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Effect of Bundled Interventions to Reduce Surgical Site Infection after Gynecologic Cancer Surgery: A Randomized Clinical Trial

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ABSTRACT

Background: Patients can avoid surgical site infections (SSIs), which are a known cause of morbidity and death. They follow between 10 and 35 percent of gynecologic oncology operations performed globally.

Objective: To assess how bundled therapies affect the reduction of SSI following gynecologic cancer surgery.

Patients and methods: Between January and December 2019, a tertiary university hospital conducted a single-center open-labeled randomised clinical study. Fifty women with gynecological cancer procedures were recruited in the trial and were randomly assigned in a 1:1 ratio to either bundled care (group I) or normal hospital care (group II). Overall surgery site infection was the main result, while duration of hospital stays and readmissions were the secondary results, etc. **Results:** The overall infection rate was 20% in group I and 64% in group II (p= 0.002). The length of hospital stays; was 4.68 ± 3.437 days in group I and 8.48 ±7.171 days in group II (P= .021).

Conclusion: Significant decreases in SSIs and length of hospital stays following major gynecologic cancer surgery were linked to the SSI reduction bundle.

Recommendations: Implementation of the bundled interventions in gynecologic oncology patients as a routine care and further studies are needed to generalize the results of the current study.

Keywords: Bundled interventions, SSIs, Gynecologic cancer, Gynecological surgery.

INTRODUCTION

SSIs are one of the surgical complications; defined as infection occurring after surgical procedures. Between 10 and 35 percent of gynecologic oncologic procedures result in SSI [(1)]. The removal of hair, normothermia, glycemic management, and perioperative antibiotic administration protocols are all well adhered to, yet they have not been shown to reduce the incidence of SSIs. This suggests the need for further evidence-based therapies to improve SSI rates[(2)].

The impact of bundled efforts on SSI rates after surgery for gynecologic cancer is still poorly understood, and the results of the individual studies on the impact of care bundles on SSIs are inconsistent [(3,4)]. The application of bundled care was not reported to be applied on oncologic surgery in the setting of the current study; so, this would be implemented to assess the effect of the bundled intervention on reducing SSI among gynecologic oncologic surgery.

The study's objective was to assess how bundled therapies affected the risk of SSI following gynecologic cancer surgery.

PATIENTS AND METHODS

Between January and December 2019, a tertiary university hospital conducted a single-center open-labeled randomised clinical study.

Study population

Women who had undergone surgery for gynecologic cancer were invited to take part in the research. Women with immunocompromised illnesses, severe chronic disabling diseases, or septic focus infections, were not allowed to participate in the study. In addition, ladies who were sensitive to chlorhexidine gluconate and those who declined to take part in the research were not included.

Sample size

Using the Open Epi software programme, version 2.3.1 (Epi-infoTM, CDC, and USA. 2016), the sample size was determined. According to earlier research, 35% of infections occur with routine treatment. With a two-sided χ^2-test with α of 0.05, it was estimated that a 50% difference with the use of bundled care would be clinically significant. To detect a 50% difference in the infection rate with bundled intervention, a minimum sample size of 50 women was required, and 80% power was needed [Odds Ratio=0.02].

Randomization

After evaluation and disclosure of the trial, the participating women were randomised in a 1:1 ratio to either bundled care (group I) or normal hospital treatment (group II) for evaluating surgical site infection within the 30-day postoperative period. A computer-generated table of random integers with allocation concealment was used for the

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randomisation. The allocation treatment was written on cards and sealed in opaque, stapled envelopes with sequential numbers. Following the completion of all baseline evaluations by the recruited individuals, the envelopes were unsealed. Allocation could not be altered after it was completed.

Study interventions

In the **routine hospital care group,** the women received routine perioperative hospital care.

In the **bundled care group,** the women received the surgical site infection reduction bundle that could be expected to reduce SSI; which included pre-, intra-, postoperative, and dismissal interventions.

Preoperative interventions included an emphasis on preoperative patients' education, blood glucose control, oral antibiotics, skin preparation with a 4% chlorhexidine gluconate antibacterial solution and sterile cloths. The skin was cleansed with a 4% chlorhexidine gluconate shower; the night before and morning of the procedure. Women were given two doses of neomycin and metronidazole the night before surgery and within an hour of the incision since antibiotic prophylaxis was deemed to be beneficial when the proper medicine is administered between 15 and 60 minutes.

