Journal of the Nigerian Surgical Research Society

ORIGINAL ARTICLE

# Dirty laparotomy wound irrigation for prevention of surgical site infection: a comparison of normal saline vs 1% povidone iodine solution.

LA Ehiagwina[1], J Kpolugbo[1], AE Dongo[1], V Odigie[2], E Irekpita[1], E Tagar[1], AA Okomayin[1], C Odion[1], EO Ijiogbe[1], IN Omoregbe[1]

**Abstract**:

**Background:** Surgical site infection (SSI) is a serious complication that limits the expectations and benefit of surgical interventions following laparotomy for secondary peritonitis. It is associated with increased morbidity and mortality. The effectiveness of normal saline compared to povidone iodine in intraoperative wound irrigation during closure of laparotomy wounds for reduction of surgical site infection remains contentious.

**Aim and objective:** The study aims to evaluate if any, the advantages of irrigating laparotomy wounds of secondary peritonitis with 1% Povidone Iodine solution over Normal Saline in SSI prevention.

**Methods:** This was a prospective randomized study which was carried out in the department of surgery at Irrua Specialist Teaching Hospital over a 12-month period. Sixty-four (64) patients who were admitted in our department for secondary peritonitis who met the inclusion criteria were randomly assigned into two groups. Group A had the subcutaneous layer irrigated with 250mls of Normal Saline (N-S) while Group B had the subcutaneous layer irrigated with 250mls of 1% Povidone iodine (PVI). Post-operative wound outcomes were measured by comparing the infection rates of the wounds. A p-value $\leq 0.05$ was considered significant.

**Results:** In all, there were 43 (67.19%) males and 21 (32.81%) females. The mean age in group A was 46.67 ± 2.92 years while group B was 41.21± 2.79 years (p-value 0.18). Surgical site infection was seen in 16 of 64 (25%) participants, 8 in each of the sub-groups (p 1.00).

**Conclusion:** The SSI rate after laparotomy for secondary peritonitis in this study was 25% each in the Normal Saline and 1% Povidone Iodine arms. There was no significant difference.

**Key words:** Normal saline, Povidone iodine, Wound irrigation, Dirty wounds, Surgical site infection.

[1]Department of Surgery, Irrua Specialist Teaching Hospital, Irrua
[2]Department of Surgery, University of Benin Teaching Hospital, Benin City

**Corresponding Author:** Dr. L.A Ehiagwina, Consultant General Surgeon, Department of Surgery, Irrua Specialist Teaching Hospital, Edo State, Nigeria. Email: ehiamed@yahoo.com. Tel: +2348067884254

## Introduction

Surgical site infection (SSI) is a serious complication that limits the benefit of surgical interventions following laparotomy for secondary peritonitis. It is associated with increased morbidity and mortality. Surgical site infections (SSI) after laparotomy for secondary peritonitis have been shown to cause longer hospital stays, postoperative readmissions and significantly increased costs. It is also associated with significant patient discomfort, financial loss, decreased patient satisfaction and a decreased quality of life.[1,2] It also represents a considerable burden for the patients and the healthcare systems in terms of re-operation, increased post-surgical pain, poor wound healing and poor cosmetic appearance.[3,4] Studies have also shown that SSI in dirty laparotomy wounds predisposes patients to incisional hernia,[5] and also results in deleterious effects such as patient psychosocial distress and decreases patient productivity.[6,7] An incidence of 2% to 30%, or even higher, has been reported, depending on the indication of surgery and patient characteristics.[2]

Some measures have been tested with demonstrable success in reducing SSIs in dirty laparotomy wounds in developed countries, but there is rare evidence in low-and-middle income countries, particularly in Sub-Sahara Africa. Therefore, there is constant debate in literatures on the best measures for managing dirty wounds following laparotomy for secondary peritonitis.[1]

Different methods have been used in an attempt to prevent SSI in dirty laparotomy wounds. The practice of wound irrigation is an old time practice with acclaimed efficacy in reducing SSI.[8] Some of the common irrigation solutions that have been used in the irrigation of surgical wounds in an attempt to reduce SSIs include sterile water, hydrogen peroxide, sodium hypochlorite, normal saline, povidone iodine and antibiotic solutions.[9,10] Irrigation of the subcutaneous layer shown to reduce the incidence of wound infection by evacuating cellular debris, trapped infected fluid contents and bacteria from the wound surface at the time of closure.[11] However, the choice of irrigation solution is largely based on surgeon's personal experience and preferences, institutional policies and procedures or even economic considerations.[12]

This prospective study aimed to investigate the effects of irrigating the laparotomy wounds of secondary peritonitis with normal saline on SSIs compared to using 1% Povidone Iodine solution at Irrua Specialist Teaching Hospital (ISTH), Irrua. This will provide some guiding principle in the choice of wound irrigation solution with respect to infection control after laparotomy for secondary peritonitis.

