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CONSENSUS ON NURSING GUIDELINES TO MANAGE PATIENTS ADMITTED TO INTENSIVE CARE UNITS WITH AN OPEN ABDOMEN: E-DELPHI METHOD

Submitted in fulfilment of the requirements
for the degree MNurs (Clinical) in Health Sciences

by

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Declaration

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I, Nicole Barbara Mitropapas, declare that this dissertation, titled "**CONSENSUS ON NURSING GUIDELINES TO MANAGE PATIENTS ADMITTED TO INTENSIVE CARE UNITS WITH AN OPEN ABDOMEN",** is my own work and that all sources that have been used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted for any other degree at any other institution.

14/06/2024

NICOLE BARBARA MITROPAPAS **Date**

Researcher signature

Dedication

To **all nurse practitioners working in intensive care units (ICU)** who are faced with challenges when caring for patients admitted with an open abdomen and who welcomes a guide to provide evidence-based practice to allow for optimal care and improved patient outcomes.

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Abstract

Introduction and background: Open abdominal surgery and leaving the abdomen open after surgery has become the go-to management for severe abdominal conditions and complications. These patients are usually critically unstable after surgery on admission to the ICU, posing multiple challenges to the ICU team and nurses. As nurses in ICU provide 1:1 specialised care and play a vital role in the management of a patient with an open abdomen in the ICU, these patients are challenging for the nurses. Therefore, it is imperative to ensure that there are updated guidelines readily available for nurses caring for the patients with an open abdomen in the ICU to alleviate the nursing challenges and to improve patient care and outcomes.

Aim: To obtain consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen.

Research design and methods: A modified e-Delphi consensus design. An expert panel was compiled, consisting of ICU nurses, surgeons, and intensivists with expertise in the management of patients with an open abdomen in intensive care units was invited to participate. Data were collected using the Qualtrics survey platform. The expert panel were asked to rate the importance on each guideline statement as well as the importance and practicality of each nursing intervention, using a 4-point Likert scale. Experts were allowed to add comments/suggestions to refine the guidelines and accompanying interventions.

Results: Thirty-one experts completed Round 1, 22 Round 2 and 18 Round 3. Most experts were nurses (71%). Consensus was achieved with agreement of >80% and the guidelines were refined as suggested by experts. Five nursing statements with their accompanying nursing interventions were introduced to the experts. Consensus of >80% were obtained on the content of the nursing statements and their accompanying nursing interventions, but refined changes were made on the guideline statements and accompanying nursing interventions which were presented to the experts in round two and three and obtained >90% consensus.

Conclusion: The panel of experts were able to reach consensus on the nursing guidelines presented in Round 3, concluding that the 2020 guidelines have been updated. The aim for the future would be to introduce the nursing guideline in practice and in training and allow for the development of a nursing protocol related.

Keywords: Intensive care unit, modified e-Delphi, nursing guidelines, open abdomen

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LIST OF ABBREVIATIONS	
ABBREVIATIONS	**ITEM**
ACS	Abdominal compartment syndrome
APP	Abdominal perfusion pressure
ARDS	Acute respiratory distress syndrome
CVP	Central venous pressure
EAF	Entero-atmospheric fistulas
EVLWI	Extra-vascular lung water index
IAH	Intra-abdominal hypertension
IAP	Intra-abdominal pressure
ICU	Intensive care unit
MAP	Mean arterial pressure
MOF	Multi organ failure
OA	Open Abdomen
PCWP	Pulmonary capillary wedge pressure
PPV	Pulse pressure variation
SV	Stroke Volume
SVV	Stroke volume variation
TAC	Temporary abdominal closure
WSACS	World Society of the Abdominal Compartment Syndrome

*For the purpose of **anonymity**, invitations to the survey were sent individually to the expert panel members.*

Guidelines forms part of an 'evidenced-based toolkit' which provides the possibility to improve the patient management and the patient outcomes (Pereira, Silva, Carvalho, Zanghelini and Barreto, 2022:2)

CHAPTER 1 ORIENTATION TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND

Leaving the abdomen open after abdominal surgery has become the go-to management for severe abdominal complicated conditions (Fitzpatrick 2017:22; Willms, Schaaf, Schwab, Richardsen, Jänig, Bieler et al 2017:481). Complicated conditions include abdominal trauma, abdominal compartment syndrome, pancreatitis and any medical or surgical complications which have an indication to leave the abdomen open (Willms et al 2017:482). Open abdominal surgery is a surgical procedure that is performed in the operating theatre through a laparotomy, the abdominal cavity is intentionally left open, exposing the abdominal contents to prevent further complications (Willms et al 2017:482).

The open abdomen technique was first mentioned in 1940 by Ogilvie (Saluja, Mitra & Dhingra 2020:193; Kreis, de Mol van Otterloo & Kreis 2013:25). The indication then was for abdominal disasters during World War II but currently the indication is primarily for damage control surgery in trauma and non-trauma patients (Saluja et al 2020:194). The open abdominal technique can also be used in situations where there is clear visceral oedema, if unable to find the source of infection, and if a relook or re-exploration is needed (Coccolini, Roberts, Ansaloni, Ivatury, Gamberini, Kluger et al 2018:2).

The main indications to perform open abdominal surgery followed by leaving an open abdominal wound post-surgery are to facilitate early relook without causing further fascial damage, prevent excessive contamination, allow for decompression, prevention and treatment of abdominal compartment syndrome (ACS)/intra-abdominal hypertension (IAH) (Saluja et al, 2020:193; Coccolini et al, 2018:2).

Once the decision is made to intentionally leave the abdomen open, the abdomen is covered by a technique called a temporary abdominal closure (TAC) (Martin & Sarani 2022:3). The TAC is used to ‘close’ the abdominal cavity to regulate and monitor fluid

losses. Several techniques are available for attempting the TAC, such as the patch closure, negative pressure dressing and silo closure, all dependent on what is available at the specific healthcare institution (Martin & Sarani 2022:4).

Patients with an open abdomen(OA) are managed in the intensive care unit (ICU) for an average of 13 to 65 days, which can increase the morbidity and mortality rates (Willms, Schaaf, Schwab et al 2017:481). Following open abdominal surgery, patients are still at risk for developing severe complications, such as ventilator-associated pneumonia in 30% and acute renal failure in 22% of cases, with an increase in morbidity and mortality (Willms et al 2017:481). These patients are in a critical phase as they face multiple challenges physiologically and mechanically. The patients' chance for survival may improve by ensuring adequate and optimal medical and nursing management (Willms et al 2017:482).

The patient undergoing a laparotomy and leaving the abdomen open is at risk for complications related to the initial laparotomy, such as developing an entero-atmospheric fistula, a 'frozen abdomen', intra-abdominal abscesses and a lengthy closure date of the open abdomen (Coccolini et al 2018:2). Risks related to the frozen abdomen and entero-atmospheric fistulas (EAF) are due to delayed closure of the open abdomen as well as not allowing for optimal temporary closure methods. Therefore, complications increase the mortality rate for the patient, the length of stay and costs (Coccolini et al 2018:11).

Complications such as EAFs occur in 5-19% of patients who undergo surgery for damage control through a laparotomy, thus the EAF contributes to a mortality rate of 10-20% of patients due to increased rate of infection and breakdown of surrounding viscera (Lee, Gallagher, Ejike & Hunt, 2020). Lee, Gallagher, Ejike and Hunt (2020) suggest the most efficient way to reduce the rate of complications is for early abdominal closure which can be achieved by optimal fluid balance (avoid fluid overload, avoid/reduce third spacing of fluids - reducing the evident bowel oedema); preventing significant change in haemodynamic parameters, and allowing for optimal and functional temporary closure techniques, which is mostly managed by the nurses caring for the patient in the ICU.

The outcome of the patient depends on the underlying conditions, surgical complications, and on the management received in the ICU (Willms et al 2017:482). However, the management of a patient with an open abdomen presents enormous challenges for the intensive care team (Willms et al 2017:482), specifically nurses who play an essential role as part of the ICU team in providing optimal health care. It is vital for the nurses and other members of the critical team to continuously assess the patient, interpret patient results and response to treatment, and change treatment where necessary (Lee et al 2020:29).

The nurse plays a vital role in the management of a patient with an open abdomen. The nurse contributes to stabilising the patient's haemodynamics; managing and monitoring intra- abdominal hypertension; preventing infections by infection control; allowing for optimal temporary closure dressing function; wound care; supporting nutrition and mobility (Lee et al 2020:29).

In 2014, the World Society of Abdominal Compartment Syndrome/ the Abdominal Compartment Society developed guidelines on the medical management of patients with an open abdomen in ICU. These guidelines also focus on abdominal compartment syndrome and intra-abdominal hypertension. Based on the medical guidelines developed by the Abdominal Compartment Society, nursing management guidelines for patients with an open abdomen in ICU were developed by the abdominal compartment society (Lee et al, 2020).

Strategies for the implementation of guidelines form part of an 'evidenced-based toolkit' which provides the possibility to improve patient management and patient outcomes (Pereira, Silva, Carvalho, Zanghelini & Barreto 2022:2). Guidelines form an important framework to summarise and provide the latest evidence-based practice and to inform best practices (Dobia, Ryan, Bahammam & Edwards 2019:1136). Guidelines therefore assist health care professionals to make appropriate and evidence-based decisions when managing a patient (Dobia et al 2019:1136).

1.2 PROBLEM STATEMENT

As part of the intensive care team, nurses play an essential role in the management of patients admitted to the ICU with an open abdomen. The researcher, an ICU nurse, observed that the nursing management of patients admitted to the ICU with an open abdomen, in a tertiary healthcare institution in South Africa, appeared to be challenging and problematic for the nurses. During informal discussions and meetings, nurses expressed challenges in maintaining haemostasis (focusing on fluid resuscitation and fluid losses), haemodynamic monitoring, measuring the intra-abdominal pressures, monitoring for indications of early-onset abdominal compartment syndrome, and managing the temporary abdominal closure dressing and infections. In their study of registered nurses' experiences of caring for patients with an open abdomen in an intensive care unit in Gauteng, Kearns, Nel and Chipu (2017) found similar challenges. In the ICU nurses are an important key of communication between different healthcare teams and allow for continuous monitoring and early recognition of any changes (Vance, Koczen-Doyle, McGee-McCullough, Kuzma & Butler-Lebair 2010:227). Nurses are also at the patient's bedside for 24 hours a day, and their care significantly contributes to patient outcomes (Xu, Zhang, Ding et al 2021:2).

In Kenya and Africa, Mwita, Negesa, Boeck and Wandera (2019:2) found that the biggest indication for performing a laparotomy for damage control was abdominal trauma and sepsis. Of patients requiring an initial laparotomy for damage control, 17- 25% have IAH on admission impacting the mortality rate up to 24% (Mwita et al 2019:2).

Currently, there is no consensus on the guidelines for the nursing management of patients with an open abdomen in ICU (Lee et al, 2020). The guidelines that will be used, developed by Lee et al. (2020) not only focuses on the open abdomen, but also on the management of intra-abdominal hypertension and abdominal compartment syndrome. The nursing guidelines were derived from medical guidelines and formed the nursing components. The components that are focused on in the guidelines by Lee et al. (2020) are 1) assessing for intra-abdominal hypertension and abdominal compartment syndrome; 2) open abdomen surgical site/drains; 3) optimizing regional perfusion; 4)

temporary abdominal closure dressing; 5) abdominal closure; 6) nutrition; 7) analgesia and sedation.

Reaching consensus would harmonize the nursing management of patients with an open abdomen in ICU and guidelines would be a valuable approach to enhance patient outcomes in relation to health and care (Cassidy, Harrison, Godfrey, Nincic, Khan et al 2021:2).

1.3 AIM OF THE STUDY

The aim of the study was to obtain consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen.

1.4 CONTEXT

The context of the study was nurses, doctors, intensivists, and surgeons globally working in ICUs and managing patients with an open abdomen. The study was conducted using an online platform, namely Qualtrics online survey software. The link was distributed to the identified experts via email, as the participants identified were not only nationally but globally.

1.5 PARADIGM AND ASSUMPTIONS

A paradigm is a way of looking at natural phenomena that encompasses a set of philosophical assumptions and guides a researcher's approach to enquiry (Polit & Beck 2017:712). In the pragmatic paradigm the evidence gathered becomes the information to present a new strategy for solving a problem (Polit & Beck, 2017:712). The researcher selected pragmatism as the paradigm for this study in order to obtain the participant experts' opinions on the nursing management of patients presenting with an open abdomen, post-surgery, in an ICU. McBride, Misnikov and Draheim (2021:15) describe pragmatism as an "idea or concept". Pragmatists believe that reality and knowledge are constantly changing and focus on 'what will work best' in searching for answers to a

problem and to find the best answers for the research problems (McBride et al 2021:5). In this study, pragmatism focused on the problem of nurses' finding the nursing management of a patient with an open abdomen in ICU challenging. The researcher used components from the current guidelines (Lee et al, 2020) to reach consensus on the management of patients with an open abdomen in ICU. Pragmatism is underpinned by ontological, epistemological, and methodological assumptions.

1.5.1 Ontological

Ontology is the study of being or reality. Ontological assumptions are concerned with the reality that is being investigated. Ontologically, pragmatism focuses on 'actions and change' (McBride et al 2021:5). The action of this study was to focus on reaching consensus on the management of a patient with an open abdomen in ICU to alleviate nursing challenges and improve patient outcomes in ICU.

1.5.2 Epistemological

Epistemology is concerned with the nature of knowledge, its possibility, scope and general basis. Epistemology refers to the way individuals understand reality from what they know and what is observed through interaction with the environment (Polit & Beck, 2017:15). In this study, the knowledge regarding the nursing management of a patient with an open abdomen was available in the form of guidelines that were developed by a group of international nurses, but required consensus and consensus was obtained.

1.5.3 Methodological

Methodology is a strategy or plan of action that links methods to outcomes and governs researchers' choice and use of methods and the process of the research. Methodological assumptions refer to how the researcher will gain knowledge from the participants to answer the research questions (Polit & Beck, 2017:15). In pragmatic studies, knowledge is obtained by doing and action (McBride et al 2021:5). In this study a modified e-Delphi

method was used to obtain further knowledge, to fill the gaps and to reach consensus on the nursing management of a patient with an open abdomen in the ICU.

The researcher assumed that the expert panel members

- Were knowledgeable about the topic.
- Were experts in the area of the study and working in the ICU and/or conducting research related to the nursing management of patients with an open abdomen in ICU.
- Would give truthful inputs.

Finally, the researcher assumed that the consensus guidelines would inspire change through action which should improve practice and patient outcomes.

1.6 DELINEATION

The study was conducted in collaboration with a panel of identified experts in the field of managing patients with open abdomen in ICU. The focus was on the nursing management of patients with an open abdomen in the ICU. The experts included nurses, intensivists and surgeons. Patients and their significant others were not included.

1.7 SIGNIFICANCE

A research study should be significant to the nursing profession and contribute to the body of knowledge (Brink, van der Walt & van Rensburg 2018:61). Guidelines are crucial for making decisions in practice (Wangler & Jansky 2021:322). The components available in guidelines allow for health professionals to make informed decisions regarding the treatment and the care of patients admitted to any health care institution, allowing for improved patient outcomes (WHO, 2022).

Consensus on the guidelines and adjustments to improve patient outcomes should assist nurses globally to provide evidence-based and updated management of the patient with an open abdomen in the ICU and reduce the risk of complications as well the morbidity and mortality of these patients in ICU. Furthermore, the guidelines should be incorporated

into nursing education and nursing management to improve patient outcomes and to inform nursing research (see Chapter 5 for additional implications).

1.8 RESEARCH DESIGN AND METHODS

A research design is the overall plan for addressing a research question, including the specifications for enhancing the integrity of the study (Polit & Beck 2017:164). In this study, the researcher selected a consensus research design, using a modified e-Delphi method. Chapter 3 discusses the research design and methodology in detail.

1.9 DEFINITION OF KEY TERMS

For the purposes of this study, the following key terms were used as defined below.

1.9.1 Guidelines

Pereira, Silva, Carvalho et al (2022:2) define guidelines as "systematically developed statements to assist the practitioner and patient decisions about appropriate healthcare for specific clinical circumstances". In this study, guidelines referred to the nursing guidelines developed of the Abdominal Compartment Society by Lee et al. (2020) to assist nurses in their management of patients admitted to ICU with an open abdomen. These guidelines were presented to a panel of experts to reach consensus.

1.9.2 Intensive care unit (ICU)

An intensive care unit (ICU) is an organized system within a medical facility for the provision of care to critically ill patients with multiple complications, that provides intensive and specialized medical and nursing care and possesses an enhanced capacity for monitoring multiple modalities of physiologic organ support to sustain life during a period of life-threatening illnesses (Marshall, Bosco, Adhikari, Connolly et al 2017:270).

In this study, an ICU referred to a unit in a hospital where critically ill patients are admitted and specifically the patient with an open abdomen after surgery, who required multiple organ support and continuous invasive or non-invasive monitoring.

1.9.3 Nurse

The International Council of Nurses (ICN, 2002) defines a nurse as "a person who has completed a program of basic, generalized nursing education and is authorised by the appropriate regulatory authority to practise nursing in his/her country. The nurse is prepared and authorised (1) to engage in the general scope of nursing practice, including the promotion of health, prevention of illness, and care of the physically ill, mentally ill, and disabled people of all ages and in all health care and other community settings; (2) to carry out health care teaching; (3) to participate fully as a member of the health care team; (4) to supervise and train nursing and health care auxiliaries; and (5) to be involved in research." In this study, a nurse is referred to a person who has completed a basic generalised nursing programme and is authorised by the nursing council of the specified country, to practice in ICU and manage patients admitted with an open abdomen.

According to the *Nursing Act, 33 of 2005* (South Africa 2005:1), the term "nurse" refers to a Registered Nurse, Enrolled Nurse, Enrolled Nurse Assistant, or Student Nurse as a person registered by the South African Nursing Council (SANC) to practise as a nurse and administer medication either independently or under direct supervision according to their rank. A professional nurse (PN) is a person who is qualified and competent to independently practise comprehensive nursing in the manner and to the level prescribed and who is capable of assuming responsibility and accountability for such practice (South Africa 2005:6).

1.9.4 Nursing management of an ICU patient

The nurse is able and competent in managing the complex, continuously changing, technical critical care of the critically ill patient, whilst advocating for the patient's rights and directives to allow for the best outcomes for the critically ill patient (Vance, Koczen-

Doyle, McGee-McCullough et al 2010:236). In this study, nursing management referred to the highly specialised care the nurse provides the critically ill patient presenting with an open abdomen to the ICU.

1.9.5 Open abdomen

An open abdomen refers to leaving the abdomen open following abdominal surgery; the abdominal fascial edges of the paired rectus abdominus muscles are opened to allow for the damage control surgery, preventing abdominal compartment syndrome and intra-abdominal hypertension and allow for re-exploration of the abdomen at a later stage without causing any further damage to the fascia (Coccolini et al 2018:2). This definition was used in this study.

1.10 ETHICAL CONSIDERATIONS

Ethics deals with matters of right and wrong. When humans are used as study participants, care must be taken to ensure that their wellbeing and rights are protected (Polit & Beck 2017:138). In this study, the researcher obtained permission to conduct the study and upheld the principles of beneficence, respect for human dignity, and justice (Pilot & Beck 2018:139).

1.10.1 Permission

The researcher obtained ethical approval and permission to conduct the study from the Faculty of Health Sciences of the University of Pretoria (see Annexure A).

1.10.2 Beneficence

The right to protection from discomfort and harm is based on the ethical principle of beneficence. The principle of beneficence states that one should do good and, above all, do no harm (Polit &Beck 2018:143). During the data collection process, the

researcher ensured no harm or discomfort to the participant experts, by not placing the panel members at any disadvantage or exploiting them (Polit & Beck 2018:145). The researcher informed the participants of the aim, risks and benefits and potential implications of the study and that participation was voluntary. The researcher kept the panel members' personal information and contributions confidential and in a secure location to ensure the integrity of the study. The researcher will keep copies of the study and data safe and secure for up to 15 years, to ensure complete confidentiality and security of the participants.

1.10.3 Respect for human dignity

The principle of respect for human dignity includes the right to self-determination and full disclosure (Polit & Beck 2018:147). The researcher informed the participants that they had the right to decide whether to volunteer to participate, without pressure or coercion, and the right to disclosure, and could withdraw from the study at any time should they wish to do so. The participants were able to contact the researcher for any concerns or questions via the email address provided in the information guide in the email invitation (see Annexure B).

1.10.4 Justice

The principle of justice refers to the right to privacy and the right to fair treatment (Polit & Beck 2018:149). The researcher assured the participants of privacy, confidentiality and anonymity, treated all the participants with respect and fairly, and was available to all the panel members for any queries. The researcher assured the participants that the data collected would only be shared with the research team and the anonymity of the panel members ensured that none of the data collected could be linked to any of the participants.

1.11 LAYOUT OF THE STUDY

The study consists of five chapters. Table 1.1 presents the layout of the study.

Table 1.1 Layout of the study

CHAPTER	TITLE	BRIEF DESCRIPTION
1	Orientation to the study	Introduces the problem, purpose, research design and methodology, paradigm and assumptions, key terms and ethical considerations of the study.
2	Literature review	Discusses the literature reviewed and explored on defining an open abdomen and the importance of nursing management of the patient with an open abdomen.
3	Research design and methodology	Discusses the research design and methods in depth.
4	Results and findings	Discusses the data analysis and interpretation and results, in an article submitted to a peer reviewed journal.
5	Conclusion, implications for practice, limitations, and recommendations	Briefly describes the results, implications and limitations of the study and makes recommendations for further study.

1.12 SUMMARY

This chapter described the background to, problem and purpose, research design, paradigm, and significance of the study, and defined key concepts. Chapter 2 discusses the literature review conducted on open abdomen in ICU and nursing management.

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CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 introduced and outlined the study, including the problem, purpose and research design. This chapter discusses the in-depth literature review conducted for the study. A literature review involves researching, reading and understanding literature relevant to a study (Brink, van der Walt & van Rensburg 2018:55).

The researcher examined literature related to the open abdomen in the ICU, focusing on knowledge of an open abdomen, and nursing management of the patient with an open abdomen in the ICU globally.

2.2 RATIONALE FOR THE LITERATURE REVIEW

The purpose of a literature review is to convey what is currently known regarding the topic of interest and to assist researchers to comprehend and extend their knowledge of the phenomenon under study (Polit & Beck 2017:88). Guidelines form part of an *'evidenced-based toolkit'* which provides the possibility to improve patient management and patient outcomes (Pereira, Silva, Carvalho, Zanghelini and Barreto, 2022:2). Guidelines form an important framework to summarize and provide the latest evidence-based practice, to inform best practices, and assist health care professionals to make appropriate and evidenced-based decisions when managing a patient (Dobia, Ryan, Bahammam and Edwards, 2019:1136).

The literature review therefore examined available knowledge on the open abdomen and surrounding aspects, focusing on the nursing care. Using CINAHL, MEDLINE (PubMed/Ovid) and Google scholar databases, the researcher found several medical guidelines available on the medical management of a patient with an open abdomen but only one nursing guideline based on the medical guidelines for the management of a patient with an open abdomen in ICU. The researcher found that the abdominal

compartment society's nursing guidelines on intra-abdominal hypertension and the open abdomen for the management of a patient with an open abdomen (Lee, Gallagher, Ejike & Hunt 2020:13-26) are available but need further discussion and consensus.

Further discussion and consensus on the nursing guidelines were required so that these guidelines could be used in clinical practice to provide critical care nurses with guidance and evidence-based practice verified by experts in the area of abdominal surgeries and management of the open abdomen in the ICU. The researcher was of the opinion that obtaining global consensus on these existing guidelines might provide clinical practice with evidence-based guidance and improve clinical nursing practice in managing a patient with an open abdomen in the ICU from a nursing perspective, where the nurse plays a vital role in the ICU team managing the patient with an open abdomen.

2.3 OPEN ABDOMEN

2.3.1 Definition

An open abdomen (OA) refers to a condition where the fascial edges of the paired rectus abdominus muscles and the skin are intentionally left open to help prevent the development of intra-abdominal hypertension, abdominal compartment syndrome, trauma-related injuries and pancreatitis, allow for re-exploration, and to treat severe intra-abdominal sepsis (Ceresoli, Salvetti, Kluger, Braga, Vigano, Fugazzola et al., 2020:54; Chiara, Cimbanassi, Biffl, Leppaniemi, Henry, Scalea et al., 2016:173; Fitzpatrick, 2017:22; Einav, Zimmerman, Tankel and Leone, 2021:1; Martin and Sarani, 2022:1). An open abdomen is performed through a surgical procedure known as a laparotomy that allows for space for damaged or oedematous viscera to expand, reducing the risk for developing intra-abdominal hypertension, abdominal compartment syndrome and other related complications (Fitzpatrick, 2017:22; Einav et al., 2021:1).

The OA technique leaves the abdominal contents exposed allowing for space for viscera expansion but temporarily closed, using a temporary cover placed at the end of the surgery to cover the abdominal contents (Fitzpatrick, 2017:23; Martin et al., 2022:1). Therefore, the OA is defined as not closing the abdominal rectus sheath after the surgeon has closely assessed the physiology, identified the injuries, and identified the need for re-exploration. The decision regarding leaving the open abdomen is usually made intra-

operatively depending on the patient's injuries and haemodynamic status (Boolaky, Tariq and Hardcastle, 2022:1; Fitzpatrick, 2017:23).

When the surgeon decides to leave the abdomen open, a temporary abdominal closure (TAC) is applied to the OA. The TAC is placed to cover and to protect the abdominal viscera, limit any heat and fluid loss, and prevent fascial retraction. When the OA technique was first used, primary skin closure was used with sutures or towel clips and then came the Bogota Bag, by suturing a sterilised intravenous fluid bag to the skin. However, these techniques can also contribute to intra-peritoneal fluid loss and worsening oedema of the viscera due to the inflammatory process related to the trauma and initial surgery, and constant fluid resuscitation can still cause ACS (Boolaky et al., 2022:2; Crumley, 2022:1). Negative pressure wound therapy (NPWT) was developed to prevent the onset of ACS, by using an opsite sandwich and vacuum packing to seal the viscera. The NPWT consists of a large plastic drape to protect the viscera, covered with large abdominal swabs or a sponge material, and the top layer a perforated plastic where suction drains are placed to allow for negative pressure (Boolaky et al., 2022:2). If either the Bogota Bag or the NPWT is not used, the Witmann patch can be used. The Witmann patch is a mesh patch that is sutured to the rectus sheath edges and then a negative pressure dressing is applied (Boolaky et al., 2022:2; Mahoney, Bugaev, Appelbaum, Goldenberg-Sandau, Baltazar, Posluszny et al., 2022:1; Crumley, 2022:1). The Witmann patch used in combination with NPWT has been found to have the highest closure rate (77.8%), lowest mortality rate (15.7%) and lowest complication rates (Mahoney et al., 2022:7).

The main aim in managing a patient with an OA would be to ensure early definitive closure of the abdomen. When referring to the closure of the abdomen, primary closure is known as closing the abdomen within 10 days after the initial surgery, and delayed primary fascial closure is known as closing the abdomen only after 10 days from the initial surgery but still within the same admission. Definitive fascial closure is where the ventral hernia is allowed with or without skin grafting and then closing the area later within 6-12 months (Boolaky et al., 2022:2).

When attempting to close the OA, universal criteria are used. The universal criteria for OA wound closure are as follows: (1) an IAP <15mmHg; (2) no evidence of a bowel leak; (3) no evidence of bowel oedema; (4) optimal abdominal wall integrity; (5) no sign of infection and that source control has been attained, and (6) optimal nutritional status to allow for optimal wound healing (Boolaky et al., 2022:2).

Even though the OA has been identified as being successful in preventing or treating deranged physiology in patients presenting with severe injuries or critical illness, it should be borne in mind that the OA is a non-anatomical situation that has the potential for severe side effects (Coccolini, Roberts, Ansaloni, Ivatury, Gamberini, Kluger et al., 2018:2).

Table 2.1 World Society of Abdominal Compartment Syndrome (WSACS) consensus definitions important when managing a patient with an open abdomen

Consensus definitions	
Normal Intra-abdominal pressure (IAP)	5-7mmHg
IAP	General pressure within the abdominal cavity
IAP monitoring	Measured in mmHg Measured at end expiration in supine position Measured through injecting 25mls of fluids into the bladder Zero reference level is the midaxillary line at the level of the iliac crest
Intra-abdominal hypertension (IAH)	Pressures ≥12mmHg
Abdominal compartment syndrome (ACS)	Sustained IAP >20mmHg with new onset organ dysfunction or failure

Source: (Smit, Van Meurs and Zijlstra, 2022:2)

2.3.2 Pathophysiology

Patients admitted to the ICU with an open abdomen present with inflammatory changes related to the bowel injury. During the inflammatory and shock state, the blood shunts to the vital organs and away from the intestines increasing the risk for further intestinal ischaemia and also bowel reperfusion after haemostasis and resuscitation. When reperfusion occurs to the intestinal tract, free radical induced mucosal damage allows for extravasation of fluid from the intestinal lumen into the interstitium. It has been found that there is a link between ischaemia-reperfusion injury and acute lung injury, so the main aim is to allow for lung protective mechanical ventilation with targeted plateau pressures less than 30cmH20 (Griggs and Butler, 2016:571). When looking at the ischaemia-reperfusion injury, it causes fluid shifts from the intravascular space into the interstitial spaces, especially around the bowel wall, resulting in intravascular hypovolaemia. Although crystalloid resuscitation can restore the intravascular volume, it can, in turn, worsen bowel oedema. The worsened bowel oedema can further increase the IAP, prevent primary closure, and increase the patient's risk for developing an enteroatmospheric fistula (Griggs et al., 2016:571).

When the patient is admitted to the ICU with an open abdomen and packing of the abdomen, the patient is at risk for decreased mesenteric venous return which increases the hydrostatic pressure causing venous engorgement and worsens the bowel oedema and fluid shifting. Together with the bowel wall oedema, it causes the formation of an ileus, where the ileus impairs peristalsis and lymphatic drainage, which further contributes to the worsening in the bowel oedema. All these factors further contribute to the patient developing ACS and cause the bowel to become friable and increase the risk of developing a fistula (Griggs et al., 2016:571). Therefore, it is important for the ICU team to apply optimal resuscitation methods to allow for fluid resuscitation, where needed, but to prevent fluid overload. Consequently, the aim is to improve the perfusion but prevent complete volume overload (Griggs et al., 2016:571; Martin et al., 2022:8).

2.3.3 Benefits

The benefits of leaving the abdomen open post-initial laparotomy include preventing IAH and ACS with the proper use of a temporary abdominal closure, reducing the insults of fascial edges, facilitating re-exploration, and decreased mortality (Boolaky et al., 2022:2; Crumley, 2022:1). In addition, the OA assists with planned re-explorations (Crumley, 2022:1; Martin et al., 2022).

2.3.4 Indications

There are different indications that may require the abdomen to be left open. These indications can be grouped into three categories: anatomical, physiological and logistical reasons (Chabot and Nirula, 2017:1). The anatomical reason for leaving the abdomen open is when the fascial edges cannot be brought together after the laparotomy has been performed; the physiological reason is due to systemic dysfunctions and logistically it is for expected re-exploration (Chabot et al., 2017:1). The open abdomen is therefore seen as the go to treatment for abdominal trauma, life- threatening intra-abdominal complications (vascular/sepsis/intra-abdominal hypertension) applying damage control surgery. The damage control surgery that takes place is a series of interrupted operations in critically ill patients who are too unstable to continue with the initial laparotomy (Chabot et al., 2017:1). The main aim is to find the initial problem, such as identifying a major bleed, stopping the bleeding, and to leave the abdomen open until the patient is more stable to complete the initial surgery. The patient will then be transferred to the ICU for critical care, to correct the acidosis, coagulopathy and allow for continuous resuscitation until the patient is stable enough to return to theatre to complete the initial surgery (Fitzpatrick, 2017:24).

When a trauma patient, usually haemodynamically unstable, is admitted to hospital, initial damage control surgery (DCS) will be performed by laparotomy to identify and manage any life-threatening conditions/injuries (Coccolini et al., 2018:1; Chabot et al., 2017:1; Boolaky et al., 2022:1). After the life-threatening injuries, such as severe haemorrhage and spillage of enteric contents, have been controlled, the patient is assessed for acidosis, coagulopathy and hypothermia. The abdomen will then be left open to allow for

adequate resuscitation in the ICU until the patient is haemodynamically stable to complete the initial surgery, definite repair of the injuries and to close the abdomen (Chabot et al., 2017:1). Damage control surgery is therefore seen as the most common procedure resulting in the OA (Boolaky et al., 2022:1).

