

This BPR Brief is an abridged version of **Best Practice Recommendations for the Prevention and Management of Surgical Wound Complications**. In alignment with a global health-care perspective, Wounds Canada is committed to provide support to patients to help them adapt to and self-manage their condition in the face of social, physical and emotional challenges. This document uses the **Wound Prevention and Management Cycle** (WPMC) (Figure 1) as the basis for clinical decision making. For clinicians, this document is meant as a cue for treatment; it provides non-inclusive examples listed below each recommendation. For policy makers, it highlights (in ***bold italics***) actions and policies that support best practice.

Wounds Canada follows a population health strategy for wound care that enables us to address the entire range of individual and collective factors that determine health, including:

- Better health: health of the general population improved; behavioral, social, economic and environmental determinants addressed; preventative care rewarded
- Better health care: patient-centred, reliable, safe, evidence-based treatment; care managers co-ordinate total health-care delivery; evidence-based treatment with outcome tracking
- Better value: costs and cost improvements monitored; readmissions to hospital reduced; early interventions to reduce per patient cost implemented; unnecessary or duplicate procedures eliminated; information management technologies utilized

For more information on content, levels of evidence or tools related to a particular recommendation, click on the links provided.

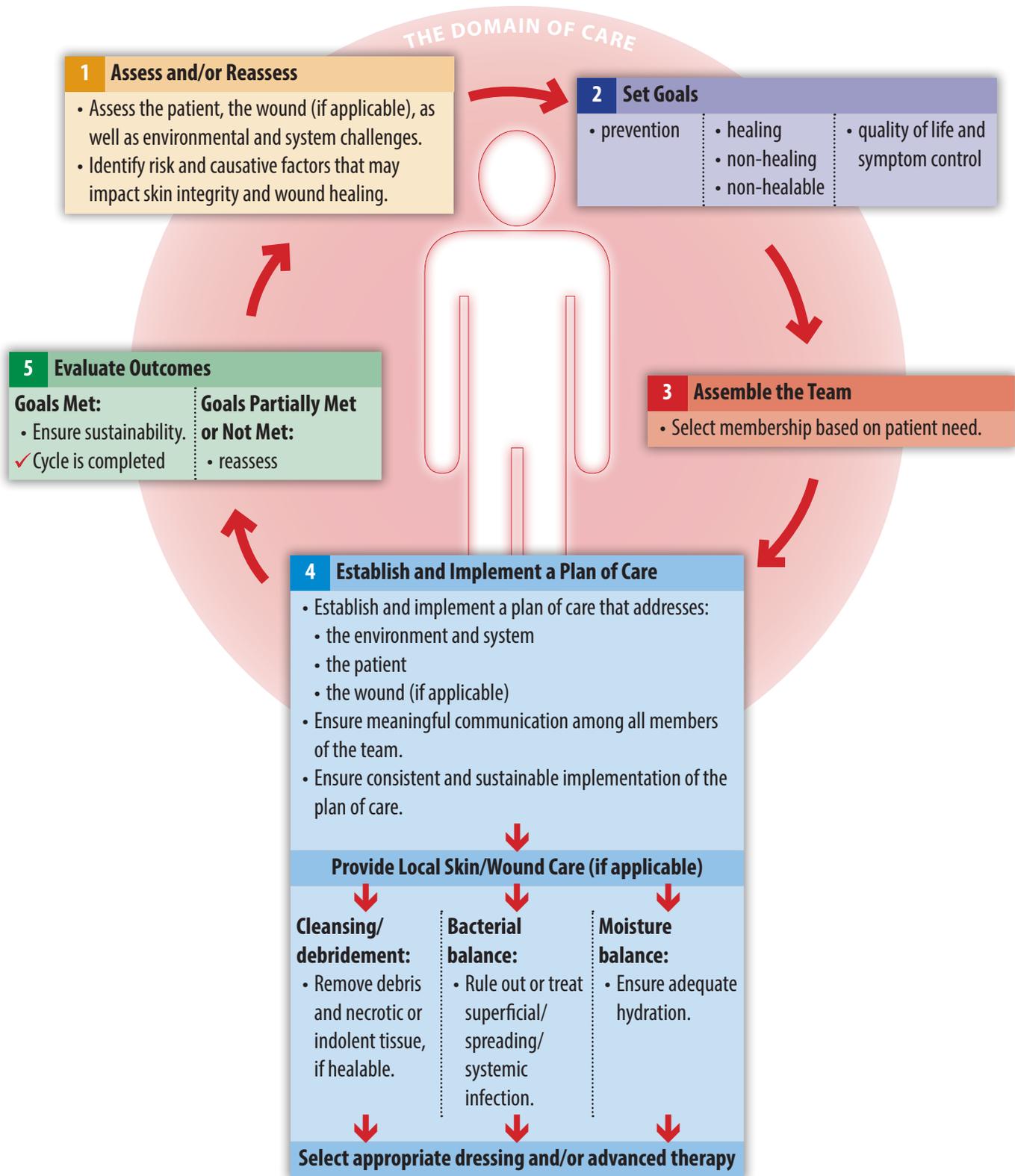
We strongly recommend that before using this BPR Brief the user read the full best practice recommendation (BPR) document. To obtain a copy of the full document, go to: www.woundscanada.ca/docman/public/health-care-professional/552-bpr-prevention-and-management-of-surgical-wound-complications.