Intraoperative interventions:

Intravenous (IV) antibiotics were administered prophylactically in accordance with routine institutional recommendations, which comprised giving one dose of 2 g cefotetan 60 minutes before the initial surgical incision and re-dosing as needed. Strict glycemic control was achieved by using IV insulin infusions to maintain glucose levels between 140-170 mg. During fascial closure, separate sterile wound "closing trays" and staff gloves were used, as well as intraoperative supplementary oxygen for maintaining normothermia.

Postoperative interventions:

Temperature was monitored and recorded to ensure normothermia. All health care staff had practiced good hand hygiene when dealing with the women using hand-cleansing agent. Wound dressing was removed within 24–48 hours. Women's skin was cleaned with 4% chlorhexidine gluconate after wound dressing removal. Early ambulation, leg and deep breathing exercises were encouraged. Elastic stocking was applied to prevent blood clots and enhance recovery.

Study outcomes:

The primary outcome of this study was the overall surgical site infection between both groups. Secondary outcomes included the superficial, deep and organ SSI, the length of hospital stays (LOHS) and the hospital readmission.

Ethical approval:

Ethics Committee of the Assiut University gave its approval to this study. All participants gave written consent after receiving all necessary information. The Helsinki Declaration was followed throughout the study.

Statistical analysis

Utilising SPSS 20 statistical software, data were gathered, coded, and examined. Quantitative data were presented as range, mean, standard deviation, and median and were compared using the Student's t-test for regularly distributed continuous data and the Mann-Whitney test for abnormally distributed continuous variables. Frequency and percentage were used to present categorical data, which were compared by chi^2 test and Fisher's exact test. When it was equal to or less than 0.05, the p-value was deemed significant.