The Eastern Association for the Surgery of Trauma (EAST) and the World Society for Emergency Surgery (WSES) guidelines support the use of the open abdomen technique in trauma patients with the following: (1) acidosis with a pH <7.2; 2) hypothermia with a temperature <35°C; (3) any clinical coagulopathy with a transfusion of more than 10 units of red blood cells; (4) persistent hypotension (SBP <90mmHg), and (5) a base deficit >8 (Boolaky et al., 2022:1; Chabot et al., 2017:1; Fitzpatrick, 2017:23). Non-trauma indications for an OA include conditions such as pancreatitis, sepsis and intra -abdominal bleeding or intra-abdominal hypertension (Fernández, 2016:25).

Predictors of abdominal compartment syndrome (ACS) can be used to determine the indications for an OA. The following are predictors of ACS: (1) Intra-abdominal hypertension (IAH) ≥20mmHg with new onset organ dysfunction; (2) including abdominal packing (3) aggressive fluid administration; (4) bowel oedema; (5) retroperitoneal haematoma; (6) elevated bladder pressure; (7) raised peak airway pressure on the closing of the abdomen, and (8) inability to gain control of contamination or planned relook to check on the bowel viability (Boolaky et al., 2022:2; Chabot et al., 2017:2). Table 2.2 lists the indications for open abdominal surgery and for leaving the abdomen open.

Table 2.2 Indications for open abdominal surgery and leaving the abdomen open

INDICATION	CONDITION
Damage control surgery	Patients presenting with an acute abdomen with: • Unstable haemodynamic (SBP <90mmHg); • Acidosis pH <7.2; base deficit >8 • Coagulopathy > 10 units blood products • Hypothermia<35°C Patients presenting with trauma and non-trauma conditions:

	• Penetrating and nonpenetrating trauma • Vascular surgery and uncontrolled bleeding
Abdominal compartment syndrome and/or severe bowel oedema	Patient presenting with increased intra-abdominal pressures of >20mmHg due to an acute abdomen caused by one of the following: • Necrotizing pancreatitis • Intra-abdominal sepsis • Large fluid resuscitation • Retroperitoneal swelling/ haematoma • Bowel obstruction
Re-exploration	If patient needs a re-exploration when presenting with: • Intra-abdominal sepsis • Bowel obstruction • Bowel ischaemia • Bowel perforations
Damage control surgery	Patients presenting with an acute abdomen with: • Unstable haemodynamic (SBP <90mmHg); • Acidosis pH <7.2; base deficit >8 • Coagulopathy > 10 units blood products • Hypothermia<35°C Patients presenting with trauma and non-trauma conditions: • Penetrating and nonpenetrating trauma • Vascular surgery and uncontrolled bleeding

Sources: Boolaky et al. (2022); Fitzpatrick (2017); Kreis (2013)

2.3.4.1 Intra-abdominal hypertension (IAH)

Intra-abdominal hypertension is defined when there is an elevated intra-abdominal pressure leading up to abdominal compartment syndrome which is defined as the development of pressure-induced multi-organ dysfunction and failure (Cheatham, 2009:1;

Smit et al., 2022:2). Increased intra-abdominal pressures can place significant strain on the surrounding organs resulting in organ failure in the cardiac, pulmonary, renal, gastrointestinal, hepatic, and central nervous system (Cheatham, 2009:1; Smit et al., 2022:2).

IAH is seen as a range of pathophysiological changes, starting with reduced blood flow to the surrounding organs resulting in multi-organ dysfunction, failure and ACS (Cheatham, 2009:1). IAH and ACS are independent predictors of mortality in the critically ill patient in the ICU (Cheatham, 2009:4; Smit et al., 2022). The WSACS guidelines grade IAH as indicated in Table 2.3.

Table 2.3 The WSACS grading of IAH

Grade 1	IAP 12-15mmHg
Grade 2	IAP 16-20mmHg
Grade 3	IAP 21-25mmHg
Grade 4	IAP >25mmHg

Source: De Laet, Malbrain and De Waele (2020)

2.3.4.2 Abdominal compartment syndrome (ACS)

ACS can be referred to as the pattern of symptoms that take place when there is a slight increase in the intra-abdominal pressure, known as intra-abdominal hypertension (IAH). Therefore, IAH is developed when there is a continuous intra-abdominal pressure >12mmHg. The continuous IAH present in the abdominal cavity can be caused by any trauma, vessel disruption resulting in bleeding, large fluid resuscitation, as well as any condition that may increase the pressure within the abdominal cavity. The biggest factors that can lead to the development of IAH are diminished abdominal wall compliance, oedematous bowel and increase in abdominal contents with a capillary leak or massive fluid resuscitation, therefore the open abdominal technique is used to put a halt on the progression of the IAH (Fitzpatrick, 2017:24). According to Chabot et al. (2017), ACS can be identified by using the standard definitions.

Abdominal pressures are measured via bladder catheterisation, and the normal pressures are 5mmHg- 7mmHg. Therefore, ACS is seen as a critical condition, whether due to trauma, any vascular disruption or any condition that warrants a decompressive laparotomy (Fitzpatrick, 2017:24). ACS, in turn, causes reduced ventricular filling due to reduced venous return caused by the increased pressures on the inferior vena cava or on the portal vein. The reduced venous return also results in poor perfusion to the vital organs (heart, lungs, kidneys and the brain), resulting in multi organ failure (Fitzpatrick, 2017:24).

When looking at the pressures of the abdomen, intra-abdominal hypertension can be identified with pressures greater than 12 mmHg, but ACS is identified with pressures greater than 20mmHg presenting with any new onset organ dysfunction. Abdominal perfusion pressures (mean arterial pressure-intra-abdominal pressure) of more than 50mmHg have shown optimal outcomes for the patient and improved mortality and morbidity (Chabot et al., 2017:2; Fitzpatrick, 2017:24). Intra-abdominal pressure is therefore defined as the constant pressure that is maintained within the abdominal cavity therefore it is very important for the critical care nurse to monitor the IAP to determine indications for early onset ACS (Fitzpatrick, 2017:24).

ACS develops when the IAH worsens into an ACS with constantly high IAP which, in turn, results in multi-organ failure due to reduced perfusion. When looking at IAH, IAH is defined by 4 grades: 1st grade – IAP 12 to 25mmHg; 2nd grade – IAP 16 – 20mmHg; 3rd grade – IAP 21 – 25mmHg, and 4th grade – IAP > 25mmHg. The most effective way to address the ACS is early recognition and early intervention (Fitzpatrick, 2017:24). ACS is categorised into two types, namely primary ACS and secondary ACS. Primary ACS is when the patient presents with an injury or disease in the abdominopelvic area that needs early surgical intervention. Secondary ACS is when the patient's primary condition or disease is not in the abdominopelvic area, but causes oedema and increased pressures in the pelvic area (Fitzpatrick, 2017:23).
When looking at ACS, the patient (medical or surgical) is at risk for developing ACS in the following situations: (1) any abdominal surgery; (2) large volume fluid resuscitation, and

(3) any new onset failure of the pulmonary, renal, or hepatic systems. The WCACS recommend that if the patient presents with two or more of the risk factors mentioned, a baseline of intra-abdominal pressures must be done and recorded. If the pressures obtained show IAH, the pressures must be measured more frequently to be able to determine any severe change or increase in pressures (Chabot et al., 2017:2; Fitzpatrick, 2017:23).

If the pressure in the abdomen increases significantly, it is important to try and relieve the pressure non-surgically, by inserting a nasogastric tube/rectal tube to remove the intraluminal contents, reducing the rate of the enteral feeds, and administering promotility agents (Chabot et al., 2017:2). These non-surgical strategies can help to reduce intestinal distension and in turn reduce the intra-abdominal pressures and the effect of ACS (Chabot et al., 2017:2).

If the non-surgical strategies do not improve the abdominal perfusion pressures and reduce the intra-abdominal pressures and the patient becomes more haemodynamically unstable and not responding to fluids, it can worsen the ACS, leading to poor pulmonary compliance, causing metabolic acidosis due to poor perfusion, and a drop in pH which further compromises the cardiac output. Therefore it is vital for the surgeon to open the abdomen in the ICU to relieve the pressures and to improve the perfusion (Chabot et al., 2017:2).

The TAC dressing is ideally tension free, but patients are still at risk to develop ACS repeatedly especially in a situation where the patient needs ongoing fluid resuscitation. The incidence of developing ACS after the initial DCS has been reported as 6-14%, therefore it is important for the ICU team to continuously monitor the bladder pressures for patients at risk for developing ACS (Chabot et al., 2017:6). When the intra-abdominal pressures are constantly increasing with new onset organ failure, it is imperative for the surgeon to reopen the dressing and allow for abdominal decompression and improve the abdominal perfusion pressures (Chabot et al., 2017:6).

2.3.5 Contraindications

Although damage control surgery has become the key in treating any pathologies related to the abdomen, several studies have warned against the overuse of an open abdomen as the open abdomen has its own complications such as developing an ileus (13%), developing an anastomotic leak (7%), causing fascial dehiscence (11%) and an increase in surgical site infections (19%) (Chabot et al., 2017:1).

2.3.6 Damage control surgery

Using the open abdomen management technique has been recognised as a vital approach in managing intra-abdominal sepsis, but now has extended to a larger group of patients from intra-abdominal sepsis, medical conditions such as intra-abdominal hypertension; pancreatitis; peritonitis; vascular emergencies to abdominal trauma and non- trauma related abdominal injuries or conditions (Coccolini et al., 2018:6; Kreis, 2013:527; José Santivañez Palominos, Arturo and Manuel, 2019:3).

Since the 1990s, damage control surgery has become the go-to management in the management of patients presenting with severe physiological changes who need lifesaving surgical interventions to prevent any deterioration in their condition (Kreis, 2013:527). Damage control surgery is performed swiftly and immediately through a laparotomy to attend to the life-threatening abdominal condition, whether trauma or bleeding (Fitzpatrick, 2017:25; Griggs et al., 2016:567). The timing of damage control surgery is very important as it needs to be done before the patient starts to deteriorate and becomes too critical and unstable to move to the operating room (Fitzpatrick, 2017:25). The main goal for performing the initial damage control laparotomy is to obtain haemostasis in a patient that is presenting with bleeding, sepsis or any bowel leakage that may cause the patient to become unstable and critical (Fitzpatrick, 2017:25). It is advised that damage control surgery be performed early before the patient's condition severely deteriorates and the patient becomes coagulopathic, hypothermic, severely acidotic with a base deficit >15mmol/L or requires a massive transfusion (Fitzpatrick, 2017:25; Griggs et al., 2016:568; Boolaky et al., 2022:1).

After the damage control surgery has been done and the life-threatening condition treated temporarily, the patient is then moved to the ICU where the second phase of the damage control starts (Fitzpatrick, 2017:25). The second phase of damage control in the ICU is to achieve haemostasis in terms of stabilising the physiological parameters, including transfusion of blood products, fluid resuscitation, invasive monitoring for blood pressure and cardiac parameters, rewarming, and metabolic support (Fitzpatrick, 2017:25). The final phase and main aim of damage control surgery is to take the patient back to the operating room and perform the definitive repair of the initial life- threatening condition and close the abdomen (Fitzpatrick, 2017:25).

Recent studies have concluded that the use of damage control surgery in severe life-threatening conditions, such as trauma or any other critical illness, reduces the mortality and immediate postoperative complications such as multiple organ failure (Fitzpatrick, 2017:25), but have clear warnings about the overuse of DCS and the OA as it places the patient at risk for developing further complications such as an ileus (13%), anastomotic leak (7%), fascial dehiscence (11%) and surgical site infections (19%) (Chabot et al., 2017:1; José Santivañez Palominos et al., 2019:3). When the decision has been made to perform DCS on a patient, it is important to focus on damage control resuscitation (DCR) post operatively (Chabot et al., 2017:1).

2.3.6.1 Specific management principles following damage control surgery

After the damage control surgery has been performed and the patient has gone through the resuscitation phase, the open abdomen presents with multiple challenges for the intensivist and ICU team, in terms of mechanical ventilation, maintaining optimal haemodynamic status and fluid haemostasis (Griggs et al., 2016:571). When looking at the ICU management of the patient with an open abdomen, the following aspects are vital: (1) multidisciplinary approach; (2) IAP measurement is essential in all critically ill patients at risk for developing IAH/ACS; (3) physiological optimization is a vital determinant in critical patients; (4) use of inotropes and vasopressors should be patient specific; (5) optimal fluid balance to aim for haemostasis; (6) aim for normothermia, and

(7) when patient is coagulopathic reduce the TAC suctioning to prevent further bleeding (Coccolini et al., 2018:7):

- *Damage control resuscitation*

It is important to incorporate DCR after DCS to improve patient outcomes post-operatively (Chabot et al., 2017:1). DCR focuses on managing the patient's resuscitation post-operatively by incorporating early use of blood products and preventing over-resuscitation of crystalloids in trauma patients to prevent onset of complications such as acidosis, coagulopathy and hypothermia (Chabot et al., 2017:1).

- *Nutrition*

A patient that is admitted to the ICU with an open abdomen is in a persistent catabolic state as well as a physiological pro-inflammatory hypermetabolic state, immediate and optimal nutritional support is vital in improving patient outcomes. The American Society for Parenteral and Enteral Nutrition advises initiating enteral feeding within 24 to 48 hours to meet the metabolic needs of the patient (Chabot et al., 2017:5). However, it is important not to commence any enteral feeds when there is a discontinuation in the intestinal tract after damage control surgery or in patients with a high output fistula or in patients with signs of intestinal obstruction (Coccolini et al., 2018:7). It is important to take note that the patient will return to theatre multiple times which poses interruptions in enteral feeding and not obtaining nutritional goals (Martin et al., 2022:9). Parenteral nutrition should be considered in combination with enteral feeding to be able to meet the patient's nutritional goals (Martin et al., 2022:9).

Nutritional support for these patients is essential but very difficult because of the physiological pro-inflammatory hypermetabolic state they are in excluding the initial insult of the laparotomy. The body is therefore unable to compensate for the insensible losses which, in turn, leads to delayed wound healing and closure, increases the risk of infections and significantly increases the mortality rate. Enteral nutrition is important to initiate once the resuscitation phase has been completed (Boolaky et al., 2022:2; Coccolini et al., 2018:7).

In addition to the normal requirements of 25–35 kcal/kg/day of non-protein energy and 1.5–2.5 g/kg/day of protein, it is anticipated that patients with OA will lose an additional 29 g protein per litre of wound exudate and patients with fistulas will lose an additional 2 g/l of protein, therefore enteral nutrition plays a vital role in the patient with an OA in ICU (Boolaky et al., 2022:2).

Initial concerns regarding enteral nutrition were that the patients could develop a paralytic ileus due to the exposed viscera and that the enteral nutrition might worsen the bowel oedema and cause abdominal distension, but it was argued that early enteral feeds are now deemed safe and beneficial to use in a patient with an OA. The early use of enteral feeds is associated with a reduced incidence of ventilator-associated pneumonia (VAP) (43.8% vs 72.1%), allows for earlier wound closure (74% vs 49%) and reduces the formation of fistulas (9% vs 26%) (Chabot et al., 2017:6).

- *Mechanical ventilation*

The increased IAP severely affects the pulmonary compliance with a 50% reduction in pulmonary compliance with an IAP at 16mmHg (Griggs et al., 2016:571). As the abdomen becomes more distended, the chest wall compliance reduces. With the reduced chest wall compliance and the increased abdominal pressures, the lungs are not able to expand completely and therefore reduce the inspiratory tidal volumes, which can lead to hypoxia, respiratory acidosis thus worsening the overall acidosis. Together with the reduced chest wall compliance, atelectasis occurs due to the increased pressures on the chest wall from the increased IAP which worsens the ventilation-perfusion mismatch (Griggs et al., 2016:571; Chabot et al., 2017:6).

The patient is at risk for developing an acute lung injury or acute respiratory distress syndrome (14%) due to the reduced chest wall compliance and increased IAP therefore it is important to ensure the patient receives lung protective ventilation to help prevent the onset of the acute lung injury (Chabot et al., 2017:6). Lung protective ventilation is achieved by ventilating the patient with lower tidal volumes and higher rate (Griggs et al., 2016:571).

- *Haemodynamic monitoring*

Maintaining haemostasis and optimal perfusion remains a challenge for the ICU team. When the IAP increases above 10mmHg, it results in an increase in the afterload, a decrease in the preload, and reducing the left ventricular compliance which, in turn, reduces the cardiac output. Further compression of the vascular beds causes a significant increase in the systemic vascular resistance. The elevated thoracic pressure due to the increased IAP causes a significant increase in the pulmonary capillary wedge pressure and central venous pressure which, in turn, also reduces the cardiac output, consequently it may not be useful to monitor the CVP and PCWP in patients with increased IAP and ACS (Griggs et al., 2016:571).

Performing regular IAP measurements may help to guide the ICU team in the haemodynamic monitoring and the management of the patient. Patients with an open abdomen present with dehydration, significant protein loss and electrolyte derangements due to hypotonic fluid losses from the peritoneal cavity. The protein loss across the wound bed reduces the oncotic pressure and further contributes to volume loss (Griggs et al., 2016:571). Due to the high protein losses and reduced oncotic pressure, colloid resuscitation is more beneficial to achieve haemostasis and diuresis should only be considered after the resuscitation phase has been completed. The ICU team should focus on resuscitation for the first 12 to 24 hours (Griggs et al., 2016:571).

- *Intra-abdominal pressure monitoring*

Increased IAP causes compression on the vena cava resulting in a significant decrease in venous return to the heart, reducing the preload. A significant drop in the preload causes a decrease in the cardiac output resulting in decreased blood flow and perfusion (Smit et al., 2022:3). Increased IAP causes an upward shift in the diaphragm thereby increasing the intra-thoracic pressure which results in reduced lung compliance, increasing airway pressure and the work of breathing (Smit et al., 2022:3).

With fluid resuscitation with the aim for haemostasis will further increase bowel oedema, increase oedema in the abdominal and thoracic wall compliance and in turn also further

increase the IAP (Smit et al., 2022:3). Intra-cranial pressure (ICP) is also affected as the elevated intra-abdominal pressure reduces the venous return to the brain causing a decrease in cerebral blood flow and, in turn, increasing the ICP (Smit et al., 2022:3). Further hypoperfusion of the spleen causes splantic ischaemia, leading to reduced mucosal perfusion and bacterial translocation and then bowel ischaemia and multi-organ failure follows (Smit et al., 2022:3). A further hypoperfusion to the hepatic flow results in a build-up of plasma lactate which in turn worsens the metabolic acidosis (Smit et al., 2022:3).

Serial IAP measurement is done 4-6 hourly with 25ml of sterile saline with a patient in the supine position measured at end expiration with the transducer zeroed at the midaxillary line at the iliac crest (Smit et al., 2022:2). IAP measurements are the most accurate in a patient who is completely sedated and mechanically ventilated (De Laet et al., 2020:3). Patients that have spontaneous breaths or are supported on non-invasive ventilation may have abdominal wall muscle contraction which may cause an increased IAP measurement (De Laet et al., 2020:3). Awake patients may have an elevated IAP of >20mmHg without any organ dysfunction due only to abdominal wall muscle contractions (De Laet et al., 2020:3).

- *Intervention methods to treat IAH*

The correct method for treating IAH will depend mainly on the cause of the IAH and the degree of organ dysfunction (De Laet et al., 2020:7).

- ✓ *Decreasing intraluminal volume*

Decreasing excessive volume from the gastrointestinal tract by the use of prokinetics or enemas. Further decompression of the gastrointestinal tract can be done by inserting a nasogastric tube and/rectal tubes to decompress the gastrointestinal tract (De Laet et al., 2020:7):

- ✓ *Decreasing extraluminal volume*

A percutaneous catheter can be inserted to drain the excessive fluid and can also be used as a tool to measure the IAP (De Laet et al., 2020:7).

- ✓ *Improving abdominal wall compliance*

Conditions increasing the abdominal wall compliance can be attended to by doing an escharotomy of burns over the abdomen, loosening bandages over the abdomen to reduce the external pressure, and changing the patient's position to reduce the pressure on the abdomen. If the abdominal wall compliance does not improve, analgesia or sedation can also be attempted to improve the abdominal wall compliance and reduce the IAP (De Laet et al., 2020:7).

- ✓ *Decompressive laparotomy*

If the condition warrants a decompressive laparotomy, it will help to reduce the intra-abdominal volume and ultimate treatment for ACS (De Laet et al., 2020:7).

The effects of intra-abdominal hypertension are not limited to the intra-abdominal organs alone, but rather directly or indirectly affect every organ system in the body (Cheatham, 2009; Lee et al, 2020). Elevated IAP can cause significant impairment of cardiac, pulmonary, gastrointestinal, hepatic, and central nervous system functioning (see Figure 2.1).

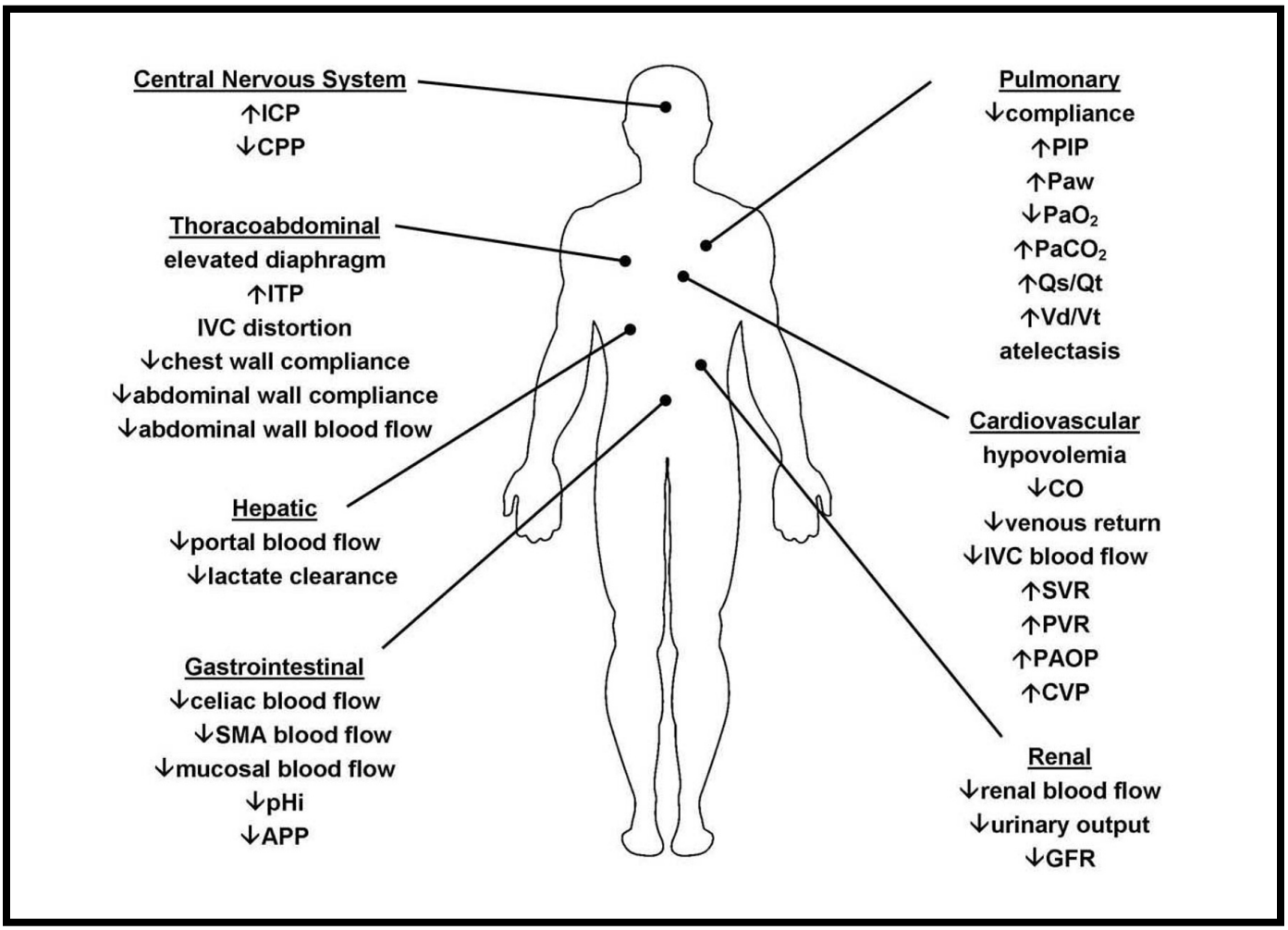

Figure 2.1 Pathophysiologic implications of intra-abdominal hypertension

ICP-intracranial pressure; CPP-cerebral perfusion pressure; ITP-intrathoracic pressure; IVC-inferior vena cava; SMA-superior mesenteric artery; pHi-gastric intramuscosal pH; APP-abdominal perfusion pressure; PIP- peak inspiratory pressure; Paw-mean airway pressure; PaO2 – oxygen tension; PaCO2 – carbon dioxide tension; Qs/Qt – intrapulmonary shunt; Vd/Vt-pulmonary dead space ; CO-cardiac output; SVR-systemic vascular resistance; PVR-pulmonary vascular resistance; PAOP-pulmonary artery occlusion pressure; CVP- central venous pressure; GFR- glomerular filtration rate.

Figure 1 was published in Cheatham ML. Abdominal compartment syndrome: pathophysiology and definitions. *Scand J Trauma Resuscitation Emerg Med and*

2009;17:10. doi:10.1186/1757-7241-17-10. The publishing article is available from http://www.sjtrem.com/content/17/1/10. Figure 1 was republished by (Lee, Gallagher, Ejike and Hunt, 2020) . The article is available from DOI: 10.4037/ccn2020772.
Source: Cheatham (2009:10)

2.3.6.2 Temporary abdominal closure (TAC)

After the damage control surgery has been performed and the abdomen cannot be closed due to infection, oedema, bleeding or to allow for re-exploration, the abdomen is left open but requires a dressing that covers the abdominal cavity. A temporary abdominal closure dressing is applied (Fitzpatrick, 2017:25; Boolaky et al., 2022:2). The TAC should cover the exposed contents thereby protecting the exposed viscera, fascia and skin, to allow for the bowel to expand and to limit contamination (Fitzpatrick, 2017:25). TAC can be performed using different techniques, including biological or synthetic systems such as the Wittman patch, Bogota bag or negative pressure wound therapy (NPWT) between the fascial edges (Fitzpatrick, 2017:25; Boolaky et al., 2022:2; Martin et al., 2022:4; José Santivañez Palominos et al., 2019:10). The type of technique used depends on what is available. The main aim of using one of these techniques is to ensure that the exposed viscera is covered to help reduce ACS and oedema (Fitzpatrick, 2017:25; Chabot et al., 2017:3).

Recently, Negative Pressure Wound Therapy (NPWT) has become the go-to for abdominal closure, as NPWT wound dressing systems are most successful in draining and removing abdominal fluids which in the end may help with early closure. The VAC abdominal dressing uses 3 layers with a vacuum seal. The first layer consists of polypropylene sheet that covers the exposed viscera, then two drains are placed over the sheet and tunnelled under the skin and connected to a negative suctioning device (Fitzpatrick, 2017:26; Chabot et al., 2017:3; Martin et al., 2022:4; Fernández, 2016:26).
The negative pressure that is applied when using any type of NPWT helps to improve the rate of granulation; drain excessive fluids (bacteria-rich fluids, cytokines and inflammatory mediators), and aid in early abdominal closure (Fitzpatrick, 2017:26).

The most effective techniques used are the Witmann patch and the NPWT, with the lowest mortality and complication rates (Fitzpatrick, 2017:26; Chabot et al., 2017:3; Martin et al., 2022:4).

2.3.7 Complications

Various complications can result from leaving the abdomen open, such as:

2.3.7.1 Infectious complications

Patients with an OA are at increased risk for developing infections. Complications in relation to the infection increase after 8 days receiving the initial OA and largely reduce the chances of early fascial closure (Chabot et al., 2017:6; Griggs et al., 2016:572; José Santivañez Palominos et al., 2019:11). Not only does the intra-abdominal infection delay the primary fascial closure but other systemic infections such as bacteraemia or pneumonia can also delay the primary closure which, in turn, can increase patients' mortality rate and stay in the ICU (Chabot et al., 2017:6). Infectious complications and fistulas directly affect the time to fascial closure. Therefore patients not able to go for delayed primary closure present with longer ICU stays, increased ventilator support requirements, increased hospital stay and increased mortality rates (Griggs et al., 2016:572).

2.3.7.2 Delay in re-exploration

Generally a re-exploration will be aimed to take place after 24hours of the initial surgery to allow for the completion of the initial surgery, but even one hour in delay of the re-exploration may cause a 1.1% decrease in the rate of primary fascial closure (Chabot et al., 2017:7).

2.3.7.3 Enteroatmospheric fistulae

The most common and most feared complication of an OA is the development of an enteroatmospheric fistula (EAF). The incidence rate of developing an EAF is 2 to 42.2% in open abdomens. A higher prevalence of an EAF is seen in patients with a septic OA, where the incident rate increases by 12% (Boolaky et al., 2022:2; José Santivañez

Palominos et al., 2019:11). The most frequent causes of the patient developing an EAF are exposed bowel contents, continuous infection, bowel ischaemia, distal obstruction, multiple laparotomies and the use of a mesh when applying the TAC. The risk also increases for the patient to develop other complications, such as intra-abdominal abscesses, ventral hernia, ACS complicated with acute respiratory distress syndrome (ARDS) and multi-organ failure (MOF), derangements in fluids and electrolytes and uncontrolled intra-abdominal infections (Boolaky et al., 2022:2; José Santivañez Palominos et al., 2019:11).

2.3.7.4 Hypothermia

Hypoperfusion due to hypothermia, temperature of <35°C, further causes hypoperfusion resulting in anaerobic metabolism at the cellular level, worsening the lactic acidosis and resulting in multi-organ failure (Fitzpatrick, 2017:8).

2.3.7.5 Inadequate nutritional state

Due to the patient's constant catabolic state, the nutritional need severely increases. It is challenging to maintain an adequate nutritional state in the critically ill patient with an open abdomen, especially when a protein intake of 1.5-2.5g/kg per day should be maintained (Fitzpatrick, 2017:13).

2.3.7.6 Prolonged ICU and hospital stay

Patients with an open abdomen are at risk to develop multiple complications from infections to delayed wound closure, which prolongs ICU and hospital stay, so it is important to allow for continuous assessment to reduce the onset of complications in ICU (Fitzpatrick, 2017:34).

2.3.7.7 Bleeding

The patient is at risk for bleeding, due to the extensive gastrointestinal vasculature, where the surgery may place the vasculature at risk and cause extensive bleeding. It is important to ensure that the VAC/NPWT dressing is intact and delivering lower pressures of -25mmHg to -50mmHg to prevent further stimulation of bleeding (Fitzpatrick, 2017:34).

2.4 SPECIFIC NURSING MANAGEMENT OF A PATIENT WITH AN OPEN ABDOMEN

The critical care nurse plays a vital role in the critical care team, where the nurse not only cares for the patient but also for the family, allowing for holistic patient care. The nurse is vital to provide information, guidance and emotional support to the patient and the patient's family (Fitzpatrick, 2017:22). The critical care nurse also plays a vital role in caring for the critically ill patient admitted to the ICU with an open abdomen, by providing continuous assessments, interpretation of vital data and adjusting therapies according to patient needs and patient prescription (Fitzpatrick, 2017:2).

The nurse should focus on the following:

- *Physiological status*: The nurse plays a vital role in monitoring the patient's physiological status and to provide optimal resuscitation (together with the managing intensivist and surgeon) to obtain haemostasis and restore the physiological status (Fitzpatrick, 2017:8).
- *Hypothermia, coagulopathy and acidosis*: Together with the critical care team the nurse observes the patient's haemodynamic and physiological status, allowing for optimal volume resuscitation with blood products, correcting coagulopathy and warming the patient up (Fitzpatrick, 2017:8).
- *Pain management and sedation*: It is vital for the nurse to continuously assess the patient and ensure that the patient is pain free and comfortable, by confirming that the analgesic infusions are running as prescribed by the intensivist to manage the post-operative pain and the open abdomen.
- *Monitoring for complications*: *Intra-abdominal pressure monitoring:* With the continuous assessment of the patient by the nurse who is next to the patient's bed 24/7, the nurse plays a vital role in the early recognition of onset IAH/ACS.