Introduction

The Canadian Patient Safety Institute has identified the safety of surgical care as one of its four priority areas. Surgical procedures can be performed either as inpatient, day surgery with admission of at least one night, or, depending on the procedure, in outpatient ambulatory care settings. Many surgical procedures are complex and may carry significant risks for patients regardless of the health-care setting. The patient facing surgery brings their own unique individual health history: while some bring excellent health with the expectation of rapid healing, others have surgery when their complex health history/issues seriously impair their general recovery and wound healing abilities. Surgical site infection (SSI) is the most common health-care-associated infection and, with up to three-quarters of all surgical procedures performed in the hospital outpatient setting, most SSIs will now be recognized in the community. Approximately 77% of surgical-patient deaths are reported to be related to infection.

Disclaimer: This document provides a clinical enabler for the recommendations outlined in the Best Practice Recommendations (BPRs) for the Prevention and Management of Surgical Wound Complications. It is not meant to provide comprehensive information on the given topic. For more information on a particular recommendation or a copy of the full document go to: www.woundscanada.ca/docman/public/health-care-professional/552-bpr-prevention-and-management-of-surgical-wound-complications

Figure 1: Wound Prevention and Management Cycle (WPMC)



For the complete version of Best Practice Recommendations for the Prevention and Management of Surgical Wound Complications, visit [here](#).

1 Assess and/or Reassess

- Assess the patient, the wound (if applicable), as well as environmental and system challenges.
- Identify risk and causative factors that may impact skin integrity and wound healing.

Complete a holistic **patient assessment** to identify factors that may affect surgical wound healing in the pre-, intra- and post-operative phases. The preoperative phase is a critical time, offering the opportunity to create an environment that prevents surgical wound complications. Surgical wounds should be assessed and reassessed during the entire post-operative phase, and the findings documented using a standardized and comprehensive wound assessment tool to provide a baseline that can help with the identification of wound changes. This information assists with identifying either wound healing or deterioration and should guide ongoing treatment decisions.

1.1 Select and use validated patient assessment tools.

Some of the tools available for use in the assessment of persons with or at risk for surgical site complications are:

- **Barber Measurement Tool (BMT)**: uses the percentage reduction in wound size over time as an indicator of healing
- **ASEPSIS tool**: developed to evaluate the effectiveness of antibiotic treatment on surgical site infections by examining wound characteristics
- **Granulometer**: assesses the status of skin grafts
- **Outcome and Assessment Information Set-C (OASIS-C)**: contains a section for surgical wounds

1.2 Identify risk and causative factors that may impact skin integrity and wound healing (patient, wound, environment and system).

Complete a holistic patient assessment to identify factors that may affect surgical wound healing in the pre-, intra- and postoperative phases. It is crucial to provide a culturally sensitive environment for care.

