Optimal Use of Procalcitonin for Antimicrobial Stewardship

Sara Nelson, MD[1], Kimberly Boeser, PharmD, BCPS AQ-ID[2], Gretchen Sieger, MS[1], Lei Zhang, MS[1], Patricia Ferrieri, MD, FIDSA[1,2], Stephen Dittes, MD[3], Nishant Sahni, MD, MS[2], Michelle Borchart, PharmD, BCPS[3], Emily Medcraft, PharmD, BCPS[3], Ron Greenberg, PharmD, BCPS[4], Susan Kline, MD, MPH, FSHEA[1,2]
1.University of Minnesota, Minneapolis, MN. 2. University of Minnesota Medical Center and University of Minnesota Masonic Children's Hospital, Minneapolis, MN. 3. Fairview Southdale Hospital, Edina, MN. 4. Fairview Ridges Hospital, Burnsville, MN.

Background and Methods

Antibiotic misuse is common, a costly problem and leads to development of multi-drug resistant bacteria. Procalcitonin (PCT) has been shown in some clinical settings to decrease patients' exposure to antibiotics. Our novel approach involved an Antimicrobial Management Team (AMT) based PCT algorithm that was implemented in the Fairview Health System to evaluate the impact on antimicrobial prescribing.

We implemented a three-part intervention of a PCT-based antibiotic use protocol, integrated in the electronic health record, face-to-face education to providers, and daily review of patients with PCT test results, along with real-time advice by the AMT. We compared measures obtained during the 6-month intervention period, Nov 2015 through April 2016, to the baseline data, Dec 2011 through Oct 2015, to determine the primary outcomes of DOT, LOS, intensive care unit LOS, (30-day all cause) mortality and readmission. We also conducted a pre and post-intervention survey.

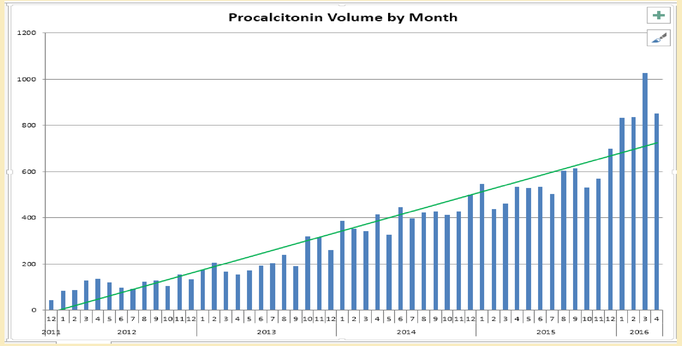

Figure. 1

Results

Variable	Statistics	Before Intervention 12/6/2011-10/31/2015 (N=9699)	After Intervention 11/1/2015-4/30/2016 (N=3000)	P-value
Age at Admission	n	9699	3000	<0.0001
	Mean (SD)	61.53 (17.53)	62.17 (17.97)	
Male – n(%)	Male	4783 (49.31)	1484 (49.47)	0.9438
Race/Ethnicity	White	7743 (82.56)	2390 (82.96)	0.6454
	Black	881 (9.39)	266 (9.23)	
	Hispanic	154 (1.64)	49 (1.70)	
	Other	601 (6.41)	176 (6.11)	
Length of stay	n	9698	2905	
	Median	6.08	5.04	
	IQR	(3.00, 12.00)	(3.00, 10.00)	
Length of stay in log scale	n	9698	2904	<0.0001
	Mean (SD)	1.79 (1.09)	1.60 (1.11)	
Length of ICU stay	n	2036	467	
	Median	4.90	4.50	
	IQR	(2.07, 10.93)	(1.85, 9.47)	
Length of ICU stay in log scale	n	2036	467	0.1651
	Mean (SD)	1.50 (1.22)	1.42 (1.14)	
Days of Therapy	n	8500	2538	
	Median	9.00	8.00	
	IQR	(5.00, 18.00)	(4.00, 14.00)	
Days of therapy in log scale	n	8500	2536	<0.0001
	Mean (SD)	2.18 (1.04)	2.01 (1.03)	
Mortality	Yes	1566 (16.15)	321 (10.70)	<0.0001
30-day readmission at encounter level	Yes	2527 (26.05)	676 (22.53)	<0.0001
Infection disease team (ID) consultation	Yes	2732 (28.17)	811 (27.03)	0.0749

Table 1.