The nurse will measure the IAP 4 to 6 hourly (allowing for serial monitoring) and asses for any increasing intra-abdominal pressures (Smit et al., 2022:2). The nurse will perform intra-abdominal pressure monitoring by injecting 25mls of fluid (lukewarm saline) into the bladder using the urinary catheter, whereas the bladder functions as a passive reservoir.

- The pressure that is present in the abdominal cavity is transmitted to the bladder and gives a true reading of the intra-abdominal pressures (Fitzpatrick, 2017:8; Smit et al., 2022:2).

- *Monitoring for any bleeding*: The nurse plays a vital role to detect any early onset vascular bleeding or a drop in the haemoglobin. The risk of oozing post-operatively is significantly high due to the extensive vasculature of the gastrointestinal organs (Fitzpatrick, 2017:11).
- *Providing nutritional and metabolic support*: Optimal nutritional support in the critically ill patient can reduce onset of complications, such as local and systemic infections, delayed closure and fistula formations, and help to improve overall patient outcomes (Dissanaike, Pham, Shalhub, Warner, Hennessy, Moore et al., 2008:6; Fitzpatrick, 2017:11).

2.5 SUMMARY

As open abdominal surgery and leaving the abdomen open post-operatively has become the go-to management for abdominal complications and conditions, it poses multiple challenges to the team in ICU, especially to the nurses who are at the bedside 24 hours, providing specialised care (Xu, Zhang, Ding, Liu and Zhang, 2021). To ensure that improved and evidence-based nursing care is rendered to the patient and optimal patient outcomes, it is vital to provide nurses with updated guidelines on how to manage the patient with an open abdomen in the ICU. The guidelines should form part of an *'evidenced-based toolkit'* which provides the possibility of improving patient management and outcomes (Pereira et al., 2022:2).

This chapter discussed the literature review on the open abdomen conducted for the study. Chapter 3 describes the research design and methodology of the study.

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CHAPTER 3: RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

Chapter 2 discussed the literature review conducted for the study. This chapter describes the research design and methodology of the study.

3.2 AIM OF THE STUDY

The aim of the study was to obtain consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen.

3.3 RESEARCH DESIGN

A research design is the overall plan for addressing a research question, including the specifications for enhancing the integrity of the study (Polit & Beck 2017:164). The researcher chooses the research design to achieve the purpose of the study and answer the research questions (Brink, van der Walt & van Rensburg 2018:184). Research designs help researchers minimize bias and guide the whole process of answering the research questions in order to obtain accurate and interpretable evidence (Polit & Beck, 2017:164; Brink, van der Walt & van Rensburg, 2018:184). Therefore, the best design for a study is the one most appropriate to the research problem and purpose. In this study, the researcher selected a consensus research design, using a modified e-Delphi technique. The main aim in using a consensus design is to determine the extent to which experts on the research topic agree about a given problem and solving it, focusing on consensus measurement and consensus development (Jones & Hunter 1995:378).

3.4 RESEARCH METHODOLOGY AND METHODS

Research methodology is the plan for conducting the specific steps of a study. The research methods are the techniques, steps or procedures researchers use to collect, structure and analyse data systematically (Polit & Beck 2017:165). The research

methodology includes the population, sample and sampling, and data collection, analysis and interpretation. Consensus methods assist researchers to synthesise information by harnessing the insights of appropriate experts to enable decisions to be made. Two consensus methods used in medical, nursing and health services research are the Delphi process and the nominal group technique (NGT) (Jones & Hunter 1995:378). In this study, the researcher used a modified e-Delphi process to obtain consensus on the nursing guidelines to manage patients admitted to the ICU with an open abdomen (see chapter 4, section 4.3.3).

The research methodology includes the population, sampling and sample, and data collection and analysis.

3.4.1 Population

A population is the entire aggregate of cases in which a researcher is interested (Polit & Beck 2017:173). In this study, the population consisted of national and international experts. An expert refers to an individual that is knowledgeable about or a specialist in the area of the study or specific subject (Trevelyan & Robinson 2015:425). For the purpose of this study, experts were defined as nurses, intensivists and surgeons that had experience and were knowledgeable about the management of a patient with an open abdomen in ICU.

To be included in the study, the experts had to

- Be qualified nurses, intensivists, and surgeons.
- Be fluent in English.
- Have more than three years' experience in managing patients with an open abdomen in ICU, and/ or
- Have published a minimum of two peer reviewed articles on the management of patients with an open abdomen in ICU.

3.4.2 Sampling

Sampling is the process of selecting a part of the population to represent the total population (Polit & Beck 2017:173). Purposive sampling was used to identify potential

experts. The members of the expert panel were recruited through purposive snowball sampling (Keeney, Thom, Turner et al 2021:590). The researcher contacted members of the Critical Care Society of Southern Africa and the World Federation of Critical Care to identify and provide a few expert details, via email. The researcher also searched CINAHL, Medline, Pubmed and other Internet databases and mailing lists to identify experts who met the inclusion criteria, using the terms 'open abdomen', 'open abdomen in ICU' and 'nursing care of the open abdomen', to recruit potential participants.
The researcher used snowball sampling by asking experts to suggest other experts that they knew of who met the inclusion criteria (Keeney, Thom, Turner et al 2021:590). Then the researcher sent formal invitations to the experts via email.

3.4.3 Sample

A sample is a group of people or elements that are selected for a study. There is no consensus on the optimal number of participants that should be included in the expert panel during an e-Delphi (Taylor, Feltbower, Aslam et al 2016:3). Although there is no suggested minimum number, Romero-Collado (2021:101) states that the more participants, the better the results.

The researcher selected a heterogenous sample, focusing on a large panel of experts, to ensure a wider range of expertise and perspectives (Taylor, Feltbower, Aslam et al, 2016). The researcher aimed to include experts from different countries and regions who contribute to the World Health Organization (WHO) including Africa, the Americas, South East Asia, Europe, and Eastern and Western Mediterranean as well as different health care professions (viz. nurses, surgeons, and intensivists)

The aim was to invite at least 15 participants to ensure that if attrition happened, it was still an acceptable number of experts (Trevelyan & Robinson, 2015:423). A total of 139 experts were identified through purposive and snowball sampling. Of the 139 experts invited via email to participate, 31 (22%) volunteered. Invitations to participate in Rounds 2 and 3 were only sent to the experts who completed Round 1. Of the experts,

22 (70%) completed Round 2 and 18 (81%) completed Round 3 (see chapter 4, table 4.1 for participants' demographic profile).

3.4.4 Data collection and organization

Data collection is the precise, systematic gathering of information relevant to the research purpose or objectives of the study for statistical exploration of a problem (Polit & Beck 2017:175).

In this study, a modified e-Delphi was used to collect data. An e-Delphi can be used to reach consensus as it is a formal or structured method when there is a desire to obtain the opinions of experts on a specific challenge (Trevelyan & Robinson 2015:423; Taylor, Feltbower, Aslam et al 2016:2). The rationale for using the e-Delphi method is to determine consensus on best guidelines to inform practice specifically when agreement has not been reached (Trevelyan et al., 2015:1). The e-Delphi method creates space for the combination of information, ideas and thoughts of different participants (Varndell, Fry & Elliott, 2021:2). The e-Delphi method has a clear advantage over other consensus data-collection methods, as it does not require face-to-face contact whilst ensuring that each expert's opinion matters and allows for anonymity (Trevelyan & Robinson 2015:2).

The data collection and organisation are discussed in terms of an overview, characteristics, aims and objectives, response rate, strategies and weaknesses, limitations, data collection process and data analysis.

3.4.4.1 Overview

The Delphi technique was initially applied in the defence industry, but has been expanded and is also used in nursing and health research (Barrett & Heale 2020:68; Byrne, McSharry, Meade, Lavoie & Bacon 2020:3; Niederberger & Spranger 2020:2). The Delphi method is primarily used for the incorporation of knowledge and allows for the identification of areas of consensus and areas of disagreement (Niederberger & Spranger 2020:2).

Traditionally, surveys are used to gather opinions of participants on the research question at hand. Surveys are regarded as an easy method to gather and receive

honest opinions anonymously, using open-ended or closed questions, depending on the information already known on the topic under research (Brady 2015:3; Byrne, McSharry, Meade et al 2020:3; González-García, Díez-Fernández, Martín-Espinosa et al 2020:2). Maintaining the participation levels at 50% to 80% is vital for reaching consensus (González-García, Díez-Fernández, Martín-Espinosa et al, 2020) therefore the researcher should aim to maintain optimal participation.

Guidelines are important tools to guide the healthcare worker on the management of a patient and to support clinical practice, therefore gaining consensus from experts is a common approach (Barrett & Heale 2020:68). Gaining consensus allows the researcher to report findings from experts in the specific field on the research question and to address issues in healthcare (Barrett &Heale 2020:68; Brady 2015:3) and to allow for the development of a consensual guidance on best practice (Jünger, Payne, Brine et al 2017:6). With a good research question and a clear study design, the Delphi method can make a valuable contribution to nursing evidence because the most important resource is being used, namely expert knowledge through practice and experience (Barrett & Heale 2020:69).

3.4.4.2 Characteristics

Since its development in the 1950s, the Delphi method has evolved for use in any field but the characteristics of the method remain based on Dalkey and Helmer's initial principle (Barrett & Heale 2020:68; Niederberger & Spranger 2020:2). The first characteristic is the series of 'rounds', where the selected experts are asked to give their opinion on the topic being discussed. The information gathered during the first round then establishes the next round's questions for the experts to give their opinion, which allows the study to evolve (Barrett & Heale, 2020; Byrne, McSharry, Meade et al, 2020; Jünger, Payne, Brine et al 2017:6).

The second characteristic of the Delphi method is that the participating experts are able to see the results obtained in the previous rounds, so that they can reflect on the other participants' opinions. This also allows the participants to give feedback on the obtained

results. When using the Delphi method to gather opinions from expert participants, it is designed to allow for the formation of a consensus view which answers the initial research question (Barrett & Heale 2020:68). Table 3.1 indicates the application of the main characteristics of the Delphi method in the study.

Table 3.1 Application of the main characteristics of the Delphi method in the study

MAIN CHARACTERISTICS OF THE DELPHI METHOD	APPLICATION IN THE STUDY
1) It allows for the experts who are participating to remain anonymous.	• The participant experts were only known to the researcher. • Individual emails were sent to the experts.
2) A standardised survey can be used in each round, but adapted or changed as needed.	• Each round's survey was adapted according to the feedback received. • Refined components were presented in round 2. • Refined guidelines were presented in round 3.
3) It allows for grouping of similar answers statistically.	• Similar comments received from each round were grouped together and used to refine the components.
4) It allows for anonymous feedback from the expert participants.	• The experts' details were only known to the researcher and not to other participants. • Feedback presented after each round remained anonymous.
5) It allows for repetitions of a survey	• All three rounds were repetitions of the guidelines, but contained refinements according to experts' suggestions and consensus reached on the refined components.

Source: Niederberger & Spranger (2020)

3.4.4.3 Aims

The main aim for using the Delphi method is to gain consensus on the research question or problem, but the researcher needs to plan thoroughly before using the method to be able to obtain consensus (Keeney, Thom, Turner et al 2021:594). In the health sciences, the objectives of the Delphi method are (1) the identification of the current knowledge available; (2) improvement in future situations predictions; (3) prompts to resolve controversial findings/opinions; (4) the identification and formation of standards or guidelines; (5) the development of measurement tools and identifying indicators, and (6) the formation of recommendations for actions (Niederberger & Spranger 2020:2).

In this study, the aim was to obtain consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen. Consensus was achieved (see Chapter 4, Table 2).

3.4.4.4 Response rate

There are no set guidelines on the response rate of Delphi .studies, but a response rate of more than 70% per round is necessary to obtain rigour and consensus (Keeney Thom, Turner et al 2021:592). Attrition is highly likely to happen in this type of study due to several rounds that need to be conducted so there is a higher risk for participants to withdraw from the study especially in the last rounds (Keeney, Thom, Turner et al 2021:592).

The researcher aimed to have at least 15 to 20 expert participants. A total of 31 expert participants volunteered to participate, which was regarded as adequate. Table 3.2 lists the steps taken to help reduce the attrition rate during the study (Keeney, Thom, Turner et al 2021:593).

Table 3.2 Steps taken to overcome attrition

STEPS TO OVERCOME ATTRITION	APPLICATION IN THIS STUDY
1. Introduce study to participants and explain what will be expected of them.	• An invitation email was sent to all the identified experts with each round (see Annexures B, C and D).
2. Obtain clear and written consent from all prospective participants.	• Prior to commencing the e-Delphi, participants were emailed an information leaflet. Informed consent formed part of Round 1 and participants were required to agree to participate prior to commencing with Round 1
3. Clearly inform the prospective participants that the study will be conducted in several rounds and will involve receiving feedback.	• The introduction to the study, in the email invitation, stated clearly that the study would be conducted over 3 different rounds over a time span of a few weeks. • It was also made clear that the results would be given as feedback prior to commencing the next round (see Annexures B, C and D).
4. Ensure continuous communication via email and reminders to the participants to remind them of the study, rounds and when to submit the survey, as well as to retain participants.	• Reminder emails were sent out one week prior to closure date (see Annexures B, C and D). • The researcher indicated clearly that she was available at any time for any questions.
5. Limit the rounds to two or three rounds to prevent participation exhaustion from the participants.	• A three-round Delphi was conducted and consensus was reached on the refined guidelines.

Source: Keeney, Thom, Turner et al (2021)

3.4.4.5 Strengths and weaknesses

Using the Delphi method allows for a wide approach in gathering views on the research question from a selected group of expert participants who are geographically scattered (Barrett & Heale 2020:68; Msibi, Mogale, de Waal & Ngcobo 2018:2).

The use of the Delphi method allows for reflection where the participants can reconsider their opinions in the light of the feedback from the other participants (Barrett & Heale 2020:68). The method also ensures anonymity among the expert participants which allows them to be open and give their honest opinion on the research question. With the anonymity, it allows for all opinions to be seen and decreases the occurrence of the 'halo effect' where superior experts are given extra authority (Barrett & Heale 2020:69; Brady 2015:3).

The Delphi method has several weaknesses. The method can be very time consuming and difficult, especially when the study needs to conduct multiple rounds to obtain consensus on the research question. It requires the participants to participate in multiple rounds which also increases the risk for higher dropout rates because multiple rounds can be time consuming and, in turn, can affect the validity of the study (Barrett & Heale 2020:68). Another weakness is that the participants are able to change their opinions after feedback has been given, which can lead to bias on where the experts would rather allow their opinion to fit in the major opinion group (Barrett & Heale 2020:68).

In this study, the researcher informed all the experts in the initial invitation email that the study would be conducted over 3 rounds and that the survey was lengthy and time consuming. Thirty-one (31) experts volunteered to participate.

3.4.4.6 Limitations

The Delphi method has the following challenges that must be kept in mind when conducting a Delphi study: (1) problem identification: ensure accurate understanding of a problem before selecting a problem; (2) understanding the process: regarding all the different rounds and allowing for feedback, and (3) finding a sample: finding the correct

and most suitable group of people to participate in the study and correctly preparing the group for participation (Hasson, Keeney & McKenna 2000:1009). There is no fixed or constant method for reporting data, different studies use different methods in reporting their data (Hasson, Keeney & McKenna 2000:1013).

3.4.4.7 Data-collection process

The researcher re-organized the original guidelines developed by Lee, Gallagher, Ejike and Hunt (2020) to ensure that they focus on the management of an open abdomen. (See Annexure K). The researcher contacted the authors, Lee, Gallagher, Ejike and Hunt via email on two separate occasions and no response was received in relation to using the guidelines as basis for consensus.

Following ethical approval from the Faculty of Health Sciences Research Ethics Committee, data was collected using a modified e-Delphi survey consisting of three rounds.

First, the e-Delphi survey was piloted by nurses (n=4) and an intensivist (n=1) who were not part of the expert panel but met the inclusion criteria. The survey was then piloted for a second time by critical care nurses (n=2) and a Qualtrics specialist (n=1). Minimal adjustments were required. The corrections were made as suggested. The rationale was to ensure the feasibility of the study, test the clarity of the questions and have an estimate on how long the survey would take to complete (Dobia, Ryan, Bahammam & Edwards 2019:1134; Romero-Collado 2021:3).

Secondly a formal invitation (see Annexure B) was sent via email to the identified potential experts who met the inclusion criteria. The invitation informed the identified experts about the topic, aim and importance of the study. Once the experts agreed to participate, they could continue to the survey by clicking on the provided link supplied on the invitation email. The link opened the survey that was presented on the Qualtrics online platform. A detailed discussion was presented at first glance at the survey and what was expected of the participants. It also indicated clearly that the research study

would take place over 3 different rounds with the aim of obtaining consensus and the inclusion criteria to enable participation. If the experts agreed to participate voluntarily and gave consent they could continue with the survey.

In Round 1, the survey started by obtaining demographic characteristics and then continued to the survey itself. Round 1 invitation and survey link were presented on Qualtrics online platform (see Annexures B and E); Round 2 invitation and survey link were presented on Qualtrics online platform (see Annexures C and F), and the final round (Round 3) was presented on a Microsoft Word program (see Annexures D and G).

Moreover, in the introduction to the research study on the Qualtrics survey, Lee, Gallagher, Ejike and Hunt's (2020) original guidelines for the management of intra-abdominal hypertension and an open abdomen (see Annexure D) were attached as reference (see Annexure K). In each round, the experts had 2 to 3 weeks to complete the survey, and a reminder email was sent to the experts a week prior to the closing date (see Annexures B, C and D) (Romero-Collado, 2021:3).

3.4.4.8 Round 1

Round 1 was presented on the Qualtrics online platform through the link provided on the invitation email. The survey consisted of the all the components from the guidelines on the nursing management of a patient with an open abdomen in ICU, focusing on the nursing guideline statements and the accompanying nursing interventions (see Annexure E).

The experts were presented with the five nursing guideline statements and accompanying nursing interventions developed by Lee et al (2020). They were asked to complete the survey based on their personal opinion of what they considered the 'best clinical practice' for the management of patients with an open abdomen in ICU would be:

- To rate their level of agreement on the importance of the nursing guideline statements, using a 4-point Likert scale (1 = Not important at all; 2 = Not important; 3 = Important, and 4 = Very important).
- To rate their level of agreement on the importance, using a 4-point Likert scale (1 = Not important at all; 2 = Not important; 3 = Important, and 4 = Very important) and the practicality (1 = Not practical at all; 2 = Not practical; 3 = Practical and 4 = Very practical) on the accompanying nursing interventions.
- To add any comments or suggest any changes to the nursing guideline statement/intervention.

Responses from Round 1 were exported to Microsoft Word, analysed and the results informed Round 2.

3.4.4.9 Round 2

The experts' suggestions were incorporated to refine the nursing guideline statements and the accompanying nursing interventions. Only the refined nursing statements and interventions were placed on the Qualtrics online survey for Round 2.

The experts received an e-mail with feedback from Round 1 and a link to the Qualtrics survey for Round 2. The experts received the same instructions as in Round 1, and were presented with the refined nursing guideline statements and accompanying nursing interventions based on the data received and analysed in Round 1.

They were asked to complete the survey based on their personal opinion of what they considered 'best clinical practice' for the management of patients with an open abdomen in ICU would be:

- To rate their level of agreement on the refined nursing guideline statement.
- To rate their level of agreement on the refined nursing interventions.
- To add any comments or suggest any changes to the nursing guideline statement/intervention.

The responses from Round 2 were exported to Microsoft Word, analysed and the results informed Round 3. Data were exported to Microsoft Word and analysed. The results informed Round 3.

3.4.4.10 Round 3

The results from Round 2 as well as the refined nursing guideline statements and accompanying nursing interventions were e-mailed to the experts in a Microsoft Word document for final inputs. In Round 3, the experts were asked to assess the refined nursing guidelines and rate level of agreement and add any additional comments or suggestions.

3.4.5 Data analysis

Data was analysed after each round and shared with the expert panel members before commencing the next round, to inform the experts on the data collected thus far (see Annexure H for summary of feedback from Rounds 1 and 2). The quantitative data collected from each round were analysed using the Qualtrics online platform and exported to Microsoft Word for analysis (Keeney, Hasson & McKenna, 2011:72).

The rating of the components was grouped into two categories: (1) Very important and important and (2) not important and not important at all; (1) Not practical at all and not practical and (2) practical and very practical (Lange, Kopkow, Lützner, Günther, Gravius, Scharf et al, 2020:4). Components with an agreement rate of > 80% were not included in the next round, but components with an agreement rate of >80% with suggestions were refined and included in the next round.

Components with an agreement of 60% to 80% were included for the next round. The experts' suggestions were analysed, using Burnard's method of content analysis (Carter, O'Donoghue, Dworzynski, O'Shea, Roberts, Reeves et al, 2021:3; Keeney, Thom, Turner et al, 2021:590). To avoid bias, two independent coders analysed the data.

The qualitative data was analysed using content analysis by grouping similar statements that focused on similar topics together in order to form a consensus out of the experts' suggestions, using Burnard's method of content analysis (Keeney, Hasson & McKenna 2011:72) .

Consensus is general agreement among members of a group. In this study, the researcher aimed to achieve 80% consensus on the components of nursing guidelines to manage patients admitted to intensive care units with an open abdomen (Carter, O'Donoghue, Dworzynski, O'Shea, Roberts, Reeves et al 2021:3). Consensus of 80% and more on the components was achieved (see Chapter 4 for discussion).

3.5 RIGOUR

The cornerstone of good research is establishing integrity. However, identifying and gauging methodological rigour for the Delphi technique is difficult. The 'holy grail' of research is establishing methodological rigour, which refers to a researcher's responsibility to ensure rigour that procedures have been adhered to and confounding factors eliminated to produce dependable results (Hasson & Keeney. 2011:1695). When using an e-Delphi method, four main approaches are used to ensure the rigour of the study, namely content, face, construct, and criterion-related validity (Hasson & Keeney. 2011:1696). Table 3.3 lists the application of the four main approaches to ensure rigour in the study.

Table 3.3 Main approaches used to ensure rigour in the study

MAIN APPROACHES SUGGESTED TO ENSURE RIGOUR	APPLICATION IN THE STUDY
1. Content and face validity are ensured by making use of a group of experts' opinions rather than one person's opinion. In addition, the process is based on the opinion of experts in the real world. Including open-ended	• An expert panel was identified, and a large group (139 experts) were invited • 31 experts volunteered to participate • The experts were asked to add any additional comments or suggestions to allow for refining and changes to the

questions will enable the experts to generate additional components.	guidelines.
2. Providing the experts with feedback from each round prior to initiation of the next round increases construct validity. In addition, the experts are not anonymous to the researcher, which therefore permits validation and ensures that experts' inputs are correctly interpreted.	• A document with feedback from each round was attached to the invitation email (see Annexure H). • The experts had to include their email addresses at the end of the survey link in order to receive the survey for the next round, so the experts were only known to the researcher.
3. Criterion-related validity will be established through the feedback from experts during each round as they will identify and agree upon each component (concurrent validity). Secondly, predictive validity will be measured in terms of the accuracy of the Delphi and agreement percentage (≥ 80%) of components that will be included.	• Only refined nursing guideline statements and nursing interventions were included in round 2 as well as components that received <80% consensus. • Feedback was presented and attached to the invitation email.

Source: Keeney, Hasson and McKenna (2011)

The study was conveyed and reported on using the *Guidance on Conducting and Reporting Delphi Studies (CREDES)*, which allowed for consistency and the quality of conducting the Delphi study (Jünger, Payne, Brine et al, 2017; Endacott, Scholes, Jones et al 2022) and subsequently ensuring the rigour of the study (see Annexure I).

3.6 SUMMARY

This chapter discussed the research design and methods used in the study. Chapter 4 discusses the study results and is presented in an article format.

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CHAPTER 4: RESULTS AND DISCUSSION

4.1 INTRODUCTION

Chapter 3 described the research design and methodology used to achieve the aim of the study. This chapter presents the results of the study in an article format.

4.2 OUTCOMES

Consensus was reached with an international panel of experts (N=31) on the nursing guideline statements and accompanying nursing interventions. The nursing guidelines were refined and updated.

The report was submitted to the Journal of Clinical nursing, a peer reviewed journal.

The report followed the author guidelines for the selected journal and is presented following Section 4.4. The report is in line with the Guidance on Conducting and Reporting Delphi Studies (CREDES) (Jünger et al, 2017) (Annexure I).

4.3 SUMMARY

This chapter discussed the achievement of consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen. The guidelines form part of an 'evidence-based toolkit' which provides the possibility to improve patient management and patient outcomes (Pereira et al 2022:2). It is therefore an important framework to summarize and provide the latest evidence-based practice and to inform best practices (Dobia et al 2019:1136), and assists health care professionals to make appropriate and evidence-based decisions when managing a patient with OA (Dobia et al 2019:1136). Chapter 5 presents the conclusions, implications for practice, limitations, and recommendations of the study.

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CONSENSUS ON NURSING GUIDELINES TO MANAGE PATIENTS ADMITTED TO INTENSIVE CARE UNITS WITH AN OPEN ABDOMEN: AN E-DELPHI STUDY

Running title

Nursing guidelines for open abdomen

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Conflict of interest

No conflicts of interest were identified by the research team.

Abstract

Aim(s): To obtain a consensus on the use of nursing guidelines for managing patients with open abdomens admitted to intensive care units.

Background: Critically ill patients who present with an open abdomen in the intensive care unit pose multiple challenges, especially for nurses, who play a pivotal role in the management

of these patients. Updated evidence-based guidelines should be developed for nurses to alleviate nursing challenges when managing these patients.

Design: A modified e-Delphi consensus design

Methods: An expert panel, including nurses, surgeons, and intensivists with expertise in managing patients with open abdomens in intensive care units, was invited to participate. The data were collected using the Qualtrics survey platform. The expert panel was asked to rate the importance of each guideline statement as well as the importance and practicality of each nursing intervention using a 4-point Likert scale. Experts were allowed to suggest changes to refine the guidelines and interventions.

Results: Thirty-one experts participated in Round 1, 22 participated in Round 2, and 18 participated in Round 3. Most of the experts were nurses (71%). The experts were informed of five nursing statements and their interventions. A consensus >80% was obtained on the content of the nursing statements and their interventions, but refined changes were made to the guideline statements and their interventions, which were presented to the experts in rounds two and three. A consensus >90% was obtained after Round 3.

Conclusion: The panel of experts was able to reach a consensus on the nursing guidelines in Round 3, concluding that the 2020 guidelines have been updated. In the future, nursing guidelines should be introduced in practice and in training and a nursing protocol should be developed.

Reporting method: The study adhered to the relevant EQUATOR reporting guidelines: Guidance on Conducting and Reporting Delphi Studies (CREDES) checklist.

Key words: Intensive care unit, modified e-Delphi, nursing guidelines, open abdomen

Implications for the profession and/or patient care

Guidelines to manage patients admitted to intensive care units with an open abdomen were updated and refined by an international panel of experts. These consensus guidelines should be implemented by nurses in intensive care units to manage patients with open abdomens as these interventions may improve patient care and outcomes.

Impact

- Reaching consensus on a guideline to nurse patients with an open abdomen promotes evidence-based and updated management for patients admitted to intensive care units
- The consensus guideline provides a framework for nurses to deliver high quality care and enhances the consistency and continuity of care
- Implementing the consensus guideline may recognise the invaluable contributions of nurses to the multi-disciplinary approach required for effective care of patients with an open abdomen in intensive care units

Patient or public contribution

Healthcare professionals, including nurses, intensivists, and surgeons, who are knowledgeable and have experience in the management of patients admitted to the intensive care unit with an open abdomen shared their expert knowledge and experience during the three Delphi rounds.

1. INTRODUCTION

Open abdominal surgery and leaving the abdomen open after surgery have become go-to management strategies for severe abdominal conditions (Fitzpatrick, 2017; Willms et al., 2017; Chipu et al., 2017). Because nurses are at the patient's bedside for 24 h (Xu et al., 2021), they play a pivotal role in the patient's stabilization and management. The nurse cares for the critically ill patient admitted to the ICU with an open abdomen, by providing continuous assessments, interpretation of vital data and adjusting therapies according to patient needs and patient prescription (Fitzpatrick, 2017; Chipu et al.,2017). The nurse furthermore provide information, guidance and emotional support to the patient and the patient's family (Fitzpatrick, 2017; Yoo et al.,2020). Patients admitted to the intensive care unit (ICU) with an open abdomen pose multiple challenges for nurses (Chipu et al.,2017), as most patients are critical and unstable (Fitzpatrick, 2017; Chipu et al.,2017).

Nurses should have clear and updated guidelines to enable them to achieve quality care (Guerra-Farfan et al., 2023; Chipu et al.,2017). Lee et al. (2020) developed nursing guidelines for the management of patients with an open abdomen in the ICU based on the medical guidelines developed in 2014 by the Abdominal Compartment Society. These guidelines have not been agreed upon internationally and need further discussion (Lee et al., 2020). Therefore, this study aimed to obtain international consensus on the guidelines for the nursing management of patients admitted to the ICU with an open abdomen to ensure improved and evidence-based nursing care.

2. BACKGROUND

Open abdominal surgery has become the gold standard for managing severe, complicated abdominal conditions (Fernández, 2016; Fitzpatrick, 2017; Willms et al., 2017). Various

indications exist for leaving a patient's abdomen open postoperatively. These indications are grouped into three different categories: anatomical (when the fascial edges cannot be brought together after a laparotomy), physiological (systemic dysfunctions), and logistical (expected re-exploration) (Chabot and Nirula, 2017). The open abdomen is also used to treat abdominal trauma and life-threatening intra-abdominal complications (vascular/sepsis/intra-abdominal hypertension), as well as for damage control.

Patients with an open abdomen are managed in the ICU for an average of 13 to 65 days and are at risk of developing severe complications, such as ventilator-associated pneumonia (30%) and acute renal failure (22%), consequently increasing morbidity and mortality (Willms et al., 2017). Patients are also at risk for complications related to initial laparotomy, such as the development of entero-atmospheric fistulas, a "frozen abdomen," intra-abdominal abscesses and a lengthy closure date of the open abdomen (Boolaky et al., 2022; Coccolini et al., 2018; Willms et al., 2017). Risks related to frozen abdominal tissue and entero-atmospheric fistulas are due to delayed closure of the open abdomen and failure to allow optimal temporary closure methods. Therefore, complications increase the length of hospital stay, hospital costs and morbidity, and mortality rate for these patients (Coccolini et al., 2018; Kirkpatrick et al., 2018; Willms et al., 2017). The outcome of patients who present with an open abdomen to the ICU depends on their underlying condition, surgical complications, and management (Boolaky et al., 2020; Willms et al., 2017).

In the ICU, the critical care team continuously assesses the patient, interprets patient results, and adapts treatment interventions where necessary (Fitzpatrick, 2017; Lee & et al., 2020). Nurses, as vital members of the critical care team and working for 24 h at the bedside, should monitor the patient's physiological and haemodynamic status and provide optimal resuscitation, continuously assess pain and ensure that the patient is pain free and comfortable, measure the intra-abdominal pressure, monitor for bleeding and provide nutritional and metabolic support (Dissanaike, et al., 2008; Fitzpatrick, 2017; Smit et al., 2022). The patient is admitted to the ICU with a temporary abdominal closure using for example the Bogota bag, Wittman Patch and Synthetic meshes (Fitzpatrick, 2017). Recently, Negative Pressure Wound Therapy has become the go-to strategy (Smit et al., 2022). The dressing covers the exposed

viscera, fascia and skin, to allow the bowel to expand and to limit contamination (Fitzpatrick, 2017; Boolaky et al., 2020). The nurse is responsible for ongoing monitoring of the wound for signs of healing or complications, ensure that the Negative Pressure Wound Therapy system is maintained as well as observe for its integrity, effluent drainage, vascular supply to the wound, and any areas of new intestinal fluid leakage (Fitzpatrick, 2017; Chipu et al.,2017).

Nurses are faced with different challenges (Xu et al., 2021; Chipu et al.,2017) when managing patients with open abdomens. Challenges include hemodynamic monitoring and stabilization of patients, managing and monitoring for intra-abdominal hypertension, preventing infections, ensuring that the temporary closure dressing functions optimally, providing wound care, and supporting nutrition and mobilization (Lee et al., 2020; Chipu et al.,2017). Having set guidelines will form part of the *'evidenced-based toolkit',* which will allow for improved patient management and outcomes (Pereira et al., 2022; Chipu et al.,2017).

