

## Effect of Individualized Nursing Intervention on Postoperative Complications among Adult Patients with Abdominal Surgery

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### Abstract:

**Background:** Risk of mortality and complications following abdominal surgery is high as the global average. **Aim:** To determine the effect of the individualized nursing intervention on postoperative complications among adult patients with abdominal surgery. **Research design:** A Quasi-experimental research design. **Setting and Subjects:** General surgical department and outpatient clinic at Aswan university hospital on a convenience sample of 180 adult patients with abdominal surgery and divided into two groups. **Tools:** (I). Demographic and clinical data of adult patients with abdominal surgery, (II). The African Surgical Outcomes Study (ASOS) in addition to the individualized nursing intervention. **Results:** There was no statistically significant difference between both groups regarding the baseline demographic and clinical data. The majority of the studied patients in both groups had a high-risk ASOS  $\geq 10$  with no significance difference ( $>0.05$ ). The minor percentage of the patients in study group (5.7%) had a superficial/deep surgical site, or body cavity infection but control group had other severe complications and postoperative bleeding (12.3 % and 11%) respectively. **Conclusion:** There was a statistically significant difference between the studied patients in both groups regarding abdominal surgical postoperative complications (P. 0.004\*). **Recommendations:** Implementation strategies for resource-limited environments must include the use of educational meetings, tailoring and practicing interventions, and provision of feedback to change health-care provider behavior.

**Keywords:** *Abdominal surgery, Individualize nursing intervention & Postoperative complications.*

### Introduction

Postoperative complications remain a serious concern for both the healthcare system and the individual patient, and they are linked to poor outcomes and increased healthcare expenses. The risk of mortality following surgery is twice as great in Africa as it is in the rest of the world. The majority of these deaths occur on hospital wards following surgery (Thomas & Kathryn, 2021).

Like other surgeries, Abdominal surgery has some postoperative complications such as hemorrhage, infections, cardiac arrest, acute respiratory distress syndrome and fibrotic scarring. Transurethral resection (TUR) syndrome is a fluid overload resulting in disturbed electrolyte balance and hyponatremia due to excess (Thomas & Kathryn, 2021).

The African Surgical Outcomes Study (ASOS) Surgical Risk Calculator is a straightforward preoperative risk assessment tool with excellent discrimination and calibration for predicting in-hospital mortality and serious surgical complications. Because surgical patients in Africa have a low risk profile, surgical risk factors (indication, urgency,

severity, and type) are the primary predictors of severe postoperative morbidity (Kluyts et al., 2018). Because the risk calculator does not require any further testing, it could be used on any adult patient with surgical intervention. Finally, because the score can be calculated and given on a card, it does not necessitate the use of a computer or internet. This risk assessment approach could be used in preoperative clinical decision-making to identify patients who are at a higher risk of complications after surgery. This would enable well-informed judgments about postoperative care and human resource allocation (Meyer et al., 2018).

Clinical difficulties following discharge from the hospital could be a signal for a major change in the recovery of a patient with surgical intervention, potentially of increasing the risk of reoperation, length of stay, bed arrangement, and mortality rate (Ribeiro, 2017).

Although there is no consensus on the actual incidence of postoperative complications, as rates are estimated to range from 5.8% to 43.5 percent in the first 30 days, with overall mortality rate ranging from 0.79 percent to 5.7 percent depending on the type of operation and severity of the complications.

Additionally, various problems are linked to a 7.2-fold, which increase the risk of death rate (Siqueira & Diccini, 2017)

Currently, the incidence of problems rises in direct proportion to the number of surgical procedures performed. Every year, approximately 234.2 million surgical procedures are conducted around the world, with seven million of them resulting in avoidable complications, making this a huge public health issue (Ribeiro, 2017)

Post-discharge complications among patients with abdominal surgery who have been assessed and monitored retrospectively, using secondary data (medical records searches) or outpatient return (patient interviews and/or reassessment). There are few studies that go into detail into the major issues, and the many methodologies utilized make it difficult to establish comparisons that would provide an accurate picture of the situation (Transparency Market Research, 2018)

Providing patients with either a package of enhanced postoperative surveillance interventions (admission to a higher-care ward, increased frequency of postoperative nursing observations, assigning the patient to a bed in view of the nursing station, allowing family members to stay in the ward, and placing a postoperative surveillance guide at the bedside) for those at high risk (i.e., with African Surgical Outcomes Study Surgical Risk) or standard postoperative surveillance interventions (Thomas & Kathryn, 2021).

