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Reducing The Percentage Of Intravenous Line Related Complications From 30% To Less Than 15% In Pediatric Intensive Care Unit Over Four Weeks.

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Abstract:
Background: *Hospital acquired infection (HAI) contribute significantly to pediatric morbidity and mortality. Although there are many factors involved in development of HAIs, some of the common procedures done in PICU setup like phlebotomy, intravenous peripheral and central line insertion are potent sources of Hospital Acquired Infections (HAIs). Few projects have been carried over across the globe which shows decline in spread of sepsis if proper standardized protocols are carried out in a planned and organized process. One such process is known as Plan-Do-Study-Act (PDSA) cycle. The present study is a quality improvement project using multiple PDSA cycles and Fishbone matrix to decrease the percentage of IV line related complications in PICU.*
Material and Methods: *Pediatric Intensive Care patients were studied over a period of 6 weeks. The first 2 weeks included baseline data collection of the status of IV extravasations. Using PDSA (Plan-Do-Study-Act) cycles, interventions were introduced and data was collected over the next 4 weeks. Interventions included training of resident doctors and staff nurses regarding aseptic techniques like hand-washing followed by drying of hands and wearing of gloves before all IV procedures, flushing of the I.V.cannulae 3 times a day, checklist for thrombophlebitis.*
Results: *The incidence of thrombophlebitis reduced from 27.5% to 13.8% post-intervention along with reduction in fever, leucocytosis and upscaling of antibiotics.*
Conclusion: *A quality improvement model therefore can be successfully used to decrease the incidence of IV line associated complications in the PICU and thus helping to reduce hospital acquired infections.*
Key Word: Thrombophlebitis, PDSA cycle, Aseptic techniques.

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I. Introduction:

Hospital acquired infection (HAI) contribute significantly to pediatric morbidity and mortality. Although there are many factors involved in development of HAIs, some of the common procedures done in PICU setup like phlebotomy, intravenous peripheral and central line insertion are potent sources of Hospital Acquired Infections (HAIs). This is probably because there is no standard procedure being followed for such procedures in PICU setup. These procedures, if not done under aseptic technique can lead to thrombophlebitis which can progress further towards sepsis. Some of the ways to reduce such HAIs are reporting and surveillance system improvement [1], local determinants of infection identification [2], standard precaution implementation along with use of care bundles [3] and improving education and skills of staffs [2, 4]. Few projects have been carried over across the globe which shows decline in spread of sepsis if proper standardized protocols are carried out in a planned and organized process. [5, 6] One such process is known as Plan-Do-Study-Act (PDSA) cycle. A PDSA cycle is a process by which an organized team can try and implement a given change and then reflect on the usefulness of that change prior to implementing it on a larger scale for the sake of improvement in quality of health care. [5] The present study is a quality improvement project using multiple Plan – Do – Study-Act (PDSA) cycles and Fishbone matrix to decrease the percentage of IV line related complications in PICU.

II. Material And Methods:

This is a prospective observational study done in patients of Unit 2 admitted in Pediatric Intensive Care Unit (PICU) of Sir J.J. Hospital, Mumbai. The study was carried over a period of 6 weeks. During the first 2 weeks baseline data was collected prior to the Interventions. After 2 weeks, interventions were introduced and the data collection continued for another 4 weeks. The central venous catheters were not taken into consideration for this study.

The interventions executed were as follows:

1. Hand-washing- The doctors and nursing staffs carried out hand-washing for atleast 1 minute before any IV procedures by following WHO 6 steps of hand-washing:

i. Rubbing the palms.
ii. Rubbing the dorsum.
iii. Interlacing of fingers.
iv. Interlocking of fingers.
v. Rotation of the thumb.
vi. Rubbing the tips of fingers.