Guidelines are crucial because they summarize current evidence-based practices to inform best practices and offer assistance to nurses in making appropriate and evidence-based decisions when managing patients with an open abdomen (Dobia et al., 2019; Chipu et al.,2017). The aim of the consensus in this study was to incorporate expert opinion and knowledge regarding the nursing guidelines for patients with open abdomens in the ICU. A consensus on the guideline may assist nurses globally in providing evidence-based and updated management of patients with an open abdomen and contribute to improved patient care and standardised nursing care (Rasmussen et al.,2023) of patients when managed in the ICU.

3. METHOD

3.1 Aim

To obtain a consensus on the nursing guidelines developed by Lee et al. (2020) for managing patients admitted to the ICU with an open abdomen.

3.2 Design

We used a consensus design with a modified e-Delphi approach (Brady, 2015). The consensus design allowed collaboration with experts to share their experience (Nasa et al., 2021) and insight (Fink-Hafner et al., 2019). The e-Delphi method has an advantage over other consensus data collection methods, as it does not require face-to-face contact while simultaneously ensuring that each expert's opinion matters and allows for anonymity (Trevelyan & Robinson, 2015). Furthermore, the e-Delphi method created space for numerous participants (Varndell et al., 2021) from different geographical areas. In this study, rather than starting with the traditional Round 1, which begins with an open-ended questionnaire, we presented five guideline statements with their interventions developed by Lee et al. (2020), which included nursing guideline statement 1 and 17 accompanying interventions and focused on assessing for intra-abdominal hypertension/abdominal compartment syndrome, nursing guideline statement 2 and nine accompanying interventions focused on optimizing regional perfusion and fluid balance and damage control resuscitation, nursing guideline statement 3 and five accompanying interventions focused on abdominal closure, nursing guideline statement 4 and six accompanying interventions focused on nutrition and nursing guideline statement 5 and two accompanying interventions focused on analgesia and sedation.

This approach is an acceptable modification of the Delphi process reported previously (Hsu & Sandford, 2019).

3.3 Ethical considerations

Ethical approval was obtained from the Faculty of Health Sciences Research Committee of the [Blinded] (68/2023). All the experts volunteered to participate, and informed consent was implied by completing the survey.

3.4 Expert panel

Experts were defined as individuals who were knowledgeable or specialists in the area of the study (Trevelyan & Robinson, 2015, p. 425). We defined experts as nurses, intensivists, and surgeons who are knowledgeable about and have experience in the management of patients admitted to the ICU with an open abdomen. We opted to include experts from different members of the multidisciplinary team to enhance the objectivity of the consensus, increase cautious considerations (Chen & Qin, 2023) and potentially increase buy in during implementation.

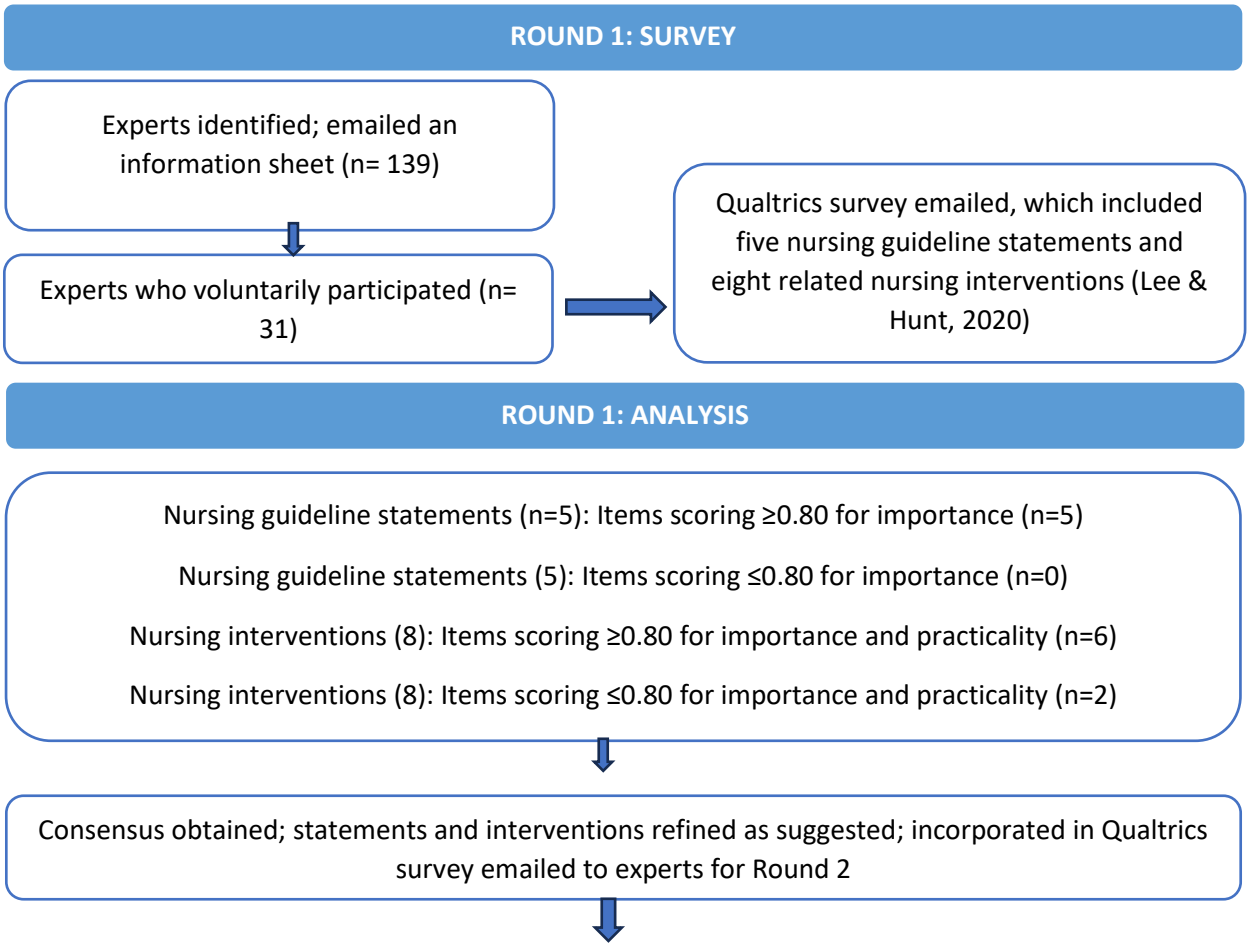
The inclusion criteria for the experts were preset, clear and precise (Fink-Hafner et al., 2019) and included 1) qualified nurses, intensivists, and surgeons; 2) able to communicate in English; 3) had more than three years of experience managing patients with an open abdomen in the ICU; or 4) had at least two peer reviewed articles published on the management of patients with an open abdomen in the ICU.

A total of 139 experts were identified through purposive and snowball sampling and invited to participate via email. Previous studies have shown that inquiring about potential panelists' interest before the study increased their buy-in and decreased attrition from subsequent rounds (Beiderbeck et al., 2021). The email included a brief introduction to the study, the purpose and value thereof, and what would be expected from participants. Although an ideal number of experts for inclusion in the Delphi method has not been established (Beiderbeck et al., 2021), the suggested number of experts is more than eight (Nasa et al., 2021). A total of 31 experts participated; this sample size was considered adequate.

3.5 Data collection

The experts were contacted via email containing the link to the online survey via the Qualtrics online platform. Participants were informed that by completing the survey, informed consent was implied. The experts provided their demographic information (country of origin, speciality, number of years managing patients with open abdomens in the ICU and, if applicable, the number of published articles on managing these patients) and then continued with the survey questions. The survey questions were based on Lee and Hunt's (2020)

The experts were requested to complete the rounds within 2 to 3 weeks. The data collected from Rounds 1 and 2 were exported into Microsoft Word (Figure 1).



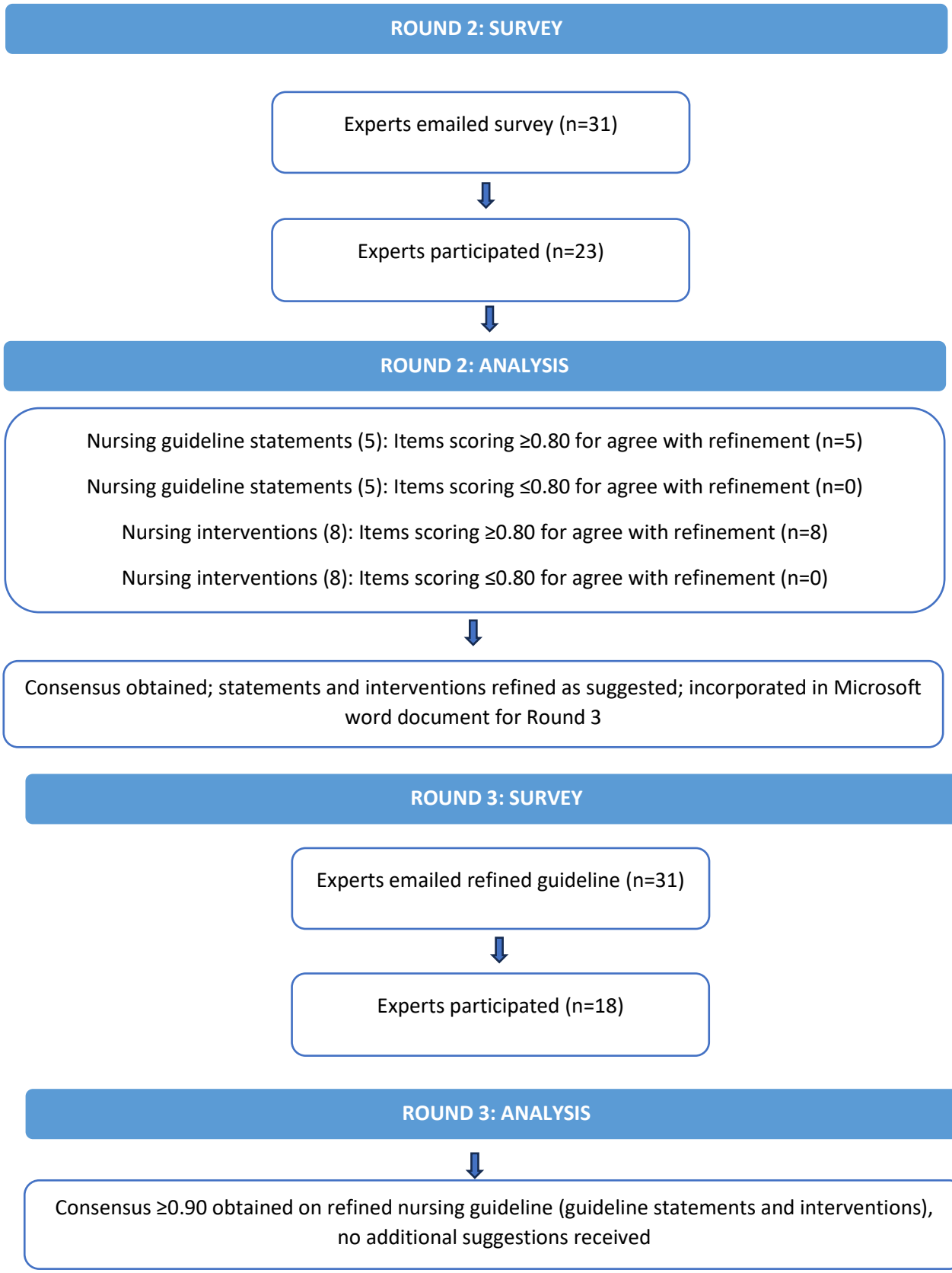


Figure 1: Flowchart summarizing the experts and e-Delphi process

3.5.1 Round 1

The first survey was piloted by four critical care nurses and an intensivist. Their suggestions were addressed, and the survey was adjusted accordingly. The survey was then piloted for a second time by two critical care nurses and a Qualtrics specialist. Minimal corrections were made, and the survey was used in Round 1. The experts were presented with the five nursing guideline statements and their interventions developed by Lee et al. (2020). The participants were asked to rate their level of agreement on the importance of the nursing guideline statements using a 4-point Likert scale (1 = not important at all, 2 = not important, 3 = important, and 4 = very important). The experts were subsequently asked to rate their level of agreement on the importance of the nursing interventions using a 4-point Likert scale (1 = not important at all, 2 = not important, 3 = important, and 4 = very important) and practicality (1 = not practical at all, 2 = not practical, 3 = practical, and 4 = very practical). Third, experts were asked to suggest any changes to the nursing guideline statement or intervention. The responses were analyzed, and the results were recorded in Round 2.

3.5.2 Round 2

Only the refined statements and interventions were included in the Qualtrics online survey for Round 2. The experts received an e-mail with feedback from Round 1 and a link to the Qualtrics survey for Round 2. The experts received the same instructions as in Round 1. The data were analyzed, and the results informed Round 3.

3.5.3 Round 3

The results from Round 2, as well as the refined nursing guideline statements and their interventions, were e-mailed to the experts in a Microsoft Word document for final input. The experts were asked to assess the refined nursing guidelines, rate the level of agreement and add any additional comments or suggestions.

3.6 Data analysis

The quantitative data collected using the Likert scale were analyzed through Qualtrics, and a summary was downloaded as suggested by Keeney et al. (2021). Expert participant responses of the nursing guideline statements were coded using I-CVI as important/very important vs not important/not important at all. The responses of the nursing interventions were coded using I-CVI as important/very important vs not important/not important at all as well as practical/very practical vs not practical/not practical at all. An I-CVI score was calculated for each statement and intervention.

The ratings of the Likert scale components were grouped into two categories: 1) very important and important; 2) not important and not important at all; 1) not practical at all and not practical; and 2) practical and very practical (Lange, Kopkow, Lützner, Günther, Gravius, Scharf et al., 2020). Components with an agreement rate >80% were not included in the next round, but components with an agreement rate >80% with suggestions were refined and included in the next round. Components with an agreement of 60 to 80% were included in the next round. Experts' suggestions were analyzed through content analysis, using Burnard's method of content analysis as suggested by (Carter et al., 2021; Keeney et al., 2021). To avoid bias, two independent coders analyzed the data.

3.7. Rigour

We used the Conducting and Reporting of Delphi Studies (CREDES) reporting guidelines to ensure rigorous reporting of the Delphi (Jünger et al., 2017).

4. RESULTS

4.1 Expert participants

Three e-Delphi rounds were conducted as suggested by Niederberger and Spranger (2020). The three-round e-Delphi survey was conducted between June 21, 2023 (start of Round 1) and September 22, 2023 (end of Round 3). Of the 139 experts who were invited via individual email to participate, 31 (22%) volunteered (Table 1). Invitations to participate in Rounds 2 and 3 were only sent to the experts who completed Round 1. Twenty-two (70%) of the experts completed Round 2, and 18 (81%) completed Round 3.

Table 1 Experts demographic characteristics (n = 31)

DEMOGRAPHIC CHARACTERISTICS	COUNT (%)
Country of residence	
South Africa	22 (71)
Cyprus	1 (3)
Belgium	1 (3)
Nepal	1 (3)
Papua New Guinea	1 (3)
United Kingdom	1 (3)
Colombia	1 (3)
Turkey	1 (3)
Australia	1 (3)
Italy	1 (3)
Current job description	
Nurse	22 (71)
Doctor	2 (5)
Surgeon	4 (11.8)
Intensivist	3 (8.8)
Highest professional qualification	
Diploma	1 (2.9)
Degree	11 (32.4)
Honours degree	3 (8.8)
Master's degree	11 (32.4)
PhD	8 (23.5)

Most of the experts were nurses (71%) or were from South Africa (71%). Five (14.7%) experts published articles related to the management of patients with an open abdomen in the ICU, with a mean of 9.8 and a standard deviation of 7.2.

4.2 Round 1

During the data analysis, a pattern of incomplete data was identified from the responses, and of the 43 responses, the complete-case analysis deletion technique was used to minimize bias (Polit & Beck, 2021). The experts' (n = 31) responses were logged, and the data were analyzed. Refer to Table 2 for a summary of the results.

In Round 1, the importance of all five nursing guidelines had an I-CVI >80%. The I-CVI and consensus decision for each nursing guideline statement and accompanying interventions are presented in Table 2. All the nursing interventions had an I-CVI >80%, indicating the importance of these interventions. Regarding practicality, three nursing interventions had an I-CVI <80%.

The nursing interventions that scored ≤0.80 for importance or practicality or included suggestions were refined and included in Round 2. During Round 1, the following nursing guidelines were focused on:1) assessing for intra-abdominal hypertension/abdominal compartment syndrome (consisting of 1 statement and 17 nursing interventions. Nursing statement refined, none of the statements or interventions were removed from the guidelines.); 2) optimizing regional perfusion: Fluid balance & damage control resuscitation (consisting of 2 statements and 9 nursing interventions. Both nursing statements were refined and added to Round 2 and 7 of the 9 interventions were refined and added to Round 2); 3) abdominal closure (consisting of 1 statement and 5 nursing interventions. The nursing statement was refined and added to Round 2 and 3 of the 5 interventions were refined and added to Round 2.); 4) nutrition (consisting of 2 statements and 6 interventions. The nursing statements were refined and added to Round 2 and 5 of the 6 interventions were refined and added to Round 2. Added two nursing

statements to the guideline) and 5) analgesia and sedation (consisting of 1 statement and 2 interventions. The nursing statement was refined and added to Round 2 and 1 of the 2 interventions were refined and added to Round 2.) (Supplemental data A)

4.3 Round 2

The data were analyzed similarly in Round 2 as in Round 1. In Round 2, the I-CVI (%) for the importance of all five of the nursing guideline statements was more than >80%. The suggestions were analyzed, and the statements were refined.

All the nursing interventions had an I-CVI for importance of >80%. The practicality had an I-CVI >80%. The nursing interventions that scored ≥0.80 for importance or practicality but included suggestions were refined and added to Round 2. None of the statements or interventions were removed from the guidelines.

During Round 2, the following nursing guidelines were reviewed: 1) intra-abdominal hypertension and abdominal compartment syndrome (11 refined interventions, of which four were further refined); 2) optimizing regional perfusion and fluid balance and damage control resuscitation (2 refined statements, 7 refined interventions, of which one was further refined); 3) abdominal closure (5 interventions with no further refinement needed); 4) nutrition (2 statements and 5 interventions with no further refinement needed); and 5) analgesia and sedation (1 refined statement and 1 refined intervention with no further refinement needed) (Supplemental data B).

4.4 Round 3

A level of agreement (I-CVI) of ≥0.90 was obtained in Round 3, and no further suggestions were made.

The progression of the nursing guideline statements and interventions through the Delphi rounds are described in detail in Table 2.

Table 2: Summary of results

Summary Nursing guideline statement	Round 1 (n=31)		Consensus decision	Round 2 (n=23)		Consensus decision	Round 3 (n=17)		Consensus decision
	Important	I-CVI (%)		Agree	I-CVI (%)		Agree	I-CVI (%)	
1. Assessing for intra-abdominal hypertension/abdominal compartment syndrome Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient. It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	31	100	R2	23	100	R3	18	100	A
2.1 Optimizing regional perfusion: Fluid balance Use a protocol to try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure.	31	100	R2	23	100	R3C	18	100	A
2.2 Optimizing regional perfusion: Damage control resuscitation. a) Use an enhanced ratio of plasma/packed red blood cells for resuscitation of massive hemorrhage instead of low or no attention to plasma/packed red blood cell ratios.	30	97	R2++	21	90	R3C	18	100	A
b) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in hemodynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.	30	97	R2	22	95	R3C	18	100	A
c) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens.	29	94	R2	23	100	R3C	18	100	A
d) Nurses should be familiar with systems used in their individual practice environments.	29	94	R2	23	0	R3C	18	100	A
3. Abdominal closure It is recommended that conscious and/or protocolized efforts be made to obtain early or at least same hospital-stay abdominal fascial closure in patients with open abdominal wounds.	29	94	R2	23	0	R3C	18	100	A
4. Nutrition a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.	31	100	R2+A	21	90	R3C	18	100	A

b) It is recommended to initiate gastric and colonic prokinetic agents.	29	94	R2+A	22	1	R3C	18	100	A
Added: c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach)	-	-	-	22	95	R3C	18	100	A
Added: d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.	-	-	-	23	100	R3C	18	100	A
5. Analgesia and sedation It is suggested that clinicians ensure that critically ill or injured patients receive optimal pain and anxiety relief.	31	0	R2	22	95	R3C	18	100	A

Nursing interventions	Round 1 (n=31)				Consensus decision	Round 2 (n=23)		Consensus decision	Round 3(n=17)		Consensus decision
	Important	I-CVI (%)	Practical	I-CVI (%)		Agree	I-CVI (%)		Agree	I-CVI (%)	
1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment syndrome.											
1.1a) Initiate intra-abdominal pressure measurements as ordered.	31	100	24	75	R2+	23	100	R3C	18	100	A
1.1b) Implement, monitor, and record intra-abdominal pressures.	31	100	25	84	R2	23	100	R3	18	100	A
1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP.	31	100	27	90	R2	22	95	R3C	18	100	A
1.1d) Consider developing a nurse-driven protocol.	31	100	27	90	A	-	-	R3C	18	100	A
1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).											
1.2a) Ensure that gastric/intestinal tubes are patent and functioning as ordered	31	100	31	100	A	-	-	R3C	18	100	A
1.2b) Use evidence-based methods to identify tube location. Two or more methods are recommended. Observe for respiratory distress. If available, use capnography and use pH strips to measure pH of aspirate. Examine the visual appearance of tube aspirate. Review radiographic reports for confirmation of blind-inserted nasogastric tube.	30	97	26	84	R2	22	95	R3	18	100	A
1.2c) Prevent constipation, by ensuring adequate nutrition and hydration.	29	94	29	94	R2	23	100	R3C	18	100	A
1.2 d) If the patient is constipated, advocate for a laxative and stool softener.	30	97	30	97	A	-	-	R3C	18	100	A
1.2 e) Discuss with provider whether a rectal tube will assist with decompression.	28	90	31	100	R2	23	100	R3C	18	100	A
1.2 f) Monitor and record bowel movements.	30	97	31	100	A	-	-	R3C	18	100	A
1.2 g) Monitor accurate input and output.	31	100	30	97	A	-	-	R3C	18	100	A
1.2 h) Ensure adequate hydration.	31	100	31	100	A	-	-	R3C	18	100	A
1.2 i) Administer medications as ordered (e.g., stool softeners, laxatives, and prokinetic agents).	31	100	31	100	R2	23	100	R3C	18	100	A
1.2 j) Administer enemas as ordered.	30	97	29	94	R2	22	95	R3C	18	100	A
1.2 k) Positioning: avoid high Fowler position, if possible.	29	94	28	90	R2+	23	100	R3C	18	100	A
1.2 l) Assessment of patient: Monitor surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	31	100	31	100	R2	23	100	R3C	18	100	A
1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids in collaboration with provider where indicated.	31	97	29	94	R2	23	100	R3C	18	100	A

Nursing Interventions	Round 1 (n=31)				Consensus decision	Round 2 (n=23)		Consensus decision	Round 3 (n=17)		Consensus decision
	Important	I-CVI	Practical	I-CVI (%)		Agree	I-CVI (%)		Agree	I-CVI (%)	
2.1 Nursing interventions for optimizing regional perfusion and fluid balance:											
2.1 a) Monitor intake and output.	30	97	30	97	R2+	22	95	R3C	18	100	A
2.1 b) Notify provider if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.	90	97	29	94	R2	23	100	R3C	18	100	A
2.1 c) Assess for peripheral edema.	29	94	31	100	R2	22	95	R3C	18	100	A
2.1 d) Monitor laboratory results, including hemoglobin and hematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, and report as needed.	31	100	30	97	R2	22	95	R3C	18	100	A
2.1 e) Assess patient response to fluids, blood transfusions, and diuretics needed.	31	100	30	97	A	-	-	R3C	18	100	A
2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.	30	97	28	93	R2	23	100	R3C	18	100	A
2.1 g) When possible, use volumetric (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) rather than pressure-based (Central venous pressure (CVP) or Pulmonary Capillary Wedge Pressure (PCWP) end points of volume resuscitation.	28	90	22	71	R2+	23	100	R3C	18	100	A
2.2. Nursing interventions for managing the fluid balance:											
2.2 a) Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management.	31	100	28	90	A	-	-	R3C	18	100	A
2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, collaboration with the surgical team will become necessary.	31	100	26	84	R2	23	100	R3	18	100	A
3.1. Nursing interventions for facilitating abdominal closure:									18	100	A
3.1 a) Various methods may be used to help close the abdomen, including but not limited to negative pressure wound therapy and dynamic fascial tension devices/systems.	31	100	23	74	R2	23	100	R3C	18	100	A
3.1 b) Nurses should be competent with systems used in their individual practice environments.	31	100	26	84	R2	23	100	R3C	18	100	A
3.2. Nursing assessment and management of the temporary abdominal closure device.											
3.2 a) Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation, increase in intra-abdominal hypertension after application or adjustment of dynamic tension devices, and intra-abdominal hypertension after fascia and/or skin closure.	31	100	28	90	A	-	-	R3C	18	100	A
3.2 b) Monitor the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.	31	100	28	90	R2	23	100	R3C	18	100	A
3.2 c) Maintain the function of the temporary abdominal closure device.	31	100	26	84	A	-	-	R3C	18	100	A

Nursing interventions	Round 1 (n=31)				Consensus decision	Round 2 (n=23)		Consensus decision	Round 3 (n=17)		Consensus decision
	Important	I-CVI (%)	Practical	I-CVI (%)		Agree	I-CVI (%)		Agree	I-CVI (%)	
Nursing interventions regarding the assessment and management of nutrition:											
4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen.	31	100	27	87	R2	23	100	R3C	18	100	A
4.1 b) Monitor accurate intake and output and consult dietician for recommendations.	31	100	27	87	A	-	-	R3C	18	100	A
4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or undergoing active resuscitation.	31	100	26	84	R2	23	100	R3C	18	100	A
4.1 d) Limit interruptions in enteral nutrition.	30	96	26	84	R2	21	90	R3	18	100	A
4.1.e) If IAP remains elevated, discuss with provider whether gastric and colonic prokinetic agents (e.g., metoclopramide, erythromycin, neostigmine) are appropriate for the patient.	29	94	26	84	R2	22	95	R3C	18	100	A
4.1 f) If IAP remains elevated, collaborate with the nutritionist and provider to minimize or discontinue enteral nutrition.	29	94	26	84	R2	23	100	R3C	18	100	A
Nursing interventions regarding the management of pain and anxiety											
5.1 a) Assess for pain by using a standardized pain assessment scale; assess for anxiety.	31	100	31	100	A	-	-	R3C	18	100	A
5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain, while limiting associated complications such as oversedation.	31	100	29	94	R2	23	100	R3C	18	100	A

*R2- Refined and added to Round 2; R2+ - Refined and attached more information and added to Round 2; A- Accepted – not included in Round 2; R3- Refined for Round 3; R3C- Completed included in R3

*IAP: Intra-abdominal pressure; MAP: Mean arterial pressure; APP: Abdominal perfusion pressure

5. Discussion

This study aimed to reach a consensus on the nursing guidelines developed by Lee et al. (2020) for managing patients admitted to the ICU with an open abdomen. A heterogeneous sample, comprising 31 experts working in the ICU, including nurses, doctors, surgeons, and intensivists, allowed for a wider range of expertise and perspectives (Taylor et al., 2016, p. 3). One of the main concerns indicated by the experts was the use of the phrase “as ordered” in the nursing statements. To prevent confusion, the phrases were altered from “as ordered” to “as prescribed,” which was accepted. Table 3 provides the refined nursing guidelines and interventions for managing patients admitted to the ICU with an open abdomen.

Table 3. Refined nursing guidelines and accompanying nursing interventions for patients with an open abdomen admitted to the intensive care unit

NURSING GUIDELINE STATEMENTS	NURSING INTERVENTIONS
Assessing for intra-abdominal hypertension (IAH)/abdominal compartment syndrome (ACS) Measure IAP when any known risk factors for IAH/ACS are present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing IAH/ACS. Provide ongoing assessment for the organ system manifestations of IAH/ACS.	**Measure intra-abdominal pressure (IAP)** • Initiate IAP measurements in a patient with suspected IAH/ACS. • Implement, monitor, and record IAP, 4 to 8 hourly. Monitor more frequently if IAH identified. • Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability. • Consider developing a nurse-driven protocol. **Decreasing IAPs** • Ensure that gastric/ intestinal tubes are patent and functioning as ordered. • Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location. • Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration. • If the patient is constipated, advocate for a laxative and stool softener. • Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression. • Monitor and record bowel movements. • Monitor accurate input and output. • Ensure adequate hydration.

	• Administer medications as prescribed (e.g., stool softeners, laxatives, and prokinetic agents). • Administer enemas as prescribed. • Positioning: Avoid high Fowler/prone position, if possible. Allow for head of bed elevation of 30°.
	Assessment and management of open abdomen surgical site/drains
	Assessment • Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae. **Management** Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consultation with a wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.

Optimizing regional perfusion	**Assessment of fluid balance**
Fluid balance Consider using the ROSE concept* to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of IAH/ACS after resuscitation has been completed and the inciting issues have been addressed. Note: A positive fluid balance may contribute to IAH and negatively affect the ability to achieve fascial closure. *ROSE concept: R: Resuscitation; O. Optimization; S: Stabilization; E: Evacuation	• Monitor intake and output. Take in consideration the insensible losses. • Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour. • Continuous assess for peripheral edema. • Monitor laboratory results, including hemoglobin and hematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed. • Assess patient response to fluids, blood transfusions, and diuretics needed.

Damage control resuscitation Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive hemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon. When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon. No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in hemodynamically stable patients with IAH after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to the specific patient. *Note: If IAP is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's IAH/ICS is refractory to medical management.	• Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance. Consider using the ROSE concept in collaboration with the treating doctor/surgeon. • When possible and depending on availability, use advanced hemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke volume [SV], pulse pressure variation [PPV], or stroke volume variation [SVV] and extra vascular lung water index [EVLWI]). **Management of fluid balance** Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management. • When interventions to lower IAH are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary. • Note: In a medical patient, advocate to consult the treating team to involve the surgeon.

Temporary abdominal closure dressing Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens. Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.	**Assessment** • Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation, increase in IAH after application or adjustment of dynamic tension devices, and IAH after fascia and/or skin closure. • Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.
	Management Maintain the function of the temporary abdominal closure device.
Abdominal closure Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.	**Facilitating abdominal closure** • Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems. Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available.

Nutrition No recommendations can be made related to the optimal timing of nutrition in IAH/ICS, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications. Advocate for gastric and colonic prokinetic agents. Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.	**Assessment** • Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon. • Advocate for gastric and colonic prokinetic agents. **Management** • Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician. • Limit interruptions in enteral nutrition. Latest evidence suggests discontinuing routine monitoring of gastric residual volumes as it decreases the enteral nutrition delivery. • If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (e.g., metoclopramide, erythromycin, neostigmine) are appropriate for the patient. • If IAP remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.
Analgesia and sedation It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).	**Assessment** • Assess for pain by using a standardized pain assessment scale; assess for anxiety. **Management** • Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.

The first guideline statement and intervention addresses monitoring and measuring of intra-abdominal pressure (IAP). To broaden the applicability of the guidelines, the statement was refined by adding "*using available devices, may it be invasive or noninvasive devices to measure intra-abdominal pressure*." Adding this sentence allows the guidelines to be used in a wider range of ICUs, and nurses are guided to measure IAP using devices available to them. The experts mentioned that the equipment used to measure and monitor IAP may not be readily available in developing countries, such as South Africa. Nonetheless, measuring IAP in patients with acute abdomen or after laparotomy is crucial, as early detection of elevated IAP can ensure early intervention, improved patient outcomes, and prevention of unwanted complications (Coccolini et al., 2018; Prasad et al., 2017). The experts commented that nurses are responsible for early detection and early intervention for raised IAPs. Routine monitoring of IAP every 4 to 8 h is needed to ensure early detection of raised IAPs to prevent ACS and further complications such as multiorgan failure (Boolaky et al., 2020; Coccolini et al., 2018).

In the case of elevated IAP, nasogastric tubes can be placed for decompression. Evidence shows that correct tube placement can be ensured via X-rays (Taylor & Manara, 2021). We refined the nursing interventions to allow for chest X-rays to confirm the placement of nasogastric tubes. In practice, methods such as tube aspiration and auscultation are also used, but evidence shows that these methods can be misleading, as when auscultating a similar gurgling sound is heard over the epigastrium when the tube is misplaced into the tracheobronchial tree, pleural space, or esophagus (Taylor & Manara, 2021).