### Significance of the study:

According to surgical department records, the number of patients diagnosed with abdominal surgeries in 2020-2021 about 256 patients (Aswan University statistical records, 2020-2021). According to experience of the researcher in caring for patients with abdominal surgery, it was noticed that this patient at risk for develop postoperative complications, that due to lack of special intervention, which could be a predispose factors for such group of patients to get a variety of complications. Each patient has different characteristics clinical situation, living situation, routines, individual preferences and medical needs, requiring a plan of care (road map for care) that reflects who this individual is and take to account on that deference. Therefore, there was a need for assessing the risk level, and implement an individualized nursing intervention to avoid the development of this problem.

### Aim of the study:

To determine the effect of the individualized nursing intervention on postoperative complications among adult patients with abdominal surgery. **This through;**

- Assessing the level of risks among both groups to select the high-risk patients
- Developing and implementing the individualized nursing intervention based on the identified needs for the study group.
- Assessing the effect of the individualized nursing intervention on the postoperative complications among adult patients with abdominal surgery
- Compare between the effects of the individualized nursing intervention on the postoperative complications among study group with control one.

### Subjects and Methods

#### Research hypotheses:

There would be significantly decrease in the postoperative complications in the study group versus the control group after implementation of the individualized nursing intervention for adult patients with abdominal surgical

#### Research design:

Quasi-experimental research design was utilized to fulfill the aim of this study.

#### Setting:

The study was conducted at Aswan university hospital in general surgical department (where the patients undergoing abdominal surgery admitted in it) in addition to outpatient clinic (where the patients return to follow up in it).

#### Subjects:

A sample of 180 adult patients undergoing abdominal surgery (i.e. appendectomy, cholecystectomy, exploratory laparotomy for unexplained symptoms that upset the abdominal cavity or unexplained abdominal bleeding). The sample was divided equally on random basis into two groups (90 patients for each group), from both sexes with age ranged between 18 and 60 years old.

#### Sample size

In this study sample, size of the studied patients was calculated by using the epi- info program with a confidence level at 95% and the flow rate of patients 256 cases in 2020-2021. So, the sample was calculated to be 193 patients 13 patients drop out during the data collection, only 180 patients agreed to participate and completed the study period that divided into two groups in a randomized way according to the admission date.

#### Tools of the study:

Two tools were used to collect the required data.

**Tool (I). Demographic and clinical data of adult patients with abdominal surgery:**

This tool was developed by the researcher after passing through an extensive and relevant review of literature. It comprised the following items: Patient profile concerned with the demographic variables: name, age, sex, educational level, marital status, and employment. Also it included the comorbidity diseases such as; hypertension, diabetes and chronic obstructive pulmonary disease. Postoperative complications.

**Tool (II). The African Surgical Outcomes Study (ASOS) Surgical Risk Calculator for preoperative risk prediction of severe postoperative complications and death:**

The ASOS Surgical Risk Calculator is a simple preoperative risk stratification tool that provides good discrimination and calibration for prediction of in-hospital mortality and severe postoperative complications developed by **Biccard et al., (2018)**. This tool used pre application of the individualized nursing intervention to assess the level of risks among both groups then select the high-risk patient for implementation of the individualized nursing intervention (study group).

It included the following items:

Age: (18- 29 years old = 0 point, 30-69 years old = +1 point,  $\geq 70$  years old = +3 points),

American Society of Anesthesiologists: (ASA 1 = 0 point, ASA 2 = +2 point, ASA 3 = +5 points, ASA 4 and more = +8 points),

Surgery timing: (Elective surgery =0 point, Urgent surgery = +3 points, Emergent surgery = +4 points),

Surgery severity: (Minor = 0 point, Intermediate = +1 point, Major = +4 points),

Totally risk stratification: the high risk (ASOS score  $\geq 10$ ) and low risk (ASOS score  $< 10$ ) (**Biccard et al., 2018**).

**The individualized nursing intervention:****It aimed to enhance postoperative surveillance and prevent complication for patients at high risk.**

It was emphasized by **Thomas & Kathryn, (2021)**.

It included the five enhanced postoperative surveillance interventions as possible, including admitting the patient to a higher care ward than had been planned at the time of surgery, increasing the frequency of postoperative nursing observations, assigning the patient to a bed visible from the nursing station, allowing family members to stay with the patient in the postoperative ward, and placing a postoperative surveillance on the patient

It was simplified in Arabic language and was supported by photo illustrations and colored pictures.