Procalcitonin has been increasingly ordered over the past four years (Figure 1). Comparing pre and post intervention groups, there have been significant decreases over time. The median LOS decreased from 6 to 5 days (p<0.001), median DOT decreased from 9 to 8 days (p<0.001), mortality decreased from 16.2% to 10.7 % (p<0.001), and readmission decreased from 26.1% to 22.5% (p<0.001)(Table 1). When we compared the same 6-month period of each year, the differences in LOS (p=0.16), DOT (p=0.14), and readmission (p=0.21) were not observed between the 6-month period immediately pre and post-intervention (Table 2).

Variable	Statistics	11/1/2012-4/30/2013 (N=648)	11/1/2013-4/30/2014 (N=1358)	11/1/2014-4/30/2015 (N=2089)	11/1/2015-4/30/2016 (N=3000)	P-value
Age at Admission	n	648	1358	2089	3000	<0.0001
	Mean (SD)	63.04 (17.63)	60.35 (17.13)	62.31 (17.62)	62.17 (17.97)	
Male – n(%)	Male	321 (49.54)	683 (50.29)	1004 (48.06)	1484 (49.47)	0.5389
Race/Ethnicity	White	523 (82.62)	1082 (81.85)	1663 (81.80)	2390 (82.96)	0.8056
	Black	59 (9.32)	137 (10.36)	203 (9.99)	266 (9.23)	
	Hispanic	7 (1.11)	33 (2.50)	36 (1.77)	49 (1.70)	
	Other	44 (6.95)	70 (5.30)	131 (6.44)	176 (6.11)	
Length of stay	n	648	1358	2089	2905	
	Median	8.21	6.75	5.33	5.04	
	IQR	(4.00, 16.00)	(4.00, 13.00)	(3.00, 11.00)	(3.00, 10.00)	
Length of stay in log scale	n	648	1358	2089	2904	<0.0001
	Mean (SD)	2.10 (0.97)	1.85 (1.06)	1.66 (1.15)	1.60 (1.11)	
Length of ICU stay	n	155	317	390	467	
	Median	5.67	4.31	4.88	4.50	
	IQR	(2.89, 14.50)	(2.00, 10.33)	(1.91, 11.03)	(1.85, 9.47)	
Length of ICU stay in log scale	n	155	317	390	467	0.3334
	Mean (SD)	1.66 (1.43)	1.44 (1.14)	1.47 (1.26)	1.42 (1.14)	
Days of Therapy	n	614	1201	1790	2538	
	Median	12.00	10.00	8.00	8.00	
	IQR	(6.00, 21.00)	(5.00, 18.00)	(4.00, 16.00)	(4.00, 14.00)	
Days of therapy in log scale	n	614	1201	1790	2536	<0.0001
	Mean (SD)	2.37 (1.05)	2.25 (1.02)	2.07 (1.07)	2.01 (1.03)	
Mortality	Yes	154 (23.77)	253 (18.63)	306 (14.65)	321 (10.70)	<0.0001
30-day readmission at encounter level	Yes	168 (25.93)	384 (28.28)	508 (24.32)	676 (22.53)	0.0001
Infection disease team (ID) consultation	Yes	206 (31.79)	371 (27.32)	598 (28.63)	811 (27.03)	0.0326

Table 2.

Survey Results

Post-intervention survey results showed more people were confident in interpreting PCT results pre and post education and intervention (15% vs 34%). Also, the majority of people (59%) incorporated using PCT into their clinical practice after education and intervention.

Summary

The number of PCT tests ordered has increased significantly over time. LOS, DOT, mortality and readmission decreased significantly post intervention. However, the differences in LOS, DOT and readmission were not observed between the 6-month period immediately pre and post-intervention.

Limitations

The 6-month intervention time period may have been too short to measure long-term effectiveness of the intervention.
Providers only attended one training session, which may not have been enough education to improve understanding and use of PCT. Additional training sessions may be required.

Next Steps

The next step is to evaluate whether the use of antibiotics, per protocol guidance, improved in the 24-hrs post PCT result, after introduction of the PCT algorithm.

Office: 420 Delaware St. SE.,
MMC #250, Minneapolis, MN 55455
E-mail:nels1499@umn.edu
Phone: 612-624-9996
FAX: 612-625-4410

FAIRVIEW