RESULTS

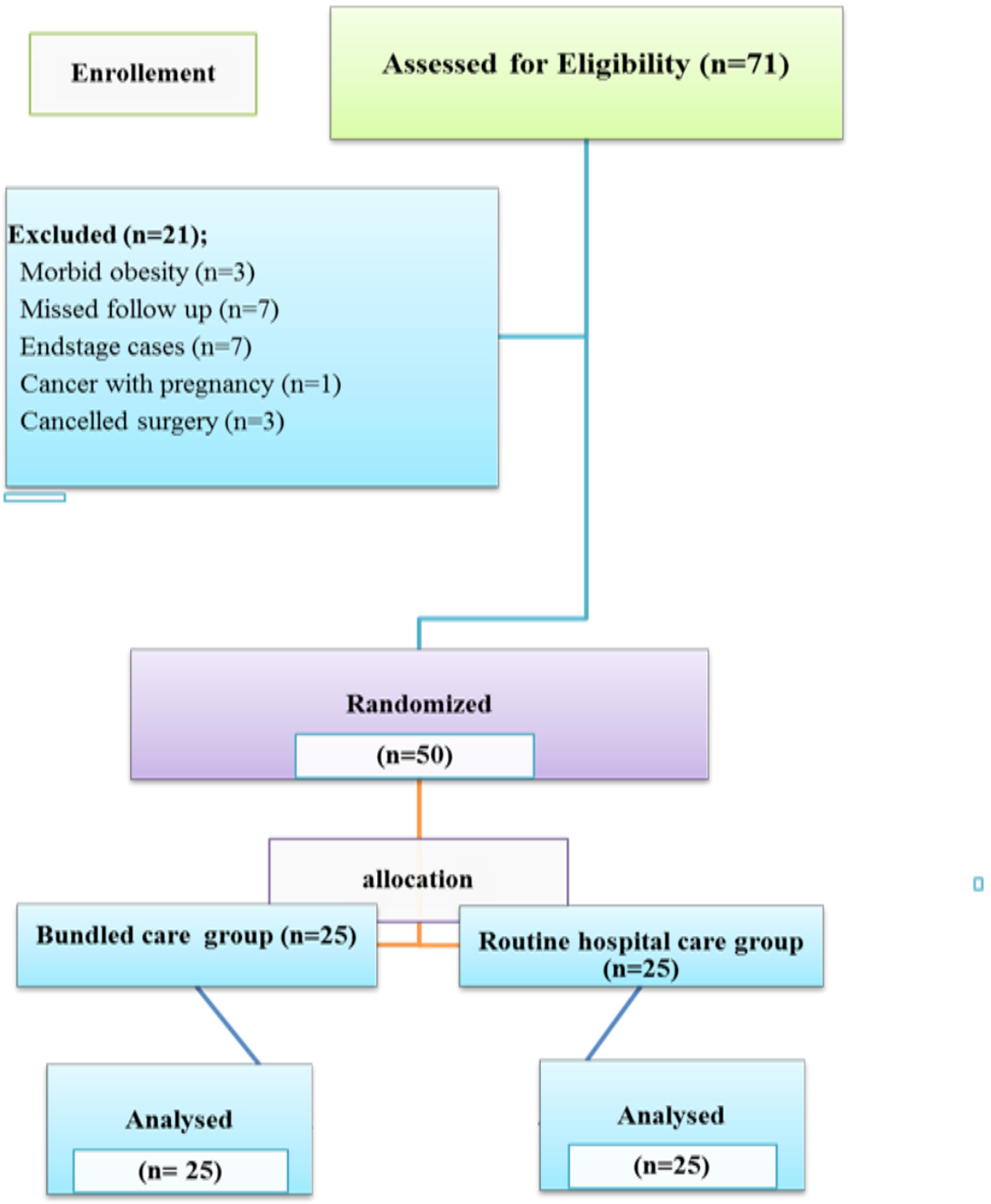

Figure (1): The study flowchart.

The median age of the women was 53 years in both groups. More than two third of women 68% in bundled group were from rural areas compared to 84% in the other group. The majority of women in both groups (92% and 96% respectively) were housewives (P= 1.000). More than three quarters of women in both groups were illiterate. Obesity and overweight were the most common. None were underweighted and morbid obesity was excluded Also one third of women (32% and 36%) were diabetic (Table 1).

Table (1): The characteristics of the study participants undergoing gynecologic cancer surgery.

Variables	Group				P. value
	Bundled group (n= 25)		Routine hospital care group (n= 25)		
	No.	%	No.	%	
Age (years)					
Range	24-75		18-69		0.513
Mean ± SD	53.32±12.805		50.92±12.958		
Median	53		53		
Residence					
Rural	17	68.0	21	84.0	0.321
Urban	8	32.0	4	16.0	
Occupation					
Employed	2	8.0	1	4.0	1.000
House wife	23	92.0	24	96.0	
Parity					
Nulliparous	4	16.0	5	20.0	0.828
Multipara	11	44.0	12	48.0	
Grandmultipara	10	40.0	8	32.0	
Educational level					
Illiterate	21	84.0	20	80.0	0.340
Read and write	0	0	2	8.0	
Secondary	1	4.0	2	8.0	
University	3	12.0	1	4.0	
Marital Status					
Single	3	12.0	2	8.0	0.720
Married	18	72.0	17	68.0	
Divorced	0	0.0	1	4.0	
Widow	4	16.0	5	20.0	
Weight (kg)					
Range	50 - 105		42 -115		0.220
Mean ± SD	76.228 ± 16.7563		70.680 ±14.7443		
Median	75		70		
BMI					
Range	20.96 - 39.50		18.67 - 39.79		0.129
Mean ± SD	29.7381 ± 6.02750		27.3933 ± 4.59982		
Median	27.55		27.34		
ASA score					
ASA I	9	36.0	7	28.0	0.809
ASA II	9	36.0	10	40.0	
ASA III	5	20.0	7	28.0	
ASA IV	2	8.0	1	4.0	
Hypertension					
None	13	52.0	12	48.0	0.777
Yes	12	48.0	13	52.0	
Diabetes mellitus					
None	17	68.0	16	64.0	0.765
Yes	8	32.0	9	36.0	
Previous operations					
No	19	76.0	15	60.0	0.225
Yes	6	24.0	10	40.0	

* Statistically significant difference ($p<0.05$), ** Statistically significant difference ($p<0.01$)

Uni-variable: Continuous variables were presented as median, Mode and range. Categorical variables were presented as frequency and percentage. Bi-variable analysis: Student's t test (CI: 95), Mann-Whitney test (if continuous variables) & if categorical variables: x^2 test or Fisher Exact.