**Content validity and reliability:**

**The validity** of the used study' tools (I) and the individualized nursing intervention was checked by

(5) expert professors in the field of nursing and surgery in faculty of nursing and faculty of medicine at Assiut and Aswan universities, whom reviewed them for its relevance, clarity, comprehensiveness, applicability and easiness. Minor modifications required correction were carried out accordingly.

**The Reliability:** The interrater reliability of **tool II (The African Surgical Outcomes Study (ASOS))** its internal consistency calculated via the Cronbach  $\alpha$  was 0.805.

**Methods:****Administrative approval:**

An approval from faculty of nursing, Aswan University was taken. Hospital permission from the head of general surgery departments was taken after clarification of the aim and nature of the study.

**Ethical consideration:**

The study followed the principles of **Helsinki (1996)** declaration for medical research. The proposal of the current research was approved from the ethical committee in the faculty of nursing. There was no risk for study subject during application of the research. Informed consent obtained from the patients who are willing to participate in the study after explaining the nature and purpose of the study. Patients had the right to refuse to participate and/or withdraw from the study without any rational and at any time to maintain anonymity.

**A pilot study:** It was carried out on 10% of the study subjects (18 patients; 9 from each group), who added to the main study. The pilot study was done to ensure clarity, applicability, feasibility of conduction of the study tools, and time needed for each tool to be filled in. No modifications were done according to the pilot study findings. So patients included in the pilot study were within the studied groups.

**Data collection (fieldwork) procedure:**

An explanation of the purpose of the research was done to the directors of Aswan University hospital and general surgical departments. The researcher gave the directors of the outpatients' clinics a copy of the official letter and schedule of the selected subjects.

It was done by pretest, the researcher started to collect data from 1st of July 2021 to 31 of December 2021. The total period for data collection was (24 weeks) about 6 months period.

**Data collection done through the following phases:****Preparatory phase:**

- Needed administrative permissions obtained, assessment of the study setting for the possibility of meeting patients for assessment and implementation of the individualized nursing intervention.

- The researcher developed the first tool after reviewing the related literature and translate the individualized nursing intervention into Arabic language to ease its application. At the first interview, researchers introduced themselves to initiate line of communication, and then explained the nature and purpose of the study. Time of data collection decided according to the studied sample. Data collection done in the morning shift was planned after coordination between the researcher managers of the departments and the outpatients' clinics.

#### Assessment phase:

Before the application of the individualized nursing intervention on patients the researchers assessed patients' personal and clinical data (**Tool I**) and their level of risk using (**Tool II**) to take the baseline data (pre-test). It took about 30 minutes, about 3-4 patients per day/ twice weekly. This step performed for both groups. Data collection conducted in the dressing rooms in both the general surgical departments. This arrangement was done with the head of the general surgical departments. Assessment of the high-risk patients by the researcher determine the study group who would receive the individualized nursing intervention.

#### Implementation phase:

Then the application of the individualized nursing intervention was performed for each patient (with high-risk of post-operative complications) among the study group separately. While the patients in the control group received the routine department care.

During the postoperative phase, high-risk patients were given a designed individualized intervention to enhanced the postoperative surveillance.

#### Evaluation phase:

Both groups were followed up twice weekly for 4 weeks (as a post-test) in the general surgical departments and after their discharge during their weekly visits at the outpatients' clinic, using **Tool I part 2** (clinical data) and the evaluation took about 20 minutes to assess their surveillance and complications.

Follow up was performed for the studied group for one week postoperatively to detect the occurrence of postoperative complications such as superficial or deep surgical site, or body cavity infection, bloodstream infection or acute respiratory distress syndrome, urinary tract or acute kidney injury, cardiac arrest, pneumonia, postoperative bleeding, other severe complications or no complications

#### Statistical analysis:

All data was tallied and examined. For statistical analysis, SPSS software version 19 was used. Frequency and percent were used to express categorical data. The mean and standard deviation (SD) were used to express numerical data. The T-test was used to compare the three sets of numerical data that were analyzed. The Chi square test was developed to compare numerical data groups. If the P-value was less than 0.05, it was regarded significant, if it was less than 0.001, and if it was more than 0.005, it was considered non-significant.