## MATERIAL AND METHODS

This was a prospective randomized study carried out in the inpatient's surgical department of Irrua Specialist Teaching Hospital, Irrua, Nigeria, from October, 2021 to September, 2022 after obtaining institutional ethical clearance and individual written informed consent from every patient recruited.

**Inclusion criteria:** All consenting patients who were 18 years of age and above, who had exploratory laparotomy for secondary peritonitis from gastrointestinal perforation within the study period.

**Exclusion criteria:** Patients with peritonitis from causes other than gastrointestinal perforation.

Patients with comorbid conditions such as diabetes mellitus, chronic renal failure, or any other immunocompromised state. Also excluded were patients who had previous history of allergy or who were allergic to povidone iodine.

A total of 64 patients who underwent abdominal surgeries for secondary peritonitis from gastrointestinal pathologies in the different surgical units, who met the inclusion criteria were recruited. All the 64 participants were assigned numbers 1-64. The 64 participants were then divided into two equal groups using simple random sampling technique.

Group A: Participants with all odd serial numbers were included in this group, and the subcutaneous layer was irrigated with 250 ml of warm normal saline before skin closure.

Group B: Participants with all even serial numbers were included in this group, and the subcutaneous layer was irrigated with 250 ml of 1% povidone iodine before skin closure.

After the clinical diagnosis of secondary peritonitis is made on the basis of detailed history, physical examination, relevant investigations such as chest x-ray to look for free intraperitoneal air, abdominal ultrasound for free intraperitoneal fluid collection were done. Full blood count, serum electrolyte, urea and creatinine, blood grouping and cross matching and urinalysis were done.

The preoperative preparation of each case involved resuscitation with intravenous fluid to correct for dehydration and electrolyte imbalance and administration of parenteral broad-spectrum antibiotics coverage at the time of diagnosis. A nasogastric tube was inserted and the stomach decompressed. Foley's catheter was passed to measure urine output and to ensure output was adequate before and at the time of surgery. Blood was transfused as required when the packed cell volume was lower than 30%.

Emergency laparotomy, after obtaining informed consent was done. At operation, diagnosis was confirmed and a definitive procedure for the underlying pathology done, followed by peritoneal lavage and an intraperitoneal drain was kept. After fascial closure, Group A had the subcutaneous layer irrigated with 250mls of warm normal saline while Group B had the subcutaneous layer irrigated with 250mls of 1% Povidone iodine. In both groups, skin was closed with interrupted nylon 2/0 sutures.

All patients received empirical broad-spectrum antibiotics for at least 72 hours post-operatively, which was changed where needed after culture result was obtained. Dressing protocol and techniques for all patients in each group remained same. Patients were monitored until discharge and post-operative day 30 for the development of SSI using the CDC classification system as a guide. For those who had SSI, wound swab was collected for microscopy, culture and antibiotic sensitivity.

**Data Analysis**

Data analysis was performed after the termination of the main part of the study, that is, after the last 30-day follow up visit of the last recruited patient. Data collected from the study were entered into an EXCEL spread sheet. The collected data was collated and analyzed using statistical package for social sciences (SPSS) version 22. Mean and standard deviation were calculated for quantitative variables like age. The categorical or qualitative variables like gender and wound infection were presented in terms of percentages and frequencies. Independent sample t-test was applied for the comparison of age between groups. Both groups were compared for wound infection (categorical value) applying Chi-Square test. A p-value $\leq 0.05$ was considered statistically significant.