Table (2) shows the operative characteristics; in which there was no statistical difference between both groups. The majority and the vast majority (92% and 96%) of women in bundles group and routine hospital group respectively had laparotomy surgical intervention procedure. Two thirds (64%) in bundled group and slightly less than half 48% in the routine hospital care group of the estimated blood loss during operation was class I<750. 56% and 68% of women in both groups respectively were received intraoperative blood transfusion.

Table (2): Operative characteristics for both groups

Variables	Group				P. value
	Bundled group (n= 25)		Routine hospital care group (n= 25)		
	No.	%	No.	%	
Surgical approach					
Laparotomy	**23**	**92.0**	**24**	**96.0**	**0.600**
Laparoscopy	**1**	**4.0**	**0**	**0.0**	
Laparoscopy followed by laparotomy	**1**	**4.0**	**1**	**4.0**	
Length of surgery from incision to closure (hrs.)					
Range	**1-12**		**1-9**		**0.140**
Mean ± SD	**3.10 ±0.69**		**2.354 ±0.60**		
Presence of Ascites					
No	**14**	**56.0**	**16**	**64.0**	**0.672**
Mild	**7**	**28.0**	**6**	**24.0**	
Moderate	**3**	**12.0**	**1**	**4.0**	
Marked	**1**	**4.0**	**2**	**8.0**	
Surgical complexity score					
Low	**12**	**48.0**	**8**	**32.0**	**0.513**
Intermediate	**6**	**24.0**	**8**	**32.0**	
High	**7**	**28.0**	**9**	**36.0**	
Estimated blood loss during operation (ml)					
Class I<750	**16**	**64.0**	**12**	**48.0**	**0.400**
Class II=750-1500	**6**	**24.0**	**5**	**20.0**	
Class III=1500-2000	**2**	**8.0**	**5**	**20.0**	
Class IV=>2000	**1**	**4.0**	**3**	**12.0**	
Intraoperative blood transfusion					
No	**11**	**44.0**	**8**	**32.0**	**0.561**
Yes	**14**	**56.0**	**17**	**68.0**	
Undergoing any lymph node dissection during operation					
Yes	**16**	**64.0**	**14**	**56.0**	**0.773**
No	**9**	**36.0**	**11**	**44.0**	
Postoperative blood transfusion					
No	**18**	**72.0**	**15**	**60.0**	**0.370**
Yes	**7**	**28.0**	**10**	**40.0**	

Table (3): Thirty-day postoperative follow-up revealed that five (20%) patients in the bundled group and two (8%) patients in the normal hospital care group had SSIs. With no organ or space SSI, almost 16% of the bundled group had superficial incisional infections and 4% had deep infections. In the alternative group, there were 36% of superficial incisional infections, 20% of deep incisional infections, and 8% of organ or space SSI. Group I's mean hospital stay was significantly shorter than that of group II. 4% of the bundled group and 16% of the other group experienced hospital readmissions throughout the post-discharge period. The relationship between the SSI and the risk factors that may cause the infection were demonstrated.

Table (3): The study outcomes for both groups

Variables	Group				P. value
	Bundled group (n= 25)		Routine hospital care group (n= 25)		
	No.	%	No.	%	
Development of surgical site infection					
No	**20**	**80.0**	**9**	**36.0**	**0.002***
Overall SSI	**5**	**20.0**	**16**	**64.0**	
Superficial incisional	**4**	**16.0**	**9**	**36.0**	
Deep incisional	**1**	**4.0**	**5**	**20.0**	
Organ or space SSI	**0**	**0.0**	**2**	**8.0**	
Length of hospital stay					
Range	**1- 17**		**2 - 30**		**0.021***
Mean ± SD	**4.68 ± 3.437**		**8.48 ± 7.171**		
Readmission within the post-discharge period					
No	**24**	**96.0**	**21**	**84.0**	**0.157**
Yes	**1**	**4.0**	**4**	**16.0**	
Classification of complications by Accordion grade classifications					
Non	**18**	**72.0**	**8**	**32.0**	**0.047***
Mild	**5**	**20.0**	**9**	**36.0**	
Moderate	**1**	**4.0**	**5**	**20.0**	
Severe	**1**	**4.0**	**1**	**4.0**	
Death	**0**	**0.0**	**2**	**8.0**	

*: Significant

DISCUSSION

Concerning the overall SSIs; the current study found that the rate was one fifth in the bundled group and about two thirds in the routine hospital care group with a statistically significant difference. This result agreed with **Nguyen *et al.* [5];** who conducted a study assessing the impact in patients with gynecologic oncology in Toronto, Canada, receiving an SSI prevention bundle. They studied 339 patients underwent surgery without applying bundled intervention, and 224 patients following the implementation of the bundle in February 2017. The bundle's adoption reduced the total SSIs' relative risk by more than half when compared to the pre-intervention rate (12.1% to 5.4%).