## Results:

**Table (1): Distribution of baseline demographic and clinical data of the studied adult patients with abdominal surgery in both groups (N. 180).**

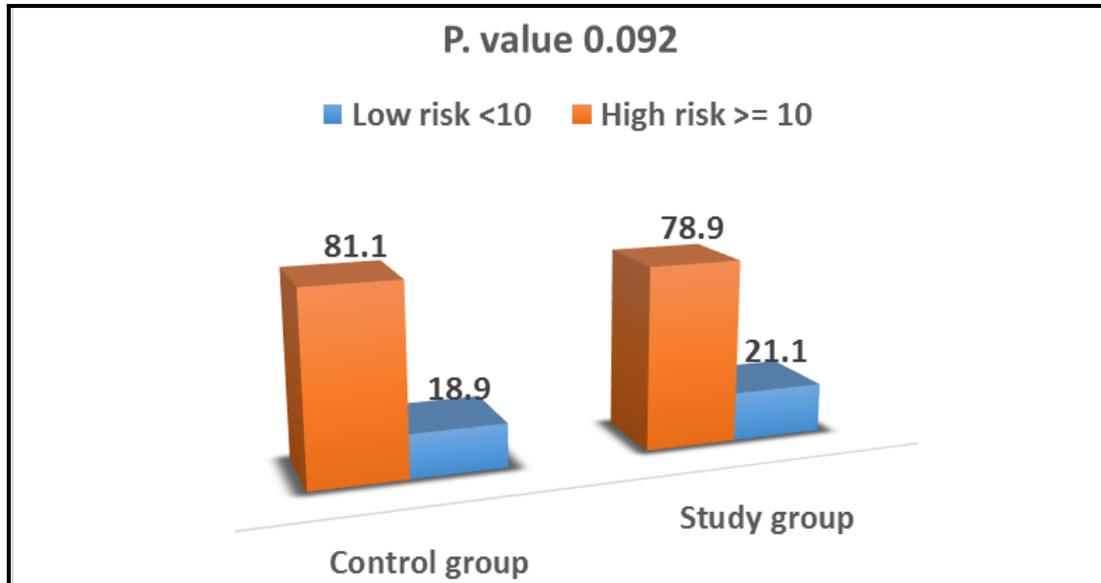
Baseline data	Study group (n=90)	Control group (n=90)	P. value
<b>A. Individual-level data</b>			
<b>Age (years)</b>			
Mean $\pm$ SD	37.4 $\pm$ 15.8	36.8 $\pm$ 15.3	0.961
<b>Sex</b>			
Male	37 (41.1%)	32 (35.6%)	0.591
Female	53 (58.9%)	58 (64.4%)	
<b>B. Comorbidity</b>			
Hypertension	14 (15.5%)	16 (17.7%)	0.424
HIV or AIDS	8 (8.9%)	8 (8.9%)	
Diabetes	6 (6.7%)	5 (5.6%)	
COPD	3 (3.3%)	2 (2.2%)	
Not present	59(65.6%)	59(65.6%)	

Chi square test significant P. value <0.05

HIV: Human immunity virus

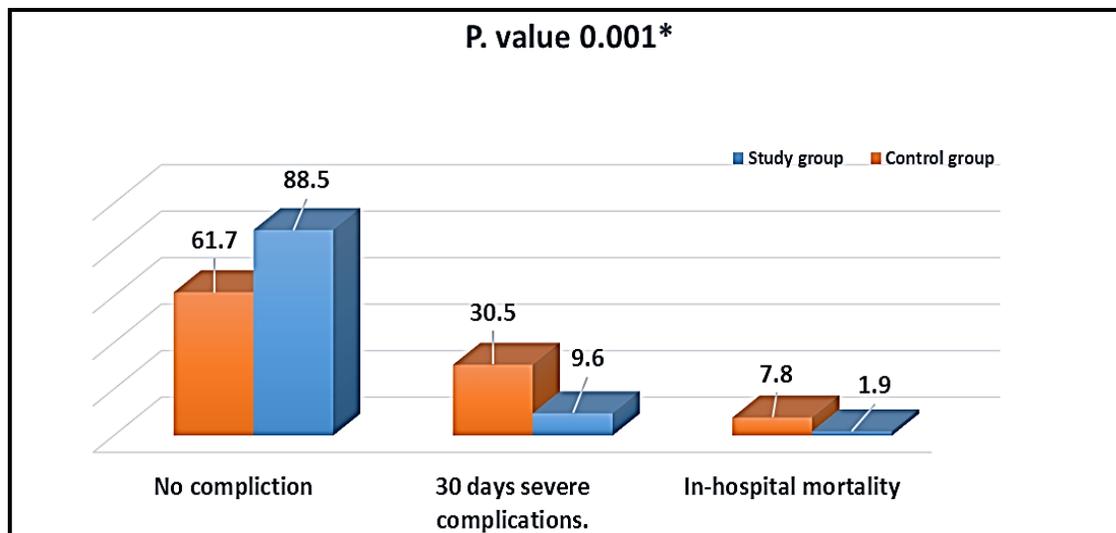
AIDS: Acquired immunodeficiency syndrome

COPD: Chronic obstructive pulmonary disease



Chi square test was used

**Fig (1):** Percentage distribution of the high and low risk according to ASOS among the studied adult patients of both groups (Pre test)



Chi square test was used

**Fig (2):** Comparison between study and control group regarding post-operative surveillance after individualized nursing intervention.