Pre-operative Risks

Key risk factors for surgical complications should be identified and addressed wherever possible. These factors include obesity, malnutrition, smoking, hypertension and coronary artery disease, pre-existing body site infection, diabetes mellitus (poor glycemic control), size and virulence of the microbial inoculum, general health and comorbid disease processes, including medications that affect integrity of the individual's host defences, alcohol or substance use, physical activity and mobility limitations, previous complications with anesthetic and surgeries, advanced age and patient emotional health and readiness for surgical intervention.

The American Society of Anesthesiologists (ASA) has established **categories** to classify the patient's physical status to identify patient-related risk factors for developing SSI.

- Class I: a normally healthy patient with no functional limitations
- Class II: a patient with mild systemic disease that limits activity but is not incapacitating
- Class III: a patient with severe systemic disease that is a not a threat to life
- Class IV: a patient with severe systemic disease that is a constant threat to life
- Class V: a moribund patient who is not expected to survive without the operation
- Class VI: a brain-dead patient whose organs are being removed with the intention of transplanting them into another patient

Intra-operative Risks

The risk of developing an SSI can be affected by the nature of the intended surgical procedure. Whether or not an SSI develops can depend upon how the following factors interact: length of the procedure, status of surgery, type of surgery, method of surgery (laparoscopic versus open surgery, level of oxygenation of the tissues, emergent [vs. elective] surgery, implants [vs. no implants], use of internal mammary artery grafts (for coronary artery bypass graft), prolonged ventilation, use of blood products and patient stress levels.

Post-operative Risks

Many of the surgical site complications and SSI risks following surgery are the same as the preoperative ones. In addition, consider postoperative surgical site infections, post-operative respiratory and urinary infections, infections secondary to wound sepsis or medical devices (such as indwelling Foley catheters and IV lines), diarrhea related to use of antibiotics, wound dehiscence (complete or partial disruption of wound closure with or without evisceration and protrusion of tissue or organs, hematoma or seromas). It is important to complete an assessment of the patient's environment to determine if their living or work situation poses additional post-operative risks for infection or slow wound healing.

1.3 Complete a wound assessment, if applicable.

Wound Characteristic	Incisional Assessment: Healthy	Incisional Assessment: Unhealthy
Colour	Will progress from red with approximated edges (days 1–4) to bright pink (days 5–14) to pale pink (day 15–1 year)	May be red days 1 to 4, may have tension on the incision line; by days 5 to 9, the incision may no longer be well-approximated, and the tension remains; By days 10 to 14, the colour may remain red or progress to bright pink, and over the next year, there may be prolonged epithelial resurfacing and/or keloid or hypertrophic scarring
Scar Tissue	Light-skinned persons will have white or silver scarring, while persons with darkly pigmented skin will progress from pale pink to darker than usual skin colour	Prolonged epithelial resurfacing and/or keloid or hypertrophic scarring
Peri-incision	Edema, erythema or skin discolouration, warmth or pain should resolve by day 5	Absence of inflammation: no edema, erythema, skin discolouration or warmth, and minimal pain at incision site; may have hematoma or seroma forming, which can progress to days 10 to 14; by days 5 to 9, the signs of inflammation may be present, extending to days 10 to 14; healing can stall or plateau, with no healing and ongoing inflammation lasting 1 to 2 years or longer
Exudate	Minimal/moderate sanguineous to serous exudate (days 1–4) but should resolve by day 5	Minimal to moderate exudate on days 5 to 9 may be serosanguinous, serous or purulent, and any type or amount of exudate beyond that is abnormal

cont'd...

Closure	Should be seen by day 4 along the entire incision; a healing ridge of newly formed collagen can be felt along the whole incision line during days 5 to 9	When healing is not progressing as expected, removal of skin closures will be delayed for primary closure; for wounds healing by secondary intention, the edges do not approximate, and the wound fails to contract; there will be a lack of epithelial resurfacing of the entire incision by day 4, or it may be only partially present with lack of the collagen healing ridge and dehiscence evident by day 14; long-term results will be keloid or hypertrophic scarring
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There are many ways to describe or classify a surgical wound. **OASIS-C item M1342** identifies four possible healing choices to describe the appearance of the wound:

1. Newly epithelialized: the site is healed and without signs and symptoms of infection.
2. Fully granulating: the wound bed is filled with granulation tissue to the level of the surrounding skin; no dead space, avascular tissue, signs or symptoms of infection and wound edges are open.
3. Early/partial granulation: $\geq 25\%$ of the wound bed is covered with granulation tissue; $< 25\%$ of the wound bed is covered with avascular tissue; no signs or symptoms of infection; wound edges are open.
4. Non-healing wound: $\geq 25\%$ avascular tissue OR signs/symptoms of infection OR clean but non-granulating wound bed OR closed/hyperkeratotic wound edges OR persistent failure to improve despite appropriate comprehensive wound management.

For wounds healing by primary closure with well-approximated incisions, the close proximity of the incisional edges leaves no areas for granulation to occur. Only the “newly epithelialized” and “not healing” choices apply. For wounds healing by secondary intention, all four choices would apply.

CDC Surgical Wounds Classification identifies the degree of contamination:

- Clean: an uninfected operative wound in which no inflammation is encountered, and the respiratory, alimentary, genital or uninfected urinary tracts are not entered.
- Clean-Contaminated: operative wounds in which the respiratory, alimentary, genital or urinary tracts are entered under controlled conditions and without unusual contamination.
- Contaminated: open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered.
- Dirty or Infected: includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

CDC Classification of a Surgical Site Infection stratifies the infection as superficial, deep or organ/space:

- Superficial incisional: involves only skin and subcutaneous tissue of the incision
- Deep incisional: involves deep soft tissues of the incision (e.g., fascial and muscle layers)
- Organ/Space: infection involves any part of the body deeper than the facial/muscle layers that is opened or manipulated during the operative procedure

2 Set Goals

- | | | |
|--------------|--|---|
| • prevention | • healing
• non-healing
• non-healable | • quality of life
and symptom
control |
|--------------|--|---|

Based on identified risk factors and a complete patient, wound and environmental assessment, goals need to be set in collaboration with the patient, family and/or care partner. Patient priorities and goals for health care in regard to the surgical wound must be identified along with the available options so that informed decisions can be made.

2.1 Set goals for prevention, healing, non-healing and non-healable wounds.

Prevention of surgical wound complications should always be considered a patient safety goal. Goals need to be determined from a patient's perspective and be created using the **SMART principle**: **S**pecific, **M**easurable, **A**chievable, **R**elevant and **T**imely.

- Pre-operative goals should revolve around maximizing patient health through goals such as nutritional support and smoking cessation.
- When the person with a surgical wound is initially recovering, they are also coping with the effects of anesthesia, analgesia, disrupted sleep patterns and impaired nutrition, and they may have weakness, nausea and pain. The initial short-term goals should address these issues and promote healing and restoration of health.
- Identify goals based on prevention or healability of wounds. The three surgical wound closure goals are as follows:
 - Primary intention is healing of a closed surgical wound. Re-epithelialization of the uppermost approximated skin edges normally occurs within 24 to 48 hours, with wound closure within two to three days. Sutures or staples are usually kept intact for seven to 10 days, at the surgeon's discretion. Acute surgical wounds heal within an expected timeframe and without complications.
 - Delayed primary closure of a surgical wound may be used to prevent infection in contaminated surgical wounds. The wound is allowed to remain open for several days before final closure to ensure all sources of contamination have been removed and/or infection is resolved. Another term for this method is healing by tertiary intention.
 - Secondary intention is healing of surgical wounds that may be dirty or infected, where the wound is left open and heals when granulation tissue fills the wound from the base up. Failed primary closure incisions that dehisce or separate are often best left to heal by secondary intention.

2.1.1 Identify quality-of-life and symptom-control goals.

Goals need to be set to support the patient through the physical and psychosocial challenges that arise from having a surgical wound; especially one that leads to complications. Not all patients look to healing as a goal of care. Pain or tenderness alone can be a symptom of a SSI, and pain levels need to be consistently addressed to determine if pain reduction goals are being met. Getting back to work or caring for family are common patient-driven goals.

3 Assemble the Team

- Select membership based on patient need.