Additionally, the current study is consistent with that conducted by **Lippitt *et al.* [1],** who between April 2014 and April 2016 at Johns Hopkins Hospital in Baltimore, Maryland, determined the rates and risk factors of SSIs associated with ovarian, fallopian tube, or peritoneal cancer cytoreductive surgery before and after the implementation of an infection prevention bundle. 219 women had surgery throughout the study period: 128 received bundle intervention treatment and 91 received pre-bundle treatment. Before and after the package, the total SSI rate was 5% and 3%, respectively.

The present investigation aligned with the findings of **Schiavone *et al.* [6],** whose research sought to examine the impact of implementing an SSI reduction bundle on the incidence of SSIs among patients with gynecologic cancer undergoing surgery at Memorial Sloan Kettering Cancer Centre in New York, USA, between 2014 and 2016. Preoperative oral antibiotics with optional mechanical bowel preparation, antibacterial solution skin preparation, and the use of a separate surgical closure tray were all included in the package. The bundle was used, and within 30 days following surgery, SSI rates were considerably decreased.

Gynecologic cancer and colorectal surgeries are the most common surgeries complicated with SSIs. The bundle intervention was implemented less commonly in the gynecologic oncology and implemented mostly in colorectal surgeries; therefore, the current study compared its results with the results of cancer of gynecologic and colorectal studies.

The current study revealed that superficial SSI represented around one fifth in the bundled group and more than one third in the routine hospital care group with statistical significance difference between both groups. This agreed with **Cima *et al.* [7];** wherein the study's superficial SSIs dramatically decreased from 4.9% prior to the treatments to 1.5% following the interventions. Also, agreed with **Martinez *et al.* [8];** who showed significantly lowering superficial SSI to 4.2% in post intervention and slightly less than one fifth in pre intervention group. According to the current study, the rate of superficial SSIs dropped from 9.7% to 4.5%, which is consistent with **Nguyen *et al.* [5]**. The present study agreed with the study of **Johnson *et al.* [2];** their study revealed that superficial SSI reduced significantly in post intervention period.

The results of the recent study on the superficial SSI rate were similar to those of **Keenan *et al.* [9],** who investigated the effect of a preventive SSI bundle on SSI rates at an academic tertiary referral centre in Durham, North Carolina, among 559 patients undergoing major elective colorectal surgery. The study was performed between January 2008 and December 2012. The outcomes were analysed and compared before and after the bundle's adoption. The study found that implementing the bundle was linked with fewer superficial SSIs (19.3% vs. 5.7%). The results also coincided with **Lutfiyya *et al.* [10],** who found that the rate of superficial SSI fell from one-fourth to 3.59%.

In relation to the deep and organ/space SSI, the current study differed from **Keenan *et al.*'s [9]**, whose research showed that there was no discernible difference between the deep and organ-space SSIs. Disagreed also with **Lutfiyya *et al.* [10];** they showed a decrease rates of deep and organ/space SSI with no statistically significant difference.

The present study concluded that the organ or space SSI was about one tenth in the routine hospital care group compared to zero percent in the bundled group with statistically significant difference between them. This result come close to **Cima *et al.* [7];** who concluded that organ/ space infections declined significantly after implementation of the bundle.

Agreed also with **Johnson *et al.* [2];** the organ or space infections declined from 3.9% to 1.1% after implementation of the bundle.

In terms of hospital stays, the current study discovered a statistically significant difference between the median length of stay in the bundled group, which was 4 days, and the median length of stay in the normal hospital care group, which was 7 days. These findings corroborated those of **Crolla *et al.* [11],** whose research showed that the presence of SSI increased the mean length of hospital admissions. **Martinez *et al.* [8]** found that patients had a shorter duration of stay following the conduction of the bundle (P = 0.049), which is consistent with the findings of the current investigation. Additionally, this study supported the findings of **Keenan *et al.* [9];** it showed that the median duration of hospital admissions was 4.6 days following a bundle intervention and 7.9 days prior to one (p=0.001).