The second guideline statement involves optimal regional perfusion. The statement was refined by adding the ROSE (Resuscitation, Optimizing, Stabilization, Evacuation) concept when managing the patient's fluid status. The ROSE concept focuses on early, adequate, goal-

directed, fluid management approaches (Malbrain et al., 2018). Further refinement was incorporated regarding damage control and resuscitation related to blood transfusions. Research suggests that the optimal way to transfuse blood products is through the use of a 1:1:1 ratio of plasma, platelets, and packed red blood cells (Patil & Shetmahajan, 2014). We added that when a patient presents with sepsis, nurses should collaborate with the prescribing or treating doctor and adhere to the current sepsis guidelines (Patil & Shetmahajan, 2014).

The experts emphasized the importance of monitoring patient intake and output to optimize fluid balance. Advance cardiac monitoring, if available, should be used to guide fluid resuscitation. In the surviving sepsis campaign of 2023 (Guarino et al., 2023) recommended the use of only heart rate and suggested that central venous pressure and systolic blood pressure were “poor indicators” of a patient’s fluid status (Guarino et al., 2023). The authors stated that dynamic measurements are more accurate in predicting fluid responsiveness. The dynamic measurements included passive leg raise together with cardiac output, stroke volume, and stroke volume variance. A passive leg raise can be used to determine a patient’s fluid responsiveness when advance cardiac monitoring is unavailable. Passive leg raise should be performed for 60 to 90 s and if there is a >15% increase in patient pulse pressure, the patient is fluid responsive and will benefit from fluid resuscitation. When caring for patients with an open abdomen in the ICU, a multidisciplinary approach is crucial for improving patient outcomes (Coccolini et al., 2018; Lee et al., 2020).

The third guideline statement focuses on abdominal closure. Most of the experts commented that it is difficult for nurses to facilitate abdominal closure, but if the nurse can ensure that the wound remains clean or that the vacuum dressing remains functional, it may assist with early wound closure and reduce the length of hospital stay. This statement aims to create a learning

environment for nurses to ensure optimal wound care and functional vacuum dressings. Nurses should be trained in wound care and how to care for a vacuum dressings when managing patients with open abdomens (Chaghari et al., 2017). The wound care nurse, ICU nurse, and surgeon are responsible for ensuring that the abdominal vacuum system remains functional to allow for early closure (Coccolini et al., 2018).

The fourth guideline focusses on nutrition. Early nutrition was key but dependent on the patient and the type of surgery. Experts highlighted the importance of collaborating with dieticians to establish optimal feeding conditions, obtain optimal nutritional conditions and improve wound closure. Evidence shows that enteral nutrition should be started as soon as possible if there are no contraindications, such as damage control surgery involving interruption of the bowel. Enteral nutrition should be introduced in small amounts and gradually increased (Coccolini et al., 2018). Early enteral feeding may help to improve internal peristalsis (Coccolini et al., 2018). In addition, prokinetic drugs or narcotic antagonists can be used to promote gastrointestinal motility (Tatsumi, 2019). Starting enteral nutrition within the first 24 to 48 h improves wound healing, allows for early fascial closure, reduces catabolism, reduces the risk of developing pneumonia and fistula formation, preserves GI tract integrity, prevents further complications, and reduces the length of hospital stay and cost (Coccolini et al., 2018).

Nurses should also monitor for refeeding syndrome by monitoring for hypophosphatemia and hypomagnesemia. Refeeding syndrome is commonly encountered but mostly overlooked when treating patients in the ICU and it can contribute to nutritional morbidity and mortality (Dhungel et al., 2019). Together with dieticians, enteral feeding rates can be adjusted to reduce the effects of refeeding syndrome, which encompasses electrolyte derangement due to

reintroduction or a rapid increase in caloric intake after being NPO ('nothing by mouth') for a while (da Silva et al., 2020). Electrolytes should be replaced as needed.

The fifth nursing guideline involves pain management and sedation. The experts commented that critically ill or injured patients should receive optimal pain and anxiety relief. Nonopioid-based analgesia should be used to prevent the development of paralytic ileus postsurgery. The use of pharmacologic and nonpharmacological pain management to prevent the formation of a paralytic ileus (Al-Jasim et al., 2022) was added. Pain-assessment tools, such as the Critical Care Pain Observation Tool (CPOT) or the Behavioral Pain Scale (BAS), can be used to guide pain management. During the ICU stay, it is important to ensure analgesia over hypnosis and consider multimodal analgesia to reduce opioid infusion, as this approach is used to keep the patient "awake" but well adapted to mechanical ventilation. (Coccolini et al., 2018).

6. Limitations and strengths

A limitation of this study was that the aim was to obtain expert opinions globally, but only a few experts responded to the invitation. Most of the responses received were from experts from South Africa; therefore, experts from developing countries were overrepresented, and the challenges regarding the availability of stock and staff were highlighted, which may be unique to the participating experts' countries of origin. A larger group of experts may have increased the reliability of the consensus obtained. However, the group of experts who participated in all three of the e-Delphi rounds were knowledgeable about the research subject, and most of them participated in all three rounds. The strengths of the study included the inclusion of a heterogeneous group of different health professionals in the ICU, which helped to provide a wider range of opinions and expertise.

7. Clinical practice relevance

Currently, the nursing guidelines available and developed by Lee and Hunt (2020) still need further discussion. The aim of this study was to obtain a consensus and allow for further refinement, which were obtained, and the guidelines were refined as per expert opinions/suggestions. These refined guidelines can be introduced in practice to help improve patient care and outcomes in patients with an open abdomen in the ICU. The refined guidelines can be used to highlight gaps in practice and can help guide in-service training. These guidelines can also be introduced at tertiary institutions during training to inform and guide training nurses.

8. Conclusions

After the first round, a consensus was obtained, but the experts added comments and suggestions with supporting evidence. The second round was conducted by introducing the refined changes to the experts to rate their agreement. A consensus was reached on their agreement with the changes, but a few further suggestions were added. Suggestions with supporting evidence were added, and a new refined nursing guideline was introduced to the experts in round 3. The experts agreed on the new refined nursing guidelines but highlighted that measuring IAP may be challenging due to stock and staff shortages.

Concluding that the 2020 guidelines have been updated based on expert review during the Delphi rounds. These new guidelines are more inclusive of low-income settings and may be more applicable in a wider range of settings and may add value in the managing of patients with open abdominal wounds.

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Supplementary data A: Refinement of guideline after Round 1

Original nursing guideline statement	Comments from experts	Refined nursing guideline statement
Nursing guideline statement 1: Assessing for intra-abdominal hypertension/abdominal compartment syndrome		
Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient. It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	• Should be assessed in all patients with open abdomens. • It's a simple bedside skill that can have far reaching benefits with regards to preventing the complications of a compartment syndrome • Would add "using approved devices" after the first 4 words of the statement. • Tools should be explained clearly as well as which one is to be used as various measuring equipment is available to be used, but not always used accurately. • It should be done every 8 hours. • It informs fluid resuscitation from insensible losses from open abdomen. Renal perfusion, intestinal perfusion. • Include "post abdominal surgery?" • In my current workplace we see open abdomens a few times a year, however the frequent measuring of intra-abdominal pressure is not common practice, and the equipment is not readily available. • I assume this is invasive monitoring, is it important to note that there is a non-invasive component as well? • Before measuring it is important to assess the any signs of abdominal distension in all the patients who are having an open abdomen. Ensure that the patient is connected to negative therapy Then measure the intra- abdominal pressure strictly 4 hourly and record.	Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome
Accompanying nursing interventions		
Original nursing intervention	**Comments from panel of experts**	**Refined nursing intervention**
1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment syndrome.		
1.1a) Initiate intra-abdominal pressure measurements as ordered.	• By measurement of the intra-abdominal pressures, you will be able to recognise changes early and intervene.	1.1a) Initiate intra-abdominal pressure measurements in a patient with suspected

	• Stock is not always available. • During orientation of staff to the unit- symptoms should be highlighted of signs and symptoms for abdominal compartment syndrome. Evaluation of patient per shift should be required particularly to Compartment syndrome signs and symptoms. • It is critical to ensure that all consumables are available to execute the intervention and that all nursing staff are well versed on how to execute the intervention - regular in-service training will be of value in this regard. • There are hardly sets available to do the measurements. • Sets for intra-abdominal monitoring not readily available in all settings. • Invasive monitoring needs to be requested by a medical physician, but non-invasive monitoring can be initiated by nursing staff. Patient advocacy and evidence-based suggestions by nursing staff as part MDT discussion is vital. • Specific monitoring equipment and doctor preference will impact on the practical implementation of the guidelines in private sector facilities. • Not practical in a government setting which is resource and staff limited. Otherwise, feasible. • Practicality depends on availability of equipment. • Due to equipment not being regularly available, such as indwelling catheter measurements, accurate measurements do not get done. In a resource poor environment without proper measuring equipment, this is not feasible and accurate.	intra-abdominal hypertension or abdominal compartment syndrome.

1.1b) Implement, monitor, and record intra-abdominal pressures.	• It can be somewhat impractical because of the labour and time required to set up. I addition, lack of resources in our setting might mean it is not always easy to secure the equipment. • As above -training and consumable availability are critical in this regard. • Once recorded, immediate intervention to decompress the abdomen can be started. • No stock available • As short staffing becomes a bigger problem more and more, nurses experience severe increases in workload and therefor quality of nursing is affected. If a patient is severely ill, management of acute life-threatening issues such as mixing inotropes et. are prioritised over 'paperwork'. • Specific monitoring equipment and doctor preference will impact on the practical implementation of the guidelines in private sector facilities. • Practicality depends on availability of equipment. • Due to equipment not being regularly available, such as indwelling catheter measurements, accurate measurements do not get done. Proper recording/monitoring can detect worsening/or improvement in intra-abdominal pressure and consequently guide the necessary interventions	1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly**.**
1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP.	• When the APP decreases there is a high risk of intra-abdominal organ complications. Every Nurse should be skilled in measuring IAP. Can be implemented with charting. • Can be time-consuming especially when staff have many pieces of information to record. • Availability of the formula visually and orientation of staff- especially agency staff • No sets available. Depends on availability of equipment to measure IAP. • If all valuables are available, calculating abdominal pressure is easily done.	1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability.

1.1d) Consider developing a nurse-driven protocol.	• Protocols are helpful in assisting and supporting the nurses for conformance and consistency. • It's very important to have standardised protocols that staff can easily follow to ensure uniform management and make management itself easier. The difficulty lies is spreading the information and ensuring that everybody is aware of it and practicing it. • Implementation depends on institutional autonomy. • Nurses are the MOST important clinical observers of pts clinical changes. • A nurse driven protocol is an excellent idea -this will potentially decrease the number of patients with significant risk factors for ACS that are missed or diagnosed late. • The timing of measurement, charting, patient choice, • Big need for this to create a safe framework for CC nurses to practice in. • Nurses today seems to fear doing what they know without the permission of the doctors. • Nurse led protocols assist in creating policies that are not only evidence based but also include the capability and resource availability of the unit that implement the policy. • This can be tailored to the needs of a particular facility, to aid in continued reliable measurements/monitoring. • A protocol is important because it creates a standard and continuity in nursing care and from patient to patient. Concerns from nurses' side can be raised and action plans be implemented.	1.1d) No refinement required

1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).		
1.2 a) Ensure that gastric/ intestinal tubes are patent and functioning as ordered	• If drainage bags are not functional the abdomen will be distended. • This is reasonable with certain tubes, such as nasogastric tubes. However, it can be impractical when it comes to more complex tubes, such as feeding jejunostomies. In such patients who have had complex surgery, the assessment of the tubes should fall with the managing surgeons. Gastric tubes need to be patent otherwise the intra-abdominal pressure increases and without monitoring patient's condition deteriorates. • Include statement on how to ensure patency? • Line patency is crucial if deflation is required. Tubes can become blocked if not regularly assessed.	1.2a) No refinement required
1.2 b) Use evidence-based methods to identify tube location. Two or more methods are recommended. Observe for respiratory distress. If available, use capnography and use pH strips to measure pH of aspirate. Examine the visual appearance of tube aspirate. Review radiographic reports for confirmation of blind-inserted nasogastric tube.	• Confirm NG tube position by radiograph. The Litmus can still give false info. • The nurses in our ICU have several duties and it can be tiresome to expect them to test the pH of gastric fluid routinely. In my experience, confirmation of tube placement lies with the doctor. • PH strips can be used to measure the PH aspirate and chest X-rays can be used to verify the actual positions of either nasogastric tubes or orogastric tubes. • In the context where I work neither pH indicators nor capnography is not available. We rely on auscultation, should this technique be included? Not sure since. • Should be recorded and confirmed with medical staff where possible. • Nasogastric tube placement should always be confirmed with radiography. I have my concerns to how practical and available the use of capnography would be in this regard.	1.2 b) Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location. Examine the visual appearance of tube aspirate and tube auscultation can also be done.

	• Time and resources can be big limitations… what about a grading system for EBP methods to check tube location. • In a resource and staff limited government hospital, not practical. Otherwise, feasible. • Tube placement confirmation is crucial in some critical patients. Ngt placement Not checked radiographic by all units. • Proper/precise placement of measuring device with ensure reprocible results. • Both capnography and pH strips are not always readily available. Radiographic review most accurate. • The medico-legal standard is to not test pH but to review the X-ray. Two methods are not required.	
1.2 c) Prevent constipation, by ensuring adequate nutrition and hydration.	• With an open abdomen often enteral nutrition is withheld depending on the surgery performed. • Nutrition and hydration are important aspects of nursing and can entail something as straightforward as a fluid bolus. Feeding can be more laborious, especially when it comes to equipment. • Dieticians to assist with the prescription of the correct diet for ICU patients to prevent constipation and diarrhoea. • Staff should be made aware of the importance of bowel movement recording and reporting of no bowel movement. • Critical patients are left without nutrition for extended periods, but TPN can be considered. • Patient's clinical pictures do not always allow for implementation of proposed medical treatment plan. • All should be on board as rest of mdt not always open to suggestions or comments. • Nutrition can he overlooked for multiple days is critically ill patients. Establishing a feeding plan, enteral or parenteral with the aid of a dietitian can	1.2 c) Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration.

	ensure optimal nutrition is present for healing as well as malnutrition. prevention/correction. • intravenous access can offer an alternative way of feeding to meet daily energy demands if the enteral route is contra-indicated.	
1.2 d) If the patient is constipated, advocate for a laxative and stool softener.	• Difficult to assess and auscultate an open abdomen to confirm constipation. • This entails suggesting and appears relatively straightforward. • Can use FASTHUGBID Mnemonic • laxatives yes for constipation to prevent the discomfort for patients, Stool softeners are useful if the bowel is active and functional. • Prevention of constipation through early intervention in mobility. • Nurses should be part of the doctors' rounds AND mention this as part of advocating for the pt • It is very important that nursing staff advocate for this -doctors often overlook this. A discussion with the involved dietician also goes a long way - possibly fibre content of the enteral feeds could be adjusted, and enteral water flushes added if this is a problem. • Again, time and resource limits • this will be an important intervention provided there is no obstruction in the intestinal tract	1.2d) No refinement required
1.2 e) Discuss with provider whether a rectal tube will assist with decompression.	• Distension might also be due to the gas which can be relieved by flatus tube. • The discussion is important, especially if it will benefit the patient. Passing rectal tubes also appears to be routine practice in our ICU. • rectal tubes used mostly for patients with severe diarrhoea. • Patient choice is important, rectal tubes can cause erosion, anal fissure. • Nurses today are scared to voice their clinical viewpoint. • Rectal tubes may dislodge, or leak leading to surrounding skin damage if not addressed in a	1.2 e) Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression.

	timely manner. As with all tubes pressure injury risk assessment is needed. Stool needs to be assessed for looseness as any larger formed stool piece can block the tube. • any measures to reduce the abdominal pressures even slightly can bring about some sort of relief/comfort in the part and the benefit of prevent further complications of an abdominal compartment syndrome. • Resource poor environments does not always have access to this and if so, sometimes wrong equipment is being used that lead to ineffectiveness	
1.2 f) Monitor and record bowel movements.	• The stool is a sign of bowel activity. • To monitor bowel movements twice a day record and report. Not ONLY Recording- SHOULD inform dr and drs rounds • Done routinely with changing, turning the patient. • Identification of constipation or loose bowels can be done easily and appropriate management implemented in a timely manner. • Presence or absence of bowel sounds is of no consequence in modern ICU management for both feeding or open abdomen	1.2f) No refinement required
1.2 g) Monitor accurate input and output.	• Open abdomen, drainage on suction can be monitored though it is sometimes not very accurate, to be able to replace the losses. • This is a laborious intervention but vitally important. It can be difficult in terms of constant measuring and the calculations. • tells you the hydration status of the patient. • Keep record and act at the earliest to correct and prevent and complications is important. • Input/output monitoring is one of the most important and clinically relevant variables charted on an ICU chart. • It can be difficult to measure stools. • Ensure calculations for cumulative totals etc and drain totals are correct.	1.2g) No refinement required

	• Fluid balance can assist in assessment of retention or excessive losses aiding the medical team with decision making. • This is feasible, particularly in patients with an indwelling urinary catheter. Tapering urine output (in the presence of an adequate fluid status) can alert to the possibility of worsening of the abdominal pressures and thus aid in early interventions. • Must include dialysis volumes	
1.2 h) Ensure adequate hydration.	• Fluid replacement very crucial to prevent dehydration. Consider insensible losses. • Hydration can be difficult in these patients especially when they tend to third-space their fluids. A fluid bolus might be more harmful than helpful. • 24 hrs intake and output give a clear indication of the hydration status. • Keep record of all intake and output. • Assessing vitals, fluid balance. • Again, Patient condition VS fluid balance aim. • Not to only follow dr instruction but to also advocate for the patient. • Advocating for fluid replacement in patients who are unable to eat/drink can prevent dehydration and AKI.	1.2h) No refinement required
1.2 i) Administer medications as ordered (eg, stool softeners, laxatives, and prokinetic agents).	• To promote gut motility. • dieticians order the probiotics, and the Doctors order the stool softeners and the nurses to give the prescribed treatment. • Depends on patient condition and staffing ratios. • If medication availability is not a problem • Using practical sense as to route of administration and a nonfunctional bowel can assist in not causing more harm with over treatment.	1.2 i) Administer medications as prescribed (eg, stool softeners, laxatives, and prokinetic agents).
1.2 j) Administer enemas as ordered.	• If indicated for and do proper assessment. • Enemas are sometimes of limited use in the ICU and sometimes do not yield the desired result. • if prescribed to be given	1.2 j) Administer enemas as prescribed.

	• Nurses need to be skilled with longer nozel applicators so as to not damage to rectum.	
1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bead elevation of 30°.	• Avoid kinkage of drainage tubes. • Positioning can usually be done easily thanks to the remote-controlled bed but can be more time-consuming when it comes to different types of positioning, e.g. nursing with the left/right side of the chest up. • most patients in ICU head end of the bed needs to be elevated 30-45 degrees high not exactly high fowlers. • Nursing staff with limited understanding of respiratory implications of increased IAP would find this difficult to understand. • improper positioning can falsely increase measurements of intra-abdominal pressures.	1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bead elevation of 30°.
1.2 l) Assessment of patient: Monitor surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	• For proper monitoring of healing, infection, and drainages. • This can be a routine part of a general check for the patient, as nurses do a top to bottom assessment. • daily assessment for both day and night staff to detect any signs of infection. • Nursing assessment for skin integrity, very important • Record keeping! and record that dr informed • All absolutely essential observations -as the nursing staff spend significantly more time with the individual patient than the doctors do,they are often the first to note abnormalities in any of the above variables. • How often do we want this to be done? Once a shift or hourly? • Frequent monitoring can aid in early identification of bleeding or perforation. • Alert the surgeon of any concerns	1.2 l) Assessment of patient: Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae**.**
1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula	• Wound care staff will advise on the type of dressings to be used and appropriate interventions. • This can be difficult especially when some equipment or dressings are not available. It is	1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to

drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids in collaboration with provider where indicated.	sometimes also hard to quantify losses when the tubes leak. • poor skin integrity leads to skin ulceration so important to prevent or reduce occurrence. • Fluid replacement with appropriate fluids and electrolyte monitoring goes hand in hand. • Essential part of holistic patient care. As mentioned above -the nursing staff are often first to note any abnormalities in this regard and they must feel empowered to discuss their concerns with the treating doctors and wound care sisters where necessary. • Wound care is not primarily roe of the bedside ICU nurse. Wound care expert and surgeon to intervene and guide. • Resource limitations • In a resource and staff limited government hospital, not practical. Otherwise, feasible. • Minimising wounds will assist in earlier healing of already established wounds. • Replacement of losses should be considered to be part of maintaining the hydration status	maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.
Original nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 2: Optimizing regional perfusion and damage control		
2.1 Optimizing regional perfusion: Fluid balance **Use a protocol to try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure.**	• This is a difficult line to walk as these patients lose a lot of fluids through various mechanisms. By avoiding a positive balance, you also run the risk of negatively affecting organ perfusion. • Fluid balance monitoring is important if over hydrated doctors to reduce the total fluid maintenance. • Critical intervention - ideally the patients fluid balance targets should be discussed and decided upon each day on the ward rounds with the treating medical team. Judicious use of fluids - including minimising the volume of IV fluid medications are mixed in as well as the use of Lasix must be considered daily. • Not a nurse task!	Consider using ROSE (Resuscitation, Optimising, Stabilisation, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure. *ROSE concept: R:Resuscitation; O:Optimization; S: Stabilisation; E: Evacuation (Malbrain, Van Regenmortel,

	Give sufficient fluid to ensure adequate intravascular volume without overloading. Use the ROSE (Malbrain et al WJS 2017) concept to determine the correct phase of fluid management.	Saugel, De Tavernier, Van Gaal, Joannes-Boyau et al., 2018:11)
2.2 Optimizing regional perfusion: Damage control resuscitation. **a) Use an enhanced ratio of plasma/packed red blood cells for resuscitation of massive haemorrhage instead of low or no attention to plasma/packed red blood cell ratios.**	• Replace what is needed. Inform clinician. • One must replace what was lost. Therefore, if there was massive haemorrhage, it is sensible to do fluid resuscitation with blood products. • Might be impractical due to availability of blood products. • All round knowledge what this entails is important. • International literature clearly shows that a 1:1:1 ratio of packed cells to plasma to platelets has an improved outcome in damage control resuscitation. • Transfusion guidelines/protocols not being followed where I work. • Surgeons often prescribe, not always evidence asked but based on how they were trained. • it's not a nurse task x3! • Communication with blood bank to assist in massive transfusion policies will benefit patient outcomes. • Blood products may not always be available during a resuscitation, there may have to be some sort of a compromise in using crystalloids in a haemodynamically unstable patient. • This only applies to the TRAUMA patient with an open abdomen from bleeding - it is not applicable to sepsis. Surviving Sepsis guidelines should be followed for abdominal sepsis as reason for the open abdomen.	a) Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon. b) When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon. c) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specifation. Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management. d) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens. e) Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.
b) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemodynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. If intra-	• Proper patient assessment will guide individualised care. • As indicated in the above comment section -it is essential to use a balanced resuscitation strategy. • Will depend on individual patient response to treatment, doctor preferences.	

abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.	• Maybe just review the updated 2021 Surviving Sepsis statements as these views are evolving presently.	
c) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens.	• This assist with wound drainage and keep the surrounding area dry. • This is relevant but not always practical or practiced often in our ICU. • negative suction good for wound closure reduces introduction of infection. • Open abdominal wound can be septic, NPWT would not be indicated. • This aids in creating a protective barrier around the organs while reducing fluid build-up in and around the abdomen. Less frequent dressing changes can also decrease risk of infection. • It is only practical if correct equipment is used and regularly revised by surgeons or primary care givers. • Know how npwt is applied, knowledge is key.	
d) Nurses should be familiar with systems used in their individual practice environments.	• This aids in creating a protective barrier around the organs while reducing fluid build-up in and around the abdomen. Less frequent dressing changes can also decrease risk of infection. • It is only practical if correct equipment is used and regularly revised by surgeons or primary care givers. • Know how npwt is applied, knowledge is key. • Continuous in-service training of the product use. • Doctors to involve nurses when connecting patients to negative suction. • Should be included in in-service training programs and in Curriculum- Critical care and Trauma. The surgical and AED and ward staff should also be included in this!!!! • working with what you have in your facility can result in improved outcomes in subsequent interventions, as skill gets better with repetition.	

	• From experience, in-service training is needed to manage complicated open abdomens on vacuum systems etc. Training to be given on equipment such as wound manage system or vac systems from companies.	
Accompanying nursing interventions		
Original nursing intervention	**Comments from panel of experts**	**Refined nursing intervention**
2.1 Nursing interventions for optimizing regional perfusion and fluid balance:		
2.1 a) Monitor intake and output.	• To determine losses. Losses can be calculated, and intake adjusted accordingly. • Proper monitoring and record all intake and output. Take appropriate action to correct this very important. this gives information as to the hydration status of the patients. • ward staff should be made aware. • Limitations on stool measurement	2.1 a) Monitor intake and output. Take in consideration the insensible losses.
2.1 b) Notify provider if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.	• Poor or no urine output may be a sign of excessive drain losses hence hypovolemia and poor perfusion to kidneys. • It is important data to share and can be easily communicated. The impracticality of it lies in the calculation. • prevent renal dysfunction. • Early intervention will prevent this. • Recordkeeping of informing doctor. • Urine output can be affected by medications, it is not also an effective tool to monitor fluid balance. • An essential intervention -action should be taken sooner rather than later and the sooner the provider is informed the earlier corrective measures can be taken. • Who is the provider? Dr or Nurse? Can we troubleshoot X1 incident of UO<0,5ml/kg/hr or do we report it- any evidence for this? • Early identification of AKI and its associated management can help patient survival.	2.1 b) Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.

2.1 c) Assess for peripheral oedema.	• Plasma proteins like Albumin could be low hence fluid in the extravascular compartment. • oedema could be a late sign prevent pulmonary oedema. • Part of Nursing assessment and report. • Important to note that peripheral oedema will be more prominent in the sacral position in the supine patient. • Frequency? • Assessment can be subjective. • this can also give an idea of the fluid status and may guide medical therapies to aid in mobilising fluids in the body.	2.1 c) Continuous assess for peripheral oedema.
2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, and report as needed.	• Ensure electrolyte balance. • The nurses don't have access to the website for patients' results and it can't be expected that they routinely check results. This, in my experience, is the doctors' responsibility. • prevent acute kidney injury. • This is largely a system issue - in state systems the doctors do this in ICU as there is usually in-house doctors, while this statement is more appropriate for private sector facilities	2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed.
2.1 e) Assess patient response to fluids, blood transfusions, and diuretics needed.	• Check skin colour, confirm haemoglobin, urine output test for specific gravity. • This entails reviewing typical parameters such as heart rate, urine output, etc. It can also be assessed with routine blood gases. • Again, prevent acute kidney injury and renal dysfunction. • Bedside staff can identify issues early and more accurately. Accompanied by successful reporting it can lead to early interventions that improve patient outcomes	2.1 e) No refinement required
2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.	• Proper assessment with individualised care. • each patient to be considered individually using the ideal body weight. • It is of utmost importance that goals and targets of therapy for the 12 hours of each shift are clearly	2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.

	discussed and outlined by medical and nursing staff involved. A clear roadmap is needed to optimise outcome. • Guidelines to fluid resuscitation not followed where I work. • Not a nurse task!	Consider using the ROSE concept in collaboration with the treating doctor/surgeon
2.1 g) When possible, use volumetric (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) rather than pressure-based (Central venous pressure (CVP) or Pulmonary Capillary Wedge Pressure (PCWP) end points of volume resuscitation.	• If proper advanced hemodynamic monitoring devices are available. But your CVP and Wedge pressures can still be used if it is the only device. • This is advanced cardiac monitoring which often needs senior doctors to review. Many parameters can be readily interpreted but others can be more difficult. • where possible depending on the equipment's available in your institution • This is dependent on the availability of monitoring equipment to achieve this. • Depends on availability of Cardiac Output monitors Limited resources. • Not every unit has access to monitor these readings. • International guidelines clearly show that dynamic variables of fluid responsiveness (SVV,PPV etc) are clearly superior to static fixed measurements such as CVP (that only has a 50 %) accuracy. Availability of these monitors may be a problem however in our setting. • Use assistance of clinical technologist to connect monitors. • Resources not available in all centres. Cardiomyopathy can affect this. • not nurse task! • This will depend on the availability of measuring devices in the institution/s. • If there is limited access to invasive hemodynamic monitoring, this won't be feasible.	2.1 g) When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).

2.2. Nursing interventions for managing the fluid balance:		
2.2 a) Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management.	• Proper assessment patient specific care. • The patient's clinical picture often precludes maintaining a negative balance. There may also be other confounding features, e.g., anuria in the presence of abdominal hypertension, making it harder to maintain a negative balance. • in depth understanding of this concept is needed for the RN to ensure the correct implementation. • Monitor and correct this very important. • Nurses must regard fluid as medication. Ensure clinicians prescribe it, not allow infusions to run indefinitely. • What about incentive losses from the open abdomen? • Difficult in resuscitation phase to maintain negative fluid balance. • Not nurse task!	2.2a) No refinement required
2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, collaboration with the surgical team will become necessary.	• For proper surgical intervention. • The surgical team needs to avail themselves should this problem arise. However, in practice, they are not always amenable to assisting. • Doctors to monitor patients closely in collaboration with nurses. • Nurses need to know that Critical care is a Practical practice implementing all acquired previous knowledge and needs to relay and record all findings. • Surgical team may not always be available to assist with surgery. • Shouldn't we consult them earlier? When is first signs of increased IAP detected? • Depends on nurse interaction with doctor. • Early intervention can identify ischemic bowel and need for surgical removal/ decision for end-of-life care.	2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary.