**RESULTS**

A total of 64 patients undergoing surgery falling under contaminated and dirty surgical

wounds were recruited, in two groups of 32 each. The age ranged from 18-74 years in the study, with mean age of 43.9 ± 16.3 years. Mean age in group A was 46.67 ± 2.92 while mean age in group B was 41.21± 2.79 (p-value 0.18). Of the 64 patients, 43 (67.19%) were males and 21 (32.81%) were females. The age distribution and other socio demographic characteristics of the participants in the two study groups is as shown in table-I, were similar with no statistically significant difference.

**Table I: Socio-demographic characteristics of the patients in the two study groups**.

| Attributes | Povidone-iodine (N=32) n (%) | Normal-saline (N=32) n (%) | $\chi^2$ | P-Value |
|---|---|---|---|---|
| **Age (Years)** | | | | |
| ≤20 | 4 (12.50) | 1 (3.13) | | |
| 21-30 | 4 (12.50) | 5 (15.63) | 4.75 | 0.54 |
| 31-40 | 11 (34.38) | 8 (25.00) | | |
| 41-50 | 5 (15.63) | 4 (12.50) | | |
| 50-60 | 2 (6.25) | 5 (15.63) | | |
| >60 | 6 (18.75) | 9 (28.13) | | |
| Age (Mean ± SD) | 41.21± 2.79 | 46.67 ± 2.92 | 1.35 | $0.18^t$ |
| **Gender** | | | | |
| Male | 21 | 22 | 0.07 | 0.79 |
| Female | 11 | 10 | | |
| Body mass index Mean ± SD ($Kg/m^2$) | 24.32 ± 1.22 | 23.06 ± 0.35 | -0.99 | $0.32^t$ |

*$\chi^2$ = Pearson chi-square, t= Independent student t-test*

**Table II: Distribution of the causes of Secondary Peritonitis in the study arms.**

| Conditions | Povidone Iodine (N=32) n (%) | Normal saline (N=32) n (%) | P-Value |
|---|---|---|---|
| Gastroduodenal Perforation | 12 (37.50) | 15 (46.88) | |
| Large bowel perforation | 2 (6.25) | 1 (3.13) | $0.175^{\#}$ |
| Small bowel perforation | 8 (25.00) | 2 (6.25) | |
| Ruptured appendicitis | 10 (31.25) | 14 (43.75) | |

*# = Fishers exact test, p-value > 0.05*

There were sixteen (25.00%) cases of incisional SSI, 14(87.50%) of which were superficial SSI, 1(6.25%) was deep incisional SSI and organ space respectively. Of the superficial SSI, 7 (43.75%) occurred in each of the Povidone iodine and normal saline subgroups respectively, while 1 (6.25%) patient had deep incisional SSI and Organ space infection in the Povidone iodine and normal saline subgroups respectively. In total, in Povidone-iodine group SSI occurred in 8 (25.00%) out of the 32 patients while in normal saline group, it was observed in 8 (25.00%) out of 32 patients, implying that SSI occurred equally in both groups (Tables III).

**Table III: Occurrence of SSI in the study subgroups.**

| SSI Type | Povidone Iodine (N=8) n (%) | Normal saline (N= 8) n (%) | P-Value |
|---|---|---|---|
| Superficial incisional | 7 (87.5) | 7 (87.5) | |
| Deep incisional | 1 (12.5) | 0 (0.00) | 1.00# |
| Organ Space | 0 (0.00) | 1 (12.5) | |

*# = Fishers exact test, SSI = Surgical Site Infections*

Fifty-six (56.00%) of the participants in this study presented beyond 24 hours to the hospital. However, this was not statistically significant (P=0.54). The mean waiting time before surgery in the hospital was 13.82 ± 3.37 hours for Povidone Iodine subgroup and 16.32 ± 4.11 hours for Normal saline subgroup, but the difference was not significant (P=0.64). Also, the mean duration of Surgery among patients in Povidone Iodine subgroup was 120 minutes and the normal saline subgroup was 136 minutes. However, difference in mean duration was not significant (P=0.17).

The mean estimated blood loss during surgery was 342.90 ± 32.30mls for Povidone Iodine subgroup and 336.66 ± 31.81mls for normal saline subgroup. This was not statistically significant (P=0.891). The duration of post-operative hospital stay ranged from six to thirty (6-30) days. The mean of post-operative hospital stay was comparable between the two subgroups, 10.75 ± 6.01 and 11.13 ± 6.26 days for povidone iodine and normal saline subgroups respectively (p= 0.74). This is shown on table IV.