2. Drying of hands after hand-washing and wearing of gloves before all I.V. procedures (I.V. insertion, checking of I.V. line, I.V. infusion and I.V. insertion) were carried out by both doctors and nursing staff.
3. Flushing 3 times per day to look for early extravasation and blockage. Two doctors and two staff nurses checked the IV sites of the patients three times a day for the signs of extravasation (redness, swelling, difficult flushing) and fever.
4. Check list by doctors and nursing staff to look for grades of thrombophlebitis [7], which include:

i. Grade I: erythema around IV puncture site with or without pain,
ii. Grade II: Grade I + pain + edema,
iii. Grade III: Grade II + palpable venous cord,
iv. Grade IV: Purulent discharge or discoloration or gangrene.

5. On the earliest sign of any redness/swelling/resistance to flush of any IV site, the line was immediately discontinued and another new line was inserted elsewhere.

The IV sites were not over wrapped with gauze in order to enable early detection of redness/ swelling. Daily temperature chart was maintained. Blood samples were sent for CBC, CRP and Blood culture in case of IV extravasation. New onset fever occurring at the time of I.V. extravasation was taken noted. Up-scaling of antibiotics for leukocytosis or positive Blood culture growth was included in the study. Data was collected over a period of 6 weeks for different grades of thrombophlebitis, new onset fever, Leukocytosis, positive blood culture and revision of antibiotics. The data obtained was studied and represented in the graphical manner.

III. Results And Discussion:

Among the patients admitted in PICU over a period of 6 weeks, there were total 447 peripheral intravenous lines. Of the total 447 peripheral I.V. lines, 178 (39.8%) lines were present in the first 2 weeks and 269 (60.2%) peripheral lines were present in the remaining 4 weeks. Out of total 447 peripheral lines, 86 (19.2%) lines had features of thrombophlebitis. In the first 2 weeks (before intervention), out of 178 I.V. lines, an average of 49 (27.5%) lines had thrombophlebitis. After intervention, out of total 269 lines over the 4 weeks, an average of 37 (13.8%) lines had thrombophlebitis.

As shown in table 1 and figure 1, in the first week, out of 108 total peripheral I.V. lines, 34 (31.5%) had thrombophlebitis - of which 20 (18.5%) were Grade I thrombophlebitis, 11 (10.2%) Grade II thrombophlebitis, 3 (2.8%) I.V. lines had Grade III thrombophlebitis. In the second week, out of 70 I.V. lines, 15 (21.4%) lines showed thrombophlebitis. Eleven lines (15.7%) Grade I thrombophlebitis, 3 (4.3%) Grade II thrombophlebitis and 1 (1.4%) line had Grade III thrombophlebitis. In the third week, out of 70 I.V. lines, 19 (27.1%) lines showed thrombophlebitis - 16 (22.9%) with Grade I thrombophlebitis and 3 (4.3%) with Grade II thrombophlebitis. In the fourth week, out of 66 I.V. lines, 11 (16.7%) lines showed thrombophlebitis - 9 lines (13.6%) had Grade I thrombophlebitis and 2 (3%) I.V. lines had Grade II thrombophlebitis. In the fifth week, out of 71 I.V. lines, 6 (8.5%) lines showed thrombophlebitis - 5 lines (7%) had Grade I thrombophlebitis and 1 (1.4%) line had Grade II thrombophlebitis. In the sixth week, out of 62 I.V. lines, 1 (1.6%) line showed thrombophlebitis which was a Grade I thrombophlebitis. None of the patients had Grade IV thrombophlebitis in the present study.

Table 1: shows distribution of different grades of thrombophlebitis associated with intravenous catheter sites over 6 6 weeks.

Week	Total I.V. Lines	Thrombophlebitis				
		Grade1(%)	Grade2(%)	Grade3(%)	Grade4(%)	Total(%)
1st	108	20(18.5)	11(10.2)	3(2.8)	0	34(31.5)
2nd	70	11(15.7)	3(4.3)	1(1.4)	0	15(21.4)
Average of IV extravasation in first 2 weeks						**49(27.4)**
INTERVENTIONS INTRODUCED						
3rd	70	16(22.9)	3(4.3)	0	0	19(27.1)
4th	66	9(13.6)	2(3)	0	0	11(16.7)
5th	71	5(7)	1(1.4)	0	0	6(8.5)
6th	62	1(1.6)	0	0	0	1(1.6)
Average of IV extravasation in next 4 weeks						**37(13.8)**