Original nursing guideline statement	Comments from experts	Refined nursing guideline statement
Nursing guideline statement 3: Abdominal closure		
	• Patient specific. All will be patient response dependent. • This is seldom easy or practical. It is important in order to ensure adequate closure but in our practice, it is often prevented by lack of resources, e.g. equipment or theatre time. • patients with open abdomens are usually very sick and easily get nosocomial infections so closing the abdomen as soon as possible is good for patients as long as there's no infection. • It is the clinician's discretion. • Have nurses adequately trained otherwise can be a mess? • Not nurse task! • While important it is not really something that the nurse can facilitate as such	Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.
Accompanying nursing interventions		
Original nursing intervention	**Comment from experts**	**Refined nursing intervention**
3.1. Nursing interventions for facilitating abdominal closure:		
3.1 a) Various methods may be used to help close the abdomen, including, but not limited to negative pressure wound therapy and dynamic fascial tension devices/systems.	• Proper assessment to be initiated. • VAC dressings are time-consuming and sometimes complicated (e.g. patients with entercutaneous fistualae). However, this task often does fall to the nursing and is routinely performed. The devices/systems mentioned are not readily available and more training is needed when it comes to managing them. • Dependent on availability of these devices/systems to achieve this goal. • One doesn't always have access to the necessary wound therapy. • These are often specialised systems that require additional training and consumables and very often need to be done under sedation. Most often need a wound care specialist or the treating surgeon to be involved. • Availability of fascial tension devises.	3.1 a) Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems**.**

	• Depends on patient, high wound exudate can make this very difficult. • Not nurse task! • Wound care nurse input is needed. • this will also be influenced by availability of devices at the institution. • Not all nurses have the correct knowledge or skill to provide npwt.	
3.1 b) Nurses should be competent with systems used in their individual practice environments.	• Continuous in-service training, product realisation. • if the tools are available yes • Nurses in general are not very familiar with advances wound care management and rely on the specialist wound care practitioner to manage the wound. I my opinion this lack of knowledge should be addressed to contribute to an improved team effort. • Depends on in service training and skills of practitioner. • Training is important. • In service training to be provided to staff if unsure about device use • Depends on nurse competency and willingness to ask for guidance if unsure. • If knowledge gaps are present, training needs to be initiated/encouraged. • Nurses are often uneducated regarding new wound systems or compliwound closure systems. then wounds would be left unattended for few days without intervention. Inservice training should be initiated.	3.1 b) Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available**.**
3.2. Nursing assessment and management of the temporary abdominal closure device.		
3.2 a) Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation, increase in intra-abdominal hypertension after application or adjustment of dynamic tension devices, and intra-abdominal hypertension after fascia and/or skin closure.	• To assess for any complications. • It can be difficult to monitor for some of these, especially in the open abdomen which has had multiple surgeries and with the use of advanced devices (that staff may not be familiar with). But in general, assessing these parameters should be part of routine checking.	3.2a) No refinement required

	• Knowledge and understanding of the device / system is needed to monitor efficacy. • As stated above the nurse is most often the first person to notice areas of concern wounds or dressing sites -as soon as any concerns are noted it must be reported to the relevant clinician and or wound care sister. • Still requires clinicians' assessment. Depends on accurate and continuous monitoring of patient by care giver.	
3.2 b) Monitor the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.	• Continuous assessment. • This requires training with the device in order to understand if there is a problem with it and how to manage it. • Knowledge and understanding of the device / system is needed to monitor efficacy. • Requires adequate training. • Frequency?	3.2 b) Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.
3.2 c) Maintain the function of the temporary abdominal closure device.	• Ensure that the device functions properly. • The nurses have several other duties, and they cannot be in charge of routine maintenance of certain devices, especially those they are not familiar with. • Knowledge and understanding of the device / system is needed to monitor efficacy. • It maybe labour intensive. The challenges of staffing ratios. • Failure to work as intended can have critical consequences. • If the nurse knows how the system work, yes. If not. Then monitoring and maintenance thereof is a problem.	3.2c) No refinement required
Original nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 4: Nutrition		
a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe	• Very important to give patient adequate nutrients, parenteral or enteral. Prokinetics may be contraindicated in some situations. • Close collaboration with the clinician and the dietician is essential in these complex patients.	a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that

and have demonstrated earlier fascial closure rates and fewer complications.	• Surgical and dietician teams need to be involved in feeding strategies to ensure safe feeding that is catered to individual patient needs. • early feeding has the benefit of aiding in recovery and maintain a positive nitrogen balance. • Supplemental parenteral nutrition should, however, not be stated for the first 3 days of non-enteral feeding but should be delayed in most patients to day 4 or 5.	the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications. b) Advocate for gastric and colonic prokinetic agents. c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach) d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.
b) It is recommended to initiate gastric and colonic prokinetic agents.	• For gastric motility and prevent paralytic ileus. Gastric residual volumes should no longer be routinely measured. • Doctor preference might influence the implementation in private sector facilities. • Following new evidence-based practices is very important. • Not nurse task!	
Accompanying nursing interventions		
Original nursing intervention	**Comments from experts**	**Refined nursing intervention**
4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen.	• Check the urea and electrolytes levels. • This responsibility lies with the nutritionist/dietician (in collaboration with the entire team). • liase with the dietician to prescribe the correct feeds. • Knowledge on nutrition will be required, often left for the dietician to evaluate. • This must be done in conjunction with a dietician that is experienced in managing these patients. • Depends on MDT resources. Should be done with or by a dietician. Not nurse task! From dieticians' side	4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon.
4.1 b) Monitor accurate intake and output and consult dietician for recommendations.	• Dieticians assist and calculate caloric requirements. not nurse task! • Dietician should be consulted early to avoid nutrition deficiencies and the complications thereof.	4.1b) No refinement required

4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or undergoing active resuscitation.	• Important depending on the surgery. add "or where there is bowel discontinuity". • Equipment may not always be readily available. Bolus feeding is laborious and time-consuming. • Nutrition part of the recovery process • RN can advocate however often left to the treating physician and dietitian to implement. • Early nutrition helps to prevent abdominal necrosis. • Not nurse task!	4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician.
4.1 d) Limit interruptions in enteral nutrition.	• Continuous feeds and aspirate to check for absorption. • Several unanticipated and unavoidable events can happen that could interrupt feeding, e.g., transporting to CT scan. • At times patients are unable to absorb feeds and the bowel needs to recover post operatively • At times feeds are interrupted for an extended period as patient is "waiting for theatre"	4.1 d) Limit interruptions in enteral nutrition. Aspirate enteral feeds to monitor absorption.
4.1.e) If IAP remains elevated, discuss with provider whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.	• Individualised care. • RN would require training on this and need to advocate for the patient. • Shouldn't we first assess whether the cause is enteral mobility related?	4.1.e) If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient**.**
4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and provider to minimize or discontinue enteral nutrition.	• Distension might indicate poor absorption. • There are no nutritionists in the hospital. • These patients are very complex to manage and need continuous reassessment and discussion with all involved parties -particularly the nursing sister, clinician (surgeon and intensivist) and the dietician. • Would add "after all other steps to decrease pressure have been performed"	4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.
Original nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 5: Analgesia and sedation		
It is suggested that clinicians ensure that critically ill or injured patients receive optimal pain and anxiety relief.	• Patients should be given analgesia for pain control and sedation only for patient discomfort. Use available pain and sedation assessment tools.	It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a

	• Analgesia is important to ensure patient recovery and comfort. However, it should be noted that complete absence of pain is not the goal, rather pain that is manageable, is. This is important as overzealous use of opioids can negatively impact on the bowel. • pain and anxiety if not treated can be a big source of stress for a patient who is already very sick. • All patients with open abdomens need optimised analgesia - sedation should be carefully considered and discussed with the clinician -weighing up the risks and benefits. Not all patients with open abdomens need sedation. • Target pain scoring. • Well done on distinguishing the difference! • Stress can delay wound healing. Patient safety should also be considered if they become too anxious or restless with a risk of self-harm (accidentally or intentionally). Non-opioid based analgesic regimen to prevent the development of a post-surgical ileus.	paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).
Accompanying nursing interventions		
Original nursing intervention	**Comments from experts**	**Refined nursing intervention**
5.1 a) Assess for pain by using a standardized pain assessment scale; assess for anxiety.	• Use available tools. • Communication with the patient is important but it might not be easy for the routine application of standardised methods of assessing anxiety or pain, e.g. in situations where a language barrier exists. Pain scales charted use the tools available in your specific hospitals. • Implementation is practical, however pharmacological knowledge is required as not to administer analgesia that may decrease motility. • Assessment of sedation and pain in the critically ill patient is neglected. Include a instrument to guide these assessments e.g. RASS for sedation and some kind of NVPS	**5.1a) No refinement required**

	• Optimising analgesia -using multiple modalities - ideally minimising opioids is one of the most important aspects of managing these patients. • Does anxiety always pain related? • Not implemented in some working environments, or no protocols exists • For patients who are conscious, co-operative and not on high-dose sedation	
5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain, while limiting associated complications such as oversedation.	• Sedation to be used for discomfort not for pain. know the signs of pain e.g., tachycardia, high blood pressure, restlessness, and sweating. • This can sometimes result in a very restless patient who is difficult to manage. • Very important to intervene in Nursing. • ICU's can be very noisy and distressing despite nurses best attempt to provide a safe and calming environment. • Not nurse task! • May be practical but often difficult in ICU patients	5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.

Supplementary data B: Refinement of guideline after Round 2

Refined nursing guideline statement	Comments from experts	Refined nursing guideline statement
Nursing guideline statement 1: Assessing for intra-abdominal hypertension/abdominal compartment syndrome		
Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	• Possible Risks to identify IACS should be shared with staff at handover, especially Agency staff. • Measurement is IAP will prevent multi organ failure due to sepsis. • I fully agree with the statement including the open abdomen risk. The last part of the sentence on the open abdomen however is not clear and concise enough in my opinion. • Intra-abdominal compartment syndrome is a preventable cause of organ ischaemia. Early detection can lead to favourable clinical outcomes. • Proper abdominal assessment to confirm any change caused by internal bleeding. • Training should be given the emphasis	Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome. Provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.
Accompanying nursing interventions		
Refined nursing intervention	**Comments from panel of experts**	**Refined nursing intervention**
1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment syndrome.		
1.1a) Initiate intra-abdominal pressure measurements in a patient with suspected intra-abdominal hypertension or abdominal compartment syndrome.	• Early identification and treatment can reduce the mortality rate. • Accurate measurements are important to ensure appropriate interventions.	1.1a) No refinement required
1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly.	• 1.1b - more frequent monitoring should be considered based on the patient's response to treatment.	1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly. Monitor more frequently if IAH identified.
1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability.	• It might be laborious for nursing to calculate the APP. As long as the IAP is recorded, it should be relatively simple for managing doctors to calculate and assess this parameter.	1.1c) No refinement required
1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).		
1.2 b) Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location.	• It is mandatory to confirm tube position with X-rays. Clinical confirmation is not adequate and not supported.	1.2 b) Use evidence-based methods to identify tube location. Latest evidence

Examine the visual appearance of tube aspirate and tube auscultation can also be done.	• Continuous monitoring of an NGT should be practical. Yes, CXR to initially confirm position but after that we need to ensure it stays safe. Length of NGT at nose? Is the NGT visibly coiled in the mouth? pH <5.5? Has the patient had any invasive procedures that could have moved the NGT i.e TEE/Bronchoscopy. Is there evidence to support auscultation?	suggests taking an abdominal x-ray to identify the tube location.
1.2 c) Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration.	• None	1.2c) No refinement required
1.2 e) Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression.	• None	1.2e) No refinement required
1.2 i) Administer medications as prescribed (eg, stool softeners, laxatives, and prokinetic agents).	• None	1.2i) No refinement required
1.2 j) Administer enemas as prescribed.	• None	1.2 j) No refinement required
1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bead elevation of 30°.	• None	1.2 k) No refinement required
1.2 l) Assessment of patient: Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	• None	1.2 l) No refinement required
1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. **Consider consult with wound care specialist.** **Ensure replacement of ongoing losses with appropriate fluids as prescribed.**	• None	1.2 l) No refinement required
Refined nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 2: Optimizing regional perfusion and damage control		
2.2 Optimizing regional perfusion: Fluid balance **Consider using ROSE (Resuscitation, Optimising, Stabilisation, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at**	• Handover of high-risk pts should be highlighted to staff, especially Agency staff. • Even though fluid balance is not controlled by nursing staff is more controlled by doctors. They decide how	2.1) No refinement required

risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure. ***ROSE concept: R:Resuscitation; O:Optimization; S: Stabilisation; E: Evacuation (Malbrain, Van Regenmortel, Saugel, De Tavernier, Van Gaal, Joannes-Boyau et al., 2018:11)**	much fluid the patient receives and a patient with severe oedema will have trouble with wound healing. • Getting rid of the fluid may not always be an easy process, particularly with reduced renal perfusion when the patient already has an acute kidney injury with anuria/oliguria.	
2.2 Optimizing regional perfusion: Damage Control **a) Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon.** **b) When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon.** **c) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specifation.** **Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.** **d) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens.**	• Should be communicated to staff where pts receive blood products. • Yes, in an ideal hospital which is not always the case blood and blood products are expensive if available yes if not crystalloids should still be used. • Possible addition of blood/pathology providers as they have input into massive transfusion activation. • This may pose a challenge for patients who do not receive blood products for religious reasons. The second challenge is the blood products are not always readily available. • Continuous in-service training of permanent staff is crucial. • Sepsis guidelines dictate crystalloid fluid resuscitation 30ml/kg /bolus. Do we follow the guidelines or stay on the conservative side case of abdominal surgery? • Possible inclusion of infectious diseases specialist if multi antibiotics or resistant organism is detected to aid in choice of antibiotics and they ongoing management post the ICU. • Appropriate and targeted treatment options applied correctly and timeously in the early stages of the disease process are more likely to be effective than any treatment modality that's not guided by evidence-based interventions. • Individualized management per patient. Agree with the statement , not sure that this is the correct place to put the note however.	**2.2) No refinement required**

e) Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.	• A more direct approach would be required. Surgery is not always ideal in all patient populations. Therefore, management should be Tailored from patient to patient. • See White et al. 2023 Sepsis-associated acute kidney injury in intensive care unit: incidence, patient characteristics, timing, trajectory, treatment, and associated outcomes. A multicentre, observational study. More info on physiological VS pathophysiological response of AKI. Could be useful for lit review • How will Agency staff be managed is important for excellence in ptcare service delivery and care in CCU. • This would be very helpful and in ICUs where this is not practised it should be introduced. • Absolutely essential -in service training is mandatory. • If education is lacking nurses can bring this up with education department of the hospital to facilitate knowledge gaps being filled. • Know what you have at your disposal will aid in aiming your expectations with regards to patient outcomes. It may also be helpful in decisions regarding referral of patients to institutions that can manage their condition appropriately when resources are in question.	
Accompanying nursing interventions		
Refined nursing intervention	**Comments from panel of experts**	**Refined nursing intervention**
2.1 Nursing interventions for optimizing regional perfusion and fluid balance:		
2.1 a) Monitor intake and output. Take in consideration the insensible losses.	• None	2.1a) No refinement required
2.1 b) Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.	• None.	2.1b) No refinement required
2.1 c) Continuous assess for peripheral oedema.	• None	2.1c) No refinement required
2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed.	• None	2.1d) No refinement required
2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance. Consider using	• None	2.1e) No refinement required

the ROSE concept in collaboration with the treating doctor/surgeon		
2.1 g) When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).	• None	2.1g) No refinement required
2.2. Nursing interventions for managing the fluid balance:		
2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary.	• I would suggest - add "consulting the treating team to involve the surgeon" in cases where the patient is a medical ICU patient.	2.2b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary. Note: In a medical patient, advocate to consult the treating team to involve the surgeon.
Refined nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 3: Abdominal closure		
Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.	• None	No refinement required
Accompanying nursing interventions		
Refined nursing intervention	**Original nursing intervention**	**Refined nursing intervention**
3.1. Nursing interventions for facilitating abdominal closure:		
3.1 a) Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems.	• None	3.1a) No refinement required
3.1 b) Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available	• Collaboration between Wound care staff Representative of company and nursing staff for effective use of systems. • Nurses to be trained in monitoring IAP. Management of complex wounds should be included in the nursing curriculum.	3.1b) No refinement required

3.2. Nursing assessment and management of the temporary abdominal closure device.		
3.2 b) Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.	• None	3.2b) No refinement required
Refined nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 4: Nutrition		
a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.	• Importance of daily monitoring...inputs of dieticians in CCU...staff need to monitor blood results indicating pts protein and feeding profile. • If it is safe enteral feeding is recommended otherwise in my practice most patients with open abdomens are put on TPN. • Emphasis on individualised assessment and decision making. • Involving a dietician to facilitate optimal early nutrition, either enteral or parenteral is best for optimal healing. Delaying nutrition can lead to other complication including malnutrition, refeeding syndrome, and poor wound healing. • Early feeding has its advantages, but adverse outcomes may persist, like a paralytic ileus which may worsen the compartment syndrome. • The patient's abdomen may be too sensitive post operatively. TPN good be a preferred alternative to prevent necrosis in the bowel.	4a) No refinement required
b) Advocate for gastric and colonic prokinetic agents.	• Both are good for the gastrointestinal system. • Gastric prokinetics yes, personally I am unsure of the role of colonic prokinetics in this patient population. • Addition of "where appropriate" as prokinetics may be contraindicated in ileus. • If available. • Provided patency of the gastrointestinal tract has been confirmed. • Decreasing the acid content in the gut could promote "good" bacteria in the gut.	4b) No refinement required
c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric	• Early "interventions" from nursing side - practical care to enhance GIT recovery.	4c) No refinement required

motility and to prevent paralytic ileus. (Multidisciplinary approach)	• Early feeding helps improve patient's condition. • A functional Gastrointestinal system may reduce one of the factors that can worsen a compartment syndrome. • Avoid the routine measurement of gastric residuals	
d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.	• Should Lactulose be given prophylactically to all patients on opioids. • In addition to replacing the electrolytes, thiamine must be added in refeeding syndromes. • Replacing electrolytes should be done intravenously to make sure it's effective in its action. • Are we checking on a daily basis?	4d) No refinement required
Accompanying nursing interventions		
Refined nursing intervention	**Comments from experts**	**Refined nursing intervention**
4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon.	• A multidisciplinary team approach is the way to go.	4.1 a) No refinement required
4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician.	• None	4.1 c) No refinement required
4.1 d) Limit interruptions in enteral nutrition. Aspirate enteral feeds to monitor absorption.	• 4.1d - there is increasing evidence that measurement of gastric residual is not to be standard of care - Diamond, S.J., Medici, V., Rice, T.W. et al. Should We Stop Using Gastric Residual Volumes?. Curr Nutr Rep 4, 236–241 (2015). https://doi.org/10.1007/s13668-015-0129-3 and Monitoring of gastric residual volume during enteral nutrition Hideto YasudaNatsuki KondoRyohei YamamotoSadaharu AsamiTakayuki AbeHiraku TsujimotoYasushi TsujimotoYuki Kataoka. Cochrane Systematic Reviews https://doi.org/10.1002/14651858.CD013335.pub2	4.1 d) Limit interruptions in enteral nutrition. Latest evidence suggests discontinuing routine monitoring of gastric residual volumes as it decreases the enteral nutrition delivery.
4.1.e) If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.	• None	4.1 e) No refinement required

4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.	• None	4.1 f) No refinement required
Refined nursing guideline statement	**Comments from experts**	**Refined nursing guideline statement**
Nursing guideline statement 5: Analgesia and sedation		
It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).	• **None**	No refinement required
Accompanying nursing interventions		
Refined nursing intervention	**Comments from experts**	**Refined nursing intervention**
5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.	• None	No refinement required

CHAPTER 5 CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter 4 discussed the findings of the study. This chapter concludes the study, discusses the original and refined nursing guideline statements, describes the limitations of the study, and makes recommendations for further research.

Presenting ICU nurses with nursing guidelines is key in providing optimal care for patients admitted in ICU with open abdomens, as nurses are a vital part of the ICU team and at the patient's bedside 24 hours a day. Lee, Gallagher, Ejike and Hunt's (2020) nursing guidelines needed further discussion and consensus. This study thus incorporated expert opinion and knowledge regarding nursing guidelines for patients with an open abdomen in ICU and supported adjustments to improve patient outcomes.

Furthermore, these nursing guidelines can be refined further as particular settings require. It is hoped that the guidelines may assist nurses globally to provide evidence-based and updated management of patients with an open abdomen and reduce the risk of complications as well the morbidity and mortality of patients when managed in ICU.

5.2 AIM OF THE STUDY

The aim of the study was to obtain consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen by examining and refining Lee, Gallagher, Ejike and Hunt's (2020) guideline statements and accompanying nursing interventions.

5.3 RESEARCH DESIGN AND METHODS

The data collection took place over three months during three e-Delphi rounds (Niederberger & Spranger, 2020) and providing feedback after each round. The e-

Delphi survey was conducted between 21 June 2023 and 22 September 2023. Out of 139 experts invited to participate in the study, 31 (22%) experts volunteered to participate in Round 1; 22 (70%) completed Round 2, and 18 (81%) completed Round 3. The majority of the experts (71%) were nurses, mainly South African; 5 (14.7%) experts had published articles related to the management of patients with an open abdomen in ICU, with a mean of 9.8 and stand deviation of 7.2 (see chapter 4, Table 4.1 for the experts' demographic characteristics).

The researcher used a consensus research design, a modified e-Delphi method. Qualitative and quantitative data were collected during each round and after each round the data was analysed and feedback provided to the experts before starting the following round. The data was collected through a three-round modified e-Delphi. Qualtrics software platform was used to invite and distribute the surveys to the experts, separately, for the first two rounds. The data collected from the first two rounds were analysed via the Qualtrics software platform and exported to Microsoft Word. The third round consisted of the refined nursing guidelines that were presented to the participants in a Microsoft Word document for the final discussion (see chapter 4 for detailed data analysis and changes).

5.4 GUIDELINES AND REFINEMENTS

Lee, Gallagher, Ejike and Hunt's (2020) nursing guidelines to manage patients admitted to intensive care units with an open abdomen formed the basis of the refinements and consensus in this study. The researcher identified 5 overarching nursing guideline statements with accompanying nursing interventions. The 5 main nursing guidelines and nursing interventions and the suggested refinements are presented and discussed next. Chapter 4 discusses the nursing guideline statements and accompanying nursing interventions with supporting evidence fully.

Nursing guideline statement 1 **Assessing for intra-abdominal hypertension/abdominal compartment syndrome**	
Original nursing guideline statement	Refined nursing guideline statement
Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome are present in a critically ill or injured patient. It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing is still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	*Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome are present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing is still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome. Provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.*
Discussion: Most hospitals, especially in developing countries, like South Africa, do not have all the equipment readily available or in stock. Therefore, the guideline statement was refined to add depending on what equipment is available, but it remains essential in the patient's treatment plan to be able to measure IAP and provide ongoing assessment to allow for early detection of IAH and prevention of ACS.	

Nursing interventions 1.1 **Assessing for intra-abdominal hypertension/abdominal compartment syndrome**	
Original nursing intervention	Refined nursing intervention

a) Initiate intra-abdominal pressure measurements as ordered.	*Initiate intra-abdominal pressure measurements in a patient with suspected intra-abdominal hypertension or abdominal compartment syndrome.*
b) Implement, monitor, and record intra-abdominal pressures.	*Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly. Monitor more frequently if IAH is identified.*
c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP.	*Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability.*
d) Consider developing a nurse-driven protocol.	*No refinement required.*
Discussion: The interventions were refined to focus on the measurement of IAP in any patient that is suspected of having intra-abdominal hypertension and abdominal compartment syndrome. If it is suspected, serial IAP measurements should be done to allow for early interventions and prevention of complications.	

Nursing interventions 1.2 **Nursing interventions to decrease intra-abdominal pressure (IAP)**	
Original nursing intervention	Refined nursing intervention
a) Ensure that gastric/intestinal tubes are patent and functioning as ordered.	*Ensure that gastric/intestinal tubes are patent and functioning.*
b) Use evidence-based methods to identify tube location. Two or more methods are recommended. Observe for respiratory distress. If available, use capnography and use pH strips to measure pH of aspirate. Examine the visual appearance of tube aspirate. Review radiographic reports for	*Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal X-ray to identify the tube location.*

confirmation of blind-inserted nasogastric tube.	
c) Prevent constipation, by ensuring adequate nutrition and hydration.	*Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration.*
d) If the patient is constipated, advocate for a laxative and stool softener.	*No refinement required.*
e) Discuss with provider whether a rectal tube will assist with decompression.	*Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression.*
f) Monitor and record bowel movements.	*No refinement required.*
g) Monitor accurate input and output.	*No refinement required.*
h) Ensure adequate hydration.	*No refinement required.*
i) Administer medications as ordered (e.g., stool softeners, laxatives, and prokinetic agents).	*Administer medications as prescribed (e.g., stool softeners, laxatives, and prokinetic agents).*
j) Administer enemas as ordered.	*Administer enemas as prescribed.*
k) Positioning: avoid high Fowler position, if possible.	*Positioning: avoid high Fowler position, if possible. Allow for head of bed elevation of 30°.*
l) Assessment of patient: Monitor surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	Assessment of patient: Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.
m) Management of the patient: Initiate	*Management of the patient: Initiate measures to*

measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids in collaboration with provider where indicated.	*maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.*
Discussion: Referring to 'as ordered' and the 'provider' is confusing because it is not clear who the 'provider' is. It was refined to "as prescribed", to give the nurse in practice more direction. The 'provider' was changed to "treating physician/surgeon" to make it clear for the nurse who to report the problems to. Latest evidence suggests that the best way of confirming the position of nasogastric tube is with a chest X-ray. Refined the interventions to confirm only with a chest X-ray. Always be mindful of the insensible losses and allow for replacement of fluid losses where needed.	

Nursing guideline statement 2.1: Optimise regional perfusion - Fluid balance	
Original nursing guideline statement	*Refined nursing guideline statement*
Use a protocol to try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and	*Consider using ROSE (Resuscitation, Optimising, Stabilisation, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial*

negatively affect the ability to achieve fascial closure.	*closure.* **ROSE concept: R: Resuscitation; O: Optimization; S: Stabilisation; E: Evacuation*
Discussion: The latest evidence-based indications for fluid resuscitation in the ICU are to incorporate the ROSE concept to be able to manage fluid. The 'protocol' was refined to the ROSE concept, to give clearer direction and guidance to the nurses in practice.	

2.1.1 Nursing interventions for optimising regional perfusion and fluid balance	
Original nursing intervention	Refined nursing intervention
a) Monitor intake and output.	*Monitor intake and output. Take in consideration the insensible losses.*
b) Notify provider if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.	*Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.*
c) Assess for peripheral oedema.	*Continuously assess for peripheral oedema.*
d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, and report as needed.	*Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed.*
e) Assess patient response to fluids, blood transfusions, and diuretics needed.	*No refinement needed.*
f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.	*Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the treating doctor/surgeon to prevent volume overload and positive fluid balance. Consider using the ROSE concept in collaboration with the treating*

	doctor/surgeon.
g) When possible, use volumetric (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) rather than pressure-based (Central venous pressure (CVP) or Pulmonary Capillary Wedge Pressure (PCWP) end points of volume resuscitation.	*When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).*
Discussion: ROSE concept was incorporated to allow for optimal fluid management of the patient in the ICU. Added: advanced haemodynamic monitoring, SVV & EVWLI, if available, to manage patient fluid status. Added: be mindful of the insensible losses, replace if needed – depending on the SVV/EWVLI values.	

2.1.2 Nursing interventions for managing the fluid balance	
Original nursing intervention	*Refined nursing intervention*
a) Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management.	*No refinement required.*
b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, collaboration with the surgical team will become necessary.	*When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary. Note: In a medical patient, advocate to consult the treating team to involve the surgeon.*
Discussion: Added: If the patient is not an initial surgical patient, advocate to involve the surgical team if IAH is suspected and advocate for serial IAP measurements.	

Nursing guideline statement 2.2: Optimizing regional perfusion: Damage control resuscitation	
Original nursing guideline statement	*Refined nursing guideline statement*
a) Use an enhanced ratio of plasma/packed red blood cells for resuscitation of massive haemorrhage instead of low or no attention to plasma/packed red blood cell ratios.	*Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon.*
b) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemodynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.	*When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon. No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specification. Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.*
c) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open	*No refinement required.*

abdomens.	
d) Nurses should be familiar with systems used in their individual practice environments.	*Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.*
Discussion: Refined the nursing interventions to focus on the 1:1:1 transfusion protocol according to latest evidence and follow latest sepsis guidelines. Added: Allow for regular in-service training of nurses in practice regarding the fluid management of a patient and the temporary abdominal dressings.	

Nursing guideline statement 3: Abdominal closure	
Original nursing guideline statement	Refined nursing guideline statement
a) It is recommended that conscious and/or protocolized efforts be made to obtain early or at least same hospital-stay abdominal fascial closure in patients with open abdominal wounds.	*Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure adequate wound care and wound care training for the nurses.*
Discussion: Refined the nursing guideline statement to focus on the training of the nurses in practice regarding optimal wound care of the open abdomen and to improve the nursing care of the temporary abdominal closure device.	

3.1 Nursing interventions for facilitating abdominal closure	
Original nursing guideline statement	Refined nursing guideline statement
a) Various methods may be used to help close the abdomen, including, but not limited to, negative pressure wound therapy and dynamic fascial tension devices/systems.	*Various methods may be used to help close the abdomen, depending on availability, including, but not limited to, negative-pressure wound therapy and dynamic fascial tension devices/systems.*

b) Nurses should be competent with systems used in their individual practice environments.	*Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service training on latest devices available.*
3.2 Nursing assessment and management of the temporary abdominal closure device	
a) Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation, and increase in intra-abdominal hypertension after application or adjustment of dynamic tension devices, and intra-abdominal hypertension after fascia and/or skin closure.	*No refinement required.*
b) Monitor the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.	*Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitoring for changes in drainage volume and appearance.*
c) Maintain the function of the temporary abdominal closure device.	*No refinement required.*
Discussion: Refined the nursing intervention to ensure the nurse in practice is knowledgeable about the temporary abdominal closure devices that are available in practice, allow for regular in-service training. Refined the nursing intervention to promote continuous monitoring of the temporary abdominal closure device to promote early abdominal closure.	

4 Nursing guideline statement: Nutrition	
Original nursing guideline statement	*Refined nursing guideline statement*
a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.	*No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.*
b) It is recommended to initiate gastric and colonic prokinetic agents.	*Advocate for gastric and colonic prokinetic agents.*
Added: c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach)	*No refinement required.*
Added: d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeon's prescription.	*No refinement required.*
Discussion: Refined the nursing guideline statement to advocate for commencing early enteral feeds if not contraindicated and if bowel is not interrupted. Incorporated the monitoring of refeeding	

syndrome as suggested in latest evidence, allowing for daily electrolyte monitoring and replacement if needed to prevent any further complications.

4.1 Nursing interventions regarding the assessment and management of nutrition	
Original nursing intervention	*Refined nursing intervention*
a) Formal nutrition evaluation should be considered in the patient with an open abdomen.	*Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon.*
b) Monitor accurate intake and output and consult dietician for recommendations.	*No refinement required.*
c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or undergoing active resuscitation.	*Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician.*
d) Limit interruptions in enteral nutrition.	*Limit interruptions in enteral nutrition. Latest evidence suggests discontinuing routine monitoring of gastric residual volumes as it decreases the enteral nutrition delivery.*
e) If IAP remains elevated, discuss with provider whether gastric and colonic prokinetic agents (e.g., metoclopramide, erythromycin, neostigmine) are appropriate for the patient.	*If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (e.g., metoclopramide, erythromycin, neostigmine) are appropriate for the patient.*
f) If IAP remains elevated, collaborate with the nutritionist and provider to minimize or discontinue enteral nutrition.	*If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.*

Discussion: Refined the nursing interventions to advocate for collaboration with the dietician and the surgeon to allow for commencing early enteral nutrition. If IAP is elevated or worsening, to discuss with the surgeon and dietician to stop the enteral feeds and consider TPN. Refined to advocate for minimal interruptions in enteral nutrition to allow for optimal nutritional delivery and to advocate for prokinetic agents.

5. Analgesia and sedation nursing guideline statement	
Original nursing guideline statement	*Refined nursing guideline statement*
It is suggested that clinicians ensure that critically ill or injured patients receive optimal pain and anxiety relief.	*It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid-based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).*
Discussion: Refined the nursing guideline statement with the main aim to prevent post-operative paralytic ileus by reducing the opioid analgesia and focusing on non-opioid analgesia to improve patient outcomes and reduced complications related to paralytic ileus. Allow for pain assessment tools to assess patient pain and anxiety levels so that adequate pain management can be achieved.	

5.1 Analgesia and sedation nursing interventions	
Original nursing intervention	*Refined nursing intervention*
a) Assess for pain by using a standardized pain assessment scale; assess for anxiety.	*No refinement required.*

b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain, while limiting associated complications such as oversedation.	Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.
Discussion: Refined the nursing intervention to focus on pain assessment to allow for optimal pain management for the patient and allow for improved patient outcomes. The main aim of the refinement of the nursing guidelines is to present the nurses in practice with a guide based on latest evidence-based practice for guidance on how to manage a patient with an open abdomen admitted to the ICU. The aim of these guidelines is to make it simpler for the nurses to care for the patients and to guide them on what will be expected of them in practice to improve patient outcomes and prevent further complications.	

5.5 LIMITATIONS

Although the aim was to obtain global expert opinions, only a few experts responded and most were from South Africa, therefore experts from developing countries were over-represented and the challenges regarding availability of stock and staff were highlighted which may be unique to the participating experts' countries of origin. A bigger and more diverse group of experts may have increased consensus reliability. However, the experts who participated in all three e-Delphi rounds were knowledgeable on the research subject. The rounds were quite lengthy and time consuming which had an impact on the number of experts who completed all three rounds. The corresponding author of the original nursing guideline on nursing a patient with an open abdomen (Lee et al.,2020), was contacted via email on multiple occasions asking for permission to use the guideline as basis for consensus, however, the author did not respond. The fact that the author did not respond may be regarded as a limitation to the study.

5.6 RECOMMENDATIONS

As nurses are a vital part of the team and are at the patient's bedside 24 hours a day, the nursing guidelines are key in improving nursing care and patient outcomes. Based on the findings of the study, the researcher makes the following recommendations for practice, the following additional strategies related to providing nursing care to a patient with an open abdomen in the ICU.

5.6.1 Practice

- Share the guidelines with the nurses caring for patients in an ICU with an open abdomen. The aim of the guidelines is to provide evidence-based practice to provide optimal care for the patients.
- The guidelines may be shared through in-service training or tertiary training to allow for improved and optimal patient care.
- Making nurses in practice aware of these guidelines and how to manage a patient with an open abdomen in the ICU will help to identify signs of increasing intra-abdominal pressure and allow for early identification of intra-abdominal hypertension and early interventions. Early identification and early interventions will help to reduce unwanted complications and reduce hospital stay, improving the mortality and morbidity rates.
- It is important for nurses in practice to be aware of the latest guidelines to guide them on the management of a patient with an open abdomen and to collaborate with the rest of the multidisciplinary team to ensure for the best care for the patient and to help reduce complications.
- The guidelines should be added to the unit protocol booklet to guide the nurses in practice on the management of a patient admitted to the ICU with an open abdomen.