**Table (2):** Comparison of postoperative complications of high-risk ( $\geq 10$  ASOS) adult patients with abdominal surgery in both groups after individualized nursing intervention.

Post-operative complications	Study group (n=71) (78.9%)	Control group (n=73) (81.1%)	P. value
Superficial or deep surgical site, or body cavity infection	4 (5.7%)	6 (8.2%)	<b>0.004*</b>
Bloodstream infection or acute respiratory distress syndrome	2 (2.8%)	3 (4.1%)	
Urinary tract or acute kidney injury	1 (1.4%)	7 (9.6%)	
Cardiac arrest	1 (1.4%)	3 (4.1%)	
Pneumonia	1 (1.4%)	5 (6.9%)	
Postoperative bleeding	3 (4.2%)	8 (11.0%)	
Other severe complications	3 (4.2%)	9 (12.3%)	

Chi square test was used

\*Statistically significant P. value <0.05

**Table (1):** Illustrates that there was no statistically significant difference between both groups regarding the baseline demographic and clinical data. The table also, reported that the mean age of the study and control groups were  $37.4 \pm 15.8$  and  $36.8 \pm 15.3$  years old respectively. More than half of them were females (58.0% and 64.4%) respectively. Regarding the comorbidity the large percentage of the patients in study and control groups (65.6%) had no comorbidity except less than one fifth of them had hypertension (15.5% and 17.7%) respectively.

**Fig (1):** Shows that there was no statistical significant difference between the study and control groups regarding the distribution of the high and low risk according to ASOS ( $P. > 0.05$ ) subjects. Also, the figure reveals that majority of patients in both study and control groups of the studied adult patients with abdominal surgery was (81.1% and 78.9%) respectively with a high risk of ASOS scores  $\geq 10$ .

**Fig (2):** Shows that there was a statistically significant difference between patients in study and control groups regarding post-operative complications after implementation of the individualized nursing intervention. There was a significant decrease in complications rate among the study group (88.5%) than the control group (61.7%) after implementation of the individualized nursing intervention ( $P. < 0.001$ ). The figure also shows that there was a significant decrease in both post 30 days complications and in-hospital mortality among the study group (9.6% and 1.9 %) respectively than the control group (30.5% and 7.8%) respectively after implementation of the individualized nursing intervention ( $P. < 0.001$ ).

**Table (2):** Reveals that there was a statistically significant difference between both groups regarding postoperative complications for studied adult patients with abdominal surgery at high-risk  $\geq 10$  ASOS between both groups after the implementation of the individualized nursing intervention with ( $P. 0.004^*$ ). The majority of the study group had a superficial/deep surgical site, or body cavity infection but control groups had other severe complications and postoperative bleeding were observed.

### Discussion:

Adult patients with abdominal surgery who are at high risk of postoperative complications and benefits greatly from improved postoperative surveillance (McLeod et al., 2020). However, the goal of this study was to determine the effect of the individualized nursing intervention on postoperative complications among adult patients with abdominal surgery. The current study found no statistically

significant difference between the two categories regarding demographic and clinical data.

His study finding is necessary in order to confirm that the two groups were comparable and to demonstrate that the groups were properly randomized. This was supported by Younes, et al., (2018), who ensured that the data was well-randomized and reliable.

The exacting study also, reported that the mean age of the study and control groups were  $37.4 \pm 15.8$  and  $36.8 \pm 15.3$  years old respectively and more than half of them were females.

This finding was essentially identical to Sugrue et al., (2019) who found no statistically significant difference in demographic data of patients with abdominal surgery between study and control groups. The current study's findings contradicted those of Mignini et al., (2018), who claimed that the only statistically significant characteristic in the study group of patients with abdominal surgeries was age, and that patients with abdominal surgeries tended to be older as well. On the other hand, the Pogorelić et al., (2020) study on patients undergoing abdominal procedures discovered that young males were more likely to survive, with no significant variations in age between the two groups.

According to Mark et al., (2018), there was no statistically significant difference in sex among patients with abdominal surgeries in both study and control groups, but females had more abdominal surgical interventions than males.

