of more than 3 days because diarrhea can recover without antibiotics. Empirical administration of antibiotics is rarely indicated in acute infectious diarrhea, because 40% of cases of infectious diarrhea recover in less than 3 days without antibiotics (Bhaveshaikh et al., 2017; Robiyanto et al., 2018). In contrast to the length of stay of pediatric patients with acute diarrhea with dehydration for more than 3 days who are given antibiotics in accordance with the recommendations of the clinical pathway of the North Jakarta Teaching Hospital, it is usually caused by not giving antibiotics on the first day of hospitalization so that antibiotics are given on the next day of treatment and caused by giving antibiotics after 3 days of treatment with the patient's condition not improving so that it takes longer to treat patients longer can be caused by the degree of dehydration, this is supported by research on the degree of dehydration can affect the length of stay in patients with acute diarrhea at BRSU Tabanan severe dehydration was longer (Rumokoy et al., 2016).

Antibiotic Administration in Acute Diarrhea Pediatric Patients with Dehydration

In this study, the increased administration of 1 antibiotic in patients with acute diarrhea with dehydration according to microbiological results can support the administration of antibiotics when the patient's condition of watery diarrhea and the patient's condition of bloody diarrhea with clinical symptoms of fever with increased inflammation, with the patient's condition of toxic state and the patient's condition of prolonged diarrhea show criteria to consider when deciding on antibiotic treatment for children with diarrheal infections (Bruzzese et al., 2018).

In other studies, antibiotics are indicated in diarrhea patients with symptoms and signs of infectious diarrhea, such as fever, bloody stools, leukocytes in the stool, reduced excretion and environmental contamination, persistent or life-saving in infectious diarrhea, diarrhea in travelers, immunocompromised patients and antibiotic administration can be empirical but specific antibiotic therapy is given to diarrhea patients based on culture and germ resistance.

Different things when not given antibiotics in the therapy of acute diarrhea patients with dehydration after clinical pathway tends to decrease compared to before clinical pathway because there is diarrhea that can recover by not giving antibiotics and some can recover by giving antibiotics, empirical administration of antibiotics is rarely indicated in acute infectious diarrhea, because 40% of cases of infectious diarrhea recover less than 3 days without antibiotic administration. In the clinical pathway, patients with acute diarrhea with dehydration at the North Jakarta Teaching Hospital are given antibiotics for certain indications such as the results of the patient's laboratory examination showing leukocyte values above the reference value, patient comorbidities that require antibiotics.

In this study, increasing therapy for acute diarrhea with dehydration was not given antibiotics based on clinical indications in the Guidelines for Therapy of acute gastroenteritis: Role of Antibiotics, Clinical Microbiology and Infection (2015) reviewed by Eugenia Bruzzese (2018) for the treatment of acute diarrhea in children states that the use of antibiotics is not routinely required but only for specific pathogens or in established clinical settings. Antibiotic therapy in patients with acute diarrhea with dehydration recommended by the clinical pathway of the North Jakarta Teaching Hospital is ceftriaxone, metronidazole and cefotaxime antibiotics.

This study was given ceftriaxone antibiotic therapy after clinical pathway increased compared to before clinical pathway based on literature clinical indications for antibiotic therapy when patients with acute diarrhea with dehydration in a toxic state or signs of invasive infection where clinical conditions recommended antibiotic therapy for dysentery diarrhea caused by Shigella bacteria, Yersinia, Campylobacter antibiotics given azithromycin or ciprofloxacin, diarrhea with fever markers of increased inflammation caused by Shigella bacteria antibiotics given azithromycin or ceftriaxone, prolonged diarrhea caused by Gram-negative Enterobacteria or Clostridium difficile bacteria antibiotics given metronidazole or cotrimoxazole, diarrhea with SIBO caused by Gram-negative Enterobacteria antibiotics given metronidazole, rifaximin or cotrimoxazole, diarrhea caused by Clostridium difficile or other antibiotics given metronidazole or vancomycin (only if Clostridium difficile is detected), traveler's diarrhea caused by ETEC (enterotoxigenic Escherichia coli),

EPEC (enteropathogenic Escherichia coli) antibiotics azithromycin or ciprofloxacin, diarrhea with toxic states caused by Gram-negative Enterobacteria or Clostridium difficile antibiotics ceftriaxone. Diarrhea conditions with these clinical symptoms can be used as a strong indication for parenteral antibiotic treatment (Giannattasio et al., 2016).

The highest use of antibiotics before and after the application of clinical pathway in this study was ceftriaxone just like the research conducted by Kristina Eni Trisnowati et al. (2017) on the study of antibiotic use in patients with acute diarrhea in pediatric inpatient wards in the form of the most commonly used antibiotic class in this study was generation 3 cephalosporins by 69.23% with ceftriaxone as the most commonly used type of antibiotic either given singly or in combination and the other two classes of antibiotics most commonly prescribed to patients in this study were: nitroimidazole antibiotics as much as 25.64% and carbapenem antibiotics as much as 17.95%. This study is different from research conducted by Fras Korompis et al., (2013) showing the number of patients with acute diarrhea who were hospitalized at BLU RSUP Prof. DR. R. D. Kandou Manado who used antibiotic drugs only amounted to 16% or 13 diarrhea patients given antibiotics used were ciprofloxacin, cotrimoxazole, metronidazole, gentamycin injection, and amoxycillin with the most widely used antibiotics being cotrimoxazole and gentamycin injection totaling 5.95% or 5 patients. This can be a difference because the antibiotic guidelines for each hospital are different and the clinical pathway is different for diarrhea patients. So, in this study the administration of antibiotics in patients with acute diarrhea with dehydration in accordance with clinical pathway showed after clinical pathway increased compared to before clinical pathway.