**Table IV: Clinical characteristics and intra-operative findings of study participants**

| Variables | Povidone-Iodine (N=32) n (%) | Normal saline (N=32) n (%) | t-test | P-Value |
|---|---|---|---|---|
| Duration of symptoms before presentation (days) | | | | |
| ≤ 1 | 5 (16.67) | 8 (25.00) | | 0.54 |
| 1-2 | 8 (26.67) | 5 (15.63) | | |
| ≥ 3 | 17 (56.66) | 19 (59.37) | | |
| Duration of surgery (Mean ± SD) min | 121.9 ± 41.71 | 136.12 ± 38.61 | 1.38 | 0.17 |
| EBL (Mean± SD) (mil) | 342.90 ± 179.89 | 336.66 ± 174.24 | -0.14 | 0.89 |
| Duration between Presentation and Surgery (Mean ± SD) (hours) | 13.82 ± 3.37 | 16.32 ± 4.11 | 0.47 | 0.64 |
| Duration of hospital stay (Mean ± SD) days | 10.70 ± 5.55 | 10.75 ± 3.30 | 0.04 | 0.74 |

*t = Independent student t-test, EBL= Estimated blood loss, Min= minutes, SD=Standard deviation*

**Table V: Comparison of Length of Hospital Stay of the Participants with SSI and those without SSI.**

| Outcome of participants | Frequency (N)=64 | Mean ±SD (days) | 95% conf. interval | P- value |
|---|---|---|---|---|
| SSI | 48 | 15.63 ± 4.59 | 9.05 –18.21 | |
| Non-SSI | 16 | 09.07 ± 3.24 | 8.19 – 11.94 | $0.04^t$ |

*t = Independent student t-test, SSI= Surgical site infection, non-SSI = non-surgical site infection.*

## DISCUSSION

This study evaluated the effectiveness of wound irrigation with either normal saline or 1% povidone iodine on the potential reduction of SSI rate following laparotomy for secondary peritonitis in a tertiary hospital in Nigeria. In this study, a little over two thirds of the participants were males. This figure is similar to findings from studies in other developing countries[13,14]

The preponderance of peritonitis among males has been adduced to be a function of the underlying pathologies, the majority of which are slightly more common among males.[13] Most of the participants were 40 years and below. This may be a reflection of the epidemiology of the underlying pathologies such as acute appendicitis and gastroduodenal ulcer perforation in this study. The mean age of the participants was 43.9 ± 16.3 years. There was no significant difference in the mean age distribution in both study arms (P=0.18). The mean age obtained in this study is similar to that reported by Koranne et al,[14] who found a mean age of 42.5 years amongst patients with secondary peritonitis. This mean age is however at variance with the study by Ayandipo et al,[15] who found a higher mean age (48 years) among patients with secondary peritonitis.

Of the 64 participants, the commonest cause of secondary peritonitis was gastroduodenal perforation (42.19%), followed by ruptured appendicitis (37.50%). The findings in this study are comparable to that of Ghosh et al,[16] who reported gastroduodenal perforation as the most common aetiology among patients with secondary peritonitis. In the said study, gastroduodenal perforation accounted for 48.44%, followed by ruptured appendix (18.53%). This is similar to the findings in this study where gastroduodenal perforation was found to be the most common aetiology among all patients with secondary peritonitis. However, this is at variance with finding by Obona et al,[17] who reported ruptured appendicitis as the commonest cause of secondary peritonitis. Ali et al,[18] found typhoid perforation as the most common cause of secondary peritonitis in his study on peritonitis. Other studies have documented small bowel perforation as the most common cause.[19],[20]These differences in the results of these studies may be due to differences in case mix, the level of education, economic development and availability of basic health facilities such as immunization, safe drinking water, safe disposal of refuse and health awareness among the study population of those studies.[16,21]

In this study, the overall surgical site infections (SSI) rate was 16 in 64 patients (25.00%), with equal distribution of 8 incidents of SSI in both study subgroups. A study by Budipramana et al,[22] on the effect of povidone iodine compared with normal saline irrigation of laparotomy wounds following perforated appendix, also showed that there was no significant difference in the

incidence of surgical site infection. So, it corroborates our finding. This is however, at variance with findings by Kashtel et al,[23] who found that normal saline reduces the SSI rates better than povidone iodine following surgery for ruptured appendicitis. Similarly, Hassan et al**Error! Bookmark not defined.** in a study evaluating the effect of wound irrigation on infection rate following appendectomy wounds reported a significant reduction in wound contamination in the normal saline group compared with povidone iodine group.