5.6.2 Education

- Nursing education institutions involved in training ICU nurses should introduce the guidelines on the nursing management of a patient with an open abdomen in

the ICU into their curricula so that the nurses have a guide to follow when nursing a patient with an open abdomen.

- Educators should evaluate the nurse's practical knowledge and competence in the care of a patient admitted to the ICU with an open abdomen and introduce these guidelines in practice, to guide the nurses.
- In-service training programmes should incorporate the nursing guidelines to inform and guide the nurses in practice, ensure they are knowledgeable, and that the evidence guides them on caring for a patient with an open abdomen in the ICU.
- In-service training should help to inform nurses in practice on how to identify early predictions of intra-abdominal hypertension and allow for early interventions.
- In-service training should identify further knowledge and skill gaps and introduce the guidelines and ensure quality patient care.
- Empower nurses in practice by involving them in in-service training and promoting sharing information on the nursing guidelines to increase staff morale and improve overall patient care and patient outcomes.

5.6.3 Management

- Hospital management should promote and provide in-service training to keep nurses up to date with the latest evidence and allow the incorporation of these guidelines in practice to improve nursing care and patient outcomes.
- Hospital management should make provision for and allow nursing staff training in practice to ensure that the nurses are informed on latest evidence and how to incorporate the nursing guidelines in practice.

5.6.4 Further research

Further studies should be conducted on the following topics:

- Development of a nurse-driven protocol focusing on the nursing care of a patient admitted to the ICU with an open abdomen

- Development of in-depth nursing guidelines on the care of different temporary abdominal closure devices used on open abdomens
- An investigation of a step-by-step algorithm for nurses to follow when nursing a patient with an open abdomen in the ICU

5.7 SUMMARY

In summary the study concludes that the 2020 guidelines to manage patients admitted to intensive care units with an open abdomen by Lee, Gallagher, Ejike and Hunt's (2020) have been updated based on expert review during three Delphi rounds. The study involved an e-Delphi technique with a panel of experts and consensus was reached on the final refinements of the guidelines. The nursing statements and interventions were presented and refined supported with latest literature.

These updated guidelines are more inclusive of low-income settings and may be more applicable in a wider range of settings and may add value in the managing of patients with open abdominal wounds.

Annexure A

ANNEXURE A
ETHICS APPROVAL

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.
- FWA 00002567, Approved dd 18 March 2022 and Expires 18 March 2027.
- IORG #: IORG0001762 OMB No. 0990-0279 Approved for use through June 30, 2025 and Expires 07/28/2026.

Faculty of Health Sciences **Research Ethics Committee**

11 April 2024

Approval Certificate
Annual Renewal

Dear Mrs NB Mitropapas,

Ethics Reference No.: 68/2023 – Line 1
Title: Consensus on Nursing Guidelines to manage patients admitted to Intensive Care Units with an open abdomen: e-Delphi Method

The **Annual Renewal** as supported by documents received between 2024-03-25 and 2024-04-10 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2024-04-10 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Renewal of ethics approval is valid for 1 year, subsequent annual renewal will become due on 2025-04-11.
- The Research Ethics Committee (REC) must monitor your research continuously. To this end, you must submit as may be applicable for your kind of research:
  a) annual reports;
  b) reports requested *ad hoc* by the REC;
  c) all visitation and audit reports by a regulatory body (e.g. the HPCSA, FDA, SAHPRA) within 10 days of receiving one;
  d) all routine monitoring reports compiled by the Clinical Research Associate or Site Manager within 10 days of receiving one.
- The REC may select your research study for an audit or a site visitation by the REC.
- The REC may require that you make amendments and take corrective actions.
- The REC may suspend or withdraw approval.
- Please remember to use your protocol number (68/2023) on any documents or correspondence with the Research Ethics Committee regarding your research.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

On behalf of the FHS REC, Dr R Sommers
MBChB, MMed (Int), MPharmMed, PhD
Deputy Chairperson *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).

Research Ethics Committee
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Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tša Maphelo

ANNEXURE B INVITATION EMAIL ROUND 1

Invitation to Participate in an Online Delphi Survey: Consensus on nursing guidelines to manage patients admitted to Intensive Care Units with an open abdomen (Round 1)

Dear Expert,

I hope this email finds you well. My name is Nicole Barbara Mitropapas, and I am currently pursuing my Masters in Nursing at the University of Pretoria. As part of my research, I am conducting a research study aimed to gain consensus on the nursing guidelines to manage patients admitted to the Intensive Care Unit (ICU) with an open abdomen. I am reaching out to you today to invite you to participate in an important online Delphi survey.

As an esteemed healthcare professional, your expertise and insights are highly valuable in helping us achieve our goal of gaining consensus on the nursing guidelines for the optimal care and nursing management of patients with an open abdomen in the ICU. The e-Delphi survey methodology, consisting of multiple rounds, is designed to reach consensus among a group of experts like yourself.

The e-Delphi survey will be conducted online and will consist of a series of questionnaires administered in three rounds. In each round, you will be asked to provide your professional opinion and expertise on various aspects of the nursing management of patients with an open abdomen in the ICU. The estimated time commitment for each round is approximately **30-40 minutes**. Rest assured that all responses will remain anonymous and confidential, and the data collected will be used solely for the purpose of this study.

Your participation in all three rounds would be highly appreciated, as it will allow us to gather diverse perspectives and foster consensus among experts in the ICU. Your involvement will contribute significantly to the consensus on the nursing guidelines that will enhance the quality of care provided to patients with an open abdomen in the ICU.

To participate in the Delphi survey, please click on the following link: https://pretoria.eu.qualtrics.com/jfe/form/SV_0jlECxdaiWsOXAO.

The first round of the survey will be open from **21/06/2023 to 07/07/2023**. We kindly request that you complete the first round within this timeframe. Subsequent rounds will be conducted in a similar manner, with clear instructions and deadlines provided in subsequent communications.

Should you have any questions or concerns regarding the e-Delphi survey or the research study itself, please do not hesitate to reach out to me directly at nicolemitropapas@gmail.com. Your feedback and input are crucial to the success of this study, and I am here to provide any assistance you may need throughout the process.

Thank you in advance for considering this invitation. Your expertise and active participation will significantly contribute to gaining consensus on the nursing guidelines to manage patients with an open abdomen in the ICU. We highly value your professional opinion and look forward to your valuable contributions.

Warm regards,

Nicole Barbara Mitropapas

Critical Care Nurse

University of Pretoria, South Africa

Friendly Reminder: Participation in e-Delphi Survey on Nursing Guidelines for Patients with an Open Abdomen in Intensive Care Units (Round 1)

Dear Expert,

Hope this email finds you well. I would like to remind you about the ongoing online e-Delphi survey on "Consensus on Nursing Guidelines to Manage Patients Admitted to Intensive Care Units with an Open Abdomen." Your participation is crucial, and I kindly request you to take a few moments to contribute your valuable insights to Round 1 of this e-Delphi survey.

As an experienced health care professional, your expertise in managing patients with an open abdomen in the Intensive Care Unit (ICU) is highly valued. This survey aims to gather expert opinions and recommendations from professionals like yourself, with the goal of gaining consensus on the nursing guidelines that will improve patient outcomes and promote best practices in critical care.

In case you haven't had a chance to participate, I kindly request that you take a few moments to complete the survey. To access the survey, please click on the following link: https://pretoria.eu.qualtrics.com/jfe/form/SV_0jlECxdaiWsOXAO.

I greatly appreciate your input, and your contribution will contribute to the advancement of critical care practices. The e-Delphi survey will only take approximately 30-40 minutes to complete, and I assure you that all responses will remain confidential and anonymous.

Please note that Round 1 of the e-Delphi survey will be open for participation until 07/07/2023. I kindly request you to complete the survey before this date to ensure your valuable insights are included.

Thank you in advance for your participation. Should you have any questions or require further assistance, please do not hesitate to reach out.

Best regards,

Nicole Mitropapas

Critical care nurse

University of Pretoria, South Africa

Annexure C

ANNEXURE C INVITATION EMAIL ROUND 2

Invitation to Participate in an Online e-Delphi Survey: Consensus on nursing guidelines to manage patients admitted to Intensive Care Units with an open abdomen (Round 2)

Dear Expert,

I hope this email finds you well. Thank you for your valuable time and willingness to participate in the first round of the e-Delphi survey with the aim to reach consensus on the guidelines on the nursing management of patients admitted to the intensive care unit with an open abdomen. I would like to invite you to participate in the **second round** of the e-Delphi survey.

Consensus was reached in the first round of the e-Delphi survey; however, the nursing guideline statements and interventions were refined as per your expert suggestions and comments received from the first round. The purpose of the second round will be to introduce the new refined nursing guideline statements and interventions, to rate your agreement and to add any further suggestions or comments.

Your valuable survey responses received from the first round, were analyzed, and placed onto a word document and is attached as feedback. Please refer to the attached document: Feedback Round 1, as reference.

The **second round** of the e-Delphi survey will be open from **28/07/2023 to 11/08/2023** and it will approximately take you **10 minutes** to complete.

To participate in the **second round** of the e-Delphi survey, please click on the following link:

https://pretoria.eu.qualtrics.com/jfe/form/SV_9ZhEnRocTmNNIgK

Should you have any questions or concerns regarding the second round of the e-Delphi survey or the research study itself, please do not hesitate to reach out to me directly at nicolemitropapas@gmail.com. Your feedback and input are crucial to the success of this study, and I am here to provide any assistance you may need throughout the process.

Thank you in advance for considering this invitation to participate in the second round of the e-Delphi survey. Your expertise and participation will significantly contribute to gaining consensus and allow for refinement of the nursing guidelines to manage patients with an open abdomen in the ICU.

Warm regards,

Nicole Barbara Mitropapas

Critical Care Nurse

University of Pretoria, South Africa

Friendly Reminder: Participation in the online e-Delphi Survey on 'Consensus on Nursing Guidelines for patients with an open abdomen in Intensive Care Units' (Round 2) requested.

Dear Expert,

I hope this email finds you well. I would like to remind you about the ongoing Second Round of the online e-Delphi survey on "Consensus on Nursing Guidelines to manage patients admitted to Intensive Care Units with an open abdomen." Your participation is crucial, and I kindly request you to take a few moments to contribute your valuable insights to the second round of this survey. As an experienced healthcare professional, your expertise in managing patients with an open abdomen in the Intensive Care Unit (ICU) is highly valued.

Consensus was reached in the first round of the online e-Delphi survey; however, the nursing guideline statements and interventions were refined as per your expert suggestions and comments received from the first round. The purpose of the second round will be to introduce the refined nursing guideline statements and interventions, to rate your agreement and to add any further suggestions or comments.

In case you haven't had a chance to participate, I kindly request that you take a few moments to complete the survey. To access the survey, please click on the following link: https://pretoria.eu.qualtrics.com/jfe/form/SV_9ZhEnRocTmNNIgK

The survey will only take approximately 10 minutes to complete, and I assure you that all responses will remain confidential and anonymous.

Please note that the second round of the survey will be open for participation until 11/08/2023.

Thank you in advance for your participation, I greatly appreciate your input and valuable time. Should you have any questions or require further assistance, please do not hesitate to reach out to me on nicolemitropapas@gmail.com.

Warm regards,

Nicole Mitropapas

Critical care nurse

University of Pretoria, South Africa

Annexure D

ANNEXURE D INVITATION EMAIL ROUND 3

Invitation to Participate in an Online e-Delphi Survey: Consensus on nursing guidelines to manage patients admitted to Intensive Care Units with an open abdomen (Round 3)

Dear Expert,

I hope this email finds you well. Thank you for your valuable time and willingness to participate in the second round of the e-Delphi survey with the aim to reach consensus on the guidelines on the nursing management of patients admitted to the intensive care unit with an open abdomen. I would like to invite you to participate in the **third round** of the e-Delphi survey.

Consensus was reached in the first round of the e-Delphi survey; however, the nursing guideline statements and interventions were refined as per your expert suggestions and comments received from the first and second round. The purpose of the third round will be to introduce the new refined nursing guideline and allow for any further comments/suggestions on the final nursing guideline.

Your valuable survey responses received from the second round, were analyzed, and placed onto a word document and is attached as feedback. Please refer to the attached document: Feedback Round 2, as reference.

To participate in the **third round** of the e-Delphi survey, please open the attached word document: **Refined nursing guideline.** Please take a few minutes to review the refined nursing guideline with accompanying nursing interventions on the word document and indicate if you have any further comments/suggestions on the document by commenting below the guideline or using track changes.

Please **return** the reviewed refined nursing guideline document to nicolemitropapas@gmail.com by **15/09/2023.**

Should you have any questions or concerns regarding the third round of the e-Delphi survey or the research study itself, please do not hesitate to reach out to me directly at nicolemitropapas@gmail.com. Your feedback and input are crucial to the success of this study, and I am here to provide any assistance you may need throughout the process.

Thank you in advance for considering this invitation to participate in the third round of the e-Delphi survey. Your expertise and participation will significantly contribute to gaining consensus and allow for refinement of the nursing guidelines to manage patients with an open abdomen in the ICU.

Warm regards,

Nicole Barbara Mitropapas

Critical Care Nurse

University of Pretoria, South Africa

Friendly Reminder: Participation in the online e-Delphi Survey on 'Consensus on Nursing Guidelines for patients with an open abdomen in Intensive Care Units' (Round 3)

Dear Expert,

I hope this email finds you well. I would like to remind you about the ongoing Third Round of the online e-Delphi survey on "Consensus on Nursing Guidelines to manage patients admitted to Intensive Care Units with an open abdomen." Your participation is crucial, and I kindly request you to take a few moments to contribute your valuable insights to the third round of this survey.

Consensus was reached in the first round of the e-Delphi survey; however, the nursing guideline statements and interventions were refined as per your expert suggestions and comments received from the first and second round. The purpose of the third round will be to introduce the new refined nursing guideline and allow for any further comments/suggestions on the final nursing guideline.

Your valuable survey responses received from the second round, were analyzed, and placed onto a word document and is attached as feedback. Please refer to the attached document: Feedback Round 2, as reference.

To participate in the third round of the e-Delphi survey, please open the attached word document: Refined nursing guideline. Please take a few minutes to review the refined nursing guideline with accompanying nursing interventions on the word document and indicate if you have any further comments/suggestions on the document by commenting below the guideline or using track changes.Please return the reviewed refined nursing guideline document to nicolemitropapas@gmail.com.

Please note: If you have no further comments/suggestions you are more as welcome just to reply 'no further comments or suggestions' to the email.

Should you have any questions or concerns regarding the third round of the e-Delphi survey or the research study itself, please do not hesitate to reach out to me directly at nicolemitropapas@gmail.com. Your feedback and input are crucial to the success of this study, and I am here to provide any assistance you may need throughout the process.

Thank you in advance for considering this invitation to participate in the third round of the e-Delphi survey. Your expertise and participation will significantly contribute to gaining consensus and allow for refinement of the nursing guidelines to manage patients with an open abdomen in the ICU.

Warm regards,

Nicole Barbara Mitropapas

Critical Care Nurse

University of Pretoria, South Africa

Annexure E

ANNEXURE E QUALTRICS SURVEY ROUND 1

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Welcome to the research study

STUDY TITLE:
CONSENSUS ON NURSING GUIDELINES TO MANAGE PATIENTS ADMITTED TO INTENSIVE CARE UNITS WITH AN OPEN ABDOMEN: AN E-DELPHI METHOD

Principal Investigator: Nicole Barbara Mitropapas
Institution: University of Pretoria, South Africa

DAYTIME AND AFTER-HOURS TELEPHONE NUMBER(S):

Daytime numbers +27721542202

After hours: +27721542202

PARTICIPANT INFORMATION AND INFORMED CONSENT

Dear Participant,

1) INTRODUCTION

I would like to invite you to participate in a research study. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained, do not hesitate to ask the investigator. Please do not continue with the survey unless you are completely satisfied with all the procedures involved. If you choose to participate, it will take you about 30 to 40 minutes to complete the survey. The study will be conducted over a minimal of three rounds. The survey will be sent to you in 3 different rounds, each round will consist of 14 days for you to return the completed survey and a reminder will be sent out a week prior to the closing date for submission. Your response will be sent back to me and I will collate the responses from all participants and provide feedback after each round.

Please note that the **inclusion criteria** for this research study is the following:

a) Qualified Nurses; Intensivists and Surgeons;

b) have more than 3 years' experience in managing patients with an open abdomen in the ICU and/or;

c) published a minimum of two peer reviewed articles on the management of a patient with an open abdomen in the ICU.

Your input as an expert in the management of patients admitted to the intensive care unit with an open abdomen will make a significant contribution to the nursing management of a patient with an open abdomen in the ICU.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of the study is to reach consensus on guidelines on the nursing management of patients admitted to the intensive care unit with an open abdomen.

3) EXPLANATION OF PROCEDURES TO BE FOLLOWED

Throughout the duration of the study to reach consensus, you will be asked to partake in an e-Delphi survey. The Delphi method is utilized to gain consensus on a specific matter.
In this study, the aim is to reach consensus on the guidelines and recommendations made regarding nursing interventions to be implemented when managing patients with an open abdomen in the intensive care unit, based on the nursing guidelines published by Lee, Gallagher, Ejike and Hunt (2020) in the American Journal of Critical care for Critical Care Nurses (Link: Nursing guidelines for intra-abdominal hypertension and the open abdomen).

These recommendations are drawn from the medical guidelines that were developed by the World Society of Abdominal Compartment Syndrome/ the Abdominal Compartment Society in 2014.

The survey includes 5 nursing guideline statements with their corresponding nursing interventions. As an expert in the field, please rate and comment on the nursing guideline statement and the corresponding nursing interventions, as follows:

Nursing guideline statement

a) Use the four-point Likert scale and rate the importance of the guideline statement.

b) Comment or add suggestions relating to the guideline statement.

Nursing interventions

a) Use the four-point Likert scale and rate the importance of each nursing intervention.

b) Use the four-point Likert scale and rate the practicality for implementing the nursing intervention.

c) Comment or add suggestions relating to the nursing intervention.

4) RISK AND DISCOMFORT INVOLVED

There are no risks involved in taking part in the study. You will be participating anonymously as the other participants will not be able to identify you. Only I, the researcher, will know your identity. You will also be able to partake in the study in your own time and own environment. This gives you full autonomy over your decision to participate or not.

5) POSSIBLE BENEFITS OF THIS STUDY

There will be no direct benefit to you from participating in this study. You will be part of a group of 12-15 experts that will reach consensus on the guidelines on the nursing management of patients admitted to the intensive care unit with an open abdomen.

6) I UNDERSTAND THAT IF I DO NOT WANT TO PARTICIPATE IN THIS STUDY, I WILL NOT BE VICTIMISED

Your participation is completely voluntary. You may refuse to participate or stop at any time during the study without giving any reason.

7) I MAY AT ANYTIME WITHDRAW FROM THE STUDY

Your withdrawal will not affect you in any way.

8) HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This Protocol was submitted to the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, telephone numbers +2712 356 3084 / +2712 356 3085 and written approval have been granted by that committee (Ethics approval nr: 68/2023). The study is structured in accordance with the Declaration of Helsinki (last update: October 2013), which deals with the recommendations guiding doctors in biomedical research involving human/subjects. A copy of the ethics approval letter may be obtained from the investigator should you wish to review it.

9) INFORMATION

If you have any questions about your participation in the research process, you should contact the researcher Nicole Mitropapas at the daytime and night-time numbers supplied at the beginning of this document.
Alternatively, you can contact any of my supervisors:
Prof Tanya Heyns +27 832873929
Prof Isabel Coetzee-Prinsloo +27 711589045

10) CONFIDENTIALITY

All data collected during this study will be regarded as confidential. Your name as well as the names of other participants will not be reported on. The researcher will keep a Participant Identification Code list (confidential list) documenting all the participants and their allocated coded trial numbers upon enrolment. This document will allow the researcher to link the coded trial number with the identity of any of the participants for participant safety as per POPIA. Results will be published or presented in such a fashion that all participants remain unidentifiable. Your identity will only be made known if you so indicate, as discussed above.

11) CONSENT TO PARTICIPATE IN THIS STUDY

I have read or had read to me in a language that I understand the above information before signing this consent form. The content and meaning of this information have been explained to me. I have been given opportunity to ask questions and I am satisfied that they have been answered satisfactorily. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I understand that if I do not participate, I will not be victimised. I hereby volunteer to take part in this study as a contributor on reaching consensus on the nursing guidelines to manage patients admitted to intensive care units with an open abdomen.

Thank you for your valuable time and for participating in the first round. Please supply your email address at the end of the survey if you would be willing to participate in the following rounds

By starting the survey, you have consented to participate voluntary in the study.

Demographic information

Country of residence

Current job description

Nurse ○ Doctor ○ Surgeon ○ Intensivist ○ Other ○

If other, please describe

Highest professional qualification

Diploma	Degree	Honours Degree	Masters	PhD	Other
○	○	○	○	○	○

If other, please describe

Please indicate the number of years of experience you have relating to the management of patients with an open abdomen in the intensive care unit

Have you published in a peer review journal on an open abdomen or on the management of an open abdomen?

Yes	No
○	○

Please provide the number of the reports published in the last five years

Block 2

1. Nursing guideline statement: Assessing for intra-abdominal hypertension/abdominal compartment syndrome

Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a

critically ill or injured patient. It is important to recognize that the patient with an “open” abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.

How important is the nursing guideline statement ‘Assessing for intra-abdominal hypertension/abdominal compartment syndrome’?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on Nursing Guideline Statement 1: 'Assessing for intra-abdominal hypertension/abdominal compartment syndrome'

Nursing interventions relating to nursing guideline statement 1 include:
1.1 Assessing for intra-abdominal hypertension/abdominal compartment syndrome with corresponding interventions numbered from a to d.
1.2 Decrease intra-abdominal pressures with corresponding interventions numbered from a to m.

1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment syndrome

1.1a) Initiate intra-abdominal pressure measurements as ordered.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.1b) Implement, monitor, and record intra-abdominal pressures.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP.

***MAP- Mean arterial pressure**

***IAP - Intra-abdominal pressure**

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.1d) Consider developing a nurse-driven protocol.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).

1.2 a) Ensure that gastric/ intestinal tubes are patent and functioning as ordered.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 b) Use evidence-based methods to identify tube location. Two or more methods are recommended. Observe for respiratory distress. If available, use capnography and use pH strips to measure pH of aspirate. Examine the visual appearance of tube aspirate. Review radiographic reports for confirmation of blind-inserted nasogastric tube.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 c) Prevent constipation, by ensuring adequate nutrition and hydration.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 d) If the patient is constipated, advocate for a laxative and stool softener.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 e) Discuss with provider whether a rectal tube will assist with decompression.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 f) Monitor and record bowel movements.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 g) Monitor accurate input and output.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 h) Ensure adequate hydration.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 i) Administer medications as ordered (eg, stool softeners, laxatives, and prokinetic agents).

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all | Not practical | Practical | Very practical

Do you have any comments/suggestions on the nursing intervention?

1.2 j) Administer enemas as ordered.

How important is the nursing intervention?

Not important at all | Not important | Important | Very important

How practical is it to implement the nursing intervention?

Not practical at all | Not practical | Practical | Very practical

Do you have any comments/suggestions on the nursing intervention?

1.2 k) Positioning: avoid high Fowler position, if possible.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 l) Assessment of patient: Monitor surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids in collaboration with provider where indicated.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

The second nursing guideline consists of 2 different statements:
2.1 Optimizing regional perfusion: Fluid Balance
2.2 Optimizing regional perfusion: Damage resuscitation; 2.2a to 2.2d

2. Nursing guideline statement:

2.1 Optimizing regional perfusion: Fluid balance

Use a protocol to try to avoid a positive cumulative fluid balance in critically ill or
injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting
issues have been addressed. Note that a positive fluid balance may contribute to
intra-abdominal hypertension and negatively affect the ability to achieve fascial
closure.

How important is the nursing guideline statement: 'Optimizing regional perfusion: Fluid balance'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Optimizing regional perfusion: Fluid balance'

2.2 Optimizing regional perfusion: Damage control resuscitation

a) Use an enhanced ratio of plasma/packed red blood cells for resuscitation of massive haemorrhage instead of low or no attention to plasma/packed red blood cell ratios.

How important is the nursing guideline statement: 'Optimizing regional perfusion - Damage control resuscitation'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Optimizing regional perfusion - Damage control resuscitation'

b) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present,

the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.

How important is the nursing guideline statement: 'Optimizing regional perfusion: Damage control resuscitation'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Optimizing regional perfusion: Damage control resuscitation'

c) Use strategies such as negative-pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens.

How important is the nursing guideline statement: 'Optimizing regional perfusion: Damage control resuscitation'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Optimizing regional perfusion: Damage control resuscitation'

d) Nurses should be familiar with systems used in their individual practice environments.

How important is the nursing guideline statement: ‘Optimizing regional perfusion: Damage control resuscitation’?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Optimizing regional perfusion: Damage control resuscitation'

Nursing interventions relating to nursing guideline statement 2 include:
2.1 Optimizing regional perfusion and fluid balance with corresponding interventions numbered from 2.1 a to 2.1 g.
2.2 Managing fluid balance with corresponding interventions numbered from 2.2 a to 2.2 b.

2.1 Nursing interventions for optimizing regional perfusion and fluid balance:

2.1 a) Monitor intake and output.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 b) Notify provider if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 c) Assess for peripheral oedema.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, and report as needed.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 e) Assess patient response to fluids, blood transfusions, and diuretics needed.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.1 g) When possible, use volumetric (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) rather than pressure-based Central venous pressure (CVP) or Pulmonary Capillary Wedge Pressure (PCWP) end points of volume resuscitation.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.2. Nursing interventions for managing the fluid balance:

2.2 a) Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, collaboration with the

surgical team will become necessary.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

3. Nursing guideline statement: Abdominal closure

It is recommended that conscious and/or protocolized efforts be made to obtain early or at least same hospital-stay abdominal fascial closure in patients with open abdominal wounds.

How important is the nursing guideline statement: 'Abdominal closure'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Abdominal closure'

Nursing interventions relating to nursing guideline statement 3 include:
3.1 Facilitating abdominal closure with corresponding interventions numbered from 3.1 a to 3.1 b.
3.2. Nursing assessment and management of the temporary abdominal closure device with corresponding interventions numbered from 3.2 a to 3.3 b.

3.1. Nursing interventions for facilitating abdominal closure:

3.1 a) Various methods may be used to help close the abdomen, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

3.1 b) Nurses should be competent with systems used in their individual practice environments.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

3.2. Nursing assessment and management of the temporary abdominal closure device.

3.2 a) Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation,

increase in intra-abdominal hypertension after application or adjustment of dynamic tension devices, and intra-abdominal hypertension after fascia and/or skin closure.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is nursing intervention to implement?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

3.2 b) Monitor the integrity and function of the temporary abdominal closure device, and monitor for changes in drainage volume and appearance.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

3.2 c) Maintain the function of the temporary abdominal closure device.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

4. Nursing guideline statement: Nutrition

a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.

How important is the nursing guideline statement: 'Nutrition'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Nutrition'

b) It is recommended to initiate gastric and colonic prokinetic agents.

How important is the nursing guideline statement: 'Nutrition'?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Nutrition'

Nursing interventions relating to nursing guideline statement 4 include:
4.1 Assessment and management of nutrition with corresponding interventions numbered from 4.1 a to 4.1 f.

4.1. Nursing interventions regarding the assessment and management of nutrition:

4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

4.1 b) Monitor accurate intake and output and consult dietician for recommendations.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or undergoing active resuscitation.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

4.1 d) Limit interruptions in enteral nutrition.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

4.1.e) If IAP remains elevated, discuss with provider whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.

How important is the nursing intervention?

Not important at all | Not important | Important | Very important

How practical is it to implement the nursing intervention?

Not practical at all | Not practical | Practical | Very practical

Do you have any comments/suggestions on the nursing intervention?

4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and provider to minimize or discontinue enteral nutrition.

How important is the nursing intervention?

Not important at all | Not important | Important | Very important

How practical is it to implement the nursing intervention?

Not practical at all | Not practical | Practical | Very practical

Do you have any comments/suggestions on the nursing intervention?

5. Nursing guidelines statement: Analgesia and sedation

It is suggested that clinicians ensure that critically ill or injured patients receive
optimal pain and anxiety relief.

How important is the nursing guideline statement: ‘Analgesia and sedation’?

Not important at all	Not important	Important	Very important
○	○	○	○

Do you have any comments/suggestions on the nursing guideline statement: 'Analgesia and sedation' ?

Nursing interventions relating to nursing guideline statement 5 include:
5.1 The assessment and management of analgesia and sedation with corresponding nursing interventions numbered from 5.1 a to 5.1 b.

5.1 a) Assess for pain by using a standardized pain assessment scale; assess for anxiety.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain, while limiting associated complications such as oversedation.

How important is the nursing intervention?

Not important at all	Not important	Important	Very important
○	○	○	○

How practical is it to implement the nursing intervention?

Not practical at all	Not practical	Practical	Very practical
○	○	○	○

Do you have any comments/suggestions on the nursing intervention?

Please feel free to add any additional suggestions/comments on the nursing guideline statements and corresponding interventions.

Please provide your email address if you would like to participate in the next 2 rounds of the e-Delphi survey.

Annexure F

ANNEXURE F QUALTRICS SURVEY ROUND 2

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Introduction to ROUND 2

STUDY TITLE: CONSENSUS ON NURSING GUIDELINES TO MANAGE PATIENTS ADMITTED TO INTENSIVE CARE UNITS WITH AN OPEN ABDOMEN: AN E-DELPHI METHOD (ROUND 2)

Principal Investigator: Nicole Barbara Mitropapas
Institution: University of Pretoria, South Africa

DAYTIME AND AFTER-HOURS TELEPHONE NUMBER(S):
Daytime numbers +27721542202
After hours: +27721542202

Dear Participant,

Thank you very much for your valuable inputs and participation in Round 1 of the e-Delphi survey with the aim to reach consensus on the guidelines on the nursing management of patients admitted to the intensive care unit with an open abdomen. Your participation in Round 1 provided consensus on the guidelines, however

suggestions were made on some of the nursing guideline statements and interventions. Your suggestions and comments were used to refine the nursing guideline statements and interventions.
The purpose for Round 2 of the e-Delphi survey is to introduce the new refined nursing guideline statements and interventions based on the comments received in Round 1, to rate your agreement and to gather any further comments or suggestions on the refined nursing guideline statements and interventions. *Please note, only the refined nursing guideline statements and interventions were added to this survey.
The survey will approximately take **10 minutes** to complete.

Thank you for your valuable time and your willingness to participate in the second round.

Please supply your email address at the end of the survey if you would be willing to participate in the next and last round.

By starting the survey, you have consented to participate voluntary.

Refined nursing guideline statements

Refined Nursing Guideline Statements (1-5)

Refined nursing guideline statement 1: Assessing for intra-abdominal hypertension/abdominal compartment syndrome

Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.

Do you agree with the refined nursing guideline statement?

Yes ○ No ○

Please add any **additional comments or suggestions**

on the refined nursing guideline statement 1.

Refined nursing guideline statement 2.1: Optimizing regional perfusion(Fluid balance)

Consider using the ROSE (Resuscitation, Optimizing, Stabilization, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed.
Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure.

Do you agree with the refined nursing guideline statement?

Yes

No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 2.1.

Refined nursing guideline statement 2.2: Optimizing regional perfusion (Damage control resuscitation) (a-d):

2.2a) Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon.

Do you agree with the refined nursing guideline statement?

Yes

No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 2.2a.

2.2b) When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon.

Do you agree with the refined nursing guideline statement?

Yes

No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 2.2b.

2.2c) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specification. Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.

Do you agree with the refined nursing guideline statement?

Yes

No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 2.2c.

2.2e) Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.

Do you agree with the refined nursing guideline statement?

Yes No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 2.2e.

Refined nursing guideline statement 3: Abdominal closure

Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.

Do you agree with the refined nursing guideline statement?

Yes ○ No ○

Please add any **additional comments or suggestions** on the refined nursing guideline statement 3.

Refined nursing guideline statement 4: Nutrition (a-d)

4.a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe

and have demonstrated earlier fascial closure rates and fewer complications.