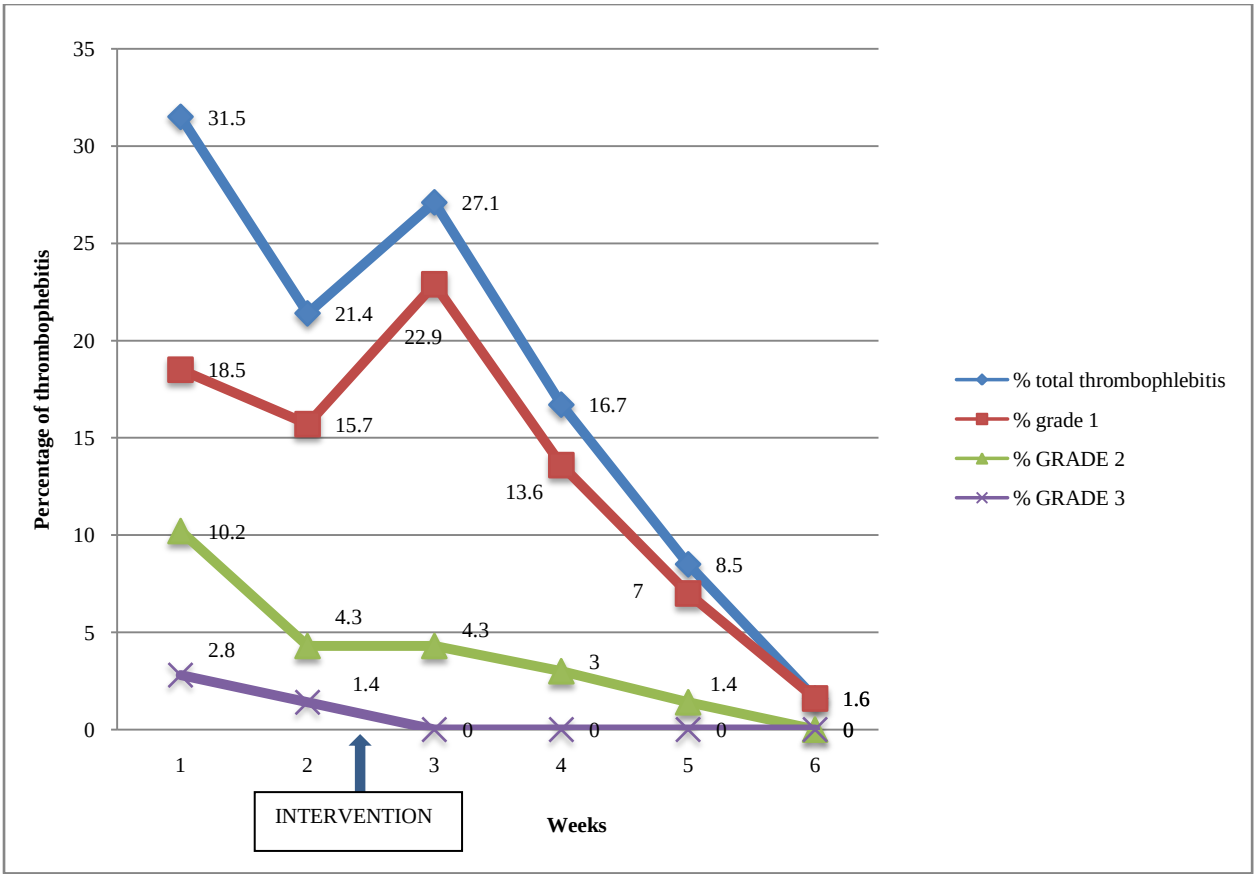

Figure 1: shows the trend of total and different grades of thrombophlebitis over a period of 6 weeks with the arrowhead pointing to the interventions made at the end of 2 weeks.