However, in a study by Singah et al[24], on clean-contaminated surgical wounds, they observed that infection rate is higher in wounds irrigated with normal saline than wounds irrigated with povidone-iodine. It should however, be noted that the difference in methodology across the various studies, such as variation in the concentrations and volume of povidone iodine used, differences in diagnosis and in the method of infection surveillance may limit the comparison of the various results.

In this present study, the length of hospital stay was between 6 to 30 days. This has obvious economic implications for the patient and the government. The mean post-operative hospital stay in days was comparable between the two groups, and expectedly longer in patients who developed surgical site infections (P=0.04).This is similar to some earlier finding by Osime et al[25], who reported a hospital stay of up to 32 days among patients who had laparotomy for typhoid perforation. Other studies have reported much longer duration of hospitalization following the occurrence of SSI.[26,27]

Considering our small sample size, further studies with larger sample size, preferably multicenter, are needed to evaluate these two approaches.

## CONCLUSION

This study showed a surgical site infection rate of 25% which is lower than the previously reported incidence in contaminated and dirty wounds following secondary peritonitis in many literatures. This lower rate may have been due to the use of normal saline or 1% povidone iodine irrigation of the wounds. The study however, did not show a significant difference between normal and povidone iodine in reducing surgical site infection when used as irrigant of the subcutaneous layer following laparotomy for secondary peritonitis. We

therefore recommend the use of normal saline as an irrigation fluid because it is readily available, cheaper and has no known sensitivities as applies to povidone iodine.

**CONFLICT OF INTEREST:** The authors have no conflict of interest to be declared.

**Funding**: The authors received no financial support for the research, authorship, and/or publication of this article.

## REFERENCES

1. Abiodun AA, Gomna A, Eletta EA, Ayeni MA, Adekanye A, Abdulrahman T et al. A 2-year Review of Wound Outcome Following Primary Skin Closure After Laparotomy for Typhoid Ileal Perforation in Bida, Nigeria. *Journal of Surgery*.2020; **8**(4):132-135.
2. Akter B, Bahar AA, Islam T, Baishnab AK, Quadir MA, Haque MF et al. Incidence of surgical site infections after emergency laparotomy for perforation peritonitis. *International Journal of Surgery Science*. 2021; **5**(2):335-338
3. Anderson DJ, Podgorny K, Berrios-Torres SI, Bratzler DW, Dellinger EP, Greene Let al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. *Infection Control & Hospital Epidemiology*. 2014; **35**(2):605-627.
4. Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. *American Journal of Health-System Pharmacy*. 2013; **14** (1):71-156.
5. Murray BW. The impact of surgical site infection on the development of incisional hernia and small bowel obstruction in colorectal surgery. *American Journal of Surgery*. 2011;**202**(5):558–560.
6. de Lissovoy G, Fraeman K, Hutchins V, Murphy D, Song D, Vaughn BB. Surgical site infection: incidence and impact on hospital utilization and treatment costs. *American Journal of*

*Infection Control*. 2009;**37**(5):387-397.