As surgery-related procedures (including preparation, intervention, discharge and follow-up) involve shorter hospital stays, a trusting, positive relationship must be developed among the patient, surgical team and follow-up clinicians. If patients are to fully participate in the planning of their care long-term, they need to know who the members of their team are and the roles each plays.

3.1 Identify appropriate health-care professionals and service providers.

Surgical-wound healing requires a collaborative and integrated team approach that allows for the safe and efficient treatment of patients undergoing surgery. This includes numerous interactions, including the physician consult to the laboratory and diagnostic department, the surgeon and in-house surgical team, community pharmacists, the pre-admission care team, community nurses, dietitians, spiritual care providers, physiotherapists and the in-house surgical team—in pre-, intra- and postoperative phases.

3.2 Enlist the patient and their family and caregivers as part of the team.

When possible, patients can work with their family doctor, the surgeon and the pre-operative team for optimal surgical preparation and post-surgical healing. Health-care professionals can help patients verbalize their wishes and set short- and long-term goals.

3.3 Ensure organizational and system support.

Wounds Canada's resources and education align with a population health management model. This model encourages the proactive management of a total population at risk for adverse outcomes through a variety of individual, organizational and cultural interventions to improve patient, clinical and financial outcomes. The interventions are based on a risk-stratified needs assessment of the population, supported by a comprehensive governance infrastructure.

To support this model and secure successful outcomes, decision makers:

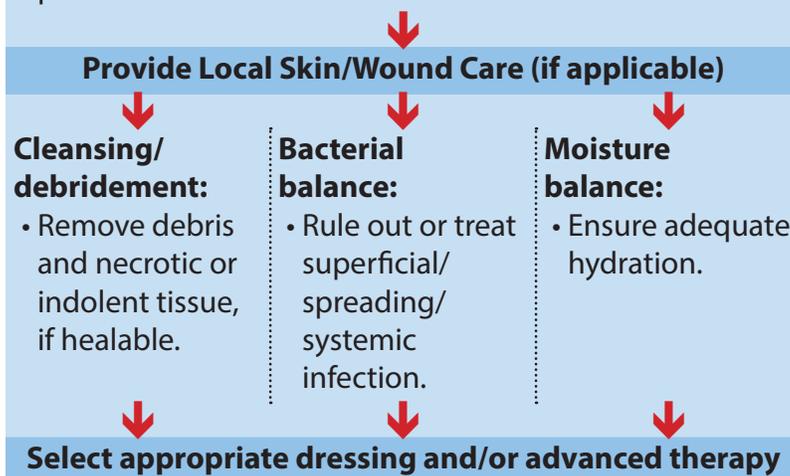
- ***Use globally recognized risk classificationsto identify risk, support prevention and develop management strategies by allocating appropriate resources such as patient education and clinical visits.***
- ***Develop policies (federal, provincial/territorial, regional and institutional) based on current evidence that acknowledge and designate human, material and financial resources to support the team in the development of a SSI program.***
- ***Establish a pathway for referral of people with surgical site complications to a multidisciplinary wound care service.***
- ***Work with the community and other partners to develop a process to facilitate patient referral and access to local resources and health professionals with specialized knowledge in wounds.***
- ***Work with community and other partners to advocate for strategies and funding for all aspects of complex surgical site care.***
- ***Ensure services and programs exist for the assessment and continuing surveillance of those defined as being at increased risk for surgical site complications, and to support management in their healthcare or community setting.***
- ***Establish, train and support an integrated team composed of interested, skilled and knowledgeable persons to address and monitor quality improvements in the prevention and management of surgical site complications.***

- **Establish and sustain a communication network between the person with the surgical site complication and the necessary healthcare and community systems.**
- **Audit all aspects of the service to ensure that local practice meets accepted national and international standards of care.**

In order to achieve these steps and improve patient outcomes, establish or adopt a system-wide care pathway.

4 Establish and Implement a Plan of Care

- Establish and implement a plan of care that addresses:
 - the environment and system
 - the patient
 - the wound (if applicable)
- Ensure meaningful communication among all members of the team.
- Ensure consistent and sustainable implementation of the plan of care.