Regarding the comorbidity, the present study found that the highest percentage of the study and control groups had no comorbidities except less than one fifth of them had hypertension.

The researcher's point of view to explain that level of blood pressure of the patient intraoperative should be measured frequently, because leaving long intervals may hypotension and hypertension may be undetected and causing intraoperative bleeding.

Preoperative hypotension and hypertension were widespread, deep, and mostly undiagnosed by routine vital-sign evaluations in a group of patients improving from abdominal surgery, according to Hallqvist et al., (2018). According to the researcher opinion, frequent or continuous blood pressure monitoring may help to detect hemodynamic disturbances earlier, facilitating treatment and preventing additional post-operative problems.

This contradicts the findings of Howell, (2018), who discovered that postoperative hypotension and hypertension were widespread, persistent, and substantial in a group of people recuperating from abdominal surgery and were mostly unnoticed by standard vital-sign evaluations. Blood pressure monitoring on a regular or continuous basis may help

detect hemodynamic disturbances earlier and hence improve therapy.

Surviving is an important quality improvement means that highlights national and international inequalities in outcomes and helps to explain why some people die after abdominal surgery (Portuondo et al., 2019).

The present study revealed that majority of the patients in both study and control groups had a high-risk according to ASOS (scores  $\geq 10$ ) with no statistical significant difference in between the both groups.

Abdominal exploratory procedures are one of the most regularly done surgeries in horse practice, according to the researcher's opinion. Although the majority of cases of horse abdominal pain cure on their own or with medical care, certain cases are fatal if surgical intervention is not pursued. Despite significant advancements in surgical case survival rates and postoperative care, equine abdominal surgery for gastrointestinal (GI) illnesses has a high mortality and complication rate (Koliarakis et al., 2020).

This corresponds to Adam & Moodley, (2021), who discovered that the majority of patients undergoing abdominal surgery had high risk of ASOS scale scores.

In this context, Biccard et al., (2021) shown that redirecting human resources to high-risk patients has no effect on patients' morbidity who are not risk classified than the high-risk, despite the fact that they may receive less care as a result.

Furthermore, Yu et al., (2020) suggested that, given the lack of harm to low-risk patients, a quality-improvement programmed in the form of an implementation of an effectiveness study for high-risk patients might be required and appropriate.

Biccard et al., (2021) reported that the usage of tools (such as the ASOS bedside guide) could diminish missing of an important management measure.

The present study revealed that there was a statistically significant difference between the patients in study and control groups regarding post-operative complications as there was a significant decrease in both post 30 days complications and in-hospital mortality after the implementation of the individualized nursing intervention.

The researcher's point of view showed that individualized nursing intervention consisting of information about abdominal surgery intervention, and the standard of care regarding these patients will help them to reduce post-operative complications.

Furthermore, the findings of this study were consistent with those of Forrester et al., (2018), who found that the outcomes measured for surveillance and post-operative complications improved in all

patients after the implementation of the individualized nursing intervention

This current finding contradicts with Stephens et al., (2018) finding, who concluded that it was unable to assess whether greater postoperative surveillance led to increased management interventions for patients with postoperative problems because it was impossible to directly measure the difference in treatment between individual patients in the intervention and other in the control groups. This could be because structural limitations hampered the ability to provide postoperative care.

According to Vickery et al., (2021), the pragmatic nature of the ASOS-2 investigation makes it impossible to evaluate whether more postoperative surveillance improves outcomes or whether incapacity to respond to postoperative problems (such as infections or bleeding) limits efficacy.

Regarding post-operative complications, the minor percentage of patients in the study group suffered from superficial/deep surgical site pain, otherwise body cavity infection but the control group had other severe complications and occurrence of postoperative bleeding

Wound complications are a prominent cause of early and late postoperative morbidity following abdominal procedures, according to McGinagle et al., (2022). Accordance to the researcher opinion, surgical wounds in normal, healthy people heal in an organized series of physiologic events that include inflammation, epithelialization, fibroplasia, and maturation.

Also, according to Moningi et al., (2019), the post-operative problems such as surgical site infection and nerve injury are common among abdominal procedures.

El Amrani et al., (2018) showed that rescue from postoperative complications considers quality improvement indicator that the national and international indicators affect positively in the outcomes following abdominal surgery.

In general, it providing feedback on the impact of an individual intervention on patient outcomes which could help to decrease significant adverse events after surgery. Despite the fact that these studies from well-resourced settings corroborate the premise, the ASOS intervention reduces postoperative mortality.