In the first week, of the total 54 patients, 3 (5.6%) patients had new onset fever corresponding to thrombophlebitis as shown in table 2 and figure 2. In the second week, out of 38 patients, 5 (13.2%) patients had new onset fever. After intervention, none of the patients had fever coinciding with thrombophlebitis. In the first week, out of 54 patients, 2 (3.7%) patients had leukocytosis corresponding to thrombophlebitis. In the remaining 5 weeks, none of the patients had new onset leukocytosis. Revision of antibiotic was not necessitated in any of the week except the third week where out of 40 patients, antibiotic revision was done in 1 (2.5%) patient. Blood culture was negative at the time of fever and leukocytosis associated with I.V. extravasation.

Table 2: Distribution of new onset fever, new onset leucocytosis and antibiotic revision done over 6 weeks.

Week	Total patients	New onset fever	New onset leucocytosis	Antibiotic revision
1st	54	**3(5.6%)**	**2(3.7%)**	0
2nd	38	**5(13.2%)**	0	0
INTERVENTIONS INTRODUCED				
3rd	40	0	0	1(2.5%)
4th	40	0	0	0
5th	40	0	0	0
6th	35	0	0	0

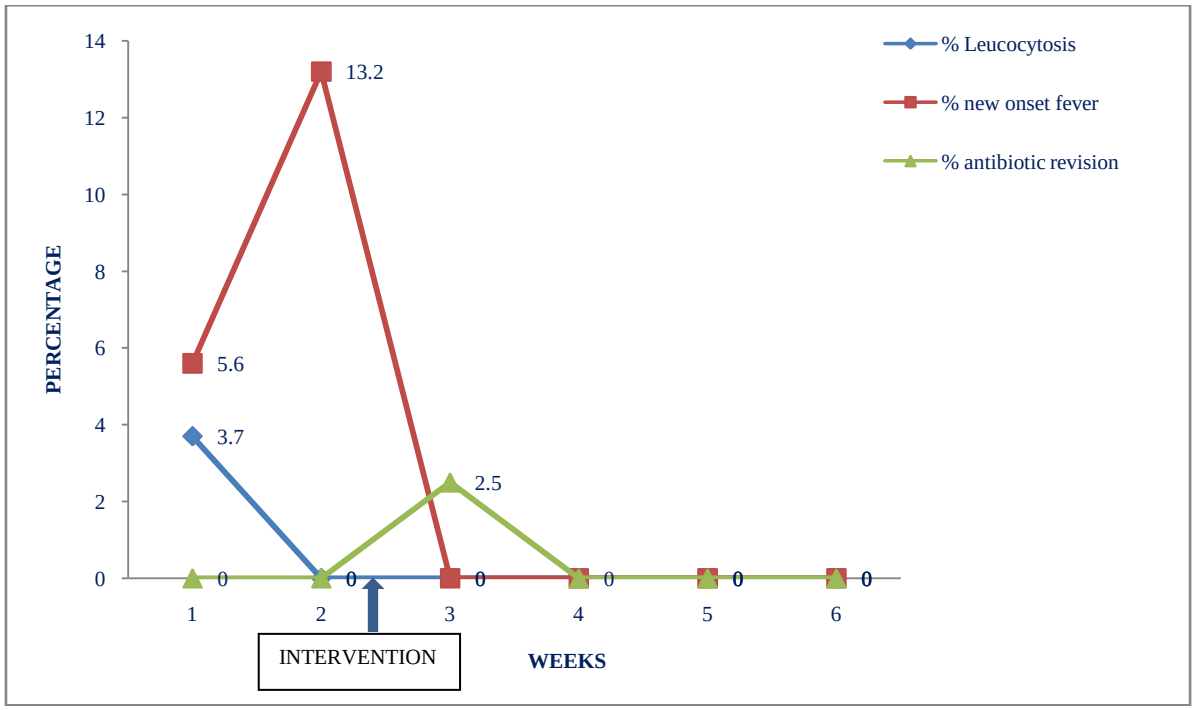

Figure 2: shows the trend of new onset fever, new onset leukocytosis and antibiotic revision done over a period of 6 weeks with the arrowhead showing the point of intervention at the end of 2 weeks.