In terms of 30-day hospital readmissions, the current study found that there was 4% in the bundled group and less than one-fifth in the unbundled group, with no significant difference (P=0.157). The current analysis concurred with **Nguyen *et al.* [5],** who discovered no significant change in readmission rates between pre and after bundle interventions. The current analysis also agreed with **Keenan *et al.* [9],** who observed no change in 30-day readmission rates between the pre and post bundle interventions.

This finding disagreed with **Martinez *et al.* [8];** whose results found that post intervention patients had trend toward lower readmission rate than pre intervention patients. Also, **Harris *et al.* [12];** disagreed with the present study as their study found a significant decrease in hospital readmission. The study of **Lippitt *et al.* [1]** did not come in alignment with the present study as they found that hospital readmission were lower in the post bundle intervention compared with the pre bundle intervention. The difference between the present study and other studies may come from difference of causes of hospital readmission for patient undergoing gynecologic cancer surgeries.

CONCLUSION

As a result of reduced postoperative complications, the use of an evidence-based SSI reduction bundle was linked to significant decreases in SSI and length of hospital stays following major gynecologic cancer surgery.

RECOMMENDATIONS

Implementation of the bundled treatments as standard therapy in gynecologic oncology patients and more research are needed to see whether the bundle may be beneficial with broader application (generalisation). Further research is needed to quantify the corresponding cost reductions. More study is needed to determine the benefit of using bundled care on specific surgical approaches, surgical types, and gynecologic cancer types.

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Conflict of Interest: Nil.

REFERENCES

1. **Lippitt M, Fairbairn M, Matsuno R *et al.* (2017):** Outcomes associated with a five-point surgical site infection prevention bundle in women undergoing surgery for ovarian cancer. Obstet Gynecol., 130(4):756-64.
2. **Johnson M, Kim S, Langstraat C *et al.* (2016):** Using bundled interventions to reduce surgical site infection after major gynecologic cancer surgery. Obstet Gynecol., 127(6):1135-44.
3. **Tanner J, Padley W, Assadian O *et al.* (2015):** Do surgical care bundles reduce the risk of surgical site infections in patients undergoing colorectal surgery? A systematic review and cohort meta-analysis of 8,515 patients. Surgery, 158(1):66-77.
4. **Taylor J, Marten C, Munsell M *et al.* (2017):** The DISINFECT Initiative: Decreasing the Incidence of Surgical INFECTions in Gynecologic Oncology. Ann Surg Oncol., 24(2):362-8.
5. **Nguyen J, Sadeghi M, Gien L *et al.* (2019):** Impact of a preventive bundle to reduce surgical site infections in gynecologic oncology. Gynecol Oncol., 152(3):480-5.
6. **Schiavone M, Moukarzel L, Leong K *et al.* (2017):** Surgical site infection reduction bundle in patients with gynecologic cancer undergoing colon surgery. Gynecol Oncol., 147(1):115-9.
7. **Cima R, Dankbar E, Lovely J *et al.* (2013):** Colorectal surgery surgical site infection reduction program: a national surgical quality improvement program--driven multidisciplinary single-institution experience. J Am Coll Surg., 216(1):23-33.
8. **Martinez C, Omesiete P, Pandit V *et al.* (2020):** A Protocol-driven reduction in surgical site infections after colon surgery. J Surg Res., 246: 100-5.
9. **Keenan J, Speicher P, Thacker J *et al.* (2014):** The preventive surgical site infection bundle in colorectal surgery: an effective approach to surgical site infection reduction and health care cost savings. JAMA Surgery, 149(10):1045-52.
10. **Lutfiyya W, Parsons D, Breen J (2012):** A colorectal "care bundle" to reduce surgical site infections in colorectal surgeries: a single-center experience. Perm J., 16(3):10-16.
11. **Crolla R, van der Laan L, Veen E *et al.* (2012):** Reduction of surgical site infections after implementation of a bundle of care. PLoS One, 7(9):e44599. doi: 10.1371/journal.pone.0044599.
12. **Harris J, Sammarco A, Swenson C *et al.* (2017):** Are perioperative bundles associated with reduced postoperative morbidity in women undergoing benign hysterectomy? Retrospective cohort analysis of 16,286 cases in Michigan. Am J Obstet Gynecol., 216(5):502. doi: 10.1016/j.ajog.2016.12.173.