The integrated team needs to create a treatment plan to eliminate or reduce factors that may negatively affect surgical-wound healing in the pre-operative, intraoperative and post-operative phases of care. Strategies that promote timely healing of surgical wounds are essential in all phases of care.

4.1 Identify and implement an evidence-informed plan to correct the causes or cofactors that affect skin integrity, including patient needs (physical, emotional and social), the wound (if applicable) and environmental/system challenges.

Pre-operative strategies

- Treatment plans may include smoking cessation, review of physical activity levels, obesity assessment and education about glycemic control, nutritional screening and counselling to correct any deficiencies that may cause delayed healing or immunosuppression.
- Pre-operative education/instruction for patients needs to reflect the needs of the individual and should include hand hygiene, SSI risks, team members' contact information, and post-operative instructions that includes information on wound care, dressing use and how to recognize wound problems.

For the complete version of Best Practice Recommendations for the Prevention and Management of Surgical Wound Complications, visit [here](#).

Safer Healthcare Now recommends four key strategies in the peri-operative phase to reduce SSIs:

1. Perioperative antimicrobial coverage
 - a. appropriate use of prophylactic antibiotics
 - b. antiseptic use – bathing, showering
 - c. decolonization
 - d. antiseptic-coated suture
2. Appropriate hair removal as directed by surgeon
3. Maintenance of perioperative glucose control
4. Perioperative normothermia

Intra-operative strategies

- Prepare the skin at the surgical site immediately before incision, using an antiseptic. If diathermy is used, antiseptic skin preparations should be allowed to dry by evaporation.
- Suturing techniques, such as continuous versus interrupted sutures, have not been found to significantly affect SSI rate, but using continuous sutures is quicker. Suturing techniques such as progressive tension closure using regular or a barbed suture technique in conjunction with drains for abdominoplasty are being explored as ways to decrease the risk of seromas, and low-tension sutures are more conducive to healing than those applied with too much tension, which can cause skin injuries on their own.
- Retention sutures, which are intended to prevent wound dehiscence in abdominal surgery, can cause increased pain, lacerations and pressure injuries. A study examining the benefit of prophylactic retention sutures post-laparotomy concluded there was no significant decrease in incidence of postoperative evisceration, wound infection and post-operative pain.

Post-operative Strategies

- Pain control: post-operative pain can be either nociceptive or neuropathic, or a combination.
 - Opiates remain key to post-operative pain management.
 - Non-steroidal anti-inflammatory agents (NSAIDs) can help to reduce the amount of opiates required in the acute phase.
 - Music therapy may reduce the patient's anxiety, pain and morphine consumption.
 - Reassess patient response to the pain management using the same re-evaluation tool.
 - Allow the patient an opportunity to discuss their knowledge and beliefs about pain management strategies. Provide information to them as needed.
- Comfort measures such as non-stick dressings, warmed solutions and sitz baths for perineal wounds can be tailored to the patient's needs and situation and evaluated for effectiveness.
- Provide nutritional support to prevent wound dehiscence caused by malnutrition.
- Manage SSIs while the patient is still in hospital or after discharge.

4.2 Optimize the local wound environment: Cleansing, debriding, managing bacterial balance and managing moisture balance.

4.2.1 Cleansing: Non-irritating wound **cleansers** such as potable water, normal saline or commercially prepared wound (see Wounds Canada's Product Pickers, below).

4.2.2 Debridement: Non-viable tissue should be **debrided** to promote wound closure (if appropriate) (see Wounds Canada's Product Pickers, below).

4.2.3 Managing bacterial balance: Any **local, spreading or systemic infection** must be treated, including osteomyelitis if present (see Wounds Canada's Product Pickers, below).

4.2.4 Managing moisture balance: Moisture can be contained or provided through dressing selection (see Wounds Canada's Product Pickers, below).

4.3 Select the appropriate dressing and/or advanced therapy.

Surgical wounds should be covered with an appropriate interactive dressing at the end of surgery. If the wound is healing by secondary intention the patient should be referred to a nurse specialized in wound, ostomy or continence care (NSWOC) or wound clinician for advice on appropriate dressings or advanced therapies (see Wounds Canada's Product Pickers, below).