A run chart analysis was done as shown in figure 3, which indicates that there is a downward trend of IV related complications after an initial rise following the interventions.

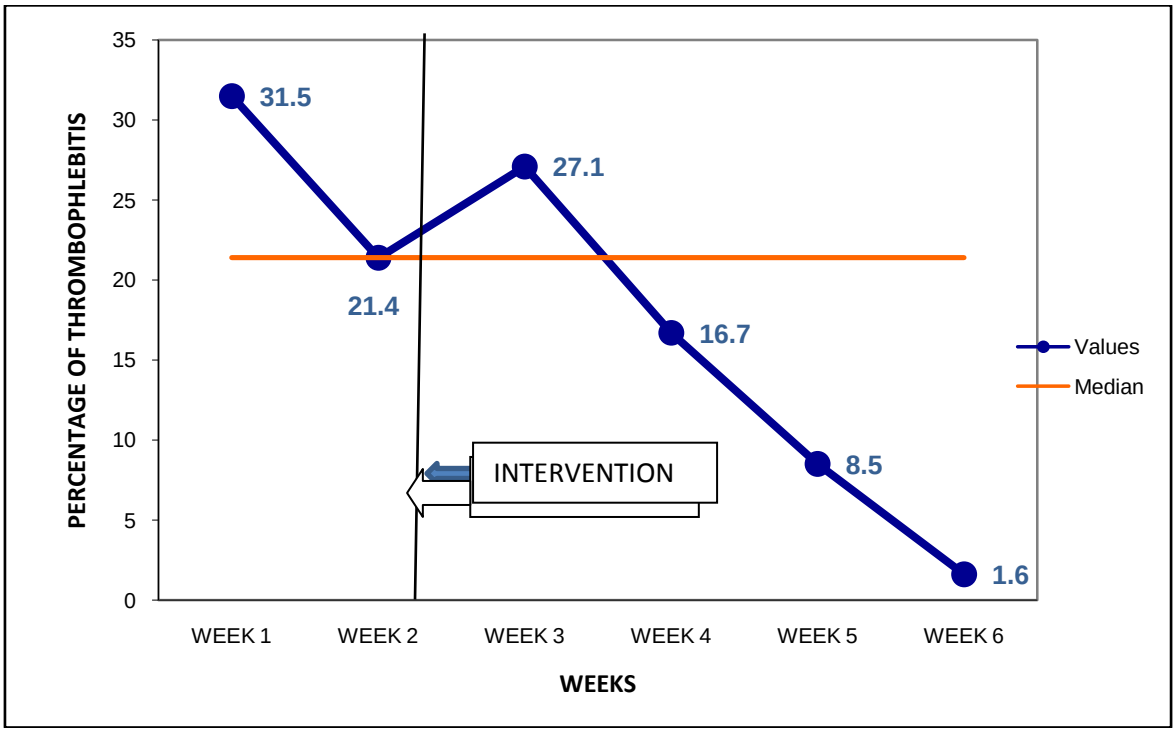

Figure 3: shows the run chart analysis of percentage of thrombophlebitis over 6 weeks with the line of demarcation between 2 weeks and 3 weeks showing the point of intervention after 2 weeks

IV. Conclusion:

Prior to the introduction of interventions, the percentage of IV thrombophlebitis was 31.5 % in the first week and 21.4% in the second week with an average of 27.4% as shown in table 1 and figures 1 and 3. After the training of the resident doctors and staff nurses and introduction of the interventions, the percentage of IV

thrombophlebitis reduced to an average of 13.8% over a period of 4 weeks. At the end of the study, in the 6th week, the percentage of IV thrombophlebitis was only 1.6 % as shown in figure 3. A quality improvement model therefore can be successfully used to decrease the incidence of IV line associated complications in the PICU within existing resources, using a combination of initial training and sustaining it through multiple PDSA cycles and thus helping to reduce hospital acquired infections.

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