Do you agree with the refined nursing guideline statement?

Yes No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 4.a.

4.b) Advocate for gastric and colonic prokinetic agents.

Do you agree with the refined nursing guideline statement?

Yes No

Please add any **additional comments or suggestions**

on the refined nursing guideline statement 4.b.

4.c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach)

Do you agree with the refined nursing guideline statement?

Yes No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 4.c.

4.d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.

Do you agree with the refined nursing guideline statement?

Yes ○ No ○

Please add any **additional comments or suggestions** on the refined nursing guideline statement 4.d.

Refined nursing guideline statement 5: Analgesia and sedation

It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as

suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).

Do you agree with the refined nursing guideline statement?

Yes No

Please add any **additional comments or suggestions** on the refined nursing guideline statement 5.

Refined nursing interventions

Refined Nursing Interventions (1-5)

1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment

syndrome (a-c).

Do you agree with the following refined nursing interventions:

	Yes
1.1a) Initiate intra-abdominal pressure measurements in a patient with suspected intra-abdominal hypertension or abdominal compartment syndrome.	○
1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly.	○
1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability.	○

Please add any **additional comments or suggestions** on the refined nursing interventions 1.1a-c.

1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).

Do you agree with the following refined nursing interventions:

	Yes
1.2 b) Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location. Examine the visual appearance of tube aspirate and tube auscultation can also be done.	○
1.2 c) Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration.	○
1.2 e) Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression.	○
1.2 i) Administer medications as prescribed (eg, stool softeners, laxatives, and prokinetic agents).	○

	Yes
1.2 j) Administer enemas as prescribed.	○
1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bed elevation of 30°.	○
1.2 l) Assessment of patient: Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	○
1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.	○

Please add any **additional comments or suggestions**

on the refined nursing interventions 1.2b-1.2m.

2.1 Nursing interventions for optimizing regional perfusion and fluid balance.

Do you agree with the following refined nursing interventions:

2.1a) Monitor intake and output. Take in consideration the insensible losses.

2.1b) Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.

2.1c) Continuous assess for peripheral oedema.

2.1d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed.

2.1f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance. Consider using the ROSE concept in collaboration with the treating doctor/surgeon.

2.1g) When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).

Please add any **additional comments or suggestions** on the refined nursing interventions 2.1a-2.1g.

2.2. Nursing interventions for managing fluid balance.

Do you agree with the following refined nursing intervention:

Yes

2.2b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary.

Please add any **additional comments or suggestions** on the refined nursing interventions 2.2b.

3.1. Nursing interventions for facilitating abdominal closure.

Do you agree with the following refined nursing interventions:

Yes

3.1a) Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems.

Yes

3.1b) Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available.

Please add any **additional comments or suggestions** on the refined nursing interventions 3.1a-3.1b.

3.2. Nursing assessment and management of the temporary abdominal closure device.

Do you agree with the following refined nursing intervention:

Yes

3.2b) Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.

Please add any **additional comments or suggestions** on the refined nursing intervention 3.2b.

4. Nursing interventions regarding the assessment and management of nutrition.

Do you agree with the following refined nursing interventions:

4.1a) Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon.

4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician.

4.1d) Limit interruptions in enteral nutrition. Aspirate enteral feeds to monitor absorption.

4.1e) If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.

4.1f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.

Please add any **additional comments or suggestions** on the refined nursing interventions 4.1a-4.1f.

5. Analgesia and sedation.

Do you agree with the following refined nursing intervention:

Ye

5.1b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.

Please add any **additional comments or suggestions** on the refined nursing intervention 5.1b.

Email address

Please add your email address if you would like to participate in the last round.

Annexure G

ANNEXURE G
E-DELPHI SURVEY ROUND 3

Refined Nursing Guidelines and accompanying Nursing Interventions for patients with an open abdomen admitted to the Intensive Care Unit	
Nursing guidelines	**Nursing interventions**
Assessing for intra-abdominal hypertension/abdominal compartment syndrome Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome. Provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	**Measure intra-abdominal pressure (IAP)** • Initiate intra-abdominal pressure measurements in a patient with suspected intra-abdominal hypertension or abdominal compartment syndrome. • Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly. Monitor more frequently if IAH identified. • Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability. • Consider developing a nurse-driven protocol. **Decreasing intra-abdominal pressures (IAP)** • Ensure that gastric/ intestinal tubes are patent and functioning. • Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location. • Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration. • If the patient is constipated, advocate for a laxative and stool softener. • Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression. • Monitor and record bowel movements. • Monitor accurate input and output. • Ensure adequate hydration. • Administer medications as prescribed (eg, stool softeners, laxatives, and prokinetic agents). • Administer enemas as prescribed. • Positioning: Avoid high Fowler/prone position, if possible. Allow for head of bed elevation of 30°.
	Assessment and management of open abdomen surgical site/drains **Assessment** • Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae. **Management** • Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.
Optimizing regional perfusion **Fluid balance** Consider using ROSE (Resuscitation, Optimising, Stabilisation, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note: A positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure. *ROSE concept: R: Resuscitation; O:Optimization; S: Stabilisation; E: Evacuation **Damage control resuscitation** Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon. When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon.	**Assessment of fluid balance** • Monitor intake and output. Take in consideration the insensible losses. • Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour. • Continuous assess for peripheral oedema. • Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed. • Assess patient response to fluids, blood transfusions, and diuretics needed. • Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance. Consider using the ROSE concept in collaboration with the treating doctor/surgeon. • When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).

No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specifation. *Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.	**Management of fluid balance** • Maintain euvolemia or negative fluid balance through patient-specific strategies for fluid management. • When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary. • Note: In a medical patient, advocate to consult the treating team to involve the surgeon.
Temporary abdominal closure dressing Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens. Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training.	**Assessment** • Monitor for proper function of the temporary abdominal closure device, skin/tissue circulation and integrity compromise that may be associated with dynamic tension or closure devices, fistula formation, increase in intra-abdominal hypertension after application or adjustment of dynamic tension devices, and intra-abdominal hypertension after fascia and/or skin closure. • Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance. **Management** • Maintain the function of the temporary abdominal closure device.
Abdominal closure Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.	**Facilitating abdominal closure** • Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems. • Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available.
Nutrition No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications. Advocate for gastric and colonic prokinetic agents. Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.	**Assessment** • Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon. • Advocate for gastric and colonic prokinetic agents. **Management** • Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician. • Limit interruptions in enteral nutrition. Latest evidence suggests discontinuing routine monitoring of gastric residual volumes as it decreases the enteral nutrition delivery. • If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient. • If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.
Analgesia and sedation It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).	**Assessment** • Assess for pain by using a standardized pain assessment scale; assess for anxiety. **Management** • Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.

Do you have any additional suggestions or comments on the refined nursing guidelines with accompanying nursing interventions?

☐ Yes | ☐ No

If yes, please add suggestions or comments below or on track changes.

Thank you for your time spent reviewing the refined nursing guideline.

*Please return the reviewed document by **15/09/2023** to nicolemitropapas@gmail.com.*

Annexure H

ANNEXURE H
FEEDBACK ROUND 2

The summary table includes the following:
Original nursing guideline and interventions presented in round 1
Refined nursing guidelines and interventions based on the comments and suggestions received in Round 1, with the level of agreement
Comments and suggestions received in Round 2
Refined nursing guidelines and interventions based on the comments and suggestions received in Round 2

Table 1: Summary on consensus: Nursing guideline statements (1-5): Round 2 (N=23)

Nursing Guideline statement	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
1. Assessing for intra-abdominal hypertension/abdominal compartment syndrome Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient. It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.			
Round 1: Refined nursing guideline statement 1 Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome and provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.	23	0	100
Comments from panel of experts • Possible Risks to identify IACS should be shared with staff at handover, especially Agency staff. • Measurement is IAP will prevent multi organ failure due to sepsis. • I fully agree with the statement including the open abdomen risk. The last part of the sentence on the open abdomen however is not clear and concise enough in my opinion. • Intra-abdominal compartment syndrome is a preventable cause of organ ischaemia. Early detection can lead to favourable clinical outcomes. • Proper abdominal assessment to confirm any change caused by internal bleeding. • Training should be given the emphasis			
Round 2: Refined nursing guideline statement 1 Measure intra-abdominal pressures when any known risk factors for intra-abdominal hypertension/abdominal compartment syndrome is present in a critically ill or injured patient, using invasive or non-invasive methods (depending on availability). Note: It is important to recognize that the patient with an "open" abdomen and temporary abdominal closure dressing are still at risk for developing intra-abdominal hypertension/abdominal compartment syndrome. Provide ongoing assessment for the organ system manifestations of intra-abdominal hypertension/abdominal compartment syndrome.			

Nursing Guideline statement	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
2.1 Optimizing regional perfusion: Fluid balance Use a protocol to try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure.			
Round 1: Refined nursing guideline statement 2.1 Consider using ROSE (Resuscitation, Optimising, Stabilisation, Evacuation) concept to manage fluid balance and try to avoid a positive cumulative fluid balance in critically ill or injured patients with or at risk of intra-abdominal hypertension/abdominal compartment syndrome after resuscitation has been completed and the inciting issues have been addressed. Note that a positive fluid balance may contribute to intra-abdominal hypertension and negatively affect the ability to achieve fascial closure. *ROSE concept: R:Resuscitation; O:Optimization; S: Stabilisation; E: Evacuation (Malbrain, Van Regenmortel, Saugel, De Tavernier, Van Gaal, Joannes-Boyau et al., 2018:11)	23	0	100
Comments from panel of experts • Handover of high-risk pts should be highlighted to staff, especially Agency staff. • Even though fluid balance is not controlled by nursing staff is more controlled by doctors. They decide how much fluid the patient receives and a patient with severe oedema will have trouble with wound healing. • Getting rid of the fluid may not always be an easy process, particularly with reduced renal perfusion when the patient already has an acute kidney injury with anuria/oliguria.			
Round 2: 2.1) No refinement required			
2.2 Optimizing regional perfusion: Damage control resuscitation. a) Use an enhanced ratio of plasma/packed red blood cells for resuscitation of massive haemorrhage instead of low or no attention to plasma/packed red blood cell ratios.			
Round 1 refined nursing guideline statement: a) Latest evidence suggests a 1:1:1 ratio of plasma/platelets/packed red blood cells for resuscitation of massive haemorrhage instead of crystalloid resuscitation in patients in need of a massive transfusion of blood products in collaboration with the treating doctor/surgeon.	21	2	90
Comments from panel of experts • Should be communicated to staff where pts receive blood products. • Yes, in an ideal hospital which is not always the case blood and blood products are expensive if available yes if not crystalloids should still be used. • Possible addition of blood/pathology providers as they have input into massive transfusion activation. • This may pose a challenge for patients who do not receive blood products for religious reasons. The second challenge is the blood products are not always readily available.			
Round 2: 2.2a) No refinement required			
b) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemodynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.			
Round 1 Refined nursing guideline statement 2.2 b) When patient presents as septic, incorporate the latest sepsis guidelines (2023) in the ICU management of the patient with an open abdomen in collaboration with the treating doctor/surgeon.	22	1	95
Comments from panel of experts • Continuous in-service training of permanent staff is crucial. • Sepsis guidelines dictate crystalloid fluid resuscitation 30ml/kg /bolus. Do we follow the guidelines or stay on the conservative side case of abdominal surgery? • Possible inclusion of infectious diseases specialist if multi antibiotics or resistant organism is detected to aid in choice of antibiotics and they ongoing management post the ICU.			

• Appropriate and targeted treatment options applied correctly and timeously in the early stages of the disease process are more likely to be effective than any treatment modality that's not guided by evidence-based interventions.			
Round 2: 2.2b) No refinement required			
c) Use strategies such as negative pressure wound therapy with temporary abdominal closure devices on critically ill or injured patients with open abdomens.			
Round 1 Refined nursing guideline statement 2.2 c) No recommendation could be made regarding the use of diuretics, renal replacement therapy, and albumin to mobilize fluids in haemo-dynamically stable patients with intra-abdominal hypertension after resuscitation has been completed and the inciting issues have been addressed. It is suggested to manage according to patient specifation. Note: If intra-abdominal pressure is more than 25 mm Hg and new organ dysfunction/failure is present, the patient's intra-abdominal hypertension/abdominal compartment syndrome is refractory to medical management.	23	0	100
Comments from panel of experts • Individualized management per patient. Agree with the statement , not sure that this is the correct place to put the note however. • A more direct approach would be required. Surgery is not always ideal in all patient populations. Therefore, management should be Tailored from patient to patient. • See White et al. 2023 Sepsis-associated acute kidney injury in intensive care unit: incidence, patient characteristics, timing, trajectory, treatment, and associated outcomes. A multicentre, observational study. More info on physiological VS pathophysiological response of AKI. Could be useful for lit review			
Round 2: 2.2c) No refinement required			
Round 1 Refined nursing guideline statement 2.2 e) Nurses should be familiar with systems used in their individual practice environments, allowing for regular in-service training	23	0	100
Comments from panel of experts • How will Agency staff be managed is important for excellence in ptcare service delivery and care in CCU. • This would be very helpful and in ICUs where this is not practised it should be introduced. • Absolutely essential -in service training is mandatory. • If education is lacking nurses can bring this up with education department of the hospital to facilitate knowledge gaps being filled. • Know what you have at your disposal will aid in aiming your expectations with regards to patient outcomes. It may also be helpful in decisions regarding referral of patients to institutions that can manage their condition appropriately when resources are in question.			
Round 2: 2.2e) No refinement required			

Nursing Guideline statement	**Round 2**		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
3. Abdominal closure It is recommended that conscious and/or protocolized efforts be made to obtain early or at least same hospital-stay abdominal fascial closure in patients with open abdominal wounds.			
Round 1 Refined nursing guideline statement 3 Aim for early and same hospital stay abdominal fascial closure, ensuring that the negative pressure wound therapy is optimal and functional. Ensure for adequate wound care and wound care training for the nurses.	23	0	100
Comments from panel of experts • Inservice training and continuity of wound management should be specifically handed over and monitored. • Most patients on negative suctions do well or recover better than when the wound is left without negative suction. • Addition of "where possible" as some facilities may manage open abdomens but not all adjunct therapies this requiring transfer to more specialised facilities. Early intervention or referral to woundcare; sometimes delayed. • The patient still has to be assessed for feasibility of closure once the target time has been reached. Some patients may take longer due to complications of the disease process.			
Round 2: 3) No refinement required			

Nursing Guideline statement	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
4. Nutrition a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.			
Round 1 Refined nursing guideline statement 4 a) No recommendations can be made related to the optimal timing of nutrition in intra-abdominal hypertension/abdominal compartment syndrome, as it is patient specific. However, several studies suggest that the use of early enteral nutrition in the open abdomen is safe and have demonstrated earlier fascial closure rates and fewer complications.	21	2	90
Comments from panel of experts • Importance of daily monitoring...inputs of dieticians in CCU...staff need to monitor blood results indicating pts protein and feeding profile. • If it is safe enteral feeding is recommended otherwise in my practice most patients with open abdomens are put on TPN. • Emphasis on individualised assessment and decision making. • Involving a dietician to facilitate optimal early nutrition, either enteral or parenteral is best for optimal healing. Delaying nutrition can lead to other complication including malnutrition, refeeding syndrome, and poor wound healing. • Early feeding has its advantages, but adverse outcomes may persist, like a paralytic ileus which may worsen the compartment syndrome. • The patient's abdomen may be too sensitive post operatively. TPN good be a preferred alternative to prevent necrosis in the bowel.			
Round 2: 4a) No refinement required			
Round 1 Refined nursing guideline statement 4 b) Advocate for gastric and colonic prokinetic agents.	22	1	95
Comments from panel of experts • Both are good for the gastrointestinal system. • Gastric prokinetics yes, personally I am unsure of the role of colonic prokinetics in this patient population. • Addition of "where appropriate" as prokinetics may be contraindicated in ileus. • If available. • Provided patency of the gastrointestinal tract has been confirmed. • Decreasing the acid content in the gut could promote "good" bacteria in the gut.			
Round 2: 4b) No refinement required			
Round 1 Refined nursing guideline statement 4 c) Work closely with the dietician and surgeon for an early and optimal feeding plan to ensure gastric motility and to prevent paralytic ileus. (Multidisciplinary approach)	22	1	95
Comments from panel of experts • Early "interventions" from nursing side - practical care to enhance GIT recovery. • Early feeding helps improve patient's condition. • A functional Gastrointestinal system may reduce one of the factors that can worsen a compartment syndrome. • Avoid the routine measurement of gastric residuals			
Round 2: 4c) No refinement required			
Round 1 Refined nursing guideline statement 4 d) Monitor for refeeding syndrome, by monitoring for hypophosphatemia and hypomagnesemia. Replace electrolytes as needed in collaboration with unit protocol or treating doctor/surgeons' prescription.	23	0	100

Comments from panel of experts

- Should Lactulose be given prophylactically to all patients on opioids.
- In addition to replacing the electrolytes, thiamine must be added in refeeding syndromes.
- Replacing electrolytes should be done intravenously to make sure it's effective in its action.
- Are we checking on a daily basis?

Round 2: 4d) No refinement required

Nursing Guideline statement	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
5. Analgesia and sedation It is suggested that clinicians ensure that critically ill or injured patients receive optimal pain and anxiety relief.			
Round 1 Refined nursing guideline statement 5 It is suggested to ensure that critically ill or injured patients receive optimal pain and anxiety relief. Consider non-opioid based analgesia to prevent the development of a paralytic ileus, post-surgery. Make use of pain assessing tools to guide pain management, as suggested in latest research, the Critical care pain observation tool (CPOT) or the Behavioural pain scale (BAS).	22	1	95
Comments from panel of experts • In service training for staff on usage and applications of pain management. • Pain can lead to ICU delirium. • Adequate analgesia can allow a patient to be active, in and out of bed. A physically active body is likely to stimulate gut motility. • Critically ill patients' pain should always be managed optimally. The Critically ill patients pain levels may not be able to be assessed accurately, so following a tool will be effective. • What else will we use then? NSAIDS increase bleeding risk. • Consider advocating to the treating team for epidural pain-relief if appropriate in the awake ICU patient in line with ERAS protocols.			
Round 2:) No refinement required			

Interventions	Round 2 Agree (Count)	Don't agree (Count)	I-CVI (%)
1.1 Nursing interventions on assessing for intra-abdominal hypertension/abdominal compartment syndrome.			
1.1a) Initiate intra-abdominal pressure measurements as ordered.			
Round 1 Refined nursing intervention 1.1a) Initiate intra-abdominal pressure measurements in a patient with suspected intra-abdominal hypertension or abdominal compartment syndrome.	23	0	100
Comments from panel of experts • Early identification and treatment can reduce the mortality rate. • Accurate measurements are important to ensure appropriate interventions.			
Round 2: 1.1a) No refinement required			
1.1b) Implement, monitor, and record intra-abdominal pressures.			
Round 1 Refined nursing intervention 1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly.	23	0	100
Comments from panel of experts • 1.1b - more frequent monitoring should be considered based on the patient's response to treatment.			
Round 2: Refined nursing intervention 1.1b) Implement, monitor, and record intra-abdominal pressures, 4 to 8 hourly. Monitor more frequently if IAH identified.			
1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP.			
Round 1 Refined nursing intervention 1.1c) Calculate and record abdominal perfusion pressure (APP): APP = MAP-IAP, using invasive or non-invasive methods, depending on device availability.	22	1	95
Comments from panel of experts • It might be laborious for nursing to calculate the APP. As long as the IAP is recorded, it should be relatively simple for managing doctors to calculate and assess this parameter.			
Round 2: 1.1c) No refinement required			

1.2 Nursing interventions to decrease intra-abdominal pressure (IAP).			
1.2b) Use evidence-based methods to identify tube location. Two or more methods are recommended. [illegible] ratory distress. If available, use capnography and use pH strips to measure pH of aspirate. Examine the visual appearance of tube aspirate. Review radiographic reports for confirmation of blind-inserted nasogastric tube.			
Round 1: Refined nursing intervention 1.2 b) Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location. Examine the visual appearance of tube aspirate and tube auscultation can also be done.	22	1	95
Comments from panel of experts • It is mandatory to confirm tube position with X-rays. Clinical confirmation is not adequate and not supported. • Continuous monitoring of an NGT should be practical. Yes, CXR to initially confirm position but after that we need to ensure it stays safe. Length of NGT at nose? Is the NGT visibly coiled in the mouth? pH <5.5? Has the patient had any invasive procedures that could have moved the NGT i.e TEE/Bronchoscopy. Is there evidence to support auscultation?			
Round 2: Refined nursing intervention 1.2 b) Use evidence-based methods to identify tube location. Latest evidence suggests taking an abdominal x-ray to identify the tube location.			
c) Prevent constipation, by ensuring adequate nutrition and hydration.			
Round 1: Refined nursing intervention 1.2 c) Prevent constipation, ensure gut motility, and prevent the development of a paralytic ileus, by ensuring adequate nutrition and hydration.	23	0	100
Comments from panel of experts None			
Round 2:1.2c) No refinement required			
1.2 e) Discuss with provider whether a rectal tube will assist with decompression.			
Round 1: Refined nursing intervention 1.2 e) Discuss with the treating physician/surgeon whether a rectal tube will assist with decompression.	23	0	100
Comments from panel of experts None			
Round 2: 1.2e) No refinement required			
1.2 i) Administer medications as ordered (eg, stool softeners, laxatives, and prokinetic agents).			
Round 1: Refined nursing intervention 1.2 i) Administer medications as prescribed (eg, stool softeners, laxatives, and prokinetic agents).	23	0	100
Comments from panel of experts None			
Round 2: 1.2i) No refinement required			
1.2 j) Administer enemas as ordered.			
Round 1: Refined nursing intervention 1.2j) Administer enemas as prescribed	22	1	95
Comments from panel of experts None			
Round 2: 1.2j) No refinement required			
1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bead elevation of 30°.			
Round 1: Refined nursing intervention 1.2 k) Positioning: avoid high Fowler position, if possible. Allow for head of bed elevation of 30°.	23	0	100
Comments from panel of experts None			
Round 2: 1.2k) No refinement required			
1.2 l) Assessment of patient: Monitor surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.			
Round 1: Refined nursing intervention **1.2** l) Assessment of patient: Continuous monitoring of surgical and drain sites for signs of infection, skin integrity surrounding the surgical site and surgical drain sites, the volume and appearance of surgical site and surgical drain output, and for the formation of enteroenteric fistulae.	23	0	100

Comments from panel of experts None			
Round 2: 1.2l) No refinement required			
1.2 m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids in collaboration with provider where indicated.			
Round 1: Refined nursing intervention m) Management of the patient: Initiate measures to maintain skin integrity adjacent to surgical wound and drains, measures to maintain patency of drains, and measures to contain fistula drainage. Consider consult with wound care specialist. Ensure replacement of ongoing losses with appropriate fluids as prescribed.	22	0	100
Comments from panel of experts None			
Round 2: 1.2m) No refinement required			

Table 2: Summary on consensus: Nursing guideline interventions (1-5): Round 2 (N=23)

Interventions	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
2.1 Nursing interventions for optimizing regional perfusion and fluid balance:			
2.1 a) Monitor intake and output.			
Round 1: Refined nursing intervention 2.1 a) Monitor intake and output. Take in consideration the insensible losses.	22	1	95
Comments from panel of experts None			
Round 2: 2.1a) No refinement required			
2.1 b) Notify provider if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.			
Round 1: Refined nursing intervention 2.1 b) Notify treating doctor/surgeon if the patient has a positive fluid balance and/or has a urine output of < 0.5 mL/kg per hour.	23	0	100
Comments from panel of experts None			
Round 2: 2.1b) No refinement required			
2.1 c) Assess for peripheral oedema.			
Round 1: Refined nursing intervention 2.1 c) Continuous assess for peripheral oedema.	22	1	95
Comments from panel of experts None			
Round 2: 2.1c) No refinement required			
2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, and report as needed.			
Round 1: Refined nursing intervention 2.1 d) Monitor laboratory results, including haemoglobin and haematocrit levels, blood urea nitrogen and creatinine levels, and serum/urine osmolality, albumin, and report as needed.	22	1	95
Comments from panel of experts None			
Round 2: 2.1d) No refinement required			
2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance.			
Round 1: Refined nursing intervention 2.1 f) Establish patient-specific goal-directed parameters for volume resuscitation in collaboration with the provider to prevent volume overload and positive fluid balance. Consider using the ROSE concept in collaboration with the treating doctor/surgeon.	23	0	100
Comments from panel of experts None			
Round 2: 2.1f) No refinement required			
2.1 g) When possible, use volumetric (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) rather than pressure-based (Central venous pressure (CVP) or Pulmonary Capillary Wedge Pressure (PCWP) end points of volume resuscitation.			
Round 1: Refined nursing interventions 2.1 g) When possible and depending on availability, use advanced haemodynamic monitoring, as a guide on fluid status and fluid resuscitation. Such as (Stroke Volume (SV), Pulse Pressure Variation (PPV), or Stroke volume variation (SVV) and EVLWI (Extra vascular lung water index).	23	0	100
Comments from panel of experts			

- Early identification saves time, money and can lead to good patient outcomes.
- Love it!

Round 2: 2.1g) No refinement required

2.2. Nursing interventions for managing the fluid balance:			
2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, collaboration with the surgical team will become necessary.			
Round 1: Refined nursing intervention 2.2 b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary.	23	0	100
Comments from panel of experts • I would suggest - add "consulting the treating team to involve the surgeon" in cases where the patient is a medical ICU patient.			
Round 2: Refined nursing intervention 2.2b) When interventions to lower intra-abdominal hypertension are failing in the presence of worsening organ failure, early collaboration with the surgical team will become necessary. Note: In a medical patient, advocate to consult the treating team to involve the surgeon.			

Interventions	**Round 2**		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
3.1. Nursing interventions for facilitating abdominal closure:			
3.1 a) Various methods may be used to help close the abdomen, including, but not limited to negative pressure wound therapy and dynamic fascial tension devices/systems.			
Round 1: Refined nursing intervention 3.1 a) Various methods may be used to help close the abdomen, depending on availability, including, but not limited to negative-pressure wound therapy and dynamic fascial tension devices/systems.	23	0	100
Comments from panel of experts None			
Round 2: 3.1a) No refinement required			
3.1 b) Nurses should be competent with systems used in their individual practice environments.			
Round 1: Refined nursing intervention 3.1 b) Nurses should be competent with systems used in their individual practice environments. Allow for regular in-service and training on latest devices available.	23	0	100
Comments from panel of experts • Collaboration between Wound care staff Representative of company and nursing staff for effective use of systems. • Nurses to be trained in monitoring IAP. Management of complex wounds should be included in the nursing curriculum.			
Round 2: 3.1b) No refinement required			
3.2. Nursing assessment and management of the temporary abdominal closure device.			
3.2 b) Monitor the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.			
Round 1: Refined nursing intervention 3.2 b) Continuous monitoring of the integrity and function of the temporary abdominal closure device and monitor for changes in drainage volume and appearance.	23	0	100
Comments from panel of experts None			
Round 2: 3.2b) No refinement required			

Interventions	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
Nursing interventions regarding the assessment and management of nutrition:			
4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen.			
Round 1: Refined nursing intervention 4.1 a) Formal nutrition evaluation should be considered in the patient with an open abdomen in collaboration with the dietician and the treating doctor/surgeon.	23	0	100
Comments from panel of experts • A multidisciplinary team approach is the way to go.			
Round 2: 4.1a) No refinement required			
4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or undergoing active resuscitation.			
Round 1: Refined nursing intervention 4.1 c) Initiate enteral nutrition as soon as possible in the patient with an open abdomen who is not in shock or post damage control surgery or undergoing active resuscitation, in collaboration with the treating doctor/surgeon and dietician.	23	0	100
Comments from panel of experts None			
Round 2: 4.1c) No refinement required			
4.1 d) Limit interruptions in enteral nutrition.			
Round 1: Refined nursing intervention 4.1 d) Limit interruptions in enteral nutrition. Aspirate enteral feeds to monitor absorption.	21	2	90
Comments from panel of experts • 4.1d - there is increasing evidence that measurement of gastric residual is not to be standard of care - Diamond, S.J., Medici, V., Rice, T.W. et al. Should We Stop Using Gastric Residual Volumes?. Curr Nutr Rep 4, 236–241 (2015). https://doi.org/10.1007/s13668-015-0129-3 and Monitoring of gastric residual volume during enteral nutrition Hideto YasudaNatsuki KondoRyohei YamamotoSadaharu AsamiTakayuki AbeHiraku TsujimotoYasushi TsujimotoYuki Kataoka. Cochrane Systematic Reviews https://doi.org/10.1002/14651858.CD013335.pub2			
Round 2: Refined nursing intervention 4.1 d) Limit interruptions in enteral nutrition. Latest evidence suggests discontinuing routine monitoring of gastric residual volumes as it decreases the enteral nutrition delivery.			
4.1.e) If IAP remains elevated, discuss with provider whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.			
Round 1: Refined nursing intervention 4.1.e) If IAP remains elevated, discuss with treating doctor/surgeon whether gastric and colonic prokinetic agents (eg, metoclopramide, erythromycin, neostigmine) are appropriate for the patient.	22	1	95
Comments from panel of experts None			
Round 2: 4.1e) No refinement required			
4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and provider to minimize or discontinue enteral nutrition.			
Round 1: Refined nursing intervention 4.1 f) If intra-abdominal pressure remains elevated, collaborate with the nutritionist and treating doctor/surgeon to minimize or discontinue enteral nutrition.	23	0	100
Comments from panel of experts None			
Round 2: 4.1f) No refinement required			

Interventions	Round 2		
	Agree (Count)	Don't agree (Count)	I-CVI (%)
5. Pain and sedation			
5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain, while limiting associated complications such as oversedation.			
Round 1: Refined nursing intervention: 5.1 b) Use pharmacologic and nonpharmacologic pain management strategies to relieve pain as prescribed, while limiting associated complications such as oversedation or paralytic ileus.	23	0	100
Comments from panel of experts • Alternative pain management can be introduced to CCU. • Limit the use of opiates.			
Round 2: 5.1b) No refinement required			

Annexure I

ANNEXURE I
CREDES GUIDELINES E-DELPHI

CREDES CHECKLIST GUIDELINES APPLICATION (Jünger et al., 2017)

Recommendations for the Conducting and REporting of DElphi Studies (CREDES)

Consensus on nursing guidelines to manage patients admitted to intensive care units with an open abdomen: A modified e-Delphi study.

CRITERIA	APPLICATION	REFERENCING
PURPOSE AND RATIONALE FOR CHOICE OF DELPHI TECHNIQUE		
Justification	Used to obtain consensus, e- Delphi values expertise of experts Consulted international experts and a heterogenous sample group Clear inclusion criteria were set for the experts To reach agreement when agreement has not been reached	Veugelers et.al., 2020; Jünger et al., 2017 Trevelyan and Robinson (2015)
PLANNING AND DESIGN		
Planning	Definition and attributes obtained from concept analysis	
	Experts introduced to the study in email invitation	Annexure B,C,D (e-mail)
	Experts consented to participate voluntary if they continued with the survey	Annexure E,F,G (e-mail) Survey link
Design	Electronic survey compiled and piloted	Annexure E,F,G (e-mail)Survey link
	Consensus was planned at >80%	Figure 1, Chapter 4
STUDY CONDUCT		
Information input	Documentation and survey reviewed by researchers before conducting study	Chapter 4
	Experts received an e-mail with all participating information and documentation	Annexure B,C,D (e-mail)Survey link
Interpretation	Results was collated, anonymised and analysed. Feedback send back with new instructions	Feedback (Annexure H) Email Survey link
Prevention of Bias	The researcher had minimal interaction with experts. No bias was made towards the experts responses due to anonymity	Individual emails sent
REPORTING		
Purpose and rational	Methodology and decisions discussed in detail	Chapter 3

Expert panel	Detailed description of the panel made	Chapter 1 & 4
Consensus	Consensus attainment discussed and clarified	Chapter 1 & 4
Results	Each round of results discussed	Chapter 4 & 5
Limitations	Limitations reported on and impact discussed	Chapter 4 & 5
Conclusion	Conclusion reflect the outcomes of e-Delphi with a view to inform practice	Chapter 4 & 5
Publication	The e-Delphi is drafted for publication in a reputable journal. Results further published into a report to the institutions that participated	

Trevelyan, E.G., Robinson, P.N. 2015. Delphi methodology in health research: How to do it? European Journal of Integrative Medicine. 7(4):423-8.