## Conclusion:

**Based on the results of the present study it concluded that:**

There was no statistically significant difference between both groups regarding the baseline demographic and clinical data. The majority of the studied patients in both groups had a high risk according to ASOS (score  $\geq 10$ ), no significance

difference. There was a statistically significance difference between both groups regarding post-operative complications after the implementation of the individualized nursing intervention (P. 0.004\*). The minor percentage of the patients in the study group had superficial/deep surgical site infection, otherwise body cavity infection but control groups had other severe complications and postoperative bleeding were observed

### Recommendations:

From the study results, it is recommended that:

- An interventional perioperative standard of nursing care is required to enhance the post-operative surveillance and prevent comorbidities and complications among adult abdominal surgical patients.
- Application of additional research on other types of adult patients undergoing surgical intervention.
- Future attempts to provide pragmatic interventions for adult patients with surgical interventions and physiological deterioration in a resource-limited environment will need to be co-designed by all local role players to ensure appropriate buy-in with the risk stratification strategy, teamwork necessary to implement the intervention, application of cognitive aids, communication of risk within the team, and feedback on patient's outcomes and nurses' performance.

### Limitation of the study:

- As the health-care providers were not masked, it was possible that intervention compliance was also over-reported.
- There were limitations to this research, as the sample size was not achieved for several reasons, including the COVID-19 pandemic, armed conflicts, and failure to obtain regulatory approvals.
- Failure to recruit a sufficient of the selected hospital might have been in part due to the limited local resources to carry out the intervention, which could be partially overcome by increased funding.

### References:

- **Adam, I., & Moodley, Y. (2021):** Positive Postoperative Blood Cultures in Major Abdominal Surgery Patients Attending a Tertiary Hospital in Durban, South Africa. *Althea Medical Journal*, 8(4), 181-187.
- **Aswan University statistical records, (2020-2021).**
- **Biccard B.M., Madiba T.E. & Kluyts H.L. (2018):** Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. *Lancet*; 23 (1), 391: 1589-1598

- **Biccard, B., du Toit, L., Lesosky, M., Stephens, T., Myer, L., Prempeh, A., & Ndaye, N. (2021):** Enhanced postoperative surveillance versus standard of care to reduce mortality among adult surgical patients in Africa (ASOS-2): a cluster-randomised controlled trial. *The Lancet Global Health*, 9(10), e1391-e1401.
- **El Amrani, M., Clement, G., Lenne, X., Farges, O., Delperro, J., Theis, D., & Truant, S. (2018):** Failure-to-rescue in patients undergoing pancreatotomy: is hospital volume a standard for quality improvement programs? Nationwide analysis of 12,333 patients. *Annals of Surgery*, 268(5), 799-807.
- **Forrester, J., Koritsanszky, L., Parsons, B., Hailu, M., Amenu, D., Alemu, S., & Weiser, T. G. (2018):** Development of a surgical infection surveillance program at a tertiary hospital in Ethiopia: lessons learned from two surveillance strategies. *Surgical Infections*, 19(1), 25-32.
- **Hallqvist, L., Granath, F., Huldt, E., & Bell, M. (2018):** Intraoperative hypotension is associated with acute kidney injury in noncardiac surgery. *European journal of anaesthesiology*, 35(4), 273-279.
- **Helsinki F., (1996):** World medical association declaration of Helsinki, Recommendations guiding physicians in biomedical research involving human subjects, Adopted by the 18th World Medical Assembly, 17c.
- **Howell, S.(2018):** Preoperative hypertension. *Current Anesthesiology Reports*, 8(1), 25-31.
- **Kathryn M, Thomas G, & Weiser R, (2021):** Enhanced postoperative surveillance versus standard of care to reduce mortality among adult surgical patients in Africa (ASOS-2): a cluster-randomised controlled trial, *Anesthesiology*, 131(2), 426-437.
- **Kluyts, H., Le Manach, Y., Munlemvo, D., Madzimbamuto, F., Basenero, A., Coulibaly, Y., & Badi, H. (2018):** The ASOS Surgical Risk Calculator: development and validation of a tool for identifying African surgical patients at risk of severe postoperative complications. *British journal of anaesthesia*, 121(6), 1357-1363.
- **Koliarakis, I., Athanasakis, E., Sgantzios, M., Mariolis-Sapsakos, T., Xynos, E., Chrysos, E., & Tsiaoussis, J. (2020):** Intestinal microbiota in colorectal cancer surgery. *Cancers*, 12(10), 3011.
- **Mark, J., Argentieri, D., Gutierrez, C., Morrell, K., Eng, K., Hutson, A., & Zsiros, E. (2018):** Ultrarestrictive opioid prescription protocol for pain management after gynecologic and abdominal surgery. *JAMA network open*, 1(8), e185452-e185452.