7. Imada S, Noura S, Ohue M, Shingai T, Sueda T, Kishi K etal. Efficacy of subcutaneous penrose drains for Surgical Site Infections in colorectal surgery. *World Journal Gastrointestinal Surgery*. 2013; **5**(4):110-114.
8. Mueller TC, Nitsche U, Kehl V, Schirren R, Schossow B, Goess R, et al. Intraoperative wound irrigation to prevent surgical site infection after laparotomy (IOWISI):study protocol for a randomized controlled trial. *Trials*. 2017;**18**(1):2-12.
9. Chundamala J, Wright JG. The efficacy and risks of using povidone-iodine irrigation to prevent surgical site infection: an evidence-based review. *Canadian Journal of Surgery*. 2007;**50**(6):473-481.
10. De Luna V, Mancini F, De Maio F, Bernardi G, Ippolito E, Caterini R. Intraoperative disinfection by pulse irrigation with povidone-iodine solution in spine surgery. *Advances in Orthopedics*. 2017;**2**(1):1-8.
11. Gill SR, Al-Adra, Campbell S, Olson DW, Rowe BH. Povidone –Iodine Irrigation of Subcutaneous Tissues May Decrease Surgical Site Infections in Elective Colorectal Operations: A Systemic Review. *Gastroenterology Research*. 2011;**4**(3):97-106.
12. Kumar A.K. Comparison of the Efficacy of Normal Saline and Povidone Iodine Wash in Preventing Surgical Site Infections. *International Organization of Scientific Research Journal of Dental and Medical Sciences*. 2019;**18**(10):76-79.
13. Balogun OS, Osinowo A, Afolayan M, Olajide T, Lawal A, Adesanya A. Acute perforated appendicitis in adults: Management and complications in Lagos, Nigeria. *Annals of African Medicine*. 2019; **18**(1):36-41.
14. Koranne A, Byakodi KG, Sardana Karbi, Helma U, Solanki RS. A comparative study between peptic ulcer perforation score, Mannheim peritonitis index, ASA score, and Jabalpur score in predicting the mortality in perforated peptic ulcers. *The Surgery Journal*. 2022; **8**(3):162-168.
15. Ayandipo O, Afuwape O, Irabor D, Abdurrazzaaq A, Nwafulume N.

Outcome of laparotomy for peritonitis in 302 consecutive patients in Ibadan, Nigeria. *Annals of Ibadan Postgraduate Medicine*. 2016;**14**(1):30-4.

16. Ghosh PS, Mukherjee R, Sarkar S, Halder SK, Dhar D. Epidemiology of secondary peritonitis: analysis of 545 cases. *International Journal of Scientific Study*.2015;**2**(12):83–88.

17. Obonna GC, Arowolo OA, Agbakwuru E, Etonyeaku AC. Emerging pattern of emergency abdominal surgeries in Ile-ife Nigeria. *Nigerian Journal of Surgical Sciences*. 2014; **24**(2):31-5.

18. Ali N, Gali BM. Causes and treatment outcome in perforation peritonitis in north eastern Nigeria. *Surgical Practice*. 2010; **14**(3):92-96.

19. Karachentsev S. Epidemiology and Management of Peritonitis at a Rural Hospital in Zambia. Annals of African Surgery.2020;17(3):120-125.

20. Khan S, Khan IU, Aslam S, Haque A. Retrospective analysis of abdominal surgeries at Nepalgunj Medical College, Nepalgunj, Nepal: 2 year's - experience. Kathmandu University Medical Journal. 2004; 2(4):336-43.

21. Itani KM, Merchant S, Lin SJ, Akhras K, Alandete JC, Hatoum HT. Outcomes and management costs in patients hospitalized for skin and skin-structure infections. *American Journal of Infection Control*. 2011; **39**(1):42–49.

22. Budipramana VS, Lesmana T, Danardono E. The effect of 5% povidone iodine irrigation compared to 0.9% saline in the post laparotomy patient on the number of surgical site infection in Dr. Soemoto hospital, Surabaya. International Journal of Pharmaceutical Research. 2020; **12**(4):1525-1529.

23. Kashtel HJ, Al-Azzawi HM, Khalaf AM. The role of normal saline irrigation versus povidone iodine of surgical wound in decreasing the rate of surgical site infection in perforated appendicitis. *International Journal of Surgery Science*. 2020; **4**(3):169-171.

24. Singh A, Goyal HO, Kaur B. Wound healing: Some observations. J Indian Med Assoc.1988; 86: 81.

25. Osime O, Osifo O. Pattern and outcome of typhoid peforation in Benin city. *The Journal of Medicine*

*and Biomedical Research.* 2007; **6**(1-2):13-18.

26. Lepelletier D, Maillard JY, Pozzetto B, Simon A. Povidone iodine: properties, mechanisms of action, and role in infection control and *Staphylococcus aureus* decolonization. *Journal of Antimicrobial Chemotherapy*. 2020;**64**(9):1-11.

27. Dani T, Ramachandra L, Nair R, Sharma D. Evaluation of prognosis in patients with perforation peritonitis using Mannheim's peritonitis index. *International Journal of Scientific and Research Publications*. 2015; **5**(5):1-35.