Clinical pathway can improve the service process, but does not improve outcomes (Rahmawati et al., 2017). Another study examined the differences before and after the clinical pathway, the results of the study were differences in medical record documents before the clinical pathway there were several actions that had not been applied, namely for diagnostic support activities showing 34 according to clinical pathway (62%) and 21 not according to clinical pathway (38%), so there was an increase in service after clinical pathway (Rahmah, 2016). This is supported by research on evaluating the implementation of elective appendicitis clinical pathway at Bethesda Yogyakarta Hospital, there was an increase in the administration of ceftriaxone antibiotics after the implementation of clinical pathway compared to before the implementation of clinical pathway. In this study, the group before the implementation of clinical pathway in antibiotic therapy using ceftriaxone was 77.5% (62 patients) and those without ceftriaxone were 22.5% (18 patients), while in the group after the implementation of clinical pathway the use of ceftriaxone increased to 86.3% (60 patients) and those without ceftriaxone 13.7% (10 patients).

Gyssens Method Analysis

The results of the analysis of antibiotic quality according to the Gyssens method using clinical pathway for children with acute diarrhea with dehydration at the North Jakarta Teaching Hospital with category 0 appropriate / wise antibiotic use after clinical pathway increased compared to before clinical pathway, antibiotic administration is carried out appropriately according to indications, bacteria

causing infection so that the successful use of antibiotics is achieved according to factors such as: accuracy of dosage, method of administration, frequency of use, and duration of administration in the use of the drug (Kementerian Kesehatan R.I., 2021).

In this study, the provision of antibiotic therapy in accordance with the clinical pathway for patients with acute diarrhea with dehydration using ceftriaxone, metronidazole or cefotaxime. With the application of clinical pathway, antibiotic administration is qualitatively better. This study compared with supporting literature with different diseases about the evaluation of the implementation of clinical pathway for elective appendicitis at Bethesda Hospital Yogyakarta which examines the clinical pathway shows that clinical pathway is very useful in significantly increasing medical compliance in the rational administration of antibiotics in accordance with the Clinical Practice Guidelines stated in the clinical pathway, namely the provision of ceftriaxone antibiotic therapy and increasing obedience to the provision of rational antibiotic therapy shown in a decrease in the variation of the antibiotic therapy process in the form of a significant decrease in the number of medics who provide double antibiotic therapy ceftriaxone combined with metronidazole.

In the clinical pathway of the North Jakarta Teaching Hospital, it is recommended to give ceftriaxone, metronidazole or cefotaxime antibiotic therapy compared to the management of the Indonesian Pediatric Association in 2009, given cotrimoxazole antibiotics if resistant then use cefixime antibiotics, if positive for parasites given metronidazole and can be given antibiotic therapy according to antibiotic sensitivity patterns in the hospital (Ikatan Dokter Anak Indonesia (IDAI), 2019). In this study, the administration of antibiotics for certain indications was compared with the study of acute diarrhea management at Dr. Cipto Mangunkusumo Hospital Jakarta Antibiotic administration is indicated in patients with symptoms and signs of infectious diarrhea, such as fever, bloody stools, leukocytes in the stool. Antibiotic administration can be empirical according to recommendations, but specific antibiotic therapy is given based on culture and germ resistance in the hospital.

Guidelines for diarrhea management suggest the use of cephalosporins only as alternative antibiotics and metronidazole is the preferred choice consistent with advice from gastroenterology organizations. So that after comparison with the literature, culture and germ resistance are needed to support the antibiotics that will be recommended in the clinical pathway for pediatric patients with acute diarrhea with dehydration at the North Jakarta Teaching Hospital so that the antibiotic therapy given is specific.

The results of the study on the rationality of antibiotic administration qualitative analysis of the Gyssens method of acute diarrhea patients with dehydration at the North Jakarta Teaching Hospital, the rationality of antibiotics after clinical pathway increased compared to before clinical pathway and irrational data after clinical pathway decreased antibiotic administration with the results of qualitative analysis of the Gyssens method with categories 3b, 4a, and 5.

Antibiotic Analysis by ATC/DDD

Total hospitalization of pediatric patients with acute diarrhea with dehydration where after the clinical pathway the total number of hospitalizations decreased before the clinical pathway. Total hospitalization is used to calculate the number of DDD-100 patient days.

The quantitative results of antibiotic use were analyzed using the ATC/DDD system according to WHO. The results of this study showed the use of antibiotics in units of DDD/100 patient-days before and after the clinical pathway showed the highest use of ceftriaxone antibiotics.

In this study, the most antibiotics used before and after the implementation of clinical pathway was ceftriaxone compared to other studies similar to the results of research conducted in India stated the use of generation 3 cephalosporins in acute pediatric diarrhea which was quite large, namely 40,406. Inappropriate use of cephalosporins is an important risk factor for the emergence of infections by resistant pathogens, viz: Clostridium difficile, methicillin-resistant Staphylococcus aureus, penicillin-resistant pneumococci, ESBL-Klebsiella pneumonia, and vancomycin-resistant enterococci (Fadilah & Budi, 2018).

This study meets the 90% DU segment where after the application of clinical pathway, the quantity of antibiotic use is in accordance with clinical pathway recommendations, this shows that the quantity of antibiotic procurement after clinical pathway has increased compared to before clinical pathway.

CONCLUSION

Based on the results of the study, it can be concluded that the application of clinical pathway in pediatric inpatients with acute diarrhea with dehydration has increased the effectiveness of antibiotic use according to recommendations, without any significant difference in clinical outcomes or length of hospitalization. Although there are differences in symptomatic therapy and qualitative use of antibiotics. In addition, there was also an improvement in the quality of antibiotic use after the application of clinical pathway although some patients experienced complications.

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