- **McGinagle, K., Spangler, E., Pichel, A., Ayyash, K., Arya, S., Settembrini, A., & de Boer, H. (2022):** Perioperative care in open aortic vascular surgery: A Consensus Statement by the Enhanced Recovery after Surgery (ERAS®) Society and Society for Vascular Surgery. *Journal of Vascular Surgery*, 22(6), 66-78.
- **McLeod, M., Signal, V., Gurney, J., & Sarfati, D. (2020):** Postoperative mortality of indigenous populations compared with nonindigenous populations: a systematic review. *JAMA surgery*, 155(7), 636-656.
- **Meyer, A., Zverinski, D., Pfahringer, B., Kempfert, J., Kuehne, T., Sündermann, S., & Eickhoff, C. (2018):** Machine learning for real-time prediction of complications in critical care: a retrospective study. *The Lancet Respiratory Medicine*, 6(12), 905-914.
- **Mignini, E., Scarpellini, E., Rinninella, E., Lattanzi, E., Valeri, M., Clementi, N., & Santori, P. (2018):** Impact of patients nutritional status on major surgery outcome. *Eur Rev Med Pharmacol Sci*, 22(11), 3524-33.
- **Moningi, S., Patki, A., Padhy, N., & Ramachandran, G. (2019):** Enhanced recovery after surgery: An anesthesiologist's perspective. *Journal of anaesthesiology, clinical pharmacology*, 35(Suppl 1), S5
- **Pogorelić, Z., Domjanović, J., Jukić, M., & Poklepović Peričić, T. (2020):** Acute appendicitis in children younger than five years of age: diagnostic challenge for pediatric surgeons. *Surgical infections*, 21(3), 239-245.
- **Portuondo, J., Shah, S., Singh, H., & Massarweh, N. (2019):** Failure to rescue as a surgical quality indicator: current concepts and future directions for improving surgical outcomes. *Anesthesiology*, 131(2), 426-437.
- **Ribeiro H.C. (2017):** Adherence to completion of the safe surgery checklist. *Cad Saúde Publica*.;33(10): e00046216. doi: 10.1590/0102-311x00046216 » <https://doi.org/10.1590/0102-311x00046216>
- **Siqueira EMP, & Diccini S. (2017):** Postoperative complications in elective and non-elective neurosurgery. *Acta Paul Enferm*; 30(1):101-8.
- **Stephens, T., Peden, C., Pearse, R., Shaw, S., Abbott, T., Jones, E., & Martin, G. (2018):** Improving care at scale: process evaluation of a multi-component quality improvement intervention to reduce mortality after emergency abdominal surgery (EPOCH trial). *Implementation Science*, 13(1), 1-16.
- **Sugrue, M., Jones, F., Deane, S., Bishop, G., Bauman, A., & Hillman, K. (2019):** Intra-abdominal hypertension is an independent cause of postoperative renal impairment. *Archives of Surgery*, 134(10), 1082-1085.
- **Thomas G., & Kathryn M., (2021):** Enhanced postoperative surveillance versus standard of care to reduce mortality among adult surgical patients in Africa (ASOS-2): a cluster-randomised controlled trial. *Anesthesiology*, 2(1), 20-36.
- **Transparency Market Research. Surgical Procedures Volumes Market: To C [Internet].** United States, 2018[cited 2019 Jun 23]. Available from: <https://www.transparencymarketresearch.com/report-toc/1289>
- **Vickery, N., Stephens, T., du Toit, L., van Straaten, D., Pearse, R., Torborg, A., ... and ASOS-2 Investigators. (2021).** Understanding the performance of a pan-African intervention to reduce postoperative mortality: a mixed-methods process evaluation of the ASOS-2 trial. *British Journal of Anaesthesia*, 127(5), 778-788.
- **Younes, F., Cosyn, J., De Bruyckere, T., Cleymaet, R., Bouckaert, E., & Eghbali, A. (2018):** A randomized controlled study on the accuracy of free-handed, pilot-drill guided and fully guided implant surgery in partially edentulous patients. *Journal of clinical periodontology*, 45(6), 721-732.
- **Yu, J., Lim, B., Lee, Y., Park, J., Hong, B., Hwang, J., & Kim, Y. (2020):** Risk factors and outcomes of myocardial injury after non-cardiac surgery in high-risk patients who underwent radical cystectomy. *Medicine*, 99(43)