Primary intention

Incisions closed by primary intention generally require:

- Application of a dry, sterile semipermeable cover dressing for 24 to 48 hours
- Negative pressure wound therapy (NPWT) to the primary incision; effective in sternotomy, orthopedic and vascular surgeries; NPWT can reduce SSI rates following invasive treatment of lower limb trauma

Secondary intention

Acute surgical wounds that are left open to heal by secondary intention require:

- A moist wound environment to support healing
- A dressing that prevents bacteria from entering and critically colonizing wound tissue

Pouching may be another option for the management of heavily exuding wounds. Negative pressure wound therapy (NPWT) can be used for types of open wounds as well as a method of bolstering flaps and skin grafts.

Dry wounds

For some wounds, too little moisture causes the wound bed to desiccate, preventing growth of granulation tissue and re-epithelialization. Dry surgical wounds with healing as a goal may benefit from the addition of a hydrogel, hydrocolloid, non-adherent mesh dressing or transparent film to hold moisture in and protect the wound bed.

4.4 Engage the team to ensure consistent implementation of the plan of care.

Individuals within the circle of care must understand their roles and responsibilities in relation to the formal care team for each specific element of care. Providing the following information to patients, families and their care partners should lead to early intervention, prompt treatment and reduce infection-related morbidity:

- The risks of an SSI and what is being done to reduce it, including any antibiotics given in hospital
- The signs and symptoms of SSI, how they are managed and who to contact if they are concerned
- The signs and symptoms of other surgical site complications such as a hernia or a wound dehiscence
- Who is responsible for what portion of their care and when should follow-ups be booked?
- How to care for the wound after discharge, including hand hygiene

Wounds Canada's Product Pickers

- **Wound Dressing Formulary:** describes common wound dressings in generic categories and lists usage considerations.
- **Wound Dressing Selection Guide:** helps users choose appropriate primary and secondary dressings based on common clinical situations and wound care goals.
- **Skin and Wound Clean-up:** helps users choose appropriate skin and wound cleansers as well as irrigating solutions.

5 Evaluate Outcomes

Goals Met:

- Ensure sustainability.
- ✓ Cycle is completed

Goals Partially Met or Not Met:

- reassess

The overall goal is to assist patients and their care partners in maximizing their rehabilitation potential. Progress toward achieving established goals must be monitored with the patient, documented and communicated to the appropriate team members.

5.1 Determine if the outcomes have met the goals of care.

The effectiveness of the interventions must be determined by a clinician who has the knowledge and skills to assess using standardized tools and methods as well as feedback from the patient and/or care partners.

5.2 Reassess patient, wound, environment and system, if goals partially met or unmet.

When goals of care are not met, the team should go back to Step 1 of the Wound Prevention and Management Cycle. Reassessment needs to consider gaps in care and the person's ability to adapt to their condition and engage in self-management. A healing wound that is not responding to the treatment plan needs to be reassessed to determine:

- What host factors are contributing to delayed healing?
- Is the treatment optimal for the situation?
- When wound healing is not feasible, whether the treatment is preventing infection and deterioration, decreasing dressing frequency, managing pain and improving the patient's quality of life, where possible.

5.3 Ensure sustainability to support prevention and reduce risk of recurrence.

Primary care/family doctors, nurse practitioners and visiting health-care professionals should recognize wound complications and immediately communicate and/or refer the patient back to the surgeon. However, it is patients and their care partners who are the first line of defence in preventing and identifying complications. Teaching materials should be available for the patient and care partners both before and following surgery so patients can prepare appropriately, making adjustments to their environment, activities, nutrition, working lives, support system and more. Outpatient clinics and surgeon's time should be optimized so that follow-ups for patients whose situation warrants it can be done in a timely manner avoiding trips to hospital emergency departments.

For additional Wounds Canada resources including monofilaments and brochures, go to: www.woundscanada.ca/health-care-professional/resources-health-care-pros/boutique

Care at Home Series:

- Caring for Yourself After Surgery: Preventing Surgical Site Infections
- Caring for Your Wound at Home: Changing